B is for Bug, O is for Oikos: A Partial Dictionary of Household Arthropods

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Abstract

Arthropods are the most numerous and diverse group of animals on the planet. This work seeks to explore the relations between humans and arthropods within the context of modern, North American homes. The unknown, sometimes undiscovered, or simply overlooked landscapes of human households provides a rich environment in which to explore the lives of arthropods that can offer different, and often humbling, perspectives to humanity. The species I explore are (for the most part) those that have cosmopolitan distributions and have specific adaptations that allow them to live alongside us in our dwelling spaces, our *oikos*. I reconceptualise human households as a multispecies assemblage, which serves as both a metaphor and a map for my explorations of the situated human-arthropod relations in this environment. I draw on a materialist approach that considers the intra- and interactions between human and nonhuman animals, plants, objects, and other things within human households. Interest in the investigation of human homes from the perspective of the natural and biological sciences has grown in recent years: I pair the scientific study of indoor arthropods with a phenomenological exploration of the lifeworlds of these creatures in order to discover why it is that these organisms make their homes alongside ours; raising the question of who is what to whom? In so doing, I also challenge the notion of what it means to be a pest by looking at the evolution and ecological roles of arthropods alongside human cultural perspectives and histories that make up what we know or think we know about these creatures. Education thus serves as a fundamental aspect of my research insofar as coming to know these organisms is essential so that we can make reasoned decisions about how we want to live with arthropods of the indoors. My objective in exploring human-arthropod entanglement within the home is to "stay with the trouble" (following Haraway, 2016b) and consider what it might mean to both live and die well with these creatures by envisioning a present in which humans accept these creatures and our shared life histories as simply a part of life. Ultimately, it is my hope that we can at least grow to tolerate arthropods, if not developing some level of respect for their presence on earth.

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Foreword

During my undergraduate career at York University in the Faculty of Environmental Studies (FES), I took a course taught by Professor Leesa Fawcett on human-nonhuman animal relations and in the final paper for this course, I tackled the issue of pesticides and looked at the rhetoric that fuels their continued use. At the time, I was also working toward my honour's thesis on honey bees and honey production and I realised that I had been constructing a hierarchy between bees and other insects that I was not able to justify. The work that I began as an undergraduate student ultimately led to my decision to return to FES for my Master's Degree in Environmental Studies (MES) in order to explore human perceptions of insects and other arthropods more deeply.

In all my studies undertaken as a part of my MES, I have sought to find connections to arthropods and have found that if you look hard enough, you will find them everywhere. The following paper is a culmination of my work at FES that began as an undergraduate and engages with all three learning components outlined in my Plan of Study – multispecies studies, scientific study of arthropods, and environmental education; though ultimately, it focuses more specifically on multispecies studies and the scientific study of arthropods. In producing this Major Research Paper (MRP), I have drawn from and expanded upon the research papers I have written throughout the course of this degree. To begin I conceptualise modern human dwellings as always already a multispecies assemblage inclusive of human and nonhuman actors. I delve into the scientific study of arthropods only to add to these narratives with reference to mythology, literature, and popular culture in order develop a fuller understanding of our perceptions of and relationships with the arthropods of the indoors. I explore the possibilities for citizen science as a method of environmental education to engage with the practices of amateur entomology and natural history writing in order to further our understanding of the indoor environment and the life that can be found within. Ultimately, this work seeks to understand how we can live well with the organisms with whom we share our homes.

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Introduction

> *We do not live in a Nuclear Age or an Information Technology Age. We do not live in a Post-Industrial Age, A Post-Cold War Age, or a Post-Modern Age. We do not live in an Age of Anxiety or even a New Age. We live in an Age of Flowering Plants and an Age of Beetles. (Hubbell, 1993, 40-41)*

Arthropods are invertebrate organisms that include insects, arachnids, myriapods (centipedes/millipedes), and crustaceans. The worlds of arthropods are vast and comprise nearly seventy-five percent of life on earth (Hatley, 2011). They have existed since the Cambrian period roughly 540 million years ago and as such they have played a fundamental role in shaping the planet as humans know it today. Beetles are the most successful group of arthropod—and arguably all—species on Earth. "There are more beetles than anything else in the animal kingdom. In numbers of species described, they represent the largest group of animals on the planet, more than 25 percent of them. Some 370,000 species have been named so far" (Hubbell, 1993, 38). Looking to their evolutionary history, beetles likely emerged during the Cretaceous period (135 million years ago) and aided in the evolution of flowering plants. Susan Hubbell, citing R. A. Crowson, author of *Biology of the Coleoptrata*, writes:

> [He] has observed that cycad fossil plants from the Cretaceous times show damage typical of the kind inflicted on today's plants by fruitworm and fungus beetles. He speculates that one evolutionary response to this damage may have been to enclose the flowering parts, giving trees and other plants that protected their seeds in this way such a reproductive advantage that, botanically, they quickly took over the planet. Today these are what we call Angiosperms, the flowering plants…. They are the most numerous of all plants, represented by about 250,000 living species. (40-41)

The lives of different arthropods on earth can offer different, and often humbling, perspectives to humanity because their history situates them that much more deeply, and successfully, in the evolutionary and geological timescale of life on earth.

There are seemingly limitless opportunities to explore the worlds of arthropods, which is part of the reason that I initially chose to limit the scope of my research to household arthropods but also because the indoor environment, particularly the home, is where human beings have the most intimate contact with these organisms. This Major Research Paper is a partial abecedary that functions as a dictionary for the unusual and near invisible realms of some of the various arthropods one might encounter in modern, North

American homes. The species I explore are (for the most part) those that have cosmopolitan distributions and have specific adaptations that allow them to live alongside us, in our dwelling spaces, our *oikos*. In venturing into the unknown, sometimes undiscovered, or often simply overlooked landscapes of human households, a rich microcosm of life emerges; by simply remaining open and curious in the most mundane of places we can make our worlds more vivid. There are as many different ways to look at, or think with, arthropods as there are individual arthropods on earth; and so, the nature of each of these entries, and the work as a whole, will always be partial, never fully articulating a complete picture of the worlds of these creatures.

Many scientists have recently turned their attention to the "indoor biome," which is defined as "the ecological realm comprising species that reside and can (although do not necessarily always) reproduce in enclosed and semi-enclosed built structures" (New Working Group on the Evolutionary Biology of the Built Environment (NWG) et al., 2015, 1). Scientists have identified this environment as an area that is vastly understudied and in need of further investigation (Barberán et al., 2015; Bertone et al., 2016; Dunn, 2014; Dunn & Beasley, 2015; J. Green, 2014; Lucky et al., 2014; Lyytimäki, 2012; Madden et al., 2016; N.W.G. et al., 2015). Likewise, this area has not been considered in great detail in the social sciences or humanities. Given this lack of attention on the household environment, I saw it as an important area to which my research could contribute. According to Bertone et al. (2016), North American human dwellings are also home to ninety-three different species of arthropod on average; many of whom may be characterised as pests simply for their presence indoors, when in fact they cause no harm to people or their belongings. Through my research I call into question the definition of a pest and challenge commonly held perceptions about some of the organisms who make their homes alongside humans. Ultimately, this work seeks to conceive of ways in which human beings can live well with our arthropod companions, creating tolerance if not respect of their existence in our lives and in our homes.

I use the concept of an assemblage following Jane Bennett (2010) and Anna Tsing (2015) to figure as both a metaphor or map connecting the various entries; while also offering a mode of thinking that emphasises the intra- and inter-relations between human beings, arthropods, and various other material aspects of our shared home environment. I approach the human-arthropod assemblage from a materialist perspective as in Donna Haraway's (2016b) articulation of "an ecology of practices, to the mundane articulating of assemblages through situated work and play in the muddle of messy living and dying" (42). The form of my MRP draws some similarities to the works of Hugh Raffles (2010) and Vinciane Despret (2016) in that it is laid out alphabetically with the intention that each of the entries serves as a stand-alone piece; though all connected through this idea of the household assemblage. On the nature of human-arthropod relations I take inspiration from Raffles when he writes, "the impossible, uncertain intimacy between you, me and those others that are simultaneously most commonplace and most alien" (68). While similar in both general topic and form to Raffles' *Insectopedia*, my focus is shifted specifically towards those cosmopolitan, synanthropic species of arthropod that live alongside humans—all the more mundane but also, in some cases, all the more troublesome. In the context of my MRP as a whole and in each the entries, this kind of assemblage-thinking is performed so as to gather together the multiple and various aspects of our relations with arthropods, characterising the entries as more exploratory than argumentative. Following Despret, I try to collect as many diverse and sometimes conflicting accounts of human-arthropod relations in order to add to the complexity of humanity's knowledge and understanding of these organisms. This work strives to emulate Despret's methodology, as described by Haraway (2015), "her kind of thinking enlarges, even invents, the competencies of all the players, including herself, such that the domain of ways of being and knowing dilates, expands, adds both ontological and epistemological possibilities, proposes and enacts what was not here before. That is her worlding practice" (5).

Within the natural and biological sciences interest in the topic of nonhuman life of the indoors has grown in recent years. Matthew Bertone et al. (2016) published their extensive survey on the arthropod life of the indoors just as I was setting out on this journey and their work has continued to inspire me throughout. I have returned to their study again and again to learn more about these creatures with whom we share our homes. Likewise, Richard Jones' (2015) comprehensive field guide to household animals, *House Guests, House Pests*, has also played a fundamental role in my exploration of indoor arthropods; especially insofar as his descriptions of these creatures are often punctuated with anecdotes from his own experience.

These two sources are essential to my entomological understanding of the lives of nonhumans within human homes – in terms of identifying which species are common to human homes, their evolution and co-evolution with humanity, and the driving ecological factors that sustain their lives indoors. Pairing this kind of scientific research into household arthropods alongside Jakob von Uexküll's (2010) phenomenological explorations of the lives of animals has been fruitful in understanding the experiential perspective of these organisms within human homes. His theory radically decentres anthropocentric conceptions of environments by considering that objects of significance to a certain organism within their environments will not necessarily be significant to other species; meaning that the world is full of significance that is imperceptible to the human. In some cases, the arthropods within our homes are not even attracted to humans, per se, but rather the significance—or the "effect marks" as Uexküll calls them—may be the presence of something else within the environment to which they are attracted that is both unknown and un-sensed by the human. What I have found throughout my research is that often in discourse surrounding arthropods humans see themselves as somehow the target of arthropods' actions; as if they are out to get us. In critically examining the household environment phenomenologically from a nonhuman animal's perspective humans can develop a deeper understanding of the relationships between arthropods, humans, other nonhumans, and things in the home. One such example is spiders, who live in human homes because of the availability of prey not because they care about humans. In fact, most spiders do not possess eyes that are capable of perceiving an object such as a human being (Hillyard, 1994). This deeper understanding of the lives of these organisms can help humans to address the question of why they are here in our homes.

To further tease out questions of human-arthropod entanglement, I draw on Haraway's concept of string figures or knots. Within these knots, Haraway (2016b) challenges humans to stay present with the world in its current state and to this I include staying present with the multitudes of indoor arthropods. "Staying with the trouble requires making oddkin; that is, we require each other in unexpected collaborations and combinations, in hot compost piles. We become-with each other or not at all. That kind of material semiotics is always situated, someplace and not noplace, entangled and worldly" (Haraway, 2016b, 4). In certain cases, human activities and practices have unwittingly fostered relations with arthropods – such as the relationship between stored grain and grain weevils. Some of these organisms have lived among humans for so long and our life histories are now so entwined that they are seemingly always already a part of humanity's pasts, presents, and futures. Haraway's (2016b) notion of staying with the trouble gives humans pause to imagine what the world would be like to accept these creatures and our shared life histories as kin; rather than attempting to eliminate them entirely. Perhaps humans can envision a present in which indoor arthropods are simply considered to be a part of life, both human and worldly? This work ultimately only touches the surface of what it means for human beings and arthropods as "companion species" to live and die well together in our shared habitat.

Grounded in multispecies studies, I frame my research as a naturalcultural history of arthropods in the home (following Haraway's (2016a) term natureculture), which includes life histories and ecological roles of these organisms as well as cultural perspectives and histories that make up what we know or think we know about the arthropods commonly encountered in households. I explore the dominant representations of terrestrial arthropods in popular media, literature, and mythology examining how culture shapes the discourse on human-arthropod relations and further how these stories relate to the specific assemblages in which these animals are enmeshed within the home. I also consider both the effects that humans have on arthropods, the effects that they can have on us, and the ways in which these relationships are enacted within the material world since relations between humans and nonhumans are multidirectional in that it is not only, nor always, the human who determines the unfolding of events. Naturalcultural history must thus consider, in the practice of writing about other animals, "that how we narrate, how we construct narratives, and how we parse their purpose matter; that any narrative, including all life writing by and about companion species, must engage these species in the fullest sense of the term, must meet them in every way possible, for this is what posthuman praxis entails" (Huff & Haefner, 2012, 167).

As part of my process and my naturalcultural history practice, I have let parts of my own home "go wild" with neglect so that I was better able to observe some of these critters in their natural habitat and to practice what Tsing (2015) calls the "arts of noticing." Like Rev. Dr. Thomas Muffet (1553-1604), author of *Theatrum Insectorum* and famed father of Little Miss Muffet, who believed that spider webs beautified the home, I have left spiders to their own devices and kept their cobwebs up in the corners of my apartment. I have even had the pleasure of bearing witness to the hatching of spider eggs on my ceiling and observed the tiny spiderlings, barely visible, drift down like snowflakes on impossibly tiny threads. In some cases, I have even invited some arthropods into my home or let some stay whom others might consider to be pests. For instance, each spring and fall a colony of small black ants makes their appearance in their uniform lines right by my desk. I sometimes lay down on the carpet and watch the ants at ground-level. In one instance I watched them carry a piece of popcorn I had intentionally dropped on the floor. Over the course of the day the ants had mostly disassembled the popcorn, but it had only moved about thirty centimetres from where I initially dropped it. They have yet to reach what Jones (2015) calls "pest proportions" so I let them continue about their business. In any case, they have never reached my kitchen where they may prove to be more of a nuisance.

My MRP engages with environmental education by stressing the importance of coming to know those organisms with whom humans share their home environments so that they can make reasoned judgements about how to live with these creatures. Jeffrey Lockwood (2013), citing Jared Diamond, writes of the problem that "spiders and insects are no longer worth the cultural investment of teaching kids to differentiate species" (174; Lemelin & Yen, 2015). This statement might be construed as a problem of naming or what Robert MacFarlane (2018) calls "lost words" when he writes, "once upon a time, words began to vanish from the language of children. They disappeared so quietly that at first almost no one noticed—fading away like water on stone. The words were those that children used to name the natural world around them" (1). Of course, MacFarlane's scope is much broader here, but the point holds for our relationships with arthropods. Education about, and the ability to identify, different species of arthropod is a part of dispelling myths surrounding these creatures but there are many other reasons that identifying species is important: to identify those that are or may be dangerous to human health, those whose populations in high numbers can destroy property or damage foodstuffs, those at risk of extinction, or possibly just identifying species for the fun of it. I explore the potential for citizen science projects to facilitate environmental education using the practices of amateur entomology and natural history—including both theoretical aspects such as compiling data and asking research questions but also the practical aspects of observation, collection, writing, and illustration[1]—in order to provide learners with a transformational education experience. The aim of which is ultimately to broaden human understanding of arthropods in human-defined spaces.

The first entry of this abecedary, A… is for Assemblage outlines the concepts assemblage, additive empiricism, and anthropomorphism as the theoretical and methodological underpinnings of my Major Research Paper. In B… is for Bed Bugs, I trace the history of the common bed bug from its first documented association with humanity through to the present-day context. I consider what it might be like to "stay with the trouble" and find ways in which we can live with this organism. C… is for the (un)Canny Centipede looks at possibly the strangest and most uncanny of all arthropods featured in this work. The double meaning of uncanny, referring to that which is both familiar and frightening, plays into some of the broader discourse on the house centipede; such as its characterisation as simultaneously both pest and pest control. In E… is for Environmental Education I explore the potential of amateur entomology in conjunction with natural history to support citizen science initiatives in providing learners with a transformational education experience grounded in principles of popular education. L… is for (Book) Louse features a piece of speculative fabulation that provided an opportunity to apply anthropomorphism constructively and explore an Uexküllian foray into the life of a book louse. O… is for *Oikos* defines the title of my MRP from the Greek word meaning house or dwelling place, which is also the root word of both ecology and economics: this entry explores human-arthropod relations within the home both ecologically and economically. In P… is for Pest I delineate the meaning of the word pest and the history of pesticide usage. I take inspiration from Richard Mabey's (2010) *Weeds*, from which I borrow the concept of "weediness" and apply it in the context of indoor arthropods to describe the quality of being a pest or "pestiness." S… is for Spiders focuses specifically on fear of spiders since arachnophobia is quite commonplace in western society; this entry seeks to dispel some misconceptions about these creatures. I conclude with T… is for Tick where

[1] Unless otherwise specified all the artwork contained within this work is my own.

the reader then leaves the home (and the arthropods found therein) for a brief sojourn through a meadow to encounter the tick, which then takes them around the world to explore the difficulties of what happens to the host-specific parasites of endangered species in the event of the latter's extinction and questions whether or not humans should care if ticks go extinct.

As I reached the end of writing my MRP, I realised that in the context of arthropod-human entanglement there are some substantial obstacles in the path to living well with these creatures. Simply because we share an environment with some of these "unloved others" (Rose & van Dooren, 2011) does not mean that our relations are mutualistic or commensal; take, for example, bed bugs or ticks whose life histories are entirely parasitic. Jacob Bull (2014) writes that love or affection is not the right register within which to meet these organisms since our relations with them tend to be defined by what he calls "ugly emotions." For precisely this reason—that we do not love or even like these creatures—he suggests that "the diverse ecological relations of 'invisible' animals… offer much to our understandings of more-than-human socialities; the 'invisible' animals of this world – the ticks… indeed worms, insects, fish and rodents are far more numerous than the visible creaturely presence witnessed as pets, companions, farm/food animals, laboratory and zoo subjects/objects" (73). These more visible relations, such as pets or laboratory animals, writes Bull "tend to focus on scenarios where the human is in the powerful position and focus on animals with whom we (humans) are willing to share our spaces and ecologies" (82). For many household arthropods, or even just arthropods in general, we are decidedly unwilling to share our spaces; as a result, these "invisible" animals, like those listed by Bull, may be overlooked by research. While I had hoped to find some way of positively relating to our arthropod counterparts in some cases it may just simply not be possible. I think that Lockwood (2013) makes a strong case for entomapatheia—the state of "not being affected by something [insects] or of lacking strong feelings" (171)—as the register in which we ought to meet arthropods. In describing the concept of entomapatheia, he cites a conversation with Harvey Lemelin: "When I asked him what would be the ideal emotional response to insects, he replied, 'That it is okay to see insects as awful and awesome, that its also okay to be ambivalent.' Being a social scientist, he's willing to accept that 'humanity, like nature, is diverse. Polymorphic interpretations and tendencies are natural. It's just the way we are.' …he maintains that we should simply 'strive for tolerance—not infatuation'" (Lockwood, 171).

A… is for Assemblage

> *Nicene Creed for would-be vital materialists: I believe in one matter-energy, the maker of things seen and unseen. I believe that this pluriverse is traversed by heterogeneities that are continually doing things. I believe it is wrong to deny vitality to nonhuman bodies, forces, and forms, and that a careful course of anthropomorphization can help reveal that vitality, even though it resists full translation and exceeds my comprehensive grasp. I believe that encounters with lively matter can chasten my fantasies of human mastery, highlight the common materiality of all that is, expose a wider distribution of agency, and reshape the self and its interests. (Bennett, 2010, 122)*

Within the home environment there are various networks of relationships and interactions between human beings and other organic species, objects, and technologies. Following other posthumanist and new materialist thinkers, I seek to explore the home as a multispecies assemblage with a specific focus on the relationships between human beings and the arthropod species that reside within North American households. Exploring the home as a multispecies assemblage disrupts the western notion of households as distinctly human environments, characterised by a modern, individualist, and bounded conception of the single-nuclear-family dwelling, by considering the ways in which human households are also home to a multitude of arthropods. I propose the term assemblage as a method of thinking with these household species so as to tease out the different relationships humans have with arthropods and other material aspects of the home that may shape or modify these relationships with a view towards destabilising human exceptionalism in order to envision the ways in which we can come to live with these creatures that share one of our most intimate environments. In other words, regarding the household as an assemblage allows us to look at these relations within a network of human and nonhuman participants; thus, this perspective breaks down dichotomies between human-nonhuman animals, culture-nature, modern-primitive and arrives at a deeper understanding of the relationships between all aspects of material life in the household. This method of inquiry also adopts Haraway's (1988) articulation of feminist objectivity, which "is about limited location and situated knowledge, not about transcendence and splitting of subject and object, it allows us to become answerable for what we learn how to see" (583). Looking at the home as a multispecies assemblage resists a view from nowhere, which in turn allows us to learn to see the relations between humans and arthropods as embedded and contextualised within the household environment and endeavours to see the home from the arthropods' different perspectives. Furthermore, in studying these relationships, humans are then able to look beyond multispecies worlds to situate them in historical contexts including the deep time of arthropod life on earth, human evolution, globalisation, and the history of the chemical pesticide industry. Making these broader connections within the multispecies assemblage of the human household, we can begin to see where different discourses—including science, culture, politics, and technology—figure into human relationships with particular household arthropods

I rely on Tsing's (2015) use of the word assemblage, which she characterises as a kind of multispecies worlding; she writes that "ecologists turned to assemblages to get around the sometimes fixed and bounded connotations of ecological 'community.' The question of how the varied species in a species assemblage influence each other—if at all—is never settled" (22). Likewise, I use the term assemblage to get around the fixed and bounded notion of the household as a strictly human space by tying in Haraway's (1988) idea that "situated knowledges are about communities, not about isolated individuals" (590). The household as a multispecies assemblage becomes a community of both human and nonhuman actors. It may be difficult to conceive of the home as an ecological community in the traditional ecological sense insofar as households are not typically considered to be natural environments. Additionally, not all species are present in all houses and the distribution of most common household arthropod species is cosmopolitan; some of them no longer have homes in the "wild." By regarding the home as a multispecies assemblage, we can better begin to comprehend the ecology of this environment in terms of what it is that arthropods are drawn to about humans and their dwelling spaces, the histories of living with or attempted extermination of these creatures, and how they live alongside each other in the human home. Since many of these creatures hail from all over the world, it is interesting to contemplate how they may interact with each other, humans, other nonhumans, or other material aspects of the home. While my focus is primarily centred around the Canadian, or North American context more broadly, many of the creatures explored in this work are present in human household contexts in other parts of the globe as well.

Bringing together some of the ideas of Haraway, Tsing, and Bennett, I envision the home as an assemblage that encompasses more than human-nonhuman animal relations. I instead look at the various ways in which these relationships are constituted by other material aspects of the home. From the perspective of human-nonhuman animal relations, Haraway's ideas of companion species and string figures provide a foundation for my conception of a household assemblage between human and arthropod beings. Haraway (2016b) writes,

> Companion species play string figure games where who is/are to be in/of the world is constituted in intra- and inter-action. The partners do not precede the knotting; species of all kinds are consequent upon worldly subject- and object-shaping entanglements. In human-animal worlds, companion species are ordinary beings-in-encounter in the house, [etc.] (13)

This quote grasps the contingent and situated nature of our relationships with arthropod species within the household assemblage. Not every home will contain the same species; likewise, those species that are present in the home arrive by way of "worldly subject- and object-shaping entanglements" (Haraway, 2016b, 13). Reasoning through these kinds of human-nonhuman animal entanglement, Haraway brings up an important question as we begin to discover the species with whom we share our homes: Who is what to whom? For us they might be a nuisance or a pest; perhaps some are seen as welcome visitors? Maybe they go unnoticed entirely? To these creatures we might be the providers of warmth and shelter, of food stuffs, we might also be sources of food ourselves, providers of blood or dead skin cells.

