Angry Arachnids Attack

By Mark C Glassy, Ph.D.

Submitted for your approval

The scary world of arachnids

OK, ‘fess up time. Yours truly genuinely thinks spiders are the creepiest little animals around and I do all I can to avoid them. When I see one in my house my ire is up and after mustering some courage I take care of the offending critter and dispatch it to the big spider web in the sky. Though all spiders are arachnids, not all arachnids are spiders.

Arachnids are a Class of invertebrate animals which comprise harvestmen, mites, scorpions, solifuges, spiders, and ticks. Of the arachnids, ticks seem the least scary though tick-born diseases are not. Scorpions are not as prevalent as spiders so most think of them as moderately scary. However, spiders are everywhere and are indeed itsy bitsy creepy crawly. So not to confuse you gentle scary readers all arachnids have 8 legs whereas insects have 6 legs (for a discussion on insects please see the article, “Insidious Insects Invade”, elsewhere).

Arachnid Angst

The term, arachnid, is derived from the Greek word ἀράχνη (*arachnē*), which originated from the myth of the hubristic human weaver Arachne who was turned into a spider. The largest Order in the Class, Arachnida, are spiders with over 100,000 species. The vast majority of arachnids are land dwellers though some inhabit freshwater environments. Unlike insects no arachnids have antennae nor wings and their body is composed of two sections, cephalothorax and abdomen, whereas insect bodies have three sections. For arachnids the cephalothorax is usually covered by a single, unsegmented carapace and the rest of the body by an exoskeleton.

Due to the micro size of the distal joints of arachnid appendages they do not have extensor muscles for movement. Instead, they extend limbs hydraulically using pressure (perhaps a natural form of steampunk hydraulics?) from hemolymph. Hemolymph is a vertebrate blood analog that circulates in arachnid bodies and makes direct contact with cells and tissues. Hemolymph is primarily composed of fluid plasma, hemocytes (a type of phagocytic cell), and many chemicals.

Arachnid physiology

Much of arachnid biology is similar to that of insects particularly in metabolism, oxygen utilization, and gas exchange. Like insects, arachnids also use tracheae, an internal series of vascular lamellar or micro tubes used for gas exchange with air. Some advantages arachnids have over insects include limbs more efficient for locomotion, internal fertilization, special sensory organs, and the ability to conserve water through efficient excretory structures. The primary waste product in arachnids is nitrogen based guanine. Furthermore, many arachnids also have a waxy layer covering their cuticle for added protection for a terrestrial life. Typically, most arachnids usually lay yolky eggs which hatch into immature versions that resemble larger adults. However, scorpions are viviparous and bear live young (see below).

Arachnid diet

Most arachnids rule over most insects. Arachnids are carnivores and typically eat insects and small animals whereas insects do not eat arachnids. Harvestmen and some mites eat solid food particles. Ticks primarily injest blood meals. To help digest prey arachnids make digestive juices in their stomachs and pour this over dead prey. These juices turn the prey into a broth-like substance that is easier to swallow and digest. In most arachnids the stomach is tubular in shape with extensive branches throughout the body. The stomach also helps in digestion by secreting digestive enzymes that further breaks down the food for easier utilization.

Arachnid sensory systems

For arachnids they use the two primary senses of sight and touch. For touch arachnids have fine sensory hairs that cover their bodies which can be relatively simple though some, called trichobothria, can be complex. For sight, they have two types of eyes called the lateral and median ocelli. The eye cornea acts like a lens and the retina does not have enough light sensitive cells for a proper image to form so for sight arachnids primarily rely on detecting movement and not resolution.

Scaling issues

There is a natural limitation in size of arachnids and the same size principles that apply to insects uniformly applies to arachnids. In the article on insects the problem with insect size, called scaling, is discussed. The issue of scaling also applies to arachnids (or all biology for that matter) so size does matter. Like insects the ability to access oxygen limits arachnid size since they do not have a respiratory system and must rely on diffusion, a rate-limiting step, to get oxygen so arachnids use gas-exchange with air. Due to these gas-exchange limitations arachnid size will forever be small. (Note: during the Carboniferous Period (the fifth Period of the Paleozoic Era) when the oxygen levels were near 20% insects were larger since it was easier to access oxygen. When oxygen levels dropped to current levels then insect/arachnid size also decreased.)