Simply looking at the relationships between human and nonhuman bodies, however, does not go far enough. Tsing (2015) writes that "humans shape multispecies worlds when our living arrangements make room for other species" (22) and there is perhaps no place where this statement is more true than in our worldings with the plethora of arthropods who make their homes alongside ours; especially those who are not known to live outside of human-defined environments. Tsing describes assemblages as "open-ended gatherings" that "allow us to ask about communal effects without assuming them. They show us potential histories in the making" (22). The ubiquitous German cockroach provides an excellent example of what we might consider "potential histories in the making": the evolutionary trajectory of this particular species has brought it to a completely synanthropic way of life as these creatures are no longer found outside of human environments. In this new living arrangement humans have also directed the evolutionary trajectory of this species to almost complete pesticide resistance by way of an anthropogenic selection pressure resulting in an evolutionary adaptation that developed over a period of as few as two years: the German cockroach now has an aversion to glucose, which is commonly used as a bait in pesticide treatments (Dunn, 2014).

We cannot begin with either a single species alone or the limited conception of the single-family dwelling to explore the environment of the human home; rather we must begin with an understanding that our living spaces are always already multiple. Many thinkers are beginning to grasp the multiplicitous nature of life and lives on Earth. Comparing the symbiotic multispecies communities of lichens to individual human beings, Griffiths (2015) contends that "lichens are not anomalies but are rather illustrative of the fact that life and nature are found, if anywhere, in the complex and queer cobbling together of multispecies relationships" (38). For Tsing (2015), the most important aspect of an assemblage is the process of "lifeways—and non-living ways of beings as well—coming together. Nonhuman ways of being, like human ones, shift historically. For living things, species identities are a place to begin, but they are not enough; ways of being are emergent effects of encounters" (23). Like Haraway's (1988) situated knowledges, Tsing's understanding of this assemblage is about the interactions and effects between humans and other nonhumans within an environment. It is this aspect of Tsing's thought that I find most compelling for the household assemblage because it emphasises both the shifting and situated natures of our relationships with arthropods in our homes as well as with other nonhuman species and non-living participants in this environment. In other words, the assemblage of human-arthropod relations in the home is then understood to be contextual and ongoing in a way that can be altered by changes in other material aspects of the home. Returning to the German cockroach as an example: as humans instigated the cockroach's aversion to glucose-baited pesticide traps there is a ripple effect throughout the household to creatures like parasitic wasps and house centipedes—predators of the German cockroach—that are no longer impacted by the effects of pesticide poisoning (Dunn, 2014). For humans, the cockroach's aversion provides another opportunity for the development of novel chemical pesticides, which gives the cockroach yet another opportunity to resist our attempts at control.

Bennett's (2010) understanding of vibrant materialism compels us to conceptualise an assemblage beyond human-nonhuman animal, or even multispecies, relations in her insistence on the material forces of nonhuman agents such as household objects or technology. Bennett writes, "assemblages are ad hoc groupings of diverse elements, of vibrant materials of all sorts. Assemblages are living, throbbing confederations that are able to function despite the persistent presence of energies that confound them from within… An assemblage is never a stolid block but an open-ended collective" (Bennett, 2010, 23-4). Looking at the German cockroach again we can see, with Bennett's help, how this particular assemblage adapts despite our attempts at control; the relationship between the cockroach and the pesticides becomes a lively, active participant that confounds human intervention. Bennett (2010) asks us to "picture an ontological field without any unequivocal demarcations between human, animal, vegetable, or mineral. *All* forces and flows (materialities) are or can become lively, affective, and signaling. And so an affective, speaking human body is not *radically* different from the affective, signaling nonhumans with which it coexists, hosts, enjoys, serves, consumes, produces, and competes" (117; emphasis in original). This lively, affective, signalling presence can be explored through arthropods' relationships with various materials within the household assemblage, including building materials, books, and processed food products like flour. Seemingly inert or inanimate objects become lively through their interactions with arthropods. In the above passage, Bennett goes beyond both Haraway and Tsing in allowing for the active aspects of materiality to become apparent, which is an important part of what I will explore throughout this assemblage: the nature of arthropod-human relations and the materiality of the home environment that is also liable to become lively within these assemblages. In this way, Bennett's description of an assemblage here further disrupts western dualisms between local/global, animate/inanimate, and culture/nature, which becomes apparent in the home environment in the cosmopolitan processes at work like the effects of globalisation on arthropod distribution or the history of the chemical pesticide industry and the use of these chemicals in the home following the Second World War. Reconceptualising the household as an ecological assemblage allows us to think within a particular, embedded context such that we can traverse the pasts, presents, and futures of human-arthropod relations. The concept of an assemblage is powerful in its ability to hold space for beings, things, and events to be multiple, beyond singularities or dichotomies, and to exist in-between rigid boundaries like nature and culture, human and animal, or one and many. Raffles (2010) considers, "if categorical segmentation is always the first step in scientific reasoning, this a world that at all times exceeds its compartments. It is the dissolution of boundaries – self, other, body, animal, vegetable, mineral. The dissolution into space" (334). The unresolved nature of these relationships within the household provides a vast potential for humanity to explore and learn from the lives of and relations with arthropods.

A… is for Additive Empiricism

> *When you are an additive empiricist, it is all forms of subtraction that have to be resisted: eliminativism of those who wish to kick the amateurs out, but also eliminativism of those who dream of bypassing science altogether. (Latour in Despret, 2016, x)*

The household environment is necessarily particular and contextualised in so far as the structure itself serves as a boundary limit to the environment. The multifaceted nature of this assemblage requires generative and inclusionary thinking, what I am calling an additive empiricist perspective, so as to find connections where they might be obscured by dominant understandings. Thinking through the many trajectories of relations among humans, arthropods, other nonhuman beings, and non-living objects within the household allows us to confront some of the many historical, political, cultural, and scientific dynamics of human-arthropod relations. Considering the multiplicitous nature of the household as a multispecies assemblage, I find an affinity with Haraway's (2016a) figure of the cyborg, which she writes is "ironic" in that it holds together "contradictions that do not resolve into larger wholes, even dialectically, about the tension of holding incompatible things together because both or all are necessary and true" (5). It is thus of the utmost importance to collect facts, information, and stories from different sources in order to cobble together a better understanding of the lives contained within human households. To explore this space, I draw on Haraway's (1988) feminist objectivity and her concept of situated knowledges: "location is about vulnerability; location resists the politics of closure, finality, or to borrow from Althusser, feminist objectivity resists 'simplification in the last instance.' That is because feminist embodiment resists fixation and is insatiably curious about the webs of differential positioning" (590). Thus, my focus on the household environment serves an important methodological purpose: to complicate and disrupt our thinking about one of the most familiar and intimate spaces, to add more to our understanding than subtract from it, and to become insatiably curious about the different beings that call our homes theirs as well.

To do so, I follow the lead of Despret (2016) in *What Would Animals Say if We Asked the Right Questions* by adapting an additive empiricist methodology to my foray into household assemblages. As Bruno Latour writes in the foreword, "the additive empiricists are just as interested in objective facts and grounded claims, but they like to add, to complicate, to specify, and wherever possible to slow down and above all, hesitate so as to multiply the voices that can be heard… Despret [is] a great proponent[s] of 'and-and'" (ix). Sometimes to ask the right question of an animal means veering from the standard protocols of science that have in many ways defined what gets to be counted in human knowledge. Problematising what it means to "do science" in her chapter "Fabricating Science," Despret compares the research of two ethologists, Amotz Zahavi and Jonathan Wright, on the Arabian babbler. For Wright, Zahavi's methods do not constitute true scientific inquiry because his method "clearly belongs to an anthropomorphic and anecdotal practice – where it is understood that an anecdote is generally defined, in this area, as an *uncontrolled* observation; that is to say, it is not accompanied by the 'right' interpretive key" (43; emphasis in original). She highlights what is lost through Wright's narrower definition of "doing science" based on tenets of sociobiology – "one cannot claim anything if there aren't any experiments, for this is the requirement of a truly objective science" (Despret, 2016, 43). The babblers, as Wright soon discovered, do not always conform to the structure of the designed experiment, and in this particular case, one babbler intervened and attempted its own form of experimentation based on its own experience and interpretation. In this way, our understanding and the lifeworlds of the Arabian babblers were made richer by the inclusion of so-called "anecdotal" or "anthropomorphic" practices that ultimately allowed the Arabian babblers to participate in the research process itself. Anthropomorphism, she contends, "no longer has to do with understanding animals with regard to human motives. It is no longer the human that is at the heart of this affair but rather the practice, and thus, a certain relation to knowledge" (Despret, 2016, 44).

The additive empiricist methodology I employ ultimately allows me to traverse the household environment as an exploration rather than an argument: to raise more questions than to "pin down" answers and to "stay with the trouble," as Haraway (2016b) might suggest. Rather than simply describing the past or making prescriptions about the future I seek to maintain the tensions of human-arthropod relations rather than synthesising or reducing them. I explore both objective facts and grounded claims from the natural and biological sciences alongside the consideration of both social and cultural aspects of human-arthropod relations and to this understanding I add my own admittedly anecdotal and amateur entomological observations of the creatures with whom I share my home. In each case it is my hope to generate new and different understandings of the species and concepts I explore. My method seeks to complicate these matters of the household with diverse knowledges so that the eventual stories told of these organisms in this work tell a story in the fullness of human understanding; while also emphasising that, however comprehensive it may seem, it is always only a partial picture taken from a human perspective. Exploring relations between arthropods and humans in the home must remain speculative to some degree so that it does not "let a situation or a position—nor even the acute awareness of pervasive dominations—define in advance what *is* or *could* be" (de la Bellacasa, 96; emphasis in original). The additive empiricism approach when taken in conjunction with the reconceptualisation of the household as an assemblage pulls together a variety of the accounts of human-arthropod relations within the confines of the human home—which may include scientific reports, cultural stories, technological histories, and routes of globalisation—within which there are bound to be some contradictions or irresolvable ideas. This approach ultimately allows for the collection of as many of the various stories surrounding the creatures with whom humans share their homes and holds them together as part of the household assemblage.

A… is for Anthropomorphism

> *The accusation of anthropomorphism, in other words, is a political accusation, a 'politics of science' [politique scientifique] that aims above all to disqualify a mode of thinking or knowing from which the scientific practice has tried to free itself, namely, that of the amateur. (Despret, 2016, 40)*

In order to develop a better understanding of the lifeworlds of the various arthropods that reside within our homes it may be helpful to employ a kind of anthropomorphism to the exploration of their lives and their relationships to us. Human perception is by definition a human perspective—and thus always anthropocentric, but in some ways also anthropomorphic—as such, I begin with full acknowledgement of my human perspective. Simply recognising the role that humanness plays in human understanding allows us to situate ourselves within the world and in so doing we may be able to use anthropomorphism as a tool for further engagement with the microcosm of life within human households. In the context of her theory of vital materialism, Bennett (2010) writes, "anthropomorphism, then, can catalyse a sensibility that finds a world not with ontologically distinct categories of beings (subjects and objects) but with variously composed materialities that form confederations" (9). In reconceptualising the household as a multispecies assemblage, I utilise anthropomorphism to highlight some of the ways of being of arthropods within the home to explore the ways in which humans and arthropods are alike and different from each other.

Uexküll (2010), in his *Foray into the Worlds of Animals and Humans*, questions the presumption that other beings experience their worlds in the same way that humans do: each animal is a subject in its own world, or *umwelt*, and certain objects become significant to the animal as either effect or perception "marks." He describes these "marks" as the subject's "gateway" to its environment: "for everything a subject perceives belongs to its *perception world* [*Merkwelt*], and everything it produces, to its *effect world* [*Wirkwelt*]. These two worlds, of perception and production of effects, form one closed unit, the *environment*" (Uexküll, 42; emphasis in original). Acknowledging, as Uexküll does, that other beings experience their environments in their own particular ways, I propose a more radical take on this view of nonhuman animal perception to suggest that we need not privilege the human perspective as the most accurate or comprehensive representation of reality; rather, the human *umwelt* is just one of many different perspectives of the material world. In imagining the worlds of indoor arthropods in such a way, I push the limits of Uexküll's conception of an animal's *umwelten* farther than he would probably like it to go. Following Heidegger, Uexküll conceives of the environments of other animals, such as the fly, as *impoverished* as compared with the environments of human beings. I propose instead that the *umwelten* of our indoor arthropod companions are not necessarily limited in scope compared to the human, but rather simply different from our own with their own perception marks that may or may not be perceptible to human beings. In this way, and especially in L… is for (Book) Louse, by following an additive empiricist methodology and a careful course of anthropomorphism I leave open the possibility that these worlds are in fact far richer and more complex than current human comprehension would suggest.

Haraway (1988) writes that there is a lesson to be learned from photographs of the way the world looks through the compound eye of an insect: "the 'eyes' made available in modern technological sciences shatter any idea of passive vision; these prosthetic devices show us that all eyes, including our own organic ones, are active perceptual systems, building on the translations and specific *ways* of seeing, that is, ways of life" (583; emphasis in original). So, perhaps the lives, perceptions, and worlds of household arthropods are no less vivid than ours, but we are unable or just unwilling to sense the particularities of their worlds through our perceptual capabilities. Raffles (2010) takes a similar view on this issue when he writes, "this concept doesn't seem hard to grasp: that the world is multiple and different for different beings; that our world is our world and theirs is theirs; that when we meet, it is across and between distinct, intersecting realities" (315-16). Anthropomorphism is important in the context of understanding the household as an assemblage, first of all because we cannot escape our human perspectives, which are also already multiple, and secondly because it may help us to better understand the ways in which arthropods and other beings living within the home experience it as their own particular habitat. Through critical anthropomorphism and speculation, questions of what is significant to these organisms in our homes arise, for instance does the organism even recognise the human as something of significance? Or, what are the marks of significance that draw them to household environment? To imagine, as I do in L… is for (Book) Louse, what the experience of the household is like from the perspective of a louse is to stretch human consciousness beyond our limited perception apparatus and to constructively apply anthropomorphism in the quest for a greater understanding of the worlds of arthropods.

It is important to always keep in mind that it is I who am doing the speculating (anthropomorphising) based on a review of scientific and cultural literature, my own observation, and critical inquiry. Despret (2016) also utilises a careful course of anthropomorphism to elucidate some lesser known aspects of familiar animals. As Latour writes in the foreword to her book it is possible to "move [from] the question of anthropomorphism to the much more interesting one of *metamorphosis*, by which I mean not only to police the boundary between what is human and what is animal (a limited question if ever there was one) but to explore the protean nature of what it means to be 'animated" (Latour in Despret, x; emphasis in original). By situating human knowledge of the household as one part of a multispecies assemblage we can then consider how "subjectivity is multidimensional; [and] so, therefore is vision. The knowing self is partial in all its guises, never finished, whole, simply there and original; it is always constructed and stitched together imperfectly, and *therefore* able to join with another, to see together without claiming to be another" (Haraway, 1988, 586; emphasis in original). Bringing awareness to the particular ways in which human beings are embedded within their households and considering how human perspectives are always already uniquely human may help us to bridge the gap in understanding what it means to take up the perspective of an arthropod. The metaphor employed by Latour of metamorphosis is very fitting for this task as is Haraway's (2016b) idea of "becoming-with" our companion species insofar as they both ask human beings to consider the ways in which our experiences overlap with other nonhumans.

Further to this point that the human perspective is always already anthropomorphic, Cohen (2015) looks at stone and acknowledges that human understanding is always situated within a particular human perspective: "the stories we know of stone will always be human stories, even if the cosmos they convey makes a problem of that category rather than celebrates some specious natural domination" (9-10). Likewise, in stories of human-arthropod relations, the acknowledgement of my human perspective does not necessitate a hierarchical relationship over these creatures; instead, I opt to metamorphose with them and explore the nature of what it means to be animated as a nonhuman within the household environment. Haraway (2016b) also contends that all creatures on earth in some way perform their own kind of world-making from their own particular perspective. She writes: "we relate, know, think, world, and tell stories through and with other stories, worlds, knowledges, thinkings, yearnings. So do all the other critters of Terra, in all our bumptious diversity and category-breaking speciations and knottings. Other words for this might be materialism, evolution, ecology, sympoiesis, history, situated knowledges, cosmological performance, science art worldings, or animism" (97). Anthropomorphism can be used as a helpful tool in exploring the household as a multispecies assemblage and in challenging and resituating what it means to be human in relation to arthropod; again, raising the question: who is what and to whom?

B… is for Bed Bug

Night, night. Sleep tight. Don't let the bed bugs bite!

Common bed bug, *Cimex lectularius*

Human beings and bed bugs share a long and storied history. Despite humanity's technological innovation in the field of chemically synthesised pesticides and all our attempts to control them, we have been unable to eliminate this creature from our homes. In fact, pesticide resistance only seems to increase this insect's ability to persist and thrive within human-defined spaces. Ultimately, if we can learn anything from the vast history of bed bug-human interactions, it is this: bed bugs have been a part of human life for over three thousand years and will very likely continue to be a part of life for human beings in the future to come. We do not have to like the bed bug, but we do need to find a register of experience within which we can meet them and accept their continued existence on earth. Following Bull (2014) in his discussion of human-tick relations, the bed bug provides instances where humans can draw on the "ugly emotions" that this species conjures in us and recognise the tensions that arise between humans and bed bugs so that we can begin to imagine ways in which we can live well together.

The common bed bug, *Cimex lectularius* L., is an insect of the order Hemiptera, what entomologists call the "true bugs." Like all members of the family *Cimicidae*, the bed bug is an obligatory hematophagous ectoparasite, which means that it feeds solely on blood and lives outside of its host's body. What makes *C. lectularius* different, however, is that it feeds almost exclusively on human blood (Koganemaru & Miller, 2013). All Hemiptera have sucking mouthparts (proboscises) designed to puncture outer layers of the plants or animals on which they feed, extracting fluids like "the sap in a leaf or the juice in another insect" (Borel, 2015, 7). In the case of bed bugs, and related species of bat and bird bugs, these sucking mouthparts are designed to extract the blood of vertebrates. *C. lectularius* has a global distribution, most prevalent in temperate regions, and although they will "occasionally feed on domesticated animals" (Koganemaru & Miller, 2013, 178), humans are their favourite food. The bed bug is a small (approximately 5mm), flat and broad, brown, wingless insect (Ter Poorten & Prose, 2005). After the bed bug has consumed its blood meal, the insect becomes engorged and red in colour; elastic membranes between its armoured plates allow its abdomen to swell since it can consume more than twice its weight in blood (Jones, 2015; Ter Poorten & Prose, 2005). The bed bug is an obligatory blood feeder throughout its entire life cycle: as soon as it has emerged from the egg, through all its nymphal stages and into adulthood, "blood serves as the sole source of [its] ingested nutrients and water" (Benoit et al., 2016, 2). Bed bugs can survive long periods without a blood meal, a year or longer in cooler environments (Benoit et al., 2016; Ter Poorten & Prose, 2005).

This troublesome insect has been "bugging" humans for thousands of years and it is called the *bed* bug for its nocturnal habits of feeding on us in our sleeping quarters. Bed bugs are found around the world alongside their human hosts in homes—especially the bedroom—but also in hotels, shelters, theatres, dormitories, office buildings, retail stores, police stations, even in public transportation and moving vans (Monosson, 2015; Potter, 2011; Romero et al., 2007). They are equipped with small, protruding compound eyes, and scientists suggest that "object recognition… play[s] a role in host detection" (Benoit et al., 2016, 2). However, they rely more critically on their olfactory receptors in all aspects of their life: using their sense of smell for host detection, navigation through dark environments, and finding a mate (Benoit et al., 2016). These sensory abilities are important for bed bugs because they do not always live on the bed itself but in the bedroom at large. The preferred habitat of the bed bug is any small, dark crevice in close proximity to a human host: this could be along the seams of the mattress, in the nightstand, or under peeling wallpaper. Bed bugs arrive in human homes and other human-defined spaces by either active or passive introduction. Active introductions occur when a bed bug moves to a new location on its own six legs. "Since bed bugs don't have functional wings, active dispersal of the colony depends on walking (or running) to a new home" (Schutt, 2008, 213). Passive introduction, on the other hand, involves "any transport method that doesn't employ the bed bugs' own locomotor ability," and relies primarily on human beings, in the movement of goods or people from one place to another (Schutt, 2008, 214). For bed bugs, "the major attractants appear to be both human body temperature and carbon dioxide production" (Ter Poorten & Prose, 2005, 184).

Human beings and bed bugs share a history that is at least three thousand years old, with the earliest evidence dating back to ancient Egypt (Benoit et al., 2016; Borel, 2015; Panagiotakopulu & Buckland, 1999; Romero et al., 2007). Some scholars posit that the bed bug adapted a taste for human blood when *Homo sapiens*—or perhaps even *Homo neanderthalensis*—when these early humans started inhabiting caves in the Mediterranean and Middle Eastern regions during the Pleistocene era; prior to coming into contact with humans, the bed bug is likely to have fed on other vertebrates inhabiting these caves, such as bats or birds (Borel, 2015; Koganemaru & Miller, 2013; Potter, 2011). In these early stages of our interactions "relations between bed bugs and people were probably intermittent, because hunters and herdsmen moved frequently. Life for host and parasite became easier with the formation of villages and cities" (Potter, 2011, 14). Borel (2015) frames this history as ongoing when she writes, "we are still watching the bed bug truly become *ours*" (207; emphasis in original). What Borel means by this statement is that on an evolutionary timescale, human beings are currently in the midst of bearing witness to the move from bat to human hosts. The extension of palaeoecological research to "occupational sites… has provided material for the examination not only of animal bones and plant macrofossils, but also of insect remains" (Panagiotakopulu & Buckland, 1999, 908). Panagiotakopulu and Buckland's (1999) research examines the occupational site at Tell el-Amarna in Egypt that was founded by Akhenaten (1352-1336 BC) and occupied by tomb workers for 20-25 years, c. 1350-1323 BC, and possibly later during Tut'ankhamun's reign by guards. Well-preserved specimens of *Cimex* were discovered at this site and according to Panagiotakopulu and Buckland (1999), "the archaeological context and associated fauna [also] supports identification as bed bugs" (908). This discovery is important for archaeoentomology because it provides the earliest physical evidence of the association between human beings and bed bugs (Panagiotakopulu & Buckland, 1999, 910).

From the Classical period, we receive a literary record of the bed bug from ancient Greece and Rome through the writing of Democritus, Aristophanes, Aristotle, Dioscorides, and Pliny (Borel, 2015; Panagiotakopulu & Buckland, 1999; Potter, 2011). Wherever we go, the bed bug comes with us: the study of archaeoentomology has also unearthed fossilised specimens of *Cimex* from a "2nd-century AD pit in the Roman town at Alcester in Warwickshire… the large number of other synanthropic insects in the Alcester pit supports the probability of the presence of bed bugs in Roman Britain" (Panagiotakopulu & Buckland, 1999, 910). The study of archaeoentomology can provide some insight into the sanitary conditions of the past; however, as Bain (2004) urges, we cannot impose "modern Western standards of hygiene on those that lived in the past. While culturally-laden perceptions of infestation, hygiene, and sanitation can be as problematic as they are burdened with our currently accepted standards of extreme hygiene, their consideration is, nonetheless, interesting" (81). Mitchell (2016) discusses further research at the site in Warwickshire that assessed the number of other ectoparasites (bed bugs, lice, fleas) in the sediment layers of this same town during Roman, Viking, and medieval periods. Interestingly, the concentrations were similar across periods, suggesting that "the Roman habit of washing at the public baths does not seem to have decreased the risk of contracting ectoparasites, compared with Viking and medieval people who did not use public baths in the same way" (Mitchell, 2016, 52-3).

Bed bugs can be tracked alongside the expansion of urbanisation and commerce, spreading from the Mediterranean and Middle Eastern regions to the rest of Europe and Asia, "reaching Italy by 77 CE, China by 600 CE, and Germany and France, respectively, in the 11^{th} and 13^{th} centuries" (Potter, 2011, 14). They have also been identified in tenth and eleventh century England in York and Norwich (Bain, 2004). The bed bug continued to run rampant in Europe; between the fifteenth and the twentieth centuries, they were human beings' constant companions (Potter, 2011). Bed bugs were presumably introduced to North America with the arrival of the Europeans. Eighteenth-century Swedish botanist Pehr Kalm observed bed bugs in Québec during a visit in 1749 and complained that they disturbed him all night (Bain, 2004). In the early nineteenth century ships and railroads enabled the spread of bed bugs across oceans and inland where they had never been seen before (Potter, 2011). At the beginning of the twentieth century central heating in buildings became more common and "bed bugs received a big reproductive boost… [;] populations had previously followed a more seasonal trend, increasing as the weather warmed, this enabled the bugs to thrive year-round" (Potter, 16). During this time an estimated one-third of houses in major European cities had bed bugs (Potter, 2011; Koganemaru & Miller, 2013); they were likewise extremely common in the United States in the early 1900s (Borel, 2015). Bed bugs were simply "*a part of life*" before the advent of synthetic chemical insecticides and their wide use during the 1950s (Romero et al., 2007, 175; emphasis added). In the latter half of the twentieth century, bed bugs became a relatively unknown and uncommon experience for those living in western industrialised nations.

The bed bug's disappearance in Western Europe and North America can largely be attributed to the re-discovery of DDT. It was not until after the development of chemical pesticides following the Second World War that they all but disappeared from the collective consciousness, existing only in myth in a way that evokes the epigraph to this entry – "don't let the bed bugs bite." DDT was originally synthesised in 1874 but remained "in obscurity until 1939 when Paul Muller, a Swiss scientist with the Geigy Company, discovered its remarkable insecticidal properties" (Potter, 2011, 21). The use of DDT as an insecticide began in earnest in 1942, when it was seen as an effective and economical method of controlling infestation in military barracks, and just three years later, it was being touted as the civilian solution to "the war on bed bugs" (Potter, 21). DDT was relatively inexpensive; as a result, as Potter (2011) describes, "the all-out civilian assault with DDT was so effective and widespread that within about five years, it became difficult to find populations of bed bugs on which to do further research" (22). Prior to the synthesis and wide use of DDT, the "gold standard" for bed bug control during the first half of the twentieth century was hydrocyanic acid (HCN, cyanide) gas. "Fumigating with cyanide was highly effective, but costlier and more dangerous… many people without the proper training and safety equipment were killed or seriously injured" (Potter, 20). Various chemical formulations have been tried in the fight against bed bugs, such as fumigation with burning sulfur or contact sprays of arsenic and mercury compounds, many of which were "as toxic to people as to pests" (Potter, 18). Pyrethrum, which is made from chrysanthemum flowers, is a safer method that has been used since the mid-nineteenth century to treat bed bugs; today a synthesised variant of pyrethrum is the most widely used compound in the fight against bed bugs (Potter, 2011). Prior to the use of chemicals, the eradication of bed bugs was a tedious process of vigilant inspection and cleaning: prevention of infestation has long been understood to be the best method of bed bug control.

Describing the recent resurgence of bed bugs in North America, Western Europe, and Australia, Borel (2015) encapsulates the effect of their return: "Somehow, although our history with this ancient pest stretches back many millennia, its brief sixty-year absence from a large swath of the world shrank our impressions of its physicality to microscopic dimension. It became both an imaginary and an invisible threat. This made the bed bug's return as a real animal that takes up spaces in the world—our world, our beds—all the more unsettling" (1). To say that the bed bug has returned or had a resurgence is not an accurate depiction of its life history on earth. Bed bug infestations have been and remain an ongoing part of life in many other parts of the world including Africa, Central and South America, and in some European countries (Koganemaru & Miller, 2013). Since the 1990s, bed bug infestations have been documented across North America, Western Europe, and Australia, especially in urban environments; reports of infestations have been increasing exponentially since then (Eddy & Jones, 2011; Hwang et al., 2005; Romero et al., 2007). Some common hypotheses for this resurgence include: pesticide resistance, changes to pest management strategies, changes to our lifestyles, an increase in immigration and global travel, exchange of second-hand materials, and a fundamental lack of awareness about bed bugs among the general population (Benoit et al., 2006; Boisvert, 2012; Hwang et al., 2005; Koganemaru & Miller, 2013; Romero et al., 2007; Ter Poorten & Prose, 2005). Although they never truly disappeared from the western world, they had become so uncommon in the latter half of the twentieth century that "even pest control professionals rarely encountered them" (Romero et al., 2007, 175).

Humanity's continued reliance on synthetic chemical insecticides since the Second World War is a relatively recent part of our history with bed bugs. In the short period of time that we have been using these products we have exerted a series of extremely intense chemical pressures against bed bug populations and the bed bug continues to respond by rapid adaptation (Potter, 2011; Romero et al., 2007). The bed bug was essentially eliminated in North America by our initial insecticidal assaults in the early twentieth century; however, even at that time, the bed bug was beginning to develop resistance. Only a few years after DDT became commercially available resistant populations were discovered; the earliest in 1947 in the barracks at Pearl Harbor (Potter, 2011, 22). Over the next decade, resistant populations were reported around the globe "from Greece, Poland, Israel, Lebanon, India… Iran, Taiwan, [and] Hong Kong…" (Koganemaru & Miller, 2013, 181). Borel (2010) provides further insight on the subject of insecticide resistance:

> In 1969 one entomology professor would write of the trend: "The events of the past 25 years have taught us that virtually any chemical control method we have devised for insects is eventually destined to become obsolete, and that insect control can never be static but must be in a dynamic state of constant evolution." In other words, in the race between chemical and insect, the insect always pulls ahead. (34)

The most widely used synthetic insecticide in the current bed bug resurgence belongs to a class called pyrethroids. But bed bugs are again gaining the upper hand, so to speak, as they develop resistance to pyrethroids. "The options for chemical control of bed bugs were diminished by regulatory restriction of chlorinated hydrocarbon, organophosphate, and carbamate insecticides in many countries. Resistance to pyrethroids, the largest remaining insecticide class, further limits these options" (Romero et al., 2007, 177-8). In a study that compared colonies of resistant bed bugs against laboratory colonies that have never been exposed to modern insecticides, it was found that "pyrethroid resistance has reached levels 10,000-fold higher than in susceptible bed bug populations" (Benoit et al., 2016). Some have suggested that this resistance may be a holdover from DDT resistance encoded into the bed bugs' DNA: "Evolution of resistance to insecticides is the expected outcome of their repeated use…. Because DDT resistance was reported decades ago, and cross-resistance between DDT and pyrethroid insecticides is common, resistance alleles already may have been present in populations" (Romero et al., 177). In spite of growing resistance, some entomologists and health care practitioners have called for the de-regulation of DDT and other organophosphate class insecticides for use against bed bugs (Aultman, 2014). Koganemaru & Miller (2013) state that insecticide resistance is the most likely cause of the recent resurgence in bed bugs around the world, and further that "re-registration of the previously available insecticides is less likely to control current populations of bed bugs" (181). New research attempts to combine the effects of different classes of insecticides by using pyrethroids alongside neonicotinoids (famously implicated in the decline of bees worldwide) under the theoretical assumption that the development of resistance to two different insecticides at once is more difficult; however, "it is possible that bed bugs may easily develop insecticide resistance to neonicotinoids as well" (Koganemaru & Miller, 182). Monosson (2015) discusses resistance more broadly suggesting that "just as we must reconsider how, when, or in what combination to use antibiotics, chemotherapy, or herbicides, we would do well to rethink insect control all together. Otherwise, we will find ourselves inundated not only with bedbugs but with lice, fleas, and agricultural pests" (104). Taken in conjunction with past pesticide failures and the ongoingness of bed bug resistance the outlook for chemical insecticides appears to be more of the same with bed bug resistance out-pacing the development of new chemical treatments. Perhaps it is time to look to alternative solutions that are less Sisyphean and require fewer fossil fuels to produce.

Given our long-shared history, the recent resurgence of bed bug populations around the world, rapid resistance to pesticides, and the increasing human population density in urban centres, it seems only likely that bed bug populations, and thus infestations, will continue to rise in the coming years. The eventual reality seems to be that bed bugs will continue to work their way back into the everyday lives of humans everywhere. After all, it was only at the beginning of the last century that a third of households in major Europeans cities lived with bed bugs. If humans can no longer arm ourselves with chemical pesticides, then we must find other ways to live with these organisms. Bed bugs can go unnoticed as they retreat into their refugia (the enclosed spaces in which they hide) during the day and if populations are left unchecked, they will rapidly increase in numbers. "Watchfulness and vigilance in hopes of preventing the establishment of bed bugs has been an oft-repeated mantra throughout the annals of bed bug management" (Potter, 2011, 16). Very simply put: persistence in inspection is the top priority in management of their populations.

According to Jones (2015) "it's only a pest if it reaches pest proportions" (38); so why then are bed bugs consistently referred to as infestations? The answer remains unclear; unfortunately, there is very little known about bed bug population and dispersal ecology, since most information we have on bed bugs comes from laboratory studies rather than from field studies in human homes (Reinhardt & Siva-Jothy, 2007). What we do know is that bed bugs have a tendency to gather together in refugia and that these aggregations of bugs are maintained via chemical signals emitted by adults in the population (Reinhardt & Siva Jothy, 2007). In the human dwelling, populations of bed bugs can "range from 4 to 221 cimicids per house to 5000 bed bugs per bed" (Reinhardt & Siva-Jothy, 361). The refugia in which they congregate are important sites for mating and feeding is an essential prerequisite for mating since "*C. lectularius* males direct their sexual interest at recently fed females" (Reinhardt & Siva-Jothy, 352). Given the right conditions—which include a host and a hiding spot—populations of bed bugs can increase rapidly as the vast range in population sizes suggests. "Once fertilized, the female may lay five eggs a week, which can add up to several hundred over her lifetime" (Borel, 2015, 5). Possibly the best way to prevent populations from reaching infestation-levels is to keep their numbers down to zero, or least very low, which means knowing what they look like and where to find them.

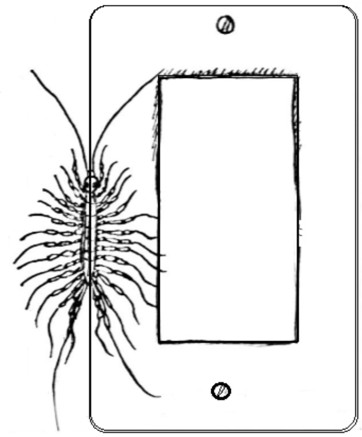
One of the most important lessons that we can take away from our history of cohabitation with bed bugs is that education and increased awareness and understanding are the best strategies for bed bug management (Aultman, 2013; Eddy & Jones, 2011; Koganemaru & Miller, 2013; Potter, 2011; Seidel & Reinhardt, 2013; Ter Poorten & Prose, 2005). In a 1908 article in the *New York Times*, medical doctor Attilio Caccini writes of the social standard of his day: "The persistency with which civilization conceals the presence of the cimex is equal only to that with which a respectable family hides the presence of its black sheep." But he ultimately seeks to challenge this social more by suggesting that we remove the taboo surrounding this organism "in order that science might be inspired by public opinion to exert itself against the peril" (Caccini, 1908). Despite making its way back into public consciousness and back into our homes the bed bug is still an unmentionable subject, which only serves to further a lack of understanding, leading to misconceptions about who is affected or even about the best methods of control. If the taboo surrounding this organism were to be removed, scientists might be better able to collect more accurate datasets for bed bug populations within the home; thus resulting in the ability to make more reasoned decisions about how to live with this organism that has been a part of human existence for so long. Bain (2004) effectively sums up our relationship with the bed bug: "Regardless of our feelings about them, this intimate fauna has played a role in our history and merits our due consideration" (87).

There are simple material ways that humans can simply be better prepared to confront bed bugs in their bedrooms. The first is clutter: bed bugs love clutter, according to many researchers looking into the current resurgence (Eddy & Jones, 2011; Koganemaru & Miller, 2013; Potter, 2011; Schutt, 2008); clutter, including personal belongings or knickknacks, "provides additional harborages [refugia] for the bed bugs, making the population more dispersed and difficult to eliminate" (Koganemaru & Miller, 184). It is evident from the average, modern, North American bedroom that bed bugs have not been of constant concern over the last few decades. The modern bedroom is generally quite cosy—as is the rest of the home—with more furniture and décor and simply the sheer number of "things" that the average North American owns (Boisvert, 2012; Koganemaru & Miller, 2013; Potter, 20111; Schutt, 2008). Another material aspect of the home to be considered is the bed itself. Potter (2011) claims that the design of the modern bed has been fundamentally shaped by the bed bug. In the eighteenth century, Southhall—one of the earliest pest control operators in Britain—suggested that beds should be constructed from simple metal designs rather than heavy, and ornately carved wood: his thought was that simplicity is the best defence against bed bugs (Boynton, 1965; Koganemaru & Miller, 2013). There are other technological developments that have come up in the recent fight against the bed bug, such as mattress and box spring encasements, which have proven to be effective in at least keeping the bed itself free from infestation; without encasements the entire mattress and box spring likely must be discarded in infested living spaces (Koganemaru & Miller, 2013; Romero et al., 2007).

Lastly, an alternative solution to dealing with bed bug populations in pest proportions that does not require the indiscriminate application of pesticides, comes from an historical Balkan method of trapping bed bugs using bean leaves (Koganemaru & Miller, 2013; Potter, 2011). "A study on the ability of plant leaf trichomes, microscopic hooked hairs, trapping insects was first published in 1943, but the idea was never pursued because soon afterward synthetic insecticides effectively reduced bed bug infestations" (Koganemaru & Miller, 186). This method of control has recently been investigated again and it shows a lot of promise: scientists are working to develop a biomimetic surface that effectively does the same thing as the fibres on the bean leaves and "may have a great potential as a non-chemical treatment to control bed bug infestation in the near future" (Koganemaru & Miller, 186). At least in this case the bed bugs are trapped, and it is thus only the bed bugs that will be killed and not all other arthropod life in the home by the use of chemical pesticides.

The long-shared history between humans and bed bugs is suggestive of a long-shared future to come. In the interest of "staying with the trouble" (following Haraway, 2016b), I have situated the current state of human-bed bug relations within the historical context to shed some light on the fact that this species was once considered to simply a *part of life*. Following Bull's (2014) line of thought about human-tick relations, "in parasites, we have creatures with whom we (humans) do not want to share our social worlds, but their persistence, shaped by long chains of evolution, insinuate parasites in human bodies and societies" (75) and in so doing they ask different questions of us. I suggest that while we need not tolerate becoming a free-for-all buffet for the bed bugs, we can use the disgust they conjure to imagine different ways of living together. Directing all of our management strategies towards the bed bugs themselves by way of chemical intervention, excludes the role that humans play in this relationship through our practices and our material worlds that directly contribute to the lifeworlds of bed bugs. Instead, humans might consider our own household practices – for instance, reducing clutter so as to limit the number of refugia present in which populations can hide. The first step is to increase awareness of bed bugs so that scientists can more accurately study their life histories, second as I have suggested is to materially alter our homes to make them less conducive to bed bugs, and finally, we might consider other, more humane, practices of eliminating them from our homes. Ultimately, though, I think we will fundamentally have to accept their presence in our homes and seek out practices that mitigate their effects on our bodies: some will still be killed in the process of mitigation but at the very least humans might rethink their commitment to chemical pesticides and the all-out assault on life in the home that harms not only arthropod life but potentially human lives and the lives of our pets.

C… is for the (un)Canny Centipede



House centipede, *Scutigera coleoptrata*

> *If it were not for the its uncanny appearance… it would not necessarily be an unwelcome visitor in houses, but on the contrary might be looked upon rather as an aid in keeping in check various household pests. Its appearance in dwellings, however, will not often be welcome notwithstanding its useful role. (Marlatt, 1902, 4)*

In the discussions that surround the house centipede it seems that "the uncanny" is something that humans identify in this organism highlighting its physical appearance. The uncanny is also expressed in the intellectual uncertainty as to how humans classify the house centipede, we see it as both a synanthrope—a species known to live alongside humans—as well as an unwelcome visitor in the home; centipedes are both familiar and frightening. Similarly, the house centipede is regarded as both pest and pest control within the home, compounding the tensions surrounding our understanding of this being. We can also view the house centipede through the lens of the double, as a materialisation of humanity's own placelessness. Furthermore, the house centipede functions as a symbol of fear and disgust but rather than it just being about its appearance, we also see something of ourselves in this symbol. There are as many different characterisations of the house centipede as it has legs, maybe more.

There is a persistent tone of dislike and fear associated with the house centipede; this sentiment is conveyed across scientific, governmental, and popular narratives, and it seems that this reaction is founded primarily on the house centipede's material body. Kevan (1983) writes, "householders are often startled, or even frightened" upon seeing a house centipede (2938). Likewise, a page from Health Canada's website suggests that house centipedes "are merely unattractive and considered a nuisance" inside the home (Government of Canada, para. 1). As a ubiquitous household arthropod, the house centipede is familiar in the home, and yet it is often greeted with fear or disgust. In this way the house centipede aligns with Freud's description of the uncanny or *unheimlich*—which translates as "unhomely"—as "that class of the frightening which leads back to what is known of old and long familiar" (219-220). If you have never met the house centipede, *Scutigera coleoptrata*, it is instantly recognisable from other indoor arthropods for both its size and multitude of legs. It is a brownish-yellow colour with three longitudinal dark stripes along the body and the legs are banded light and dark (Jacobs, 2013, para. 3). The house centipede has fifteen pairs of long legs, which gives it the appearance of being 7–10 cm long; however, its body (excluding the legs) is roughly only 2.5–4 cm in length (Jacobs, para. 3). Given the alien and total otherness (from the human perspective) of the centipede's body, the characterisation of the centipede as uncanny is unsurprising.

Part of what makes the house centipede so uncanny is that its appearance is unlike any other household arthropods in the sheer number of legs as well as its speed and locomotion. It is unsurprising, then, to see its movement included in the cultural imaginaries surrounding this being; however, this characterisation that emphasises the animal's physical appearance largely ignores the ecological role of the centipede and the evolutionary marvel that is its form. The unique form of the house centipede is the result of evolutionary adaptations that support both its locomotion and predatory nature. The house centipede's long legs contribute to its speedy gait and are also used in hunting prey. One aspect related to the locomotion of the house centipede is that the legs of this species increase in length from the front to the back (Lewis, 1981, 35). They also have additional joints on the distal end of each leg, which bear tiny spines to assist in gripping the surface (Lewis, 45-46; Cloudsley-Thompson, 1968, 56-7). This function, like the differential leg lengths, is important for locomotion because "the stride lengths of *Scutigera* greatly exceed the length of the body" (Lewis, 45). In terms of the hunting habits of the house centipede, the long legs play an important role here as well. An example cited in Lewis describes how the house centipede "pounces" on fruit flies using its anterior legs, "half lassoing them: as many as five flies were captured at one time and held between the quivering, lashing appendages" (186). Within the house centipede's *umwelt*, I speculate that it is the presence of other arthropods in the home that is the primary mark of significance for this creature as it is undoubtedly one of the top predators of arthropods within the home. From this human perspective, then, the presence of the house centipede should be marked as significant to the human being, not in itself, but as an indicator of the presence of prey species that sustain the house centipede.

Freud describes a relationship between intellectual uncertainty and the uncanny, "the essential factor in the production of the feeling of uncanniness [is] intellectual uncertainty; so that the uncanny would always, as it were, be something one does not know one's way about in" (221). It seems that humanity has been in a state of intellectual uncertainty toward the house centipede for the last century. One of the most common representations of the centipede that I encountered is an unattributed poem that is unofficially entitled, "The Centipede's Dilemma" (2016), which describes a mind-body dilemma wherein the centipede becomes frozen in uncertainty after being asked how it is that she keeps track of the movement of her legs. The poem has been adopted in different iterations by various psychologists and philosophers to describe a disconnect between mind and body. The poem also appears in Cloudsley-Thompson's *Spiders, Scorpions, Centipedes, and Mites*, citing an article from Nature (1889):

> A centipede was happy quite/Until a toad in fun/Said, "Pray which leg moves after which?"/This raised her doubts to such a pitch, /She fell exhausted in a ditch, /Not knowing how to run (55).

The evolutionary history and biology of the house centipede describes an entirely different lifeworld of the centipede than the one in the poem. In fact, the house centipede defies the human mind-body dualism expressed in the rhyme, in that each of the segments of its body, to which a pair of legs is attached, contains its own nerval ganglion (Lewis, 1). Centipedes do not have a central nervous system like a human being, but instead have decentralised nerve centres, ganglia, in each of their segments. Following Manton (1952, 1953), Cloudsley-Thompson concludes that "locomotion appears to be the habit with which their evolution has been chiefly associated" (57). Thinking with the centipede in this way, I am reminded of a passage from Uexküll (2010), "When a dog runs, the animal moves its legs. When a sea urchin runs, its legs move the animal" (76). What Uexküll describes here is a receptive property that he refers to as a "reflex person," he claims that "sea urchins have a great number of such reflex persons, which perform their reflex tasks without central direction" (76). Given the presence of ganglia in each segment, and the functional importance of its legs to both locomotion and hunting, it seems probable that the house centipede responds to its environment in a similar manner as Uexküll's see urchin.

The human form is incapable of truly experiencing the world as a centipede, first, because of our centralised nervous system but also because we lack compound eyes, multiple pairs of legs, and our bodies cannot be oriented in the same way as we stand upright, while the centipede's body and its centre of gravity are "hung from the legs" (Lewis, 41). But humans can glean some insight into the locomotion of the house centipede through technological intervention. In a captivating video on YouTube, "House Centipede in Slo Mo" (ManCraftingTM, 2015), one can witness the centipede running in slow motion, which demonstrates the wave-like undulations in the centipede's body, as well as the leapfrog-like motion of the legs: since the house centipede has such long legs, the "crossing over by consecutive legs is virtually unavoidable" (Lewis, 45) and, as such, "fields of up to four successive legs may overlap" (Cloudsley-Thompson, 56). This video is a successful example of one way of opening up the lifeworld of the house centipede to a different kind of human understanding: when witnessed at a slower pace the movement of the centipede becomes less uncanny and wonderfully mesmerising.