Scaling is related to geometry and in biology, geometry is a functional relationship. Geometry is length, area, and volume and all are proportional to each other. As size increases the length, area, and volume (or biomass) proportionally increases too. If something is three times normal size then the volume would proportionally increase 27 times! (Volumes are proportional to length, width, and height so three times normal size is 3x3x3 or 3^3=27. See Figure 1.) If an ant (*Them!*) or a grasshopper (*The Beginning of the End*) were 10 times normal size then the volume would increase a whopping 1000 times (10x10x10 or 10^3=1000)! Or, as discussed with the entomology professor in the film, *Tarantula* (see below), "A hundred times larger than normal", would be an impossible million times larger volume (100x100x100 or 100^3=1,000,000)! Simply stated, if size changes then volume changes faster. This is important because of the physical forces involved in larger sizes. For example, inertia is related to size and mass. If a fly flies into a window no harm to the fly due to small inertia (small size and mass) but if a bird flies into a window the bird could break its neck due to a larger inertia (larger size and mass). The bigger the size the more the inertia so even if a giant bug hits something more than likely the bug will suffer some damage.

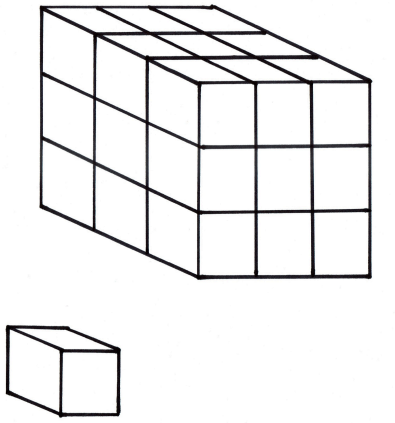


Figure 1. A visual representation of scaling. Size is a measure of volume so length, width, and height are important. If something is three times (3X) larger, then it would be three times larger by length, width, and height, which would be 3x3x3, which means 27 times larger volume!

Volume is also related to weight that can impact on muscle and bone strength. Since arachnids, small or large, do not have bones then other body parts must function in that capacity to provide strength and this puts mechanical stress on the rigid body exoskeleton. Routine locomotion could overstress the mechanical limits of large exoskeletons causing breakage. Exoskeletons and all other elements would have to proportionately enlarge at the same pace and provide

appropriate mechanical strength. An increase in size and weight could mean a change in posture. Are limbs bent or straight? When volume is in excess of the ability to carry the weight then buckling occurs with the legs. For an arachnid example, with an excessive volume there is too much pressure and mechanical strain for giant spider legs to hold the weight, not to mention any kind of movement. Just one single step of a million times larger tarantula would cause severe trauma.

In addition to size scaling there is also the issue of energetic scaling, meaning the amount of energy obtained from captured prey compared to the amount of energy expended to get that prey. This is determined by the number of feeding events and the amount of energy obtained from each feeding (not all feedings are alike; some more than others). The amount of energy obtained is determined by the type of prey (not all prey provide equal energy). Biologically, the ability to process large volumes of prey is energetically efficient; either larger prey or larger amounts of smaller prey. Large body size can provide a benefit to metabolism and movement, meaning the ability to capture more energy-rich prey. Size limitations are due to physical factors like gravity, hemodynamics, and bone mechanics which are related to the ability to access food. What this means is the large size of animals is not limited by physiology but, rather, by the limited availability of prey food. Simply stated, size is limited by energetics. In the arachnid films discussed here the animals do not get enough prey to supply their necessary energetics.

Arachnid agony

Also, with the larger surface area of bigger arachnids then dehydration due to water loss is also proportional to size. Where do these large animals get enough water, especially the desert dwelling tarantula and scorpion? Furthermore, large animals must consume large quantities of food every day so they constantly hunt for appropriate food sources.

Mighty mites

Though the name, ‘mite’ implies something small these tiny animals are to be feared. Some mites only survive on human skin. Usually, mites do no harm and are examples of commensalism and not parasitism. Newborn babies do not have mites but soon acquire them through human contact. Most mites live in hair follicles. There are about 32,000 species of mites. Some mites are so tiny that they have no heart at all.

It should be noted that some mites and ticks are indeed parasites, some of which are carriers of disease, an example being Rocky Mountain Spotted fever. Diseases from mites usually involve allergies. Chiggers, scabies, rickettsia, and dust mites are all problems. As can be determined there are no films with monster mites, small or otherwise, though a potential title like, *Scary Scabies*, does have possibilities.

Spider stuff

In the history of SF films spiders, large or small, are very popular with too many to list. In general we have small spiders (*Arachnophobia*), animal-sized spiders (*Eight Legged Freaks*, *Mesa of Lost Women*), big spiders (*Earth vs the Spider*), and giant spiders (*Tarantula*).

Jumping spiders

Due to no internal nor external support structures (no bones or exoskeleton) spiders the size of dogs or larger that jump would go splat when they land (see above comments on scaling). These animal-sized monsters must easily weigh hundreds of pounds and the larger spiders even more so and when that much weight lands after a 20 foot or more jump with no internal support structures there will be significant body damage (read: splatter).