We might read the poem about the centipede's dilemma instead as the intellectual uncertainty that is confronted by humans when the uncanny presence of the house centipede is made known inside the home: confronting both the understanding that they are synanthropic species, while also expressly wanting to eliminate them from this environment. In the quote from Charles Marlatt in the epigraph to this entry, one gets a sense of the tension and uncertainty that arises when the house centipede makes itself known within our dwellings. Humans are unsure whether to label the house centipede a pest or a form of pest control. A Google search for the term "house centipede" returns a number of hits concerning pest control from general articles and blog posts to pest control companies like Orkin. Kevan also suggests that a lack of knowledge about the house centipede contributes to the surrounding pest rhetoric: "the public reaction to its presence is predictable: 'here is a creature that we do not understand; come, let us annihilate it!'" (Kevan, 2938). Some governmental or scholarly results also tend to frame the house centipede as a pest, frequently referring to the control and management of this species (Government of Canada, 2013; Jacobs, 2013; Marlatt, 1902; Ricks, 2001). The basis for this pest rhetoric seems to be grounded primarily on the human perception of the centipede as uncanny rather than its actual behaviour within the home. Kevan, on the other hand, does not suggest that the house centipede is a pest in need of management or control; he does, however, note that public inquiry often focuses on these aspects and, ultimately, the elimination of house centipedes from the home. He offers up a response to this inquiry: "The usual response would be that centipedes are 'beneficial,' seldom abundant enough to cause a nuisance, and to all intents and purposes harmless, so that there is no necessity to do anything about them" (Kevan, 2940). The centipede can be considered a "beneficial" arthropod visitor in the home since it is an insectivorous predator, feeding on other small arthropods found in the home (Edgecombe & Giribet, 2007; Government of Canada, 2013; Jacobs, 2013; Marlatt, 1902; Ricks, 2001). Health Canada states: "centipedes are an efficient way of controlling other insect pests in your home. They like to eat spiders, bed bugs, cockroaches, silverfish, carpet beetles, or ants" (Government of Canada, para. 2). As if within the same breath, the centipede is at once condemned as a hideous invader to be eliminated from the home and revered for its predatory skills as a method of efficient indoor pest control: the dilemma is certainly more humanity's than the centipede's.

Originally native to the Mediterranean region of Europe, the house centipede has since been introduced around the world in Europe, the British Isles, Asia, South Africa, and North America (Lewis, 1981, 401). Some sources suggest that the house centipede was first introduced in Mexico or the southern United States and then increased its distribution north into Canada (Jacobs, 2013; Government of Canada, 2013). According to Kevan (1983), the house centipede was widely known in the southern United States in the late nineteenth century, and at the time was thought to be indigenous there; however, it was not identified in Canada until 1914 when the Dominion Entomologist C. Gordon Hewitt discovered the first specimen in a hotel room in Toronto (2940). Reflective of its common name, all the specimens collected in Canada that Kevan cites were found inside houses and other buildings (2950). In its history in North America, the house centipede is known as a synanthropic species, meaning it lives alongside humans and often within human habitats (Edgecombe & Giribet, 2007; Kevan, 1983). Synanthropes are defined as undomesticated species that live near and benefit from an association with human beings and their surroundings and activities, such as pigeons or raccoons (Synanthrope, n.d.). In North America, house centipedes are often found to reside within buildings and houses, especially in damp, cool areas like basements (Jacobs, para. 6; Kevan, 2950).

The material presence of the house centipede in human homes offers another way in which humanity has characterised this organism as uncanny and reflects how the identity of the human is constructed in relation to the Other; again, using the Freudian uncanny, this idea can be explored through the concept of the "double." Freud (1919), drawing on the work of his colleague, Otto Rank, suggests that the double is connected with "reflections in mirrors, with shadows" (235). At least in Canada, the house centipede's introduction is likely attributable to human activity since its history here suggests an entirely synanthropic existence. In the cosmopolitan distribution of both human beings and house centipedes, humanity might discover a strange reflection of ourselves insofar as we are both "placeless creature[s]… undecided, uncommitted creature[s] awaiting resolution" (Evernden, 1993, 117). Seeing the house centipede in this light supports a non-anthropocentric position insofar as it calls into question the centrality of the human by asking the question of who belongs where? Or who is the true invader? I asked this question of myself in my current residence shortly after moving in when I encountered a large house centipede. I contemplate the question of who the true invader in this context is because house centipedes are known to be long-lived creatures, as far as arthropods go; some sources suggest they can live up to several years (Cloudsley-Thompson, 71; Jacobs, para.4). I imagine that it could very well be the case that this centipede may have resided in the walls or floor of my apartment for longer than I have lived here myself. It is interesting to think with centipedes in this way, to consider how my home is also theirs and that in sharing this habitat, I might defer to the house centipedes' claim on the space and let them live.

The tendency to emphasise the frightening physical appearance of the house centipede, to the detriment of other aspects of its being, reifies this creature as a symbol of disgust and danger, thereby producing the "uncanny effect… when a symbol takes over the full function of the thing it symbolizes" (Freud, 244). The symbolic representations of the centipede figure into its pest-labelling. It is not only that humans find this organism to be hideous but that it also comes to represent something disgusting and potentially dangerous—although in actual fact the house centipede does not pose a significant health risk to humans. In a more extreme characterisation of the centipede as symbol of fear and disgust, we can look to the figure of the centipede in Burroughs' (2001) work *Naked Lunch*: in a scene that takes place at the "*Meeting of International Conference of Technological Psychiatry*," where Doctor "Fingers" Schafer introduces his Master Work: *"The Complete All American Deanxietized Man*" (87; emphasis in original). The man is brought into the scene where he metamorphoses into a centipede. Burroughs (2001) writes, "the Man wriggles… His flesh turns to viscid, transparent jelly that drifts away in green mist, unveiling a monster black centipede. Waves of unknown stench fill the room, searing the lungs, grabbing the stomach…" (87). This representation comprises two aspects of the Freudian uncanny: the centipede is a symbol of disgust and also as humanity's double, providing "a shadow mirror into which humanity gazes upon its ugliest potential" (Cassel, 2016, 87). Cassel writes that Burroughs' figure of the centipede serves "to remind us of the evolutionary chasm that separates humans from the other ostensibly inferior forms of life" (85). In this way, the concept of the uncanny can be useful in elucidating the inherent anthropomorphism and anthropocentrism in this discourse. Cassel's analysis of Burroughs' centipede allows us to see how the centipede is reified as a symbol anthropocentrically in the assumption of the evolutionary superiority of humanity and as uncritically anthropomorphic in the identification of the animal with negative qualities of humanity.

Humanity's decidedly human representations of the house centipede provides an opportunity to consider that in some cases these representations of a creature and the narratives surrounding it are based on a kind of human chauvinism. Instead of the assumption that humans are more evolved than the house centipede, framing encounters with this Other through the lens of the uncanny, we might instead marvel at both the differences and similarities between these beings and ourselves. Rather than dichotomising the house centipede's being as a disjunctive syllogism (us/them), we can borrow Haraway's definition of irony in the tension of holding incompatible things together, to allow for both the human and centipede voices to be heard. Returning to "The Centipede's Dilemma," it may be the case that centipedes do contemplate the movement of their legs, but it seems to me that this poem tells us more about human indecision as to how to characterise this creature; reflecting humanity's wavering opinions, ideas, and representations of the centipede, as opposed to what it is actually like to be a centipede. Importantly, I think we should take seriously artist Christopher Mane's suggestion of letting the natural world speak "as itself… not there as a moment of contemplation for the fiction of Man" and "without the intervention of psychology and economics" (qtd. in Gablik, 1995, 101; 104). Too often it is the human voice that is heard above others, so following Uexküll (2010) I have attempted to take into consideration what life is like from the centipede's perspective, not grounded in anthropocentric or anthropomorphic ideas, but to really consider their mode of being in our home environments in order to begin to understand their *umwelten*.

Manes provides a simple but fitting anecdote to support this thinking—one with which Uexküll might agree—from American author, Edward Abbey,

> If you watch a centipede for fifteen minutes, you realize it has a life, and a way of being, that's just as important to it as mine is to me. Centipedes go out, they hunt, they mate, they sleep, they calculate, and they sit around and look at things. And when I think about my life, that's exactly what I do! There are very few things in nature that don't do basically what we do. (cited in Gablik, 98)

Abbey's characterisation is unlike the dominant representations of the centipede explored here in that it does not focus on the house centipede's physical appearance but rather looks to bring to light some of the simple ways that we might approach that "impossible, uncertain intimacy between you, me and those others that are simultaneously most commonplace and most alien" (Raffles, 2010). I chose to conclude with the passage from Abbey as an example of how we might begin to live alongside this creature in our homes and allow it to speak as itself. I hope to hold all these narratives that surround ourselves and the house centipede in conjunction as both cultural and natural, human and nonhuman, scientific and metaphoric, in spite of contradiction: the result of which I hope may inspire the reader to take pause in the uncanniness of their next encounter with a house centipede so as to view it with wonder even in the face of fear.

E… is for Environmental Education

> *What beautiful and useful knowledge the teaching of natural history might put into childish heads, if only science would consider the very young; if our barracks of universities would only combine the lifeless study of books with the living study of the fields; if only the red tape of the curriculum, so dear to bureaucrats, would not strangle all willing initiative. Little Paul and I will study as much as possible in the open country, among the rosemary bushes and arbutus. There we shall gain vigour of body and mind; we shall find the true and the beautiful better than in school-books.* (Fabre, 1921, 56)

The notion that nature can be found in the city has never seemed troubling to me; however, it is important for me to recognise that I was raised by a family of naturalists in Toronto's downtown east-end, where my mother and grandmothers fostered in me a love of natural history. My worldview has been shaped by these life experiences; experiences that are not shared by everyone. The issue of access to nature is one that is often confronted in discussions of environmental education, especially in urban settings. Contributing to the issue of access is the idea that nature is something "out there," a view which many scholars highlight as still pervasive in environmental education citing that this conception of nature is perpetuated by discourses surrounding abstract environmental issues, outdoor "wilderness" experiences, and a lack of connection to local places (Bowers, 2001; Cajete, 1999; Curthoys, 2007; Russell, 1999; Warkentin, 2011). To challenge the notion of nature as something out there, my research reconceptualises the home as a natural space with its own ecology. I argue that nature, as such, is accessible even within urban environments in the (typically) culturally-defined spaces we call our homes. As opposed to other more charismatic fauna, arthropods are largely accessible for observation and study since they are numerous in urbanised environments and even in the indoors. Arthropods are "the most diverse and abundant group of multicellular life found in homes, as well as on Earth more generally" (Bertone et al., 1). As such, I believe that the study of household arthropods can provide a site of entry into the more-than-human world for environmental education.

The study of arthropods can be connected to environmental education by looking to the life and practices of nineteenth-century naturalist and entomologist Jean-Henri Fabre. Fabre is almost all but forgotten in the contemporary Western world; however, he is a popular figure in Japan's summer insect-collecting tradition, writes Raffles (2010): "there he is a stalwart of the elementary school curriculum and is often a child's first introduction to the natural world that soon comes alive in the summer insect-collecting assignments" (63-64). I innately identified with this practice from my own experiences as an avid bug observer and collector for most of my life. Raffles describes Fabre's method as one that was committed to popular pedagogy, with an impulse towards accessibility; as opposed to the dominant, elitist, laboratory science tradition of his time. Fabre dedicated his life's work to "simple behavioral experiments in natural settings, by close observation, and by the familiar combination of science and wonder" (Raffles, 2010, 61). This method resonates with my research on household arthropods in considering the adaptation of Fabre's philosophy and the Japanese tradition to inspire environmental education in increasingly urbanised and indoor environments in order to further understanding of this understudied environment.

I believe there is potential to apply the practices of amateur entomology within household environments as a way of engaging learners to get to know the variety of life within these spaces. In a student-led seminar that I taught in an applied ecology course during my degree, I included an insect collection exercise as part of my lesson. I provided the class with small plastic containers in which to collect their specimens—admittedly the supplies I provided were crude in comparison to those used by entomologists; however, everyone was successful in collecting at least one arthropod (dead or alive) and we had a chance to view the specimens using a magnifying glass. If there had been more time to dedicate to the insect collection exercise, I would have provided an identification key in order to attempt to classify the arthropods that we discovered. Identification is an important part of learning about arthropods; however, as Lockwood (2013) writes, citing Jared Diamond, "spiders and insects are no longer worth the cultural investment of teaching kids to differentiate species" (174). I find this state of affairs to be problematic – I believe that it is important for human beings to be able to recognise different species so that we can respond appropriately to their presence; for example, the ability to tell the difference between a cobweb spider, *Steatoda triangulosa*, and a black widow, *Latrodectus spp.*, the latter of which is a medically significant species in Canada due to the toxicity of its venom.

Though most of Fabre's theories and conclusions do not hold by today's scientific standards, the Japanese tradition reminds us "that to understand Fabre and his appeal, we have to listen for other languages in his work… the poetics of storytelling, and the writing that unexpectedly pulls you through the hand lens and into the wasps' nest" (Raffles, 68). Fabre's field study in entomology is written in the narrative form of natural history writing, which has the potential to make the biological sciences more accessible, but also to characterise our regular, everyday interactions with arthropod life as offering an exciting and enchanting way to encounter the natural world. Consider this passage from Fabre's (1921), *Book of Insects*, where he describes his process of uncovering the nest wherein the scarab beetle has rolled her pear-shaped collection of refuse and into which she will lay her egg. The "pear" serves as the first source of food for the newly hatched beetle larva:

> A Sacred Beetle's burrow is soon found : you can tell it by the fresh little mound of earth above it. My companion dug vigorously into the ground with my pocket trowel, while I lay down, the better to see what was being unearthed. A cave opened out, and there I saw, lying the moist earth, a splendid pear upon the ground. I shall not soon forget my first sight of the mother Beetle's wonderful work. My excitement could have been no greater had I, in digging among the relics of ancient Egypt, found the sacred insect carved in emerald. (12)

Fabre's lyrical accounts of arthropod life and the enthusiasm with which he addresses his subject is undoubtedly enchanting and could perhaps generate further interest in the study of arthropods. The practice of natural history writing has the potential to democratise environmental education—especially as it relates to the sciences, including ecology and entomology; a point with which Fabre and his followers in Japan might agree. Japan's famous anarchist and labour leader, Osugi Sakae—who completed the first systematic translation of Fabre's work into Japanese—was drawn to Fabre for the "pedagogical possibilities of popular science" as well as his "rejection of authoritarian pedagogy" (Raffles, 65-66). I agree with this characterisation of Fabre's work and believe it complements the trajectory of my suggested amateur entomological forays into the indoor environment as a site for potential experiential environmental education.

Two of the courses I took as part of the Certificate in Environmental and Sustainability Education during my master's degree employed natural history writing in the form of nature journaling as a method of learning about and connecting with the natural world. In this activity, we were encouraged to find a spot to sit and observe the world, documenting observations either in writing or illustration. While the journaling exercise did not explicitly include collection of specimens, it was possible to include items such as pressed plants; though, the journal format itself is not conducive to the collection of arthropod specimens. Perhaps this activity could be adapted by collecting specimens and bringing them back into the classroom for observation and further study. Weeks (2015) writes that "raising live insects in the classroom benefits both the students and teachers by giving them the opportunity to observe insect behavior, learn about their unique lifecycles, and ask questions inspired through their interactions with the specimens" (2). There is the potential for this kind of practice to be applied by collecting household specimens for observation in the classroom.

Moss-mimic stick insect, *Trychopeplus lacinatus*

Writing on the culture of natural history as "nature for the people," Drouin and Bensaude-Vincent (1996) write that "unlike the laboratories of physics and chemistry, the natural world appears to belong to everybody. At least in principle, anyone… is supposed to be able to contribute to the advancement of natural history" (417). Although "natural history was never 'popular in itself,' it remained open to various degrees of non-specialized language and to various forms of practice" (Drouin & Bensaude-Vincent, 424). Connecting amateur entomological collection or observation assignments with natural history practices, such as nature journaling, in the context of the household could support the development of a popular pedagogy that engages with the study of the indoor environment. Another way that natural history can be looked at as a popular practice is through oral tradition. Historically, "the impact of women in the field [of natural history] would be underestimated if one only considers publication… women played a significant—though invisible—role inside the domestic sphere. Using more or less formal means, mothers daily taught a basic knowledge of botany to their children" (Drouin & Bensaude-Vincent, 417). This statement corresponds with my own experience in natural history and insect collection as my interest in the subject and much of my preliminary knowledge were developed over many years of learning with my mother and maternal grandmother. Connecting with traditional, intergenerational knowledge through experiential learning disrupts dominant top-down epistemologies that suggest that knowledge must come from published or scientific sources rather than from within the home. Given the relative dearth of information on the organisms that live within our homes (at least from the perspective of the home environment rather than that of the laboratory), there is an opportunity for oral traditions, stories, and anecdotal evidence to contribute to the discourse on indoor environments. In this way, I think citizen science programs could draw on the practices of both natural history writing and amateur entomology in environmental education initiatives to add to the collection of data in this understudied environment. Many scientists are now turning to citizen science in order to explore these spaces that have not typically been studied, like the home or the backyard (Cooper, 20017; Dunn & Beasley, 2016; Krasny & Bonney, 2005; Lucky et al., 2014; Madden et al., 2016; N.W.G. et al., 2015).

Citizen science engages the general public with scientists, balancing the goals of collecting scientific data and educating the public about the sciences and scientific process. The Cornell Lab of Ornithology (CLO) has developed multiple citizen science projects that have provided transformative experiences for students, the public, and scientists alike. In this model, which balances scientific and educational goals, I find a parallel with the participatory practice described by Ledwith and Springett (2010) when they write that "theories are provisional ideas that are organic in relation to the ways in which we see and experience our changing world. In this sense, theory and practice form a symbiotic unity, a living praxis, knowledge in action and action as knowledge" (109). Galloway (2013) defines praxis from the Greek tradition as "activity engaged in by free people" (para. 22). In the case of the CLO, "educators and their scientist colleagues developed several Citizen Science projects where the educational goals assumed priority over the research goals" (Krasny & Bonney, 2005, 297). Galloway (2013) explains that "the introduction of new knowledge in itself is no guarantee of [what Mezirow called] 'transformative thinking,'" highlighting that simply providing new material or new theory to learners does not necessarily engage with praxis (para. 20). Instead, new information must be coupled with practice and critical reflection in order for the experience of participating in citizen science to be truly transformative. The CLO realised the importance of both practice and critical reflection in their projects through their efforts to help participants "evolve from being data collectors to true citizen scientists," which "entailed participants learning to ask and answer their own questions in addition to collecting data for studies developed by scientists" (Krasny & Bonney, 2005, 298). By prioritising the education goals over the scientific goals, the CLO was able to create a citizen science platform that was transformative for learners. These experiences were not only transformative through the development of critical thinking skills, but also through challenging students' preconceived ideas about scientists themselves. In Project PigeonWatch, participants drew a picture of a scientist before they had participated in the project, "most children drew stereotypical scientists (lab coat, messy hair, male)" (Krasny & Bonney, 302). After observing and collecting data, the students were asked again to draw a scientist and, in this case, they "drew scientists who looked less stereotyped and more like themselves" (Krasny & Bonney, 302).

Much of the dominant paradigm of education does not engage students to think critically. Formal education has focused very heavily on the production of workers (historically) and currently the production of consumers, rather than the cultivation of citizens. Bai and Romanycia (2013) agree when they write: "schools as modern institutions of intergenerational cultural transmission have been specifically mandated to perform the formal and explicit task of shaping citizenry to fit into the modernist industrial consumer society" (101). Critical thinking skills are imperative to making reasoned decisions about who we want to be and how we want to act and interact with others and the world around us. These skills are especially important in the context of our relations with arthropods so that we can make informed decisions about how to interact with these beings. Oseto (1991) comments on the importance of critical thinking skills in the context of entomology as well as other disciplines, "when we prepare doctors, lawyers, engineers, teachers, and entomologists for their chosen profession, it is really a process of training not education in the true sense of the word…. We seem to be teaching everything except the meaning and purpose of education itself" (199). I agree with this statement and recall that Chris Hedges (2009) makes a similar argument on the distinction between "training" and "education" in his book *Empires of Illusion* in the chapter on the illusion of wisdom. The citizen science programs developed by the CLO (among other organisations) highlight the importance of "incorporating opportunities for students to develop research questions… not only from a motivational standpoint (students will be more interested in their own questions), but also from a science education perspective (being able to develop research questions is an important skill)" (Krasny & Bonney, 2005, 312).

Critical thinking that allows students to develop their own questions is not only an important skill in the sciences but also an important life skill. Critical reflection and questioning are also a necessary part of praxis: synthesising theory, action, and reflection. Unlike other models of environmental education, which may address behavioural goals, citizen science "defines behavior change in terms of *critical thinking*…. Participants will be able to analyze the information about environmental issues and to make sound decisions about the environment" (Krasney & Bonney, 315; emphasis added). Providing students with the critical thinking skills to make reasoned judgements through citizen science projects is a kind of praxis, which makes an interesting connection between popular and science education. Oseto (1991) makes a similar connection, stating that "the ultimate goal of education in a free society is wisdom—the ability to make wise independent decisions based on facts and clear reasoning" (199).

One significant challenge confronted by citizen science as popular education, in contrast to both the practices of amateur entomology and natural history, is the top-down methodology of conventional science. Galloway (2013) responds to this challenge writing that "new knowledge does not have to be presented in authoritarian ways in which the educator appears omniscient and the oracle of new knowledge. Educators can choose to bring new knowledge to the group in both transparent and open ways which are to be critically engaged with from the perspective of students' experiences" (para. 16). This is one place where I think the narrative structure of natural history may be a helpful learning tool: if encounters with the world are framed as stories, one person's reflection (e.g. the scientist's) need not be hierarchically placed above the other participants; all participants (both learners and scientists) can come together to create knowledge. The practice of natural history writing, like nature journaling, also provides the opportunity for learners to reflect on their experience through the writing process. Warkentin (2011) writes about a nature journaling practice in Central Park that she assigned to her students; citing one of the student's journals, it is evident that this practice helped to facilitate critical reflection. The student writes: "I have learned to have respect for the trees, plants, and animals themselves. No matter how they got there, they are still alive and deserve to be acknowledged" (cited in Warkentin, 234). I wonder whether this sentiment might be also achieved through taking a closer look at the life found inside our homes.

In the context of the Garden Mosaics project, Krasny and Bonney (2005) describe how the students gathered stories from gardeners about their practices and compiled a database for scientists, gardeners, and non-profit organisations. Like the women (like my mother and grandmother) who imparted knowledge of natural history through oral narrative to their children, I know that knowledge is not generated by published work alone. This is an important point to keep in mind in the context of citizen science as popular education, so it does not become top-down or authoritarian. In this instance, we might take inspiration from Gramsci, as described in Mayo (1999), when he "advocates a relationship which has to be 'active and reciprocal', one whereby 'every teacher is always a pupil and every pupil a teacher'" (47). Mayo regards Gramsci's work as important in developing "a theory of radical adult education" (53). While Gramsci was definitely not referring to entomological education in this instance, I think that his work may also help to inform citizen science as popular pedagogy. Citizen science projects can provide students and adult learners alike with an opportunity to move beyond data collection and begin to ask their own questions, thereby developing critical thinking skills. Similarly, as Mayo (1999) writes, "Gramsci conceived of an adult education movement through which workers were 'educated' as producers rather than simply as 'wage earners'" (39). In this sense, citizen science projects that provide the opportunity for learners to ask their own questions and to think critically (as opposed to simply following instructions) might be considered transformative learning experiences. But perhaps they could go further by asking citizens to collect specimens or report observations and encourage them to explore their homes with curiosity.

There is great potential in the combination of amateur entomology and natural history, as demonstrated by the work of Jean-Henri Fabre, to provide an accessible scientific learning experience given the ubiquity of arthropods in our environments, even in urban areas and indoors. Since there is also a lack of data collected from such environments, there is a foreseeable need to engage the public in citizen science efforts (Cooper, 20017; Dunn & Beasley, 2016; Krasny & Bonney, 2005; Lucky et al., 2014; Madden et al., 2016; N.W.G. et al., 2015). "In fact, Citizen Science is the *only* way that many CLO scientists are able to conduct their research… [and view these efforts] as a normal part of conducting research" (Krasny & Bonney, 303; emphasis in original). Citizen science efforts may be an appropriate and effective way to collect extensive data within the indoor environment. The opportunity to think critically and engage with the world around us is available within the household environment, which has the capacity to re-enchant humans with the natural world by connecting them with the microcosm of arthropod life indoors.

L… is for (Book) Louse

Book lice (Liposcelididae) were found in 98% of homes. (Bertone et al., 2016)

Common book louse, *Liposcelis bostrychophila*

On a humid, mid-summer afternoon, Madeleine has just returned home from a trip to the library. Unbeknownst to her, the library book she has brought home contains a book louse. Madeleine unpacks her library books from her bag and stacks them up on the kitchen counter. She leaves the room to accept a Skype call from her MES supervisor.

Feeling stillness after being transported out of the library and sensing the new environment, the book louse crawls out from between the folds of the book's pages into Madeleine's kitchen. The environment is bright, but the book louse does not discern anything immediately identifiable to her through her compound eyes. She almost retreats back into the book but proceeds into the new space as the book no longer appears to her as a safe harbourage. She must find somewhere else to hide.

Book lice look very similar to parasitic lice and they are likely related, the latter having evolved from the former (Bertone et al., 2016; Jacobs, 2014; Marshall, 2006). Book lice are small creatures, approximately 1mm long, with a large bulbous head, a hump-backed thorax, and long legs with enlarged upper parts on the hindmost pair (Evans, 2007; Jacobs, 2014; Lin, 2014; Marshall, 2006). Unlike parasitic lice, however, book lice have comparatively well-developed compound eyes and sensing antennae.

The louse sets out to find a more suitable location to live, feed, and breed. She crawls along the kitchen table, and feels her exoskeleton tighten on the dry woody surface. There is no bark, she can tell from the texture beneath her feet. She knows that she must seek out moisture before it is too late, and she succumbs to desiccation. The book louse, sensing vibrations in her feet and up through the rest of her body, begins to run frantically searching for somewhere to go, a place to hide.

After her call, Madeleine returns to the stack of library books and sees what appears to be a piece of dust zigzagging its way across the table. Without a thought, she sweeps her arm across the table, brushing the dust away. This piece of dust is actually the book louse and the current of air generated by the brushing motion blows her off the table and across the kitchen to the counter on the adjacent wall.

As she alights, the book louse's tiny body relaxes into the air current, she has, of course, moved this way before and allows the gust to carry her wherever it goes. Her kind do not have wings and so are accustomed to being transported by other animals or gusts of wind. As she lands on the counter, she begins to slide, struggling to find her footing on the unfamiliar and smooth surface of the plastic countertop. Once she regains her footing, the book louse continues on her search for a place to call home. She is unfamiliar with travelling for so long on her own six feet and begins to grow tired.

Their bodies appear almost translucent ranging from a light cream colour to grayish-brown (Evans, 2007; Jacobs, 2014; Lin et al., 2014). There is nothing about the human being itself that interests book lice; they are drawn to human environments because of the wide variety of foodstuffs available to it. It is likely that the book louse only really notices humans as resource stores (e.g., grain or books), as a mode of transportation to novel environments, or as a minor disturbance to their every day endeavours (Baz & Monserrat, 1999; Bertone et al., 2016; Green & Turner, 2005; Mikac & Clarke, 2006; Portmann, 1961; Turner, 2006; Wang et al, 2016).

To the book louse, the new environment in which she finds herself is pungent with the smells of decaying matter. She is not particularly hungry at this moment in time but rather more concerned about finding a source of moisture to keep herself hydrated. She moves her antennae about, this way and that, sensing via chemical signals in the environment for anything that will provide her with both the moisture and sustenance that she needs to survive.

In the absence of a source of food, the book louse can survive relatively long periods of starvation so long as the overall environment has adequate warmth and moisture (Diaz-Montano et al., 2014; Green & Turner, 2005). As small, soft-bodied arthropods, book lice are easily susceptible to desiccation so the source of food on which they feed often needs to provide adequate moisture as well (Baz & Monserrat, 1999; Evans, *2007; Green & Turner, 2005). Book lice are demonstrated to select certain foodstuffs over others; they have a documented fondness for brewer's yeast and it is thought that they are either repelled or attracted by the volatile organic compounds released by certain foods and other products (Diaz & Montano, 2014; Green, 2008; P. Green, 2014; Green & Turner, 2005). It remains unknown whether it is the grain itself or the mold and fungi growing on stored grain to which they are most attracted.*

She scuttles across the slippery surface of the countertop toward the tantalising smells that her olfactory receptors have picked up. She begins her ascent up the wall, toward a cupboard, and easily slips between the door and frame into the dark shelves. Once inside the cupboard, the smell of wheat and mould is so strong that she does not need to use her eyes at all. She cannot sense the presence of any of her own kind, which means she is in luck – there will be plenty of resources available just for her. If she had sensed the chemical signals from another population of book lice, she would be compelled to seek out another source of food and moisture to call home.

In the back recesses of Madeleine's cupboard, the book louse discovers the source of the enticing smell: a bag of flour. She continues her journey through the dark, attracted by the smell of the grains and the presence of moisture, until she reaches it. She climbs up the exterior surface of the bag, touching the folds of paper with her delicate feet, until she finds a small hole in which to enter. Now that she has reached her destination she will not leave. Overcome with relief at having found a suitable place to rest that will provide her with moisture, sustenance, and a place to lay her eggs; the book louse begins to eat. She opens her mandibles and proceeds to devour the fine grains and mould. She grinds the fine particles up further using the protruding appendage within her jaws. Once satiated, the book louse proceeds to lay her eggs. She will never know a mate and does not require one; instead, her eggs are all genetic clones of herself. She drops them singly or a few at a time into the folds and crevices provided by the bag of flour and gently covers them with silk spun from within her body.

The next day, Madeleine's cousin Annie visits and decides to make Madeleine pancakes as a treat. Annie does not notice the louse in the flour bag. She pours the flour into a bowl and returns the bag to the cupboard. Because Madeleine never makes pancakes for herself, she rarely eats breakfast in any case, she does not notice the growing population of book lice in her pantry cupboard.

The book louse, still gripping the sides of the flour bag with her tiny feet, recovers from the startling and vigorous movement of her home. She clings with her all her might to the fold of paper in which she is nestled.

> *In the right conditions, and especially in warmer temperatures, the eggs will hatch and develop into adults in as little as three week's time (Jacobs, 2014; Turner, 2006). From this single book louse, an entire population can be spawned in a matter of months (Turner, 2006).*

L… is for *Liposcelis bostrychophila* (the common book louse)

In my speculative fiction, I have made both a stylistic and an entomological decision to separate the words book and louse, following the spelling used in Bertone et al. (2016), as it aligns better with the letter "L" chosen for this entry. Many of the other authors cited here refer to it as the "booklouse" – one word. Typically, entomologists separate the words if the organism belongs to that particular order: for example, the house fly belongs to Diptera (the order of "true flies"); whereas the butterfly does not. (Borel, 2015). Book lice, bark lice, and the so-called "true lice" are all grouped under the order Psocodea (Wikipedia contributors, 2018). Some entomologists, including Bertone et al. (2016) believe book lice and parasitic lice are close relatives, noting that they share "a long evolutionary history, living, among other places, in close association with birds, mammals and their nests (including those of primates)" (17). Marshall (2006) suggests that parasitic lice may have evolved from book or bark lice shifting from chewing on "dead organic matter to chewing on skin or feathers" leading to the "loss of formerly adaptative features like long antennae and well-developed eyes, which have little role in a parasite's life" (110).

Further, I have taken the liberty of suggesting that a singular book louse is capable of founding an entire new population from Turner (2006); however, others have suggested that smaller populations—such as one that derives from a single book louse—would be "less capable of adapting to novel stochastic habitats, as a result of the loss of adaptive or potentially adaptive genetic variation through genetic drift" (Mikac & Clarke, 2006, 528-9). In other words, smaller populations have less genetic diversity and are thus less able to deal with environmental change. That said, Mikac and Clarke (2006) write that overall the "parthenogenetic life history of *L. bostrychophila* is advantageous to its invasion success worldwide, particularly parthenogenetic or essentially clonal diversity can be high suggesting that parthenogenetic species can evolve in response to changing environmental conditions" (529). I have kept this speculative book louse true to the majority of research available that has suggested that this species is an obligate parthenogen (Lin et al., 2004; Mikac & Clarke, 2006; Robinson, 2005); while others acknowledge that it reproduces primarily through parthenogenesis (Bertone et al., 2016; Jacobs, 2014; Turner, 2006). It is only up until very recently, that the populations of sexually reproducing book lice—populations containing males—were discovered in Hawaii, and later in 2009 in Arizona (Yang et al., 2015). Whether these bisexual populations are actually of the same species as the common book louse is still unresolved (Feng et al., 2013; Yang et al., 2015).

This entry is largely an experimental exercise on writing with the animal, in this case, *L. bostrychophila*, and tries to address what it is that draws them to human environments and how it is that they experience these environments phenomenologically. I was inspired to write this piece by the writing of Adolph Portmann (1961) on dragonflies and especially by the work of Uexküll (2010). Portmann follows dragonflies through the course of their everyday lives – defending territory, hunting, and mating – and situates their activities in descriptive settings. It is evident that Portmann takes some inspiration from Uexküll. Like Portmann, I too take important lessons from Uexküll. For instance, the concept of the book louse's *umwelten*, I consider what might have significance for the book louse in my kitchen, and what sort of sensory experiences have relevance in their lives – light, movement, feelings of the feet, chemical sensations through the antennae. I chose the book louse based on data from Bertone et al. (2016), which found that they were "among the most ubiquitous indoor arthropods (found in 48 of 50 houses)" (17). In spite of their ubiquity, it seems that the book louse is still relatively unknown to the layperson, and for this reason I wanted to bring attention to their lives inside human homes. The above piece is an imagining of a moment in the life of a book louse that has been introduced from one human environment into another. Clearly, it is speculative in the sense of the impossibility of knowing the full perspective or experience of the book louse, or of any other organism for that matter; however, I have attempted to transform my research on the book louse into something of book louse experience, something that is always already partial based on the information available through scientific research and on what is comprehensible from the perspective of the human being.

Writing this piece required the development of what Hugh Raffles (2010) describes as "bug eyes" or "*mushi eyes*" from the Japanese insect collecting tradition. Raffles writes:

> A truly deep relationship with other beings results from interspecies interaction, not separation; it results not from abandoning communication in the name of paternalist stewardship but from the radical change in consciousness that comes with developing those hard-to-acquire '*mushi* eyes.' To find insects you have to understand them, you have to find a way into their mode of existence. (381)

Using "bug eyes", I had the luck of finding one book louse in my local library; however, I have not discovered any hiding anywhere in my pantry, bookshelves, potted plants or windowsills. Bertone et al. (2016) found book lice in ninety-nine percent of the homes they surveyed, so I was disappointed not to find any in mine. Having the chance to observe them in their habitat would have provided me with a deeper understanding of their lifeworlds and given me some additional insight for the writing of this entry. As such, I worked from scientific sources and translated my research into an imagined phenomenological experience from the perspective of a book louse; finding just the right amount of speculative fabulation and anthropomorphism to drive the narrative forward, all while staying true to the book louse itself.

I hope this entry articulates a way into the book louse's mode of existence. It is important to acknowledge how we, as human beings, are limited by our human sensory apparatus; e.g., that I cannot have the sensory experience that I equate with a sense of smell of volatile chemicals emitted from a bag of flour. Commenting on the presentation of the sensory experiences of other animals in writing, Huff and Haefner (2012) write, "but narrative, as humans have construed it and as it is presented in animalographies, is grounded in sight and written language or images" (162). Leading them to ask the question of whether life portrayed in text can fairly tell the stories of companion, or other nonhuman, animals. I make no claims to answer this question here but I will comment on the process of writing the animal: Imagining that I could put myself into the body of a book louse and then striving to find the words to articulate that feeling in writing, really helped me to gain insight into how the book louse *might* experience their environment; while we will never know for sure, this process may help to understand why they do what they do. Thinking in this way helped me to build empathy for the experiences of these critters and opens new and exhilarating worlds to explore within human homes. In acknowledging the limits of my perception as a human being, I endeavour to honour that other animals' perceptions of the world are their own, and that their perceptions are not considered lesser than my own.

Following Haraway (2016a), I include human beings (myself and Annie) in this story alongside the book louse to tease out the situated and entangled nature of book louse-human relations through our shared habitat: this attempt is important in the context of this entry and this particular species, because book lice are dispersed primarily by human activities. As Huff and Haefner (2012) describe, "by situating these narratives within social, cultural, and biological frameworks, Haraway shows how the posthuman weaves in and out of our contemporary lives[,] laying bare critical posthumanism's messiness" (164). Looking at my kitchen in this way I try to reconceptualise it in a way similar to Uexküll's (2010) description of the meadow from the tick's perspective, as the book louse's *umwelten*, its own particular environment from its own particular perspective in which it lives with human beings. I do not think that we need to envision the book louse's environment as necessarily poorer than the human's, as does Uexküll in his envisioning of the tick's world (following Heidegger). Agamben (2004) writes, "the animal is closed in the circle of its disinhibitors just as, according to Uexküll, it is closed in the few elements that define its perceptual world" (51). Portmann (1961) adds to this thought when he critiques the biological notion of "instinct," stating that, "insect behaviour is often supposed to be innate, rigid, unchangeable, the classic example of what was once called instinctive. But in fact parts of it may be quite plastic" (Portmann, 1961, 100). This plasticity may be demonstrated through the book louse's, among other synanthropic arthropods', ability to readily occupy and adapt to new and human-defined environments. Beyond sensory limitations across species, human understanding is also ultimately limited by human knowledge of other species.

The majority of research on the book louse has been done in the context of it being a significant pest of grain stores rather than as an organism deserving of inquiry in and of itself. According to Huff and Haefner (2012), "all life writing by and about companion species, must engage these species in the fullest sense of the term, must meet them in every way possible, for this is what posthuman praxis entails" (167). Thus, in this way, it is of fundamental importance to emphasise that the narrative is always already partial both from the limits of scientific research available and from the sensory limitations of the human being. Articulating the experiential world of the book louse through this kind of speculative fabulation adds to our collective understanding both of this species and of ourselves as human beings and the roles that we play in the lives of nonhumans. Importantly, this kind of writing adds a different perspective, one from the environmental humanities, to the research produced by the biological sciences. As a work of speculative fiction grounded in scientific study, the piece works as a kind of naturalcultural history of the book louse that can introduce this organism to learners outside of the hard sciences. Finally, including myself in the story demonstrates the ways in which human-arthropod relations are not uni-directional, and considers how we might co-exist without directly or negatively affecting one another.

O… is for *Oikos*

> *Indoor biome: the ecological realm comprising species that reside and can (although do not necessarily always) reproduce in enclosed and semi-enclosed built structures. (N.W.G. et al., 2015, 1)*

Oikos is a Greek word that refers to the "house" or "dwelling place" from which we derive the root word "eco-" of both ecology and economics (Allaby, 2015). Given this etymological connection, it is interesting that the indoor biome, specifically modern North American households, has remained largely understudied within the field of ecology until recently. The relative dearth of investigation into the human household may be because the home is typically conceived of as a cultural, as opposed to a natural, space. In the introduction to their survey on arthropod life inside fifty houses in Raleigh, North Carolina, Bertone et al. (2016) address how, in contrast to early human dwellings, "modern, Western homes are perceived of as being an environmental largely devoid of animal life," by which they mean devoid of animal life other than human life and the lives of our pets (2). The very fact that up until recently there has been no comprehensive survey of the arthropod life inside human houses is evidence of a kind of human exceptionalism. In characterising the home as a multispecies assemblage, I disrupt the modernist conception of the bounded, single-family dwelling and, in this entry, I explore in detail the historical connections between human and arthropod beings within human dwellings both ecologically and economically. Similarly, in conceiving of her string figures, Haraway (2016b) considers that "neither biology nor philosophy any longer supports the notion of independent organisms in environments, that is, interacting units plus contexts/rules," instead suggesting that "sympoiesis is the name of the game… bounded (or neoliberal) individualism amended by autopoiesis is not good enough figurally or scientifically; it misleads us down deadly paths" (33). Haraway defines sympoiesis as "collectively-producing systems that do not have self-defined spatial or temporal boundaries. Information and control are distributed among components. The systems are evolutionary and have the potential for surprising change" (33).

Many authors studying the indoor biome have commented on the general lack of scientific investigation into the ecology of indoor environments and the lifeforms therein (Barberán et al., 2015; Bertone et al., 2016; Dunn, 2014; Dunn & Beasley, 2015; J. Green, 2014; Lucky et al., 2014; Lyytimäki, 2012;

Madden et al., 2016; N.W.G. et al., 2015). "What we know today about the natural history of the indoor biome derives from the relatively small proportion of indoor species that have been studied in any detail… a group biased towards species that humans attempt to exclude from the indoor biome" (NWG et al., 226). In other words, the organisms we know the most about inside our homes are those that are considered pests. Other studies have likewise asserted the importance of studying indoor environments since humans in developed, western nations tend to spend the majority of time indoors (Adams et al., 2015; Adams et al., 2016; Barberán et al., 2015; J. Green, 2014; Kelley & Gilbert, 2013; Kembel et al., 2014; Rook, 2013). Indoors, human beings live alongside a vast diversity of arthropods, bacteria, and fungi (Bertone et al., 2016; Barberán et al., 2015; Leong et al., 2016; N.W.G. et al., 2015; Madden et al., 2016). While this entry looks specifically at arthropods, there is more research available on the microbial life of the indoors than on indoor arthropods. With regard to arthropods in the home, Madden et al. (2016) surveyed 732 homes using swab collections of settled dust, using DNA evidence from these swabs, they "noted the presence of more than 600 unique arthropod genera" in total (Madden et al., 6217). Using standard entomological collection efforts, Bertone et al. (2016) revealed that in North American houses there are on average ninety-three morphologically distinct arthropod species per home; noting that this measure looks at species diversity rather than the abundance of individual organisms (12). A better understanding of the ecological processes that play into our cohabitations with these creatures is necessary in order to determine the factors that sustain nonhuman life inside our homes, which will, in turn, allow us to make more informed decisions regarding the impacts on human beings (whether harmful, beneficial, or neutral) of living alongside these organisms.

In his book, *House Guests, House Pests*, entomologist Richard Jones (2015) explores the relationship between humans and the myriad of animals with whom we share our lodgings. In order to understand how it is that these creatures have come to inhabit our homes, Jones first provides an overview of some of the theories of human domestication from the era of prehistory to present day. He tracks the development of human practices such as wearing clothing, eating meat, the agricultural revolution, and the onset of permanent human settlements, alongside the corresponding evolution of animals that began to (and often still do) occupy these very particular, human-designed environments. Jones cites four reasons that the home benefits us as well as our nonhuman animal neighbours (arthropod or otherwise): dry shelter, warmth, stored food, and the avoidance of natural predators and parasites (39). He proceeds to take a closer look at a variety of animals in the home according to the attributes to which they are attracted: those that come in for shelter; the ones that live in the waste we leave behind; those that feed on our food, clothing, homes, and bodies; and the others that we encounter in this environment. Jones' main argument presents a challenge to the way humans normally define our homes as distinctly human environments by demonstrating how it is that the conditions we create for ourselves come to serve our arthropod companions as well. By reframing the household as an ecosystem, Jones highlights the fact that some of the creatures with whom we share our homes are no longer "wild" animals, and that many now "only occur in buildings occupied by humans" (7).

Jones (2015) draws not only on scientific literature but also on historical and cultural references to trace the evolutionary history of so-called pest species to further uncover their stories. For some species, such as the grain weevil, we have yet to pin them down—so to speak—to a so-called natural environment as they have been inhabiting our grain stores since the early stages of the agricultural revolution in the Neolithic era, anything beyond being just speculation (Jones, 114-15). While Jones does not explicitly frame it in this way, his writing speaks to an *unavoidable* crossing of species involvements: humans create environments that just happen to be very well-suited to these other animals and the responsibility for this state of affairs is neither ours nor theirs. Jones just begins to raise awareness of our homes as ecosystems; overall, the indoor biome is an area that has not been considered in great detail by the scientific community until recently (Bertone et al., 2016). Within the context of this work, I have been looking exclusively at modern, North American homes; however, the indoor biome comprises more than just human households but also other indoor environments such as "places of worship, food storage areas, commercial spaces, factories, offices, and restaurants" (N.W.G. et al., 2015, 224).

Modern western homes are unique environments that have their own distinct ecological processes, including selection pressures, the role of human activity, the origins of indoor species, dynamics between the broader landscape and the indoors, the distribution and abundance of arthropods, and the presence of microorganisms like bacteria and fungi. "Little research explores how species come to populate the indoor biome… pre-adaptations allow species to colonize built structures and then, having colonized, these species respond to local selection pressures" (NWG et al., 2015, 226). Since western homes are generally intentionally dissociated from their outdoor climatic conditions, most species found indoors must be pre-adapted to tolerate dry, warm habitats. Intentional actions taken by human being to eradicate certain species from our homes through cleaning practices, application of biocides, and other prevention methods have been shown to drive adaptation in arthropods (and bacteria) (N.W.G. et al., 226). The ubiquitous clothes moth provides an interesting example of a pre-adaptation that is able to respond to indoor selection pressures; according to David Suzuki, the clothes moth, whose larvae feed on our clothing, originally fed on animal hair. The clothes moth larvae tend to prefer natural fibres, so the interesting pre-adaptation that allows them to thrive in the home is their ability to delay metamorphosis into adulthood—undergoing anywhere from 5 to 45 successive molts before pupation—which means they can potentially wait for the arrival of an optimal food source, e.g., wool over synthetics (Verdecchia, 2017). This example clearly demonstrates how pre-adaptations respond to indoor selection pressures, and also how our things are also implicated in ecological relationships with other beings inside the home.