Spider bites

Spiders are predatory animals and they have developed many ways to obtain prey that include venoms, toxins, and poisons. As mentioned, there are about 100,000 species of spiders and just about all of them produce venom. Fortunately, the venom of just a few species are a serious concern for humans. The amount of injected venom from a spider bite can vary considerably depending upon the species of spider. Fortunately, most spider bites do not contain enough venom to cause life-threatening problems.

The venom from spider bites can be either neurotoxic (affects the nervous system) or necrotic (destroys tissues). Spider venoms are known to cause heart muscle damage, pulmonary edema (fluid in lungs), and hemolysis (destruction of red blood cells; RBCs). Neurotoxic spider venom paralyzes with muscle spasms, cramps, and twitching. Other effects include sweating, drooling, and gooseflesh and in extreme cases both blood pressure and heart rate are destabilized. Some spider venoms contain latrotoxins which cause a massive release of neurotransmitters causing muscle contractions often resulting in painful abdominal cramps.

Necrotic venom contains enzymes, such as sphingomyelinase D, that destroys tissues, much like tissue eating bacteria. Necrotic spider venom can range in symptoms from minor localized effects to severe skin lesions, renal failure, and even death. Often times it takes years for such destroyed tissues to heal leaving deep scars. At first such bites are itchy and quickly worsen within 12 to 36 hours and necrosis can develop over the next few days.

Other spider venoms work by opening sodium channels causing muscle contractions and hypertension. Just about all target ion channels in the membranes of pain-sensing neurons. Some inhibit channels whereas others activate channels. Either way, they are painful.

Welcome to my web said the spider to the fly

Spiders are best known for what they do, spin webs. Spiders use webs to trap food, wrap eggs, and rappel. (Note that in addition to insects, spiders also tend to be cannibals and eat other spiders too.) Spider webs are created out of proteinaceous spider silk extruded from its spinnerets located at the end of its abdomen. There are three types of spider silk, each coming from a different gland in the spinnerets: a trailed safety line for starting a web, sticky silk for trapping prey, and fine silk for wrapping the caught prey. The term, spider web, usually refers to a web still in use whereas a cobweb typically refers to an abandoned web. However, it should be noted that not all spiders build webs to catch prey; some pounce from hiding. Noteworthy, the tensile strength of spider silk is greater than the same weight of steel.

There are five basic types of spider webs: orb, tangle, funnel, tubular, and sheet web slingers. Most orb webs are in a vertical plane (easier to capture flying prey) and some in a horizontal plane (sheet webs) or, depending upon how the web is anchored, at any angle in between.

Spider webs seem to last forever. Every monster movie has some sort of spider web (or cobweb) somewhere in sight. In SF films even undisturbed ancient Egyptian tombs have cobwebs! This begs the question as to why these webs survive for so long. Spider silk is biological and over time will decompose and rot like any biological matter, yet, spider webs seem to be immortal. As it turns out spider web silk endures because the bacteria that would decompose the silk are unable to biologically process the excessive nitrogen in spider silk. What this means is spider silk has natural antimicrobial properties.

Tarantula (1955)
Much has been made of this film for good reason. It is an excellent film and the first to truly feature a giant spider. As a brief plot synopsis, in an isolated desert laboratory a scientist is experimenting with nutrient development on several animals one of which is a tarantula. The tarantula escapes and as a result of the nutrient treatments grows to tremendous size wreaking havoc. Ultimately the spider is burned and all is safe. Since this film has been widely discussed in these pages then for the purposes of this article will only get a minor reference. There are two scenes that deserve comment.

In one scene, Dr. Hastings (John Agar) examines under a microscope some of the white goo substance found at spider sightings and comments, “I’m not sure. It’s impossible at this stage to give you a positive answer but it is related to insect venom.” This comment underscores the general confusion people have between insects and arachnids; to many, a bug is a bug. In the second scene Hastings has an entomologist examine the goo who comments, “That was a pretty accurate analysis you made, doctor…from a species called arachnida…a tarantula to be exact but I’ve never seen venom is such quantity before. (Note: Arachnida refers to the Class of arachnids in general and is not a species name for a tarantula; I would question the entomologist’s credentials.) There is more

venom in this test tube than you will find in a hundred tarantulas." Hastings says, "You mean a tarantula that can secrete that much venom would be a hundred times larger than normal?" The professor responds, "At least that." (see above comments on scaling.)

It should also be noted that tarantula venom is not deadly to humans and as the entomology professor comments, "About as poisonous as a hornet. No fun, mind you, but harmless. The few deaths that have been reported have been the result of germs entering the wound at the time of the bite." Though their bites can cause serious issues and discomfort that could last for days no known tarantula bite has caused a human fatality. Most tarantula bites result in muscle cramps that do resolve over several days. Since tarantula venom does contain some proteins then some people may suffer allergic reactions in addition to the actions of the venom. These allergic effects, such as anaphylaxis, can be life-threatening.

In the film we see a few cattle carcases suggesting the giant tarantula fed on those. Even so, this prey would still not provide enough energy to effectively sustain the spider; it would need much more. Not to mention a source of water.

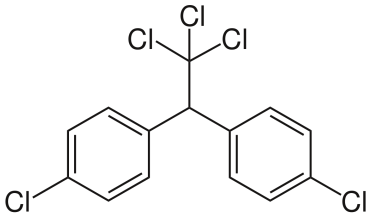
Tarantulas belong to the Theraphosidae family of spiders and about 900 species have been identified so far. Due to their size tarantulas are more fearful looking than they are venomous.

The Incredible Shrinking Man (1957)
In this film, a man, Grant, is exposed to a particle storm and as a result shrinks in size. At one point he confronts a tarantula. In this case the spider is actual size whereas the man is small in comparison so proportionally the spider seems quite intimidating. In this case not only does size matter but size is also relevant to proportions. One person's Lilliput is another's Brobdingnagian. Tiny Grant is no match for the tarantula and does his best to avoid being spider prey.

Earth vs the Spider (1958)
A giant spider is found in a cave and is knocked out with the chemical, DDT. The DDT crew use what is arguably the longest hose in cinema history, much longer than the longest fireman's hose. This hose must be many hundreds of feet long and would weigh many hundreds of pounds. Yet, pulled along by only two men. Due to the length of the hose a significant pressure would be necessary to release liquid. Later, the spider awakes from its DDT stupor and wrecks havoc. In the end the spider is crushed by a cave in. It should be noted this giant spider has thick, sticky rope-like vines for a spiderweb.

DDT
Dichlorodiphenyltrichloroethane or DDT is a colorless, tasteless, almost odorless chemical organochlorine compound originally developed as an insecticide. DDT

was used during World War II to control malaria and typhus among troops. It became infamous for its environmental impact and was banned in 1972.



DDT structure

As an insecticide, for both insects and arachnids, DDT works by opening sodium ion channels in neurons causing them to fire spontaneously which leads to spasms and death (for details on sodium channels please see the above referenced article on poisons, toxins, and venoms). Some arachnids (insects too) with certain mutations in their sodium channel gene can be resistant to DDT. This could be why the spider in this film awakened from its 'coma' after being sprayed with DDT. This spider probably has a mutation in its sodium channel gene that allowed it to survive a DDT attack.

Among other effects DDT causes eggshell thinning in birds of prey contributing to a major decline in bald eagles and peregrine falcons. Once the DDT ban was in effect (1972) these birds of prey have made a comeback. For humans, DDT is a hormone disruptor and also considered a carcinogen and classified as moderately toxic. The main problem is since DDT is highly hydrophobic (does not dissolve in water) and, therefore, fat soluble, it accumulates in tissues and ultimately causes biological problems.

The Giant Spider Invasion (1975)
A comet crashes on Earth and geodes appear each containg a tarantula. Several species of tarantula were seen suggesting an interesting diversity of spiders and not a clonal or isolated single species. As a result of the comet the normal-sized geode spiders seemingly have a collective hive consciousness and appear to act with a purpose. (Inside the geodes what do the spiders eat or where do they get water?) Some of the spiders mutate to larger size with one giant spider similar in size to that seen in the 1955 film, *Tarantula*. The difference being the giant spider seen in *Tarantula* is indeed a tarantula whereas the giant spider in TGSI is of unknown species. Frankly, this spider resembles something seen in a New Year's float parade. The legs of this giant spider are quite small and seem incapable of holding up its body not to mention actually moving. Scaling issues would certainly apply here. Careful staging of actors along with careful editing helped suspend disbelief about this giant spider making it a little more plausible though the one seen in Tarantula is more believeable.

The giant spider is seen devouring a human intact without using any pre-digestion processes like pouring digestive juices over the prey. The spider ate the human whole and it is unknown what the animal does with non-digestible clothing and metal (jewelry, belt buckle). Normal spiders egest such non-digestible matter like fur and exoskeleton and do giant spiders do the same?

From the film the effects of the comet appear to affect the growth rate of some species of tarantula. Why weren't other spiders or other animals or plants affected by the comet?

Life surviving in a geode is also a plot point in the film, *Giant from the Unknown*, where a living lizard is found inside a geode. It should be noted that the geologic forces necessary to form geodes are so extreme that no biological life form could survive the process.