Leong et al. (2016) examine the data collected in Bertone et al. (2016) alongside other factors such as house size, surrounding land vegetation cover, and mean neighbourhood income, finding that "indoor arthropod diversity increases in neighbourhoods with higher mean income, mirror[ing] the 'luxury effect' found in studies of biodiversity in the urban outdoor environment" (4). The luxury effect is an ecological pattern that identifies the ways in which "affluence, along with its many associated phenomena, tends to have a positive effect on biodiversity… [wherein] patterns of greater species richness in higher-income neighbourhoods have been demonstrated for both plants and animals, including birds, lizards and bats" (Leong et al., 1). Leong et al. hypothesise that socioeconomics contributes to the distribution and diversity of arthropods in the indoor environment. The results of their study find that indoor arthropod diversity is positively correlated with house square footage, local ground vegetation cover and diversity, and mean neighbourhood income. For instance, a larger home with a basement may provide a greater number of undisturbed spots in which arthropod populations like silverfish can thrive, so a centipede that makes its way indoors may choose to take up residence in such a home because of the availability of prey. Given that North American homes are host to ninety-three different arthropod species on average, there is certainly always something for a predator to eat. Cultural prejudice related to the presence of arthropods in the home persists despite the positive correlation of biodiversity with affluence: the association between species typically classified as pests with lower income neighbourhoods is evident through to the conclusion of Leong et al.'s study. "Our unexpected, and perhaps counterintuitive finding of higher indoor arthropod diversity in wealthier neighbourhoods highlights how much we have yet to learn about indoor ecology" (Leong et al., 5). In terms of the distribution and abundance of organisms within our homes it appears that human activity is more important than biogeography (Adams et al., 2015, 14). It has also been suggested that humans are the primary source and vector of microbial diversity within the indoors and that other nonhumans, including pets like dogs and household insects, can also influence microbial diversity in the home (Barberán et al., 2015; Kelley & Gilbert, 2013). According to Kembel et al. (2014), further research is required in order to understand how "the relative contributions of biological processes including environmental selection, dispersal, diversification, and ecological drift" occur within the indoor environment (1-2). The identification of some nonhuman animals as pests or "trash animals" is biopolitical in the sense that it also extends beyond our relationship with those beings and may also reflect preconceived ideas about other human beings (Malmud in Nagy & Johnson, 2013, xi).

In the context of arthropods in the home, Bertone et al. (2016) advocate for further research into indoor ecological processes in order to understand the impact of the species that live among and have evolved alongside us. On the harms associated with living alongside arthropod life, Madden et al. (2016) write that "some arthropods disperse pathogens and antibiotic-resistant microorganisms through homes… [while] other arthropods, including dust mites and cockroaches, affect us more indirectly, by shedding sensitizing allergens that can lead to allergic rhinitis, allergic asthma, and atopic eczema" (6214-15). The house centipede might be thought of as beneficial arthropod within our home, according to Kevan (1983), because it is such an effective predator of other arthropods that humans may consider to be a nuisance; spiders are likewise considered to be beneficial for the same reason. Bertone et al. contend that "it appears the vast majority of arthropods that live among us cause us no direct harm" (17). Qualifying this statement, they write, "unfortunately, many insects and arthropods we collected are considered pests based solely on their presence in the home… despite having no impact on people or their possessions" (Bertone et al., 17). The pest rhetoric and fear surrounding many arthropods hinders research and understanding of the creatures within human homes and the specific roles they play in this environment. Lyttimäki (2012) makes a compelling point when he suggests that, "indoor spaces need to be identified and acknowledged as spaces for the production of ecosystem services and especially as venues of their consumption…. As the world's population grows and urbanization continues, the need for producing ecosystem services within built-up areas inevitably increases" (74).

There is a definitive need for further study within the indoor environment; however, another problem arises in how ecologists might go about collecting this valuable data on the microcosm of life that occurs in our homes and other indoor environments. In their DNA analysis of arthropod life in the home, Madden et al. (2016) comment on some of the limitations and advantages of DNA-sequencing analysis from dust samples. Of the limitations, they write that this method was neither able to identify certain taxa, "due to known primer biases, limitations on reference databases or inherent limitations in sampling dust," nor could it provide "species-level resolution, necessary for additional studies of taxonomy or life history" (Madden et al., 6217-18). On the other hand, when compared with traditional arthropod collection methods, DNA analysis is able to identify the presence of partial specimens, which may not be possible using traditional collection methods. Furthermore, sampling dust inside the home is a non-invasive procedure, i.e., it does not require trained individuals to spend hours in peoples' homes, rather it can be completed by citizen science volunteers (Madden et al., 2016). Many studies are looking to engage the public in citizen science efforts in order to collect data in spaces scientists have not typically studied, like homes or backyards (Cooper, 2007; Dunn & Beasley, 2016; Krasny & Bonney, 2005; Lucky et al., 2014; Madden et al, 2016; N.W.G. et al., 2015). Citizen science efforts may be an appropriate and effective way of extending data collection efforts within the indoor biome. Likewise, I suggest that standard, rather than swab-based, collection efforts might be employed by citizen science initiatives alongside natural history writing as a form of environmental education in order to engage the public in the worlds of household arthropods.

There is still so much to be discovered in our homes, which provides a unique opportunity for scientists to engage and work with the public in collection of data from this largely understudied ecosystem. Haraway (2016b) writes of "the systemic stories of the linked metabolisms, articulations, or coproductions… of economics and ecologies, of histories and human and nonhuman critters, must be relentlessly opportunistic and contingent. They must also be relentlessly relational, sympoietic, and consequential" (49). The description she provides here feels as if it was written to describe the richness of life and ecological processes that take place under our roofs. Anecdotally, for instance, there is a colony of little black ants that lives somewhere in the walls of my apartment or in the pigeon nests on the balcony. These ants are not full-time occupants within my apartment, I usually only see them in the autumn and again in the spring for a few weeks at a time before they disappear back into the walls. I hypothesise that they come in to find a source of food or water; however, I have never found them in my kitchen. I do not know precisely why they are here, where they go, or where they come from; they are hardly a nuisance, never in sufficient numbers or specific locations that warrant concern. They stick to their trails and clean up the crumbs on my carpet, I accept their presence and we happily co-exist within the space. This is one example that shows the connections between my human activities and the ants, but there is a vast ecological network of relations within the home of which humans are largely unaware, possibly because we are not part of the equation. I wonder what do the ants eat when they are not snacking on the crumbs I drop? Ecology needs to return to its roots, to the origin of "eco" as *oikos*, the household: it is time to come home. This area of research is vital to humanity in the development of a more comprehensive conception of ourselves, our homes, and the environment at large.

P… is for Pest

> *A pest is an animal or plant detrimental to humans or human concerns including crops, livestock, and forestry. The term is also used of organisms that cause a nuisance, such as in the home. An older usage is of a deadly epidemic disease, specifically plague. In its broadest sense, a pest is a competitor of humanity. ("Pest," n.d., Wikipedia)*

The concept of a "pest" is central to understanding the relationships between humans and arthropods. The use of the term in itself "makes killable," to borrow from Haraway (2016a), the organisms to which it refers in some cases it might be applied indiscriminately (much like effects of pesticides) to all arthropods of the indoors. Each of the entries that follow under "P" are cognate words in that they rely on the root word *pest* – pest, pestiness, and pesticide. The vexedness of the term arises in that it serves as both an ontological category and a value judgement. This volatility is expressed in one way by referring to a particular organism's way of being within a given environment, for instance, as a competitor of humanity; however, in another way, it also implies a value judgement, on the part of humanity, and especially in the context of the home, in that a pest is any such organism that crosses the boundary and enters one of our most intimate environments. In "pestiness" I look at the processes at work in both human and arthropod actions that make an organism a pest, following Richard Mabey's (2015) concept of *weediness*. Finally, in "pesticide" I look at how these organisms we call pests exert a strong influence on human lives in a material way through the application of synthetic chemicals designed to kill arthropods.

In current usage, the word pest generally refers to plants or animals—specifically insects—that are harmful to human concerns, especially crops, food, or livestock. A pest is an organism that threatens human beings or their interests; ultimately, pests are those organisms that are in direct competition with human beings. Informally, however, it may also refer to an annoying person or thing. While the word pest has only been around approximately six-hundred years, the organisms to which it refers have lived on earth since before human beings first arrived on the evolutionary scene. "Competition for resources is one of the key drivers of evolution, and before modern humans evolved, their ancestors were competing against other animals for food, shelter, and territory. A large number of those competitors were the insect pests that still plague people today" (Jones, 2012, 248). In the modern world, as society becomes more globalised, there is an increase in the movement of people and goods around the globe, which "ensures that these pests are continually spread and respread through-out the world" (Jones, 249). In fact, many of these pests are now cosmopolitan species whose "true geographic origins are lost in prehistory" (Jones, 249). While my focus here is on so-called domestic pest species that occur in modern North American homes the effects of pest organisms in other environments should not be understated.

According to the Oxford English Dictionary, the word "pest" originates from the late fifteenth century French *peste* or Latin *pestis*, for "plague;" in its archaic usage, pest or the pest referred to the Bubonic plague ("Pest," n.d.). Pest populations have the capacity to plague our best efforts at controlling our environments—ecological, agricultural, domestic, and even our own bodies. Interestingly, the collective noun for a group of locusts is a plague; these organisms have significantly impacted human beings throughout our history (Britannica, para. 2). In the time before modern storage systems and chemical pesticides, and even still today, pest populations are capable of decimating crops or food stores, causing harm to the bodies of humans and livestock, destroying human property, as well as spreading disease. The plague-like impact of pest populations is rarely felt in domestic settings in modern western society; however, it is still a very real experience for many people around the globe. For instance, according to data from the World Health Organization, insects are responsible for spreading four of the top five most deadly human diseases—malaria (mosquitoes), leishmaniasis (sandflies), sleeping sickness (tsetse fly), and lymphatic filariasis (mosquitoes)—which are estimated to kill about four million people a year, roughly half of that number from malaria (Jones, 2012). The concept of a pest is experienced in different ways in different environments: human-arthropod relations are always situated and context-dependent.

What makes an arthropod a pest in the home? It is often the case that an arthropod's mere presence in the home is enough for it to be considered a pest: the idea that any or all arthropods found indoors are pests is especially predominant in western imaginaries, as evidenced, write Bertone et al. (2016), "by today's multi-billion dollar pest control industry" (2). In their survey of arthropod life found in North American homes, Bertone et al. determined that the majority of arthropod species found in the home possess life histories that pose "no direct impact on people or their possessions" (18). It is important to concede, however, the organisms such as termites can and do cause real damage to people's property. If these organisms are not competing for human resources in a way that has a direct impact on us, why do we still consider them pests? Bertone et al. suggest that in contrast to early human dwellings, "modern western homes are perceived of as being an environment largely devoid of animal life" (2). Likewise, Kellert (1993) also identifies "contemporary standards of hygiene [and] the desire for sterile home environments… particularly in highly urbanized industrial societies" as one reason for the pervasive negative characterisation of arthropods (852). Contrary to this constructed idea of the home as sterile and devoid of animal life, the results of Bertone et al.'s survey indicate a conservative estimate of the presence of over ninety different species per home on average; noting that this figure reflects diversity of species rather than the abundance of individual organisms. In any case, all the houses they surveyed contained arthropod life, which directly contradicts the predominant belief that human homes are wholly cultural rather than natural environments. Since the majority of arthropods with whom we share our homes pose little harm to human beings, the characterisation of them as pests seems better captured by the informal definition: an annoying person or thing or by the synonym, "bug." Solely by their material presence indoors an arthropod becomes a pest; in a similar way, Richard Mabey (2010) describes weeds, writing "plants become weeds when they obstruct our plans, or our tidy maps of the world" (1). An arthropod becomes a pest when it obstructs our tidy maps of the home.

The characterisation of arthropods, especially those in and around the home, as pests is supported by the work of Karl von Frisch (1960), Stephen Kellert (1993), and Baldwin et al. (2008). Frisch's book, *Ten Little Housemates*—while many years out of date now—identifies ten of the multitudes of creatures that live alongside humans in our modern homes; despite the affectionate title, he characterises each of the "housemates" as pests to be eliminated insofar as each chapter ends with suggested methods of control. Kellert's survey identifies that "among the general [American] public… feelings of fear, dislike, and indifference were the most frequently encountered view of invertebrates" (850). The survey conducted by Baldwin et al. examines the behavioural threshold at which a person would make changes to take action against a pest; their results identified that "more than 2/3 of the Florida population believed that insect pests were somewhat or very harmful to their household" (76). Baldwin et al. never qualify exactly what constitutes a pest beyond the identification of four categories of insects: crawling, flying, wood destroying, and lawn and tree pests" (75). They do however acknowledge that the responses are based on the "respondents' perceptions of a pest" (Baldwin et al., 77).

Along with the characterisation of an arthropod's mere presence identifying it as a pest, insects, especially, have long been associated with the abject or waste. The Aristotelian view of insects suggested that insects arise through spontaneous generation from waste (the most imperfect form of reproduction); according to Aristotle, "houseflies, for example, arise from manure, as do fleas… others emerge from dew, mud, wood, plants, and animal hair" (Raffles, 2010, 130-1). In many ways, the association of insect life with waste persists in contemporary human-arthropod relations. Nagy and Johnson (2013) identify some common characteristics of animals that are devalued as "trash" species: they are common or uninteresting, those with non-native origins, any classified as "exotics" or "invasive alien species," and some simply for "being ugly or for inspiring fear and disgust" (1). Most common household visitors and especially arthropods belong to at least one if not all of the categories identified by Nagy and Johnson. Drawing on the work of Mary Douglas—who writes, "dirt is matter out of place"—in a way that is reminiscent of the common phrase, "cleanliness is next to godliness," Nagy and Johnson describe how "dirt exists outside of a culture's 'normal' or 'safe' worldview" (5). They continue, "we fear what we find dirty… in many cases because these dangerous kinds of filth cannot be easily defined, controlled, or dismissed. It is no wonder plants, animals, and insects that we find difficult to define, contain, or control are deemed trash animals" (Nagy & Johnson, 5). The phrase "matter out of place" stands out in that it effectively sums up how arthropods found indoors are characterised as pests or trash animals due to human cultural beliefs that these animals do not belong in our homes. The threshold of our exterior doors and walls becomes a physical manifestation of a biopolitical line that defines certain animals as pests (in some cases, this line might be extended to the perimeter of a person's property, including gardens and outdoor space).

In the foreword to Nagy and Johnson (2013), Randy Malamud writes that "cultural prejudices, like any effective propaganda, are generalized mass market, lowest-common-denominator caricatures" linking the characterisation of certain animals as trash with the "historical phenomenon of trash-labeling certain racial, ethnic, and religious human cultures" (x). Malamud contends that when it comes to nonhuman animals, "we don't want to work very hard to problematize or reconceptualize our received ideas" (in Nagy & Johnson, 2013, xi). This association identified between trash animals and the trash-labeling of certain human cultures is evident in ideas surrounding who is affected by arthropod pests: indeed, there is a persistent belief that human beings with lower socio-economic standing are more often affected by arthropod pests. The results of Leong et al.'s (2016) analysis of the data collected by Bertone et al.'s (2016) study run contrary to this belief. They analyse the data on indoor arthropod life alongside socioeconomic factors such as house size, surrounding land vegetation cover, and mean neighbourhood income, which reveal that "indoor arthropod diversity increases in neighbourhoods with higher mean income, mirror[ing] the 'luxury effect' found in studies of biodiversity in the urban outdoor environment" (Leong et al., 4). The luxury effect is an ecological pattern that identifies the ways in which "affluence, along with its many associated phenomena, tends to have a positive effect on biodiversity… [wherein] patterns of greater species richness in higher-income neighbourhoods have been demonstrated for both plants and animals" (Leong et al., 1). Just as Malamud suggests, however, cultural prejudices persist in spite of the acknowledgment of the effect affluence has on biodiversity. Leong et al. conclude their study, "our *unexpected*, and perhaps *counterintuitive* finding of higher indoor arthropod diversity in wealthier neighbourhoods highlights how much we have yet to learn about indoor ecology" (5; emphasis added). Here we see the persistence of the association between arthropods and those of lower socio-economic standing. The identification of certain organisms as trash animals is biopolitical in the sense that it extends beyond our relationship with those beings and may also reflect preconceived ideas about other human beings.

What makes an arthropod a pest? At least indoors, it is important that we consider, for situated and practical reasons, why we might want to answer what constitutes a pest in this space; especially if we want to live responsibly alongside other nonhumans in our homes. Important to note in this case is that the categorisation of an organism as a pest derives from an entirely human-centred perspective—this kind of human exceptionalism has led to the belief that our homes are cultural spaces devoid of animal life; however, new research demonstrates this belief to be false. We share our home with multiple arthropod species most of which cause us no direct harm; thus, the categorisation of an arthropod as a pest in the home often has more to do with being in the wrong place at the wrong time. Jones (2015) calls into question the very definition of pest by distinguishing a house guest from a pest in an important way: "it's only a pest if it reaches pest proportions" (38; 200). Likewise, the Oxford Dictionary of Ecology qualifies the definition of a pest with the caveat that most insect pests "are harmless until their populations increase rapidly" in response to the availability of resources (Allaby, n.d.). Jones qualifies his definition further in his conclusion, admitting that "judgement [will be] different for each of us" (200). He does, however, urge us to think deeply about the lives with which we share our homes: to "*actually make a decision* about whether it is acceptable or not to share your home;" rather than immediately and uncritically labeling an animal a pest (204; emphasis added).

P… is for Pestiness

Pestiness: the quality of being pesty.

I suggest the term "pestiness" here—inspired by Mabey's (2010) "weediness"—to capture something of the agency of arthropods and the ongoing entanglement in which humans and arthropods are co-authors within this shared environment. Like weeds, arthropods of the indoors "thrive in the company of humans… we are their natural ecological partners, the species alongside which they do best" (Mabey, 2010, 12). In the simple fact that human beings' indoor environments likewise happen to be so well-suited to these other animals that over time they have adapted to live with us, I am reminded of the weeds' call: "*We were here before you, are your constant and ubiquitous companions, and will be here when you are gone"* (Mabey, 2010, 183; emphasis in original). This call also seems entirely fitting for the host of arthropod species who make their homes alongside ours; especially, considering the geological timeline for arthropods stretches back 540 million years into the earth's history as well as the likelihood that they will survive long after humanity ceases to exist on earth. Writing about stone, Raffles (2012) considers how verbs may be methodologically better suited to understanding our relationships to our world than are nouns: "verbs encircle these supremely protean things but don't encase them" (527). Likewise, Jones' (2015) re-defined concept of a pest in terms of proportionality ("it's only a pest if it reaches pest proportions") expresses a move away from static, general nouns to a more nuanced understanding of the unfolding ecological processes implicated between arthropods, humans, and our shared homes. Analogously, in the context of the "trash-labeling" of certain species, Nagy and Johnson (2013) cite Susan Strasser's suggestion to "focus on the *categorizing process* that defines trash," thereby drawing attention away from the thing itself—the trash or trash animal—instead concentrating attention on human actions (7; emphasis added).

Rather than focusing on the pest species themselves, we might instead move our focus toward the categorising processes that define a pest—pestiness. Strasser's suggestion is exemplified by Gavan Watson's question regarding ring-billed gulls in Toronto: "If the ring-billed gull is hated for its scavenging on our own urban leftovers, why are we not implicating ourselves in the lifestyle that leads to the creation of the waste?" (in Nagy & Johnson, 2013, 36). The focus is then shifted away from the animal toward the processes at work that lead to the labelling of something as a pest. In some ways we are willing to offer pest species more agency than we do other animals by displacing human agency within these intimate entanglements, a kind of human exemptionalism, as if to blame the animals for their encroachment on "our" space. We are also willing to extend a similar kind of agency to the weediness of certain plants "that sabotage human plans" (Mabey, 2010, 11). However, Mabey (2010) acknowledges that weeds "don't have a 'purpose', least of all to deliberately scupper our best-laid plans. Like all living things they just 'are'" (14). Arthropods likewise are not purposefully present to obstruct our plans; they just are. In this way the concept of pestiness contrasts with Bruno Latour's assertion that "we are much better at admitting that humans infect nature than we are at admitting that nonhumanity infects culture, for the latter entails the blasphemous idea that nonhumans… are actants more than objects" (qtd. in Bennett, 2010, 115). Pests upset the boundary between nature and culture, following Haraway (2016a), pestiness might be thought of as a kind of naturalcultural process that brings together the animal and the human by taking up the point of view of the entanglement itself and the processes at work within these situated encounters. Mabey (2010) describes weeds as "archaeological artefacts, embodying history as if they were arrowheads of old letters, charting our habits and beliefs. Except that in another sense they are nothing whatever like museum specimens, and are wonderfully and mischievously alive" (187). I think this comparison is apt for the pestiness of certain notorious household arthropods, like German cockroaches, which are also wonderfully and mischievously alive insofar as their bodies continue to adapt resistance to synthesised chemical pesticides. The term pest itself is not only a human construct but we have also significantly contributed to the pestiness of certain organisms by driving adaptations through human chemical innovation.

P… is for Pesticides

> *Morality never entered into discussions of killing insects, [but] morality often figured in debates about human warfare... moral concerns help to explain the popularity of insect metaphors for human enemies [because] Western thought has long regarded conquest of nature as a moral duty, rather than a moral dilemma, and conquest of insects offered an especially useful metaphor for human warfare. (Russell, 1996, 1528)*

Pesticides and insecticides have acted as one of the primary mediators of human relationships to arthropods. The application of pesticides is arguably one of the most common ways that humans interact with the microcosm of arthropod life encountered in the home. The development of chemical pesticides has largely influenced the study of arthropods: Lockwood (1987) writes that "the science of entomology is burdened with the economic reality that [the] field exists largely because of the potential application of [the] knowledge to control, and frequently kill, insects" (87). Evident the common phrase, "squash like a bug," the pest-labelling of certain animals allows them to be "made killable," to borrow Haraway's (2016a) apt phrase. Taken in conjunction with pesticide or insecticide—as the "-cide" from the Latin "-cidium" "to kill" suggests—a pest or an insect is thus something to be killed or exterminated ("-cide," n.d.). In this section, I have sought to call into question the indiscriminate pest-labelling of arthropods as well as the routinisation of death enacted upon these beings. The term pest thus denotes a biopolitical line that divides certain beings from others; if there ever were a field so saturated in the control of bodies, it is applied entomology with its history tied so closely to that of modern chemical warfare (Russell, 1996).

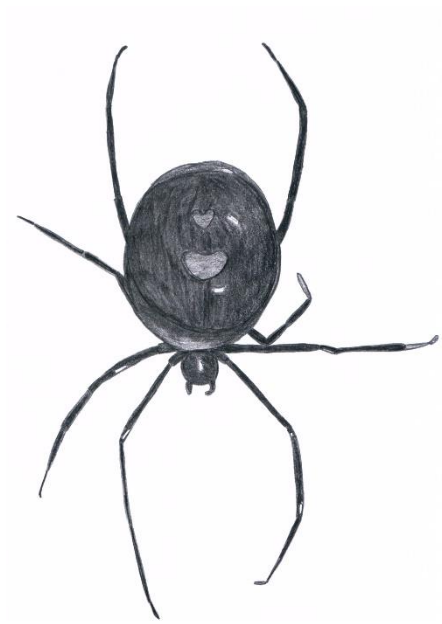
Chemical warfare and chemical pesticides were developed hand-in-hand in the early twentieth century, which proved to be of benefit to both the practical significance of entomology and the political concerns associated with chemical weapons (Russell, 1996). The perception of certain insects as pests was amplified during the two World Wars of the twentieth century. During this time, chemical warfare and pest control seemed almost to merge into one major discipline whose separate discourses provided useful "ammunition," so to speak, for both sides of the political debate. Russell (1996) writes that "describing war as pest control transformed participation in war from a potentially troubling moral issue to a moral virtue" (1509). During this time, there was a vested economic interest on the part of governments, entomologists, and chemical engineers in maintaining the status quo of arthropods as pests to be exterminated. In many ways, this view has continued to be maintained by the chemical pesticide industry today. Russell describes some of the wartime rhetoric used by entomologists, for instance L. O. Howard, chief of the Bureau of Entomology, is said to have described his department as waging "warfare against insect life," contending that "such rhetoric associated scientific activity with patriotic national priorities [and] imbued the Bureau of Entomology with the prestige of the armed forces" (1513). The metaphorical language—with regard to fighting pests—that developed during the World Wars was subsequently adopted by the chemical industry and has remained relatively unchanged in the use of words like "invasion," "attack," or "resistance" to describe our relations with arthropods as mitigated (or not in the case of resistance) by pesticides.