Arachnophobia (1990)
The fear of spiders is called arachnophobia. In this film an expedition into the Amazon (Venezuela) collects spiders. Using standard bug collection techniques the scientists spray a poison gas into a tree canopy resulting in the bugs falling into collection traps. One tarantula in particular survived the chemical poison. It is noted that this tarantula from the Amazon jumps. One member from the expedition was bitten by a spider and dies within seconds. The body casket, transported back to the US (city of Canaima), has a spider that escapes. A crow picks up the spider, flies away, and drops the spider on a farm. This spider appears to be about twice the size of a normal tarantula so the effects of the poison caused enough positive mutations that there was excessive (uniform) growth. This spider also jumps.

As a result of a spider attack a human body was completely dessicated, something spiders do not normally do; they consume prey and not just body fluids. A normal human body contains many liters of fluids and to be "completely dessicated" would mean the complete removal of this large volume which would require many, many spiders.

An entomologist identifies a new spider species which has vampire-like blood needs. Perhaps these are the spiders that leave dessicated carcasses behind. Using a syringe the entomologist seemingly removes milliliters of fluid from the spider poison glands! This fluid is then injected into a mouse who immediately dies suggesting a very toxic poison. Later, the entomologist finds the main spider colony only to be killed by the giant queen spider.

This large spider then interacts with other spiders and somehow communicates with them. A giant spider web complex is formed in the attic of a barn; all five spider web forms appear to be present suggesting the diverse and varied species of spiders are all communal. Small animals like a rat are trapped in the

webbing. One ‘main web line’ is so taut that when plucked vibrates with sound. Smaller spiders populate the area and begin a coordinated attack on people. Those bitten quickly die from the spider bite, a single spider bite, again suggesting a strong and potent venom.

A pest exterminator shoots insect poison at one spider that has no effect suggesting this spider has mutated sodium channel genes and is immune to the poison. Like all giant spiders the colony nest along with the queen are eventually set on fire.

Scorpion stuff

Scorpions are predatory arachnids and can vary in size from 9mm (0.3in) to 23 cm (9in).

In general, scorpions are larger than spiders and are easier to spot primarily due to their signature pair of grasping pedipalps or pincher claws and their segmented tail that curves over their back and ends with a stinger. The scorpion's exoskeleton is thick and sturdy and good protection from predators. Though scorpions are unable to form sharp images with their eyes their central eyes are amongst the most light sensitive of all animals. This sensitivity to dim light makes it possible for nocturnal species to use star light to navigate at night.

Scorpions are found on all continents except Antarctica and New Zealand. In general, they are not as numerous as spiders and in the U.S. are mostly confined to the Southwest. Scorpions make homes on the ground, in trees, under rocks, and in sand.

The characteristic scorpion tail is known as the metasoma though it is not an appendage or limb. The stinger is called a telson and is attached to the end of the fifth segment of the metasoma. The tail is typically carried upside down with the telson pointing forward. The telson itself includes a vesicle that contains the venom glands. The venom-injecting barb is a hypodermic aculeus.

The majority of scorpions prefer temperatures between 20 to 37^{0}C (68-99^{0}F) so moderate temperate zones. Some species survive temperatures well below freezing (Patagonia scorpions; -25^{0}C) whereas others survive desert heat (Turkmenistan; 50^{0}C). The scorpions respiratory organs, spiracles or more commonly called book lungs, may be slits, circular, elliptical, or oval openings and are located on the metasoma portion of their bodies.

The Claw, the Claw

In SF films how do giant scorpions lift their pincher claws which must weigh several hundred pounds each? With such heavy pinchers then all they need to do is land on you to kill and not actually pinch. These grasping pedipalps or pincher claws are segmented appendages and primarily used to immobilize prey, defense, and sensory purposes. Scorpion pinchers are studded with highly

sensitive tactile hairs that are sensitive to touch. These claws are composed of two parts, the fixed claw or manus and the moveable claw or tarsus. On these pedipalp claws are small granular raised ridges called keels or carinae that are used taxonomically to identify species.

How many liters of venom are in giant scorpion poison sacks? Due to the size of the stinger and the volume of poison in the sack all it needs to do is be squirted on prey to be effective. Body penetration by a stinger that size, like being gored by a steer horn, could be fatal by itself and the poison not necessary. Therefore, for these giant SF scorpions the death threat comes from their pinchers and stinger penetration and not necessarily their poison.

Scorpions prey for food

Scorpions are considered opportunistic predators and their diets primarily consist of small arthropods though some kill small lizards and snakes. However, scorpions themselves are prey to some badgers, birds, lizards, mongooses, opossums, and rodents. Once captured by scorpions prey are then crushed with the pinchers and/or injected with venom. Most scorpion venom is neurotoxic which will kill or paralyze prey. Scorpions use sharp claw-like structures in their mouths to pull small amounts of food off prey to digest. It should be noted that scorpions can only injest food that is liquified so they have external digestion in a pre-oral cavity before being sucked in liquid form. Digestion fluids are egested onto the food which liquifies it allowing it to be then sucked in. Scorpions can injest a large amount of food at one time since they have the capacity to store food in a specialized organ. Combined with a relatively inactive lifestyle scorpions can go a long time without food, sometimes upwards of a year. Non-digestible matter such as fur and exoskeleton are ejected by the pre-oral cavity.

Though most arachnids are oviparous (egg layers) scorpions are viviparous (live birth) with the young born one by one. The brood is carried on the mother's back until they have undergone at least one molt. Though most broods are around eight young scorpions the range can be anywhere between 2 to 100 scorplings. Growth occurs by shedding of the exoskeleton and it typically takes about five to seven molts to reach maturity.

One-two punch

All scorpions have venom and use it to paralyze and kill prey for food. Though it should be noted that a common misconseption is the venom is fatal to humans. Of the 1750 species of scorpions only about 25 (1.4%), primarily from the Family, *Buthidae*, have venom capable of killing a human.

Scorpions have a two-part chemical arsenal poison system kept in a glandular sac at the tip of its tail. The first, a prevenom, is a clear liquid that contains roughly 80mM potassium salt including a peptide that blocks potassium channels in the victim, making for a strong poisonous jolt of potassium even more toxic. This is followed, if necessary, with the second venom, a milky white venom, that

contains a variety of neurotoxic peptides (peptides are small stretches of amino acids hooked together) and enzyme inhibitors. Potency comes from the potassium sting and is more painful than venom, though not as deadly as the neurotoxic venom. Prevenom stuns prey. It takes many days to weeks for a scorpion to replace the peptide venom so they use it sparingly and instead use the potassium poison system, which can quickly be replenished. This is why scorpions primarily use their pinchers to capture prey.

Fluorescence

An interesting aspect about the scorpion cuticle, the outer body covering, is that it glows a vibrant blue-green when exposed to an ultraviolet light (UV) such as a black light. The fluorescence is due to the chemical, beta-carboline, in the cuticle. It is noted that many scorpions are nocturnal and emerge at night to hunt and feed. An efficient way to search for scorpions at night is to use a hand-held UV lamp and the scorpions would be easy to spot as blue-green glowing animals.

The Black Scorpion (1957)

A volcano erupts in Mexico and as a commentator says, “A new volcano is created by the mysterious and rebellious forces of nature.” A geologist (SF stalwart, Richard Denning) is called in to investigte. The action occurs in the small town of San Lorenzo.

Town peasants call the scorpion beast a “demon bull”. The geologist called in to study the volcano found obsidian rock (cooled lava) that encased a scorpion, which, when opened, is alive! This suggests a very sturdy scorpion that can withstand the geologic forces of cooling lava. Humorously, this scorpion makes squeaking noises.

Ginormous

The apparent size of the giant scorpion is over 20 feet tall at body with its tail perhaps 40 to 50 feet tall. This scorpion has “come from the bowels of the earth”. The authorities try to use poison gas to capture and kill the scorpion but this is ineffective suggesting this scorpion is immune to this poison gas.

The giant scorpion makes growling noises and since vocal cords and lungs are necessary for this the scorpion must have grown them (plausible since a giant scorpion has plenty of room for them in its abdomen). Also of interest is this giant scorpion drools excessively and this fluid loss must somehow be replaced. The giant scorpion has two large eyes at the front of its head so it is capable of 3-D depth of field vision. Based on the size of the eyes there must be plenty of rod and cone cells to capture images with high resolution (for details on eye sight please see the article, “X-The Man with the X-Ray Eyes’, elsewhere) so sight should not be the problem its smaller cousins have.

What legs you have

The legs of the giant scorpion come to a point and by supporting so much weight the leg tips would pierce the ground, especially softer soil, making walking difficult. Demonstrating its strength this scorpion has no problem lifting a truck or a tank (!) and breaking through a brick wall. To counter balance the lifting of such weights would suggest this arachnid weighs several tons which those spindly legs seemingly have no problem supporting. What about water and food? The scorpion does eats people but with all that drooling where does it get water? Since the giant scorpion literally eats people this is contrary to normal feeding behavior in which scorpions pre-digest food to liquify it since they can not eat solid food.

The giant scorpion has excellent body armor. With its uniform size increase then its exoskeleton would also be proportionately thicker and able to withstand small arms fire as well as tank shells. One person exclaimed, “I shot at that thing a dozen times”, using a handgun, to no effect.