As early as the mid-1930s the corporatisation of the chemical industry was becoming clear. Russell (1996) writes about a 1935 meeting of exterminators in which the chief of the Insecticide Division of the Department of Agriculture described a "mix of altruism and self-interest that led entomologists to promote insects as enemies" (1514). Russell cites a direct quote from the chief at this very meeting: "People must be taught that insects are enemies of man; and as the public becomes insect conscious the opportunities for service by entomologists, the insecticide chemist, the chemical manufacturer and the exterminator will increase" (1514). This statement shows the extent of the bourgeoning corporate culture of the chemical pesticide industry, the sole interest of which was the promotion of their products. This type of rhetoric played a role in molding public consciousness into perceiving insects as a threat and something to be conquered. Jones (2012) comments on the use of chemical pesticides writing, "at each turn in the battle against these fast-reproducing and fast-adapting creatures, unexpected consequences of human action have sometimes worsened the outcome, to the detriment of people, wildlife, and the environment at large" (248). Today we recognise the immense environmental damage that was inflicted by the widespread and indiscriminate use of earlier chemical pesticide formulations, such as DDT, while simultaneously grappling with the continued use of new formulations like neonicotinoids.

Still in modern, North American society the use of pesticides and insecticides is the dominant paradigm that shapes our relationships with arthropods. We remain adherents to a chemical game that we seem to be losing in so many ways as target organisms build up resistance while non-target species vanish. In all the pestiness of our household entanglements with arthropods, we can consider Raffles' (2010) claim that "this is a world that at all times exceeds its compartments. It is the dissolution of boundaries—self, other, body, animal, vegetable, mineral" (334). Our history of dependence on chemical pesticides provides a material example of the kind of biopolitical boundary crossing between human and arthropod bodies that can occur in this entanglement. As demonstrated so clearly by DDT, which began showing up in the adipose tissue of human beings soon after its deployment into the environment, these chemicals can persist for many years and take on a life of their own. Thus, epitomising the naturalcultural pestiness of our relationship with arthropods: this technological mediation of human-arthropod entanglement through the use of chemical pesticides has had the effect of strengthening resistance in many arthropod populations; while also taking on new life and wreaking havoc on our own bodies and the environment at large. Lockwood (1987) comments on the responsibility on the part of human beings when it comes to wielding such a power, quoting North Carolina State University Entomologist, Robert Rabb who said, "the use of [technological] power is a tremendous responsibility and must be done without arrogance and with a subtle sensitivity, if not a reverence, for the value of all life" (qtd. in Lockwood, 1987, 86). Arthropods, pests or otherwise, are living organisms that are embedded within a particular context and set of relations; human-arthropod entanglement is deserving of our consideration even if this consideration takes the form of critical deliberation ultimately leading to the application of chemical pesticides.

S… is for Spiders

Little Miss Muffet
Sat on a tuffet,
Eating of curds and whey
There came a big spider,
And sat down beside her,
And frightened Miss Muffet away.


Northern black widow, *Latrodectus variolus*

Spiders are found almost everywhere on earth and are largely regarded as one of the most successful groups of organisms on the planet. Their evolutionary history stretches back hundreds of millions of years. According to a City of Toronto (2012) publication, *Spiders of Toronto*, the "animals we would recognize as ancestors of the true spiders first appeared about 300 million years ago during the Devonian Period" (8). Spiders are often the first organisms to colonise novel environments following disturbances such as volcanic eruptions; further, they are found on all continents—save for Antarctica—and are even found as far north as the Arctic circle (Buddle, 2018). Just like Miss Muffet, at any give time, most humans on the planet are always only one or two metres away from a spider (Buddle, 2018; Michalski & Michalski, 2010). The proximity of spiders to human beings might come as a disturbing surprise to both arachnophobes and non-phobic individuals, but it is simply the reality of our world.

The epigraph to this entry quotes a Mother Goose rhyme that was likely based on a real girl, the daughter of Reverend Dr. Thomas Muffet (1553-1604), author of *Theatrum Insectorum*. He "believed spiders to be useful for curing various ailments, and thought that they beautified the home" (Michalski & Michalski, 2010, 11). Furthermore, Hillyard (1994) writes that Rev. Dr. Muffet experimented with spider-based medical treatments on his daughter, which ultimately lead to her phobia immortalised in the rhyme. This is a story that many individuals can relate to when it comes to spiders. Of all the animals on earth, the only one that surpasses spiders as the most despised is the snake. "According to a number of studies the spider invariably makes it to the top four or five on the list of most feared animals; it still loses out to the snake, but the latter's virtual extinction in many civilized countries will one day effect a change in that particular competition"

(Michalski & Michalski, 45). Are spiders truly deserving of this loathing? It is common knowledge that spiders are predatory, and in urban and rural environments alike, they "are one of the most important predatory invertebrates" (Lemelin & Yen, 2015, 215). In fact, most people know that spiders eat things we would rather were eaten but hate spiders anyway.

Although many claim to be afraid of spiders, only a small portion of them are truly arachnophobic. According to the *Diagnostic and Statistical Manual of Mental Disorders*, a phobia is understood to be "a marked and persistent fear that is excessive or unreasonable, cued by the presence of anticipation of a specific object or situation" (qtd. in Lockwood, 2013, 5). The documented symptoms associated with phobias are similar to a "normal fear response: sudden apprehension, loss of control, shortness of breath, increased heart rate, faintness, trembling and sweaty palms. In extreme cases the individual can become paralysed" (Hillyard, 1994, 9-10). The fear of spiders is predicated on their "apparent unpredictability and fear they can generate through their awkward movements and many legs, cultural and evolutionary pressures, biological preparedness (awareness of potential dangers) and disease avoidance (spiders are erroneously perceived to be linked to diseases, plagues and death)" (Lemelin & Yen, 2015, 216). For individuals suffering from arachnophobia, the rationality of the fear is unquestioned and often seems to them like an appropriate response to these creatures (Lockwood, 2013). Furthermore, the excessive fear leads to the belief that spiders are "bigger, uglier, jumpier, and faster" than they truly are in reality (Lockwood, 13). There is also a tendency in phobic individuals to anthropomorphise the spider in troublesome ways, imagining that the spider is angry, has deliberately singled them out, or is actively watching them (Lockwood, 2013; Hillyard, 1994). (Hillyard is quick to comment that most spiders do not actually possess the kind of eyes that allow them to see objects such as human beings.)

Is there an evolutionary basis to the fear of spiders? Many suggest that there is: Michalski & Michalski (2010) write that arachnophobia is "generally thought to be a biologically generated fear" (44). Others agree, contending that in the history of *Homo sapiens*, as well as earlier mammals, there was some advantage to an awareness of skittering movements or even to an ability to notice a spider-like clump of hair on the ground (Lockwood, 2013). "Further studies along these lines provide evidence that our responses to dangerous animals arise from 'specifically evolved primitive neural circuit that emerged with the first mammals long before the evolution of the neocortex.' In other words, we are hardwired for fear" (Öhman & Mineka (2003) cited in Lockwood, 23). This does not mean that we should uncritically accept this fear, however, as other studies have demonstrated ways in which a fear of spiders is a learned behaviour. Hillyard (1994) suggests that there are two fundamental reasons that people are prone to developing arachnophobia: "First, there may be an inherited tendency within a family to be anxious or nervous and to have fears such as those of spiders" (11). Other mental health concerns such as anxiety and depression have been linked to a familial inheritance; likewise, "adults can both reinforce and initiate fear in children through modeling. About 20 percent of children fearful of spiders and insects report learning their aversion from parents" (Lockwood, 36). Michalski & Michalski concur, suggesting that transmission in families happens "when one of the parents cannot dissimulate his or her arachnophobic sentiments" (50). The second reason that people develop a fear of spiders stems from "a *conditioning* through which the person has learnt [sic] to be afraid of spiders or has unpleasant experiences with them" (Hillyard, 11; emphasis in original). Lockwood comments that this is the most common way that arachnophobia develops, "with 40 to 50 percent of subjects recalling a frightening event" (36). Luckily, this learned behaviour works both ways according to Lockwood: neutral or positive events can serve to "immunize" children to be less affected by negative spider interactions.

Despite support for an evolutionary argument underpinning a fear of spiders, "research has not been conclusive on the origin of arachnophobia" (City of Toronto, 2012, 4). For spiders, as with snakes, placing all the blame of our fears on evolutionary history ignores the complex cultural associations surrounding these beings, including their use as symbols in mythology, literature, or film. It is also interesting to note that psychiatrists have assigned specific terminology for fears of both moths and crane flies (mottephobia and tipulophobia, respectively), both of which are arthropods that do not pose any physical harm to humans, evolutionarily or otherwise (Hubbell, 1993; Lockwood, 2013). In western culture, which I will address in more detail below, "arachnophobia has few rational causes," write Michalski & Michalski (2010), and "recent investigations have shown that people in Europe show less fear of being stung by a bee or wasp (whose stings produce almost a hundred deaths by allergic shock in Europe each year) than of being stung by a spider – the latter being a very rare occurrence and not at all threatening" (48). Commenting further on the dangers associated with spiders versus other dangers in western society, Hillyard (1994) writes: "In countries with only fairly innocuous kinds of spiders, arachnophobia seems to be a completely irrational fear. Compared with the dangers of road traffic, most spiders are totally insignificant" (4). The marked fear of spiders that is dominant in western society stands in stark contrast to the veneration of spiders in other cultures and other parts of the world, for example, the benevolent creatrix, Spider Woman, of the Pueblo people or "the cunning Ananse of Ghanaian folk tales" (Lemelin & Yen, 2015, 217-8). Spiders may be a risk for the Puebloans of the Southwestern United States where species of medical significance are present; however, there is insufficient information on the spiders of Western Africa to comment on the risk in Ghana.

If one were to determine the sentiments of those living in the west regarding spiders from news media headlines alone, one might conclude that ours is a largely arachnophobic society. For example: "Spider scare sends federal government workers home – twice" (2018), "It's not your imagination: spiders are getting bigger" (2018), or "Deadly black widow spiders are appearing in Canada" (2018). In western, industrialised countries, arachnophobia is a cultural phenomenon and, at least in Canada, this level of fear is generally unwarranted. There are few species of medical importance in North America, and most spiders worldwide can be described as shy and non-aggressive towards humans, simply because we are not their prey, unlike bedbugs or mosquitoes (Buddle, 2018; Michalski & Michalski, 2010). "Human-spider interactions are contextually, culturally, and psychologically driven," stress Lemelin and Yen (2015). "They are often the result of misunderstanding and misapprehension created by a general lack of education, research emphasizing the negative aspects of these encounters, a media covering only exceptional events, and pest control companies who prey upon people's fear and advocate for the use of insecticides and/or chemical fumigation of their homes" (Lemelin & Yen, 216). Lemelin and Yen examine the results of a study that compared fears associated with snakes and spiders in three different continental contexts: Australia, Sweden, and North America. The results indicate that "there were no differences in reported fear of snakes between the three continents, but the Australian and North American respondents reported greater fear of spiders than did the Swedes. This difference, according to the authors of the study, is attributed to the presence of potentially harmful spiders in Australia and North America and their absence in Sweden" (216). In a qualifying statement, Lemelin and Yen consider that the results for North America are largely irrelevant in the Canadian context since there are so few potentially harmful spiders found in Canada.

It is important, here, to note that all spiders are venomous with the exception of one family (Uloboridae); however, only some are medically important species, which means that their venom can have adverse impacts on human health (Hillyard, 1994; Michalski & Michalski, 2010). "The relationship between supposedly dangerous spiders and people is well documented in Australia. Australia has a reputation for venomous animals such as snakes and spiders," and yet, as in Europe, honey bees are in fact responsible for more deaths (upwards of 100) per year (Lemelin & Yen, 2015, 219). In Australia and the United States, caution surrounding particular venomous species may be warranted; however, in places like northern Europe and Canada, which have spiders that are virtually harmless, Hillyard (1994) suggests that fears may be based on more abstract qualities such as "spideriness" (5). So, in the Canadian context, while a healthy degree of caution is to be reasonably expected, arachnophobia is often unwarranted and does not accurately reflect the level of danger present.

This society-wide arachnophobia is exemplified by a recent news article, "Spider scare sends federal government workers home – twice" (2018) from Ottawa, in which a government office was suspected of harbouring an "unusual spider" so the employees were sent home and the building was fumigated. The Canadian Broadcasting Corporation (CBC) reports that this happened on two occasions in the same government building: the second time a spider was caught and sent for identification and the results came later that day, but the building managers had already opted for fumigation and sent employees home again. The unusual spider was suspected to be the feared brown recluse spider, *Loxosceles reclusa*; however, the entomologist's unofficial identification was a yellow sac spider, *Cheiracanthium mildei* ("Spider scare," 2018), which is not "considered to be of medical concern" (City of Toronto, 2018, 29). Catherine Scott, an arachnologist and PhD student at the University of Toronto is quoted in the CBC article: "This is totally absurd and a giant waste of money… Fumigating the office with chemicals is probably more dangerous to the people working in that office than a spider would have been, even if it had been a brown recluse spider"

(“Spider scare,” 2018, para. 8). In the CTV News report on the same event, Chris Buddle, arachnologist, is quoted: “I don’t doubt there were spiders there and I also don’t doubt spiders freak some people out… but I don’t think fumigation or evacuation is the right response” (“Fumigation,” 2018, para. 7). Lemelin & Yen (2015) provide an apt explanation for this kind of societal hysteria: “Fear is often perpetuated or compounded by social mores and the media, the development of pragmatic and sensitive interpretation strategies and theoretical concepts encouraging reflexivity in research and tolerance in general will be required” (223). This kind of social hysteria is evidenced by the news headlines fuelling a kind of fear of spiders; even if the content of the articles themselves demonstrate that the fear is unwarranted.

There are some positive associations in human-spider interactions such as their role in the food chain as both predators and prey; providing useful products like medicine, silk, and food for humans; as pets; and as live specimens in insectariums, zoos, and museums (Lemelin & Yen, 2015). However, the overall discourse surrounding spiders is dominated by the negative aspects including phobias and health concerns related to venom (Lemelin & Yen, 2015). Many authors suggest that education is an important tool in changing negative perceptions of spiders; one of the most important aspects of such education might be to empower the general public to know the difference between species that are of medical concern and those that are not. This point is stressed by Lemelin and Yen, who write that education strategies should not seek to ignore “people’s fear or mistrust of these animals, but rather seek to inform individuals regarding the identification and location of nefarious species, and suggest strategies to avoid conflict and/or remove the animal and provide remedies when bitten” (221). They suggest that the ultimate goal for spider education programs should not be the total elimination of fear, but rather a move “from fear to cautionary acceptance, respect, or even admiration” (Lemelin & Yen, 222). The Royal Ontario Museum (ROM) in Toronto recently featured an exhibit on spiders, “Spiders: Fear and Fascination,” which contributed to the education of the general public about spiders. The exhibit was informative and fun, with various live specimens in vivaria throughout the exhibit. It touched on many interesting biological as well as cultural aspects of spiders from around the world. “It has been researchers who have challenged the existing notions of spiders and have highlighted their intelligence, their skills, their beauty, and their contribution to social and ecological systems to the general public" (Lemelin & Yen, 223).

Beyond the general appreciation of spiders, one of the most important reasons that the public should have some education about spiders is for the identification of species of medical importance. Worldwide there are only a few spiders of medical importance, and in Canada, there is only one: the black widow. There are two species of black widow found in Canada: the northern black widow, *Latrodectus variolus*, and the western black widow, *Latrodectus hesperus* (City of Toronto, 2012; Buddle & Rice, 2018). Spiders can have two types of venom: "neurotoxic, affecting the nervous system, and cytotoxic or necrotic, causing damage to the tissues" (Hillyard, 1994, 61). Envenomation is the technical term for spider bites and the resulting syndrome is "termed araneism or, in the particular case of a black widow bite, latrodectism" (Hillyard, 62). The black widow's venom is neurotoxic and "causes humans to have muscle spasms, pain, headache, rigidity, and vomiting…. Doctors can help ease the pain with a variety of treatments from muscle relaxants to antivenom" (Buddle & Rice, 34). For the insects that are *Latrodectus*' actual prey, "the venom causes rapid paralysis which prevents escape or retaliation" (Hillyard, 62). "Though they can bite [humans], widows remain shy spiders and most often run away from danger. One researcher who studies widows tried hard to get individuals to bite by poking them and prodding them. Despite bothering them in every way conceivable, the researcher could not get them to bite unless they were squeezed. When they did bite, the spiders more often elected not to inject venom while biting" (Buddle & Rice, 34).

The considerable fears surrounding black widows likely stems from mythology. The name derives from the belief that "widow females eat their lovers. Although they sometimes devour their mates (when scientists study them in a lab), they don't do this very often" (Buddle & Rice, 2018, 32). But this mythology extends beyond the realm of the biological into the cultural. An early example of the negative associations between spiders and femininity dates back to a short horror story by Hanns Heinz Ewers (1915), *The Spider*, in which occupants of a particular hotel suite are compelled to commit suicide by a supposed femme fatale in an apartment building opposite the suite's window (VanderMeer & VanderMeer, 2011). As Michalski and Michalski (2010) write, "Ewers makes here very precise arachnological references: the spinning lady-spider in the window with her black dress with violet dots, is none other than the stunning European widow spider… (*Latrodectus tredecimguttatus*), whose bite, like that of all widows, can result in an accelerated heart rate or muscle paralysis" (95). This is but one example of many negative, misogynistic associations between femininity and arachnids present in western spider mythology about which Michalski and Michalski write: "in a certain way the ascent of the spider-woman in the nineteenth century reflected the crisis of old family values and paternal structures…. The threatening spider-woman stood for an alien, eloigned creature unencumbered by family obligations and the demands of fertility" (98).

As with many species of plants and animals, the distribution ranges for black widows, among other spiders, is shifting due to human movement around the world and global climate change (Lemelin & Yen, 2015; Michalski & Michalski, 2010; Wang et al., 2018). A recent study has suggested that *Latrodectus variolus* may be extending its range northwards into other parts of Ontario and Québec. Wang et al. (2018) suggest that the black widow's ability to adapt to human-defined environments as well as their higher metabolic rates (which evolved to allow them to adapt to colder climates) have allowed them to increase their distribution northward into Canada. Ultimately, however, the recent increase in their distribution may be attributable to the temperature of the warmest quarter of the year, which is essential to their reproductive success in venturing northward under climate change scenarios (Wang et al., 2018). Unfortunately, there are insufficient historical distribution data on *L. variolus* to "provide statistically significant evidence to support the proposed north shift scenario" (Wang et al., 8). However, they write,

> Observations in Eastern Ontario and Southern Québec (from Montreal Insectarium entomological enquiry services in 2012, 2015 and 2016) provide strong empirical support to our northern range expansion hypothesis…. Climate change, which influences seasonal temperature pattern, could be a strong contributor to the increase in occurrences of Northern black widow beyond their historical northern limit. (Wang et al., 8)

This scenario also raises the possibility of shifting ranges for other species such as the brown recluse spider, *Loxosceles reclusa*; Wang et al. comment that their models have shown a potential range expansion northward "under future climate change scenarios" for this species as well (8). Unlike black widows, recluse spiders "are the best known and most poisonous of the spiders which possess a necrotic venom. The necrosis they cause (loxoscelism) may heal slowly or not at all" (Hillyard, 1994, 63). Climate change scenarios further demonstrate the need for more education surrounding local species and their current or potential distribution ranges.

One of the main problems identified by arachnologists surrounding spider mythology concerns spider bites; this fear is present even within the medical community, again emphasising the importance of education not only for the general public but also for medical professionals in order to dispel persistent cultural myths. Many ailments are misdiagnosed as spider bites, so improving education for medical professionals will also improve the accuracy of diagnoses as well as ensure that patients are provided with appropriate treatments (Bennett & Vetter, 2004; Lemelin & Yen, 2015). Bennett and Vetter (2004) write that "in North America, many medical conditions that cause dermonecrosis have been misdiagnosed as the effects of bites from brown recluse or other spiders, and fully 80% of spider bite diagnoses are erroneous" (1099). According to Bennett and Vetter, there are many reasons for the frequency of misdiagnoses including inferential rather than fact-based animal toxicology models, circumstantial evidence (e.g., where there is no clear identification of the spider either by collection of the organism or by taking a photograph), poorly designed clinical studies, "and unfortunately, considerable hyperbole" (1099). Some of the other, more reasonable, causes of dermonecrotic lesions may include infection (bacterial, viral or fungal), certain forms of cancer, topical irritation (poison ivy, burns), or a host of other arthropods such as kissing bugs or ticks (Bennett & Vetter, 2004; Hillyard, 1994). Lemelin and Yen (2015) likewise suggest that "ongoing training of medical professionals through workshops conducted by arachnologists should be implemented… [and] much work will need to be done before some people are convinced that lethal spider bites are rare" (221).

As for the supposed brown recluse from the CBC news story? Most experts conclude that the brown recluse is not found in Canada; fewer than five have ever been found in Canada (Bennett & Vetter, 2004; Buddle 2018; City of Toronto, 2012). Given the circumstances surrounding the spider in the government building, including the hyperbole in the media, the identification of a yellow sac spider, and the fact that brown recluse spiders are not known to reside as far north as Canada, it is highly unlikely that it was indeed a brown recluse spider. One might think that the alternative identification of the spider was all the proof necessary; however, the CBC later reported that a government worker had in fact been bitten by the spider during the first incident in June 2018. Government spokesperson, Frédérica Dupuis is quoted on the CBC website, stating that "an employee sought treatment for a spider bite that occurred at work and the treating physician determined that the bite site was consistent with that of a brown recluse spider" ("Spider bit worker," 2018, para. 5). This kind of headline, reporting, and medical diagnosis only serve to contribute to excessive fears surrounding spiders. Adding to the discussion on brown recluse bites, Bennett and Vetter (2004) write that "Loxoscelism [envenomation or spider bite from a brown recluse spider] is rare even where brown recluse spiders are an abundant native species…. For example, one Kansas family collected 2055 brown recluse spiders in their home over 6 months without incident" (1099). The broader study, in which this Kansas family was participating, was designed to demonstrate how "physicians from nonendemic recluse areas often diagnose brown recluse bites which, therefore, are unlikely to be correct" (Vetter & Barger, 2002, abstract). Further, Bennett and Vetter write that "even if brown recluse spiders occasionally found their way into Canada, the statistical probability of people being bitten by immigrant spiders is effectively zero" (1100).