The geologist goes down the new volcano opening and in a huge cavern at the bottom finds the scorpion nest. Many scorpions are seen (“must be 50 of those things down there”) as well as other creatures (a “30 foot” mega-inch worm?). In a wonderful display of stop-motion animation photography the giant scorpion and worm battle. The stop motion animation was done by Willis O’Brien and Peter Peterson. Eventually, the scorpion wins and eats the worm.

The titular ginormous scorpion, the “grand daddy of them all” attacks and eats other scorpions so it is cannabalistic. It is mentioned, “They eat their own weight every three or four days”, which would be a few tons of food and is quite different from normal scorpion behavior. With such a volume demand then what do they eat? We do see scorpions attack a train and eat the people but that would not be enough. Knowing their strong appetite the authorities get the giant scorpion to follow a meat wagon into a stadium where it is attacked and after a battle is killed by electricity.

A key word in the film title, ‘black’, is problematical and hinders some of the special effects. For the stop-motion sequences the scorpions appear to be a dull grey color. When the giant scorpion is seen in other views it is clearly transparent. The special effects crew apparently did not know how to make a ‘black scorpion’ look black without compromising the integrity of the creature.

[honorable mention of other scorpions: *Clash of the Titans* (1981) (scorpions come from spilled blood of the Medusa’s head); *Stinger* (large scorpions on a submarine!); *Scorpio Gigantis*.

Tick stuff
Tick treats

In general, ticks as a species are under represented in SF films but are no less dangerous. In all, there are about 12,000 species of ticks. Ticks are typically 3 to 5 mm long and are considered external parasites. Ticks live by feeding on the blood of animals including birds, reptiles, and amphibians. There are two major types: hard ticks have a hard shell on their dorsal surface and soft ticks that have their mouthparts on the underside of their abdomens. Tick life cycles have four stages: egg, larva, nymph, and adult. The tips of each leg have a pair of claws along with sensory or tactile hairs. In general, ticks are a tough and resilient animal and can withstand extremes of environment for long periods of time. When dormant their metabolism slows enabling longer survival periods. It should be noted that migratory birds can be a source of fever-carrying ticks.

Other arachnids use poisons, venoms, and toxins, and since ticks feed on blood meals they are vectors of disease (like the Anopheles mosquitos, carriers of malaria). Tick-born diseases are caused by the transmission of pathogenic infectious agents by the tick bites, which include bacteria, protozoa, and viruses. Surprisingly, ticks can carry up to 16 different disease-causing pathogens at a time which is why those infected are so difficult to diagnose and treat. Which disease is it?

Tick transmissible bacterial infections include lyme disease, relapsing fever (Borrelia), typhus, Rocky Mountain spotted fever, Helvetica spotted fever, Bartonella, and Tularemia. Tick transmissible protozoan infections include babesiosis and cytauzoonosis. Tick transmissible viral infections include meningoencephalitis, Powassan virus, Colorado tick fever, and Crimean-Congo hemorrhagic fever. The death of former Senator Kay Haganin in 2019 (66 years old) was due to a tick disease.

Ticked off
In general, ticks tend to be more active during warmer months especially in areas of woods, bushes, high grass, and leaf litter. In many instances tick bites are often harmless with no noticeable symptoms but in some cases these bites do cause allergic reactions that can be severe. Those bitten often have symptoms of body aches, fevers, fatigue, joint pain, and/or rashes.

While blood feeding ticks excrete an anticoagulant to keep blood flowing. Once engorged from a blood meal tick weight can increase by 200 to 600 times from before feeding making their post-meal movements awkward and sluggish.

Ticks (1993)
Marijuana farming has become a high-yield, high-tech industry and some backwoods pot farmers use chemicals to enhance the growth of their plants. Some of the toxic chemical sludge spills onto a nest of ticks thereby mutating them into softball-sized creatures. Instead of ginormous ticks these creatures are of a modest size and therefore much more plausible. Supposedly fire destroys the colony.

Toxic goo

The toxic chemicals used to enhance marijuana plant growth spill onto a tick nest so for the chemicals to do their mutation work they must be absorbed through the egg sac and subsequently find its way to the tick genes to mutate the DNA. These mutations uniformly enhance growth and development, act quickly, and in a short period of time many tick egg nests are visible. Egg nests are seen inside the pot farmers barn, the campgrounds, and on trees in a forest so their proliferation is significant and fast. This brings into question the numbers and speed of development. The original nest was mutated giving rise to ticks which spread to create more nests, etc., etc., all of which takes time, fluids, and food so in the short amount of time lapsed in the film makes it quite a challenge to understand this rapidity of growth.

The vetted tick

One mutated tick attacks and partially devours a rat. Later, a dog is attacked and killed by a tick. This dog is taken to a veterinarian who comments, “Something drained your dog of all its blood.” Then, a large tick, about 20cm (8 inches) across and still alive, is extracted from the dog’s abdomen. After removing one of these large ticks from the dog the vet comments, “Vampires of the insect world”, which she uses to describe the bug. This blood engorged tick escapes and crawls very rapidly suggesting the large blood volume meal is no deterrent to movement. Then the vet steps on it commenting, “When in doubt, squash.” (Earlier a camper says, “They’re too tough to squash” (normal, small ticks) so he burns the tick with a match.)

The vet does an autopsy on this tick found in the dog and finds an illegal “herbal steroid”, used by the farmers on their marijuana fields to “accelerate growth”. Apparently, this plant steroid also works on ticks. This helps to explain the excessive and rapid growth of the ticks. Continuing, the vet says, “When a tick bites you, it numbs you so you don’t feel it. In some cases, it can produce an hallucinatory state.” These ticks make an hallucinogenic neurotoxin and based on their size their bites must inject a large volume. One of the bitten pot farmers undergoes severe hallucinogenic effects that ultimately kills him.

These ticks seem to have some sort of collective consciousness in that they have a hive mentality and act in unison. Hundreds of ticks are seen scooting about together. These large ticks jump and are seen easily crawling up walls. A tick egg nest is cut open and a large amount of greenish gooey slime pours out along with partially developed eggs. Where does the fluid volume come from?

Ticks are seen crawling under a person’s skin and freely moving about. The connective tissue that attaches skin to underlying muscle is extensive making it difficult for such an animal to move about. It would have to have some way to cut the ligands between the bottom layer of skin and the upper fascia or muscle layer. If the tick could indeed do that then it would be quite painful.

One ginormous tick, about six feet long, mutates inside the body of a victim and 'hatches', ala *Alien* chestburster-like. Based on the size this tick appears to be a few hundred pounds in weight which brings up scaling issues and support for the legs. At the end, like all things biological, fire destroys the ticks. It is interesting that when set on fire the ticks explode suggesting they may contain some sort of flammable liquid.

Summary
Bite, sting, kill.
In the history of SF cinema giant spiders were first seen in silent films before traditional insects. Even earlier is the presence of countless cobwebs in haunted house films. For just appearing in films spiders spin a bigger web in cinema, SF and otherwise, than any other animal. To list all films, not to mention TV shows (a giant spider even made an appearance in an episode from the *Gilligan's Island* TV series!), that either contain or feature arachnids is beyond the scope of this article. More to the point, the vast majority of these arachnid films involve spiders and even that list is extensive – an arachnado of films! - so to keep things simple the below list, in no particular order, is just a (totally subjective) select few that yours truly enjoys. In many of these films the arachnid (read: spider) makes only a cameo appearance and is not the star.

Tarantula (1955), *Kingdom of the Spiders* (1977), *Earth vs the Spider* (1958), *Arachnophobia* (1990), *Eight Legged Freaks* (2002), *The Black Scorpion* (1957), *Black Scorpion* (1995), *Ice Spiders* (2007), *Missle to the Moon* (1958), *Cat Women of the Moon* (1954), *The Incredible Shrinking Man* (1957), *The Giant Spider Invasion* (1975), *Kiss of the Tarantula* (1975), *Spiders* (2000), *Spiders II: Breeding Ground* (2001), *Arachnid* (2001), *Arachnia* (2003), *Queen of Outer Space* (1958), *World Without End* (1956), *Mesa of Lost Women* (1953), *Horrors of Spider Island* (1960), *Lord of the Rings* (Shelob; 2001), *Dr. No* (tarantula scene; 1962), *Lavalantula* (2015), *Stinger* (2005), *Giant Scorpion* (2016), *Scorpio Gigantis* (2006), *Clash of the Titans* (1981), and *Ticks* (1993).

Arachnids have their own instincts and by extrapolating larger versions should have the same behaviors. In comparing normal arachnid behvior with that seen by those in films it is clear some behaviors have been humanized or anthropomorphized and are not instinctual. Hive mentality and eating solid foods are not normal behaviors. Even so, none of this diminishes our enjoyment of these creepy crawly animals.

If we ignore the physically limiting scaling issues, both size and energy, then arachnid films seemingly do make sense. And, to be sure, whether they make sense or not, these films are fun to watch. Bugs, insects, arachnids, whatnot are everywhere and are an inescapable part of life. Man has learned to be in harmony with our six and eight-legged critters and though some can kill most are

our friends. Scary indeed! Arachnids, especially spiders, are here to stay and fortunately, none of them are giants.

[note: some spiders were harmed in the preparation of this article]

Thank you for reading. It's back to the lab for me. Stay healthy and eat right.