Many arachnologists agree that correct diagnoses of spider bites require a spider caught in the act of biting and then sent for identification (Bennett & Vetter, 2004; Buddle, 2018). While we will never know the full story behind the spider from the government building, the news story does provide us with an opportunity to pause and rethink the dominant discourse surrounding human-spider relations and, perhaps, to envision a future that is more understanding and tolerant of spiders. For Hillyard (1994), this future vision involves a spider version of a butterfly hot-house: "Spectacular but harmless species, necessarily of the kind that stay put in webs, would happily live together in a jungle-like environment, and some might even hang from the ceiling. It would be great fun *and* educational – the reason why spiders cause so much anxiety and arachnophobia is that they are not understood" (179-180; emphasis in original). At the Monteverde Butterfly Garden in Costa Rica, many organisms have free range of the educational building. When I visited, there was in fact a large species of orb-weaver who had spun a lovely web in the corner of the room. More so than encounters with live spiders, the internet may have the potential to ease people from arachnophobia into a moderate level of arachnophilia, or at least to an interest in spiders. For instance, videos on YouTube can provide positive spider associations such as the dancing peacock spiders cited by Lemelin & Yen (2015), which have over one million views. The fame of these spider-sensations demonstrates "that there is an interest in and a desire to learn more about spiders" (Lemelin & Yen, 223). There is also the incredibly helpful Twitter account "@RecluseorNot" (a team made up of entomologists and science communicators): Twitter users can post photographs of spiders they have found, and tag @RecluseorNot, who will identify whether the spider is indeed a brown recluse. Finally, the proliferation of memes on the internet has also provided some very charming images about spiders that could be effective in reconceptualising, or at least sparking some interest, in this group of misunderstood organisms (see Figures 1 and 2, below). To conclude this entry, I propose a different headline: "Spiders debut their new image on the World Wide Web!".

Figure 1. Spider Roommate. [Digital image]. (N.d.). Retrieved from: https://me.me/i/what-if-the-spider-you-killed-in-your-home-had-2306228

Figure 2. Spider Paw. [Digital image]. (N.d.). Retrieved from: https://www.boredpanda.com/cute-spider-paws-photo/?media_id=945798

T… is for Tick

> *If animals are human Others, insects are the Others of animals, intimately involved in our lives but much maligned. (Kosek, 2011, 231-232)*

American dog tick, *Dermacentor variabilis*

The tick can certainly be counted among those "unloved others" (Rose & van Dooren, 2011), the "invisible animals" (Bull, 2014), or "neglected things" (de la Bellacasa, 2011). The tick, however, only remains invisible and neglected until the moment that it has dropped from a shrub or blade of grass, injected its anti-inflammatory and anticoagulant saliva, and bored its way into a person's skin. According to Evans (2007), "ticks are exclusively blood-feeding external parasites. In some species the larvae and nymphs prefer smaller animals, such as rodents, while the adults attack larger animals, including human beings" (414). Surely, however, the most fascinating account of the tick comes to us from Uexküll (2010), which proceeded to spark interest in this organism across the sciences and the humanities (Agamben, 2004; Bull, 2014, Smith, 2013). Agamben (2004) describes Uexküll's phenomenological exploration of animal life, including the tick, as an expression of "the unreserved abandonment of every anthropocentric perspective in the life sciences and the radical dehumanization of the image of nature" (39; Smith, 2013, 34). However, Uexküll describes the *umwelt* of the tick as *impoverished*: it is both blind and deaf, and it "sits motionless on the tip of a branch until a mammal runs past beneath it, then is awakened by the smell of butyric acid and lets itself fall. It falls on the hairy coat of its prey, through which it must then work its way in order to get to the warm skin into which it drives its stinger, and pumps the blood liquid into itself. It has no taste organ" (179). Despite Uexküll's claim of impoverishment, the phenomenal world of the tick is quite rich: it just does not always directly translate to the phenomenal worlds of other creatures, including humans. As Smith (2013) writes,

> How and whether the tick appears to others depends on their specific senses. I might see her only after she becomes engorged on my blood; I did not feel her bite. What affects the

> tick and what effects she has on others (for instance, the disease she might carry) may not be sensed in various ways by various other species…. What has meaning for the tick, what Uexküll refers to as 'marks of significance,' is not what has meaning for other disparate species, or at least not the same meaning, or not in the same way. (35)

This quote elucidates why it is important to consider that the ways in which the tick has significance to human beings may not be significant in the same way to other nonhuman animals in their encounters with ticks.

Not all tick species are parasites of mammals as Uexküll's (2010) or Evan's (2007) descriptions would have us think; some prefer the blood of birds or reptiles (Hatley, 2011). There are approximately nine-hundred tick species worldwide and perhaps more—all obligate, hematophagous ectoparasites meaning they are blood-feeding parasites that live outside of the host—and a significant portion of them are host-specific parasites in the adult stages, meaning they feed exclusively on the blood of one particular species (Durden & Keirans, 1996). Of the hundreds of extant tick species, there are over forty that are currently under threat of extinction (Durden & Keirans, 1996; Smith, 2013). Smith (2013) comments that the discussions surrounding the preservation and extinction of species are often marked both by human exemptionalism, which "treats ecology and human community as entirely distinct realms, it considers humans as being(s) outside and/or above (exempt from) any ecological considerations," and human exceptionalism, "whether religious or humanist, regards human communities as distinguished by an ethics and/or politics in which no beings other than humans can possibly participate" (23-4). The issue of parasite preservation is even more complicated, write Durden & Keirans (1996), as "host extinction also results in coextinction in nature of all associated host-specific parasites" (87). The losses to extinction are therefore two-fold or greater in these scenarios – when a host ceases to exist, so too do its parasites. Smith suggests that the most endangered of all tick species is perhaps *Amblyomma sphendonti*, which is found only on certain islands off the New Zealand coast. This tick parasitises the endangered tuatara, which is "the [only] extant member of the entire order *Rhynchocephalia*." (Smith, 36). The decline of the tuatara and its tick can largely be attributed to the human-introduced Polynesian rat, *Rattus exulans* (Smith, 2013). If the tuatara becomes extinct, then we necessarily lose its tick to extinction as well. While a seemingly superfluous loss to some, it makes the world less rich and has potentially cascading effects throughout the ecological community as a whole.

The decline in tick populations is not only an event experienced in remote island biogeographies as there have been documented declines in tick populations in both Africa and North America. The African rhinoceros is host to four distinct specialist tick species—while the former's decline has been well-documented, the tick species have not—of the four, it has been suggested that one, *Amblyomma personatum,* is already nearing extinction (Durden & Keirans, 1996; Hatley, 2011). "As an apparent corollary," write Durden & Keirans (1996), "a documented decline in populations of oxpeckers, *Buphagus* spp., which feed largely on ticks parasitic on rhinoceroses and other large mammals in South Africa, may be a consequence of the current scarcity of these ticks" (88). In North America, *Amblyomma tuberculatum*, the largest native tick species, is also at risk as it is host-specific to the gopher tortoise, *Gopherus polypheumus*, "a threatened reptile of the coastal plain sandhill habitats with a diminishing patchy geographical distribution extending from South Carolina to Louisiana" (Durden & Keirans, 87-88). If certain tick populations are in decline around the world, what does this mean for the current discourses on protection of endangered species? Why might it matter that the ticks are nearing extinction, and not only the charismatic megafauna on which the ticks rely for food?

Ticks have not been made a priority by the large governing bodies responsible for the protection and conservation of species. Neither the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species nor the Xerces Society for Invertebrate Conservation recognises any ticks as species of concern. Hatley (2011) writes that in 2003, the IUCN was criticised for not including a broader range of parasites and, in 2009, still did not contain any ticks or mites. The IUCN currently recognises five mite species, but still not a single species of tick (IUCN, 2019). Perhaps this absence is related to the exclusion of these types of organisms from protection legislation, at least in the United States. According to Cassie Gibbs from the University of Maine, in the United States the "Endangered Species Act gives no protection to insects we regard as pests" (qtd. in Hubbell, 1993, 84). A quick review of the Act reveals that "the term endangered species means any species which is in danger of extinction… other than a species of the Class Insecta determined by the Secretary to constitute a pest" (Hubbell, 1993; U.S. Fish and Wildlife Services, 1973, 2). While ticks technically belong to the class Arachnida rather than Insecta, they are likely simply lumped into the definition of a pest. This exclusion raises an important consideration regarding how we think about and with this organism and its role in our world: is the tick only a parasite and nothing more? It also asks us to think more carefully about arthropod extinction: why do we only seem to care about "good" bugs? Demonstrative of a kind of human chauvinism, the conservation of those species deemed to be "good" bugs are considered because of their potential benefits to humanity, i.e. aesthetic or utilitarian, and does not consider how these other species—either unloved or neglected—may be essential to the functioning of the ecological community in ways that do not benefit humanity.

Parasitic species may "represent a significant proportion of total biodiversity," according to Durden and Keirans (1996): "the number… may be about four times that of free-living species" (87). They note that the loss of one or two parasite species may have little effect on an ecosystem, but "the loss of more species could have drastic consequences" (Durden & Keirans, 90). Ecologically, the tick is not only a parasite but also a source of food, as cited above in the example of the African rhinoceros and the oxpeckers. The tick also plays an important role in exerting selection pressures on host species and maintaining genetic diversity as compared with non-parasitised animals (Durden & Keirans, 1996; Hatley, 2011). In the cases of the tuatara, African rhino, and gopher tortoise, many conservation protocols for these animals actually call for the removal of ticks in relocation or capture and release programs. Tick removal programs—whether manually or chemically— "may seem justified if the survival of a host species is at stake," write Durden and Keirans; "however, ticks (and other parasites) are an integral component of healthy ecosystems and have important roles in nature, some of which may still be incompletely understood" (88). I think that it is important to emphasise here that the role of the tick may not be entirely understood. There is certainly a level of hubris in these kinds of protocols suggesting that humans believe they know best when they choose to intervene in the lives of other animals, whose declines are often more directly affected by human action than by ticks. Bull (2014) writes: "such dismissive attitudes to ticks fail to comprehend the complexity of ecosystems and have unintended consequences on the wider ecologies" (76); exemplified by the case of declining bird populations after removing ticks from the African rhino. Beisel et al. (2013) write: "Knowing insects cultivates humility through hubris: as if the ease with which they pass into our nets serves only to show how large the gaps are"

(4). Likewise, humans might cultivate some humility with regard to ticks especially in the complex ecological situations that do not directly affect human health

The question yet arises: should humans concern themselves with saving ticks from extinction? This question has been raised by scientists and philosophers alike (Durden & Keirans, 1996; Hatley, 2011; Smith, 2013). Hatley (2011) asks the provocative question, "wouldn't it actually be better, at least in many cases, if ticks were actually to become extinct?" (para. 3). From the above discussion, I think the answer is decidedly not. Dominant discourses surrounding ticks in modern society are demonstrably human exceptionalist and exemptionalist, which is evident through the human intervention in tick removal programs for certain endangered species that are deemed more valuable. Hubbell (1993) writes of the language used in the U.S. *Endangered Species Act*, suggesting that it "reflects a way of looking at the world that will strike some readers as perfectly reasonable: If we can, it's fine to get rid of pieces of the world that in are competition with us for our blood" (84). She is writing about black fly eradication programs in this instance, but the same goes for the tick when it comes to our blood and, evidently, the blood of other "valuable" species. Like black flies, ticks can spread disease, though not all species are vectors for disease, nor do all species parasitise human beings (Bull, 2014). Of the dominant discourse on ticks in general, Bull (2014) writes: "Beyond the natural sciences, the focus is almost entirely on human health… *reducing ticks to vectors of disease*. Ticks therefore, along with a range of less charismatic creatures, could be considered as 'invisible animals' as they are both out-of-sight and absent from wider academic enquiry" (73; emphasis added). Bull frames his discussion in terms an animal's "charisma" (following Lorimer (2007)); it is those species of tick that are capable of vectoring disease that become charismatic. "The charisma created between ticks and bacteria is so powerful that in our responses to ticks we overlook the alternative positions they hold, such as their roles within ecosystems or even their position as animals" (Bull, 77). This singular and all-encompassing definition of ticks, as animals "reduced to vectors of disease," is problematic insofar as it lumps together all the various species of tick with those of human medical significance. To address this problem, I return to Smith's (2013) understanding of ecological community as inclusive of more than what appears, effects, or has significance for human beings and that nonhuman animals experience their own phenomenal worlds. "For *this* understanding of ecological community… explicitly emphasises that what matters in terms of the constitution of ecological community is *always* so much more than just what matters to humans." (Smith, 25; emphases in original).

Anthropocentric ideas about, and concerns surrounding, ticks as reduced to a singular all-encompassing group inevitably drives forward the question of why we should consider ticks at all in our concerns about extinction. Smith (2013) urges us to situate the tick in broader discussions of ecological community. "A more radical ecology, then, means reconsidering the very sense of community (and 'sense of the world') in such a way that the senselessness of extinctions is rendered in ecological *and* ethical *and* political terms that are no longer beholden to either the exemption of the human (from ecology) or the exception of the ecological (from ethical and political community)," in a move toward what he describes as "ecological posthumanism" (Smith, 26; emphases in original). Returning to his exemplar species, the tick of the tuatara, he writes:

> *Amblyomma sphenodonti* probably adopts 'a sit-and-wait host-seeking strategy within the host refuge,' in this case, the tuatara's burrow… (Tuatara and tick also share the burrow, they are commensal, with a species of seabird, the Fairy Prion (*Pachyptila turtur*) of which the tick may be entirely unaware). Studies have yet to show whether *Amblyomma* can, like reptile ticks, 'synchronise their detachment with times when hosts are in refuges, or with physiological cues that indicate the host is at rest' abilities which may suggest a rather more complex sensory world that Uexküll credits them. (Godfrey, Nelson, & Bull (2011) cited in Smith, 2013, 37-8)

This passage from Smith emphasises that human knowledge of ticks and their roles in ecosystems is still only partial and not comprehensive.

Situating ticks within ecological community is one way that humans can begin to envision these creatures and the lifeworlds they inhabit more broadly. As Bull (2014) writes, "the combination of ticks, humans, technologies, bacteria and viruses create significance and have personal, social and economic consequences" (73). Likewise, de la Bellacasa (2011) proposes that "representing matters of fact and sociotechnical assemblages as matters of care is to intervene in the articulation of ethically and politically demanding issues" (100), which allows invisible animals like ticks to be perceived more clearly. She continues: "caring in this context is both a doing and ethico-political commitment that affects the way we produce knowledge about things… an ethico-political commitment to neglected things, and the affective remaking of relationships with our objects" (de la Bellacasa, 100). The term "neglected things" is particularly powerful here as many arthropods and other invertebrates are currently doomed to neglect in the current, ongoing sixth mass extinction event that is underway in the Anthropocene. This idea of neglected things figures prominently in the case of ticks who are excluded entirely from human discussions of which extinctions matter.

Rethinking potential tick extinctions as "matters of care" (following de la Bellacasa, 2011) does not entail that we must ultimately resolve our troubled relationship with this organism. As de la Bellacasa (2011) writes, "to effectively care for a thing we cannot cut off those with whom we disagree from the thing's political ecology" (90). Instead, there is potentially more opportunity for further tensions to arise, as "exhibiting [matters of care] is valuable especially when caring seems to be out of place, superfluous or simply absent" (de la Bellacasa, 93). In contrast to the better-known species that are parasitic upon human beings and potentially vector disease, those species of tick that are at risk of extinction are clearly regarded as invisible animals or neglected things by their exclusion from consideration by conservation authorities and may then benefit from being regarded instead as a matter of care. Smith (2013) writes that "these ecological relations are complex and in no sense equal or reciprocal or reducible to a simple metric. One species unwittingly gives, the other unwittingly takes, but the species that takes is actually the more dependent, the most at risk of extinction" (37). In the context of parasite extinction, "the plight of ticks in a time of extinction proves to be a series of trade-offs as the complexity of the ecological systems in which they are embedded resists any simple analysis or reading. What kills us also keep us alive. This is the unavoidable insight of any thinker who would take seriously the abysmally, even if richly interdependent relationships constituting the living world" (Hatley, 2011, para. 7).

Perhaps what is most disturbing to humans in their lived relations with ticks around the world is that "living together is a complex negotiation, often fatal, always dangerous and one in which (despite long traditions of science, much folklore and other narrative discourses to the contrary) the human is not always in the position of power" (Bull, 2014, 79). This is decidedly the case for ticks in North America that are capable of vectoring disease, such as the black-legged tick, *Ixodes scapularis*, or the lone star tick, *Amblyomma americanum*

(Evans, 2007; Government of Canada, 2018). Bull (2014) recognises that there will always be tensions between ticks and humans, and so proposes the concept of contentment "as a way of meeting ticks in an ethical position that unlike other frameworks can originate in 'ugly emotions' such as disgust and horror. It does not require me to love the tick and allows us to have different vulnerabilities… [It] is not merely reaching a state of tolerance – it is a recognition of the tensions created between ticks and people" (82). Accepting the messiness of human-tick relations, among other "creatures that trouble coexistence," suggest Beisel et al. (2014), "opens up different registers of human-nonhuman interaction to scrutiny" (9). Likewise, acknowledging *different* rather than *shared* vulnerabilities between human beings and ticks opens up a different register of human-nonhuman interaction that considers more deeply the tensions that arise in the context of the conservation of those creatures that are unloved, invisible, or neglected.

As Bull (2014) suggests, trying to meet parasitic and other "bad" organisms, like ticks and others, with love is perhaps not the right register. Maybe their characterisation as "unloved others" (following Rose & van Dooren, 2011) is the appropriate description and register in which we meet ticks. "Given that we meet them in disgust rather than affection and given the medical and cultural threats posed by ticks, love does not seem the right origin or even a desirable ending" (Bull, 81). If love is not the appropriate register in which to meet those ticks that parasitise human beings, can we come to love the ticks that live on endangered hosts? Bull's response might be appropriate in either case:

> To indulge a tick's taste for blood, even in its limited, unobtrusive and relatively unthreatening (as not all ticks carry life threatening disease) capacity, leads to a point where the responsibility formed through love, joy and maybe even flourishing, reasserts rather than transgresses the human-animal power relations creating tolerance rather than responsibility. By this I suggest that rather than responding in love and generosity to allow a tick to feed, I tolerate the tick. This is possible because of the powerful position I occupy rather than a response to the presence of the tick. (81)

I think this response offers some insight into human attitudes toward endangered ticks and their hosts in that humans need not try to love these ticks, but in consideration of their potential extinction, we can acknowledge their existence in the world and perhaps meet them with some tolerance of their ongoing presence in our lives and the lives of other nonhuman animals, including their endangered host species. Relations between human beings and endangered species need not have "positive transformation value," according to Smith (2013) who asks, "what if a tiger ate your aunt" (24-25, footnote 12)?: would the tiger be less valuable as an endangered species? In the same vein but concerning less charismatic animals, Hatley (2011) writes that "several ecological factors weigh in against dismissing the possible extinction of tick species. First, ticks have co-evolved with their host species. Just as more charismatic predators benefit their prey populations by ferreting out weakened animals, ticks have been documented as specifically attacking, at least in one case, weakened deer" (para. 7). The co-evolved ecological role of ticks on the genetic diversity and overall health of their host species also puts into perspective what tolerance might mean in the case of tick preservation. Tolerating endangered ticks that are parasitic upon specific nonhuman hosts may have very little direct impact on human lives and would simply mean no longer enacting protocols for tick removal on endangered hosts. Bull writes that, too often in considerations of multi-species ethics, mutualism and commensalism are foregrounded and "drive towards a pluralistic tolerance. In contrast, parasitism and the disgust it conjures reemphasises the politics of multi-species worlds. Disgust as it refuses the dismissive indifference of tolerance and the equation of multiplicity with commensalism, explicitly 'stays with the trouble'" (80). In ticks we find an example of an organism that both conjures disgust and is at risk of extinction, troubling our common conceptions of what it means to preserve a species. To preserve a species then is to allow for the consideration of the ecological community at large, even if it means tolerating the unloved others, and not simply considering the benefits that are offered to human beings through its preservation.

The connections to other arthropods and invertebrates are obvious. While not all feed on our bodies (some do), many are culturally considered to be disgusting or dangerous animals, regardless of whether this is true of their life histories. The tick highlights some of the major tensions that we will face, or are currently facing, in the Anthropocene as the planet is affected by anthropogenic climate change, extinction events, and the spread of invasive species and disease. As a result, the question of whether or not we should care about those unloved others, the invisible animals and the neglected things, becomes more apparent. Bull (2014) suggests that "different tensions give me options in how I negotiate my encounters" (82). This suggestion signifies that the message of tolerance as a form of ecological, political, and ethical multi-species worlding provides an optimal, and flexible, response towards those creatures who do not inspire love, affection, or care. According to Hatley (2011), "although arthropods comprise 72% of all animal species on earth, they are not nearly so well represented on lists of endangered species…. Of those arthropods that are represented, a large number consist of bees, ants, butterflies and moths" (para. 4), some of the more well-regarded species of arthropod that speak to the aesthetic and utilitarian interests of human beings. While many bees and butterflies are certainly in decline due to climate change, habitat loss and degradation, and deterioration of habitat, the results of a recently published long-term study on insect biomass demonstrates substantial declines *across* flying insects, including many that are not quite so charismatic, beneficial, and generally loved:

> Our results document a dramatic decline in average airborne insect biomass of 76% (up to 82% in midsummer) in just 27 years for protected nature areas in Germany. This considerably exceeds the estimated decline of 58% in global abundance of wild vertebrates over a 42-year period to 2012. Our results demonstrate that recently reported declines in several taxa such as butterflies, wild bees, and moths, are in parallel with severe loss of total aerial insect biomass, suggesting that it is not only the vulnerable species, but the flying insect community as a whole, that has been decimated over the last few decades. The estimated decline is considerably more severe than the only other comparable long term study on flying insect biomass elsewhere. (Hallman et al., 2017, 14)

There are simply not enough long-term data on arthropods as a whole to determine the current state of affairs, but Hallman et al.'s (2017) study indicates that we are facing a potential biodiversity crisis within the largest phylum of animals on earth that cannot be solved unless humans can learn to tolerate at least some unloved and neglected others. Ticks play a role in their respective ecosystems as parasites, as drivers of genetic diversity, as sources of food for birds; so too do other insects and arthropods in their respective ecosystems. "Loss of insects is certain to have adverse effects on ecosystem functioning, as insects play a central role in a variety of processes, including pollination, herbivory and detrivory, nutrient cycling and providing a food source for higher trophic levels such as bird, mammals and amphibians. For example, 80% of wild plants are estimated to depend on insects for pollination, while 60% of birds rely on insects as a food source" (1). It is imperative that humans begin to shift attention towards Smith's (2013) "ecological community," because insects and other arthropods are not just singular organisms: they are also essential components of a vast and complex network that is life on earth. Using "ugly emotions," as Bull (2014) suggests, to cultivate a kind of tolerance for the unloved others can facilitate a new way of relating to these organisms that foster better ecological, political, and ethical relations with our world. If we can learn to tolerate ticks as matters of care and approach them with contentment, then perhaps there is some hope for invertebrate conservation in the Anthropocene.

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