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We have never been *Homo sapiens*: *CandidaHomo* naturecultures

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This paper responds to Donna Haraway's (2003) The Companion Species Manifesto: Dogs, People, and Significant Otherness*, arguing that, Candida albicans, as opportunistic pathogens of humans, are—like dogs — "not here just to think with. They are here to live with." This paper weaves a cat's cradle of different cultural representations of human relations with Candida albicans, from public health, commodity culture, research science and art, in order to acknowledge my response-ability as an ecology of companion species. It is an embrace of the disturbing lacunae of CandidaHomo naturecultures; an attempt to grapple with the flesh of the more-than-human body.*

In 2003, Donna Haraway released the humble, seemingly innocuous treatise, *The Companion Species Manifesto: Dogs, People, and Significant Otherness*. Although 18 years had passed since the release of "The Manifesto for Cyborgs," the possibilities for living with the contradictions inherent in this "anti-essentialist and antihumanist" manifesto had barely begun to be untangled (DeKoven, 2006, p. 1694). At first glance, *The Companion Species Manifesto* (TCSM) seems to be just about dogs, an attempt at "dog writing[1]," where Haraway (2003) emphatically rejects the dog as metaphor, insisting that "dogs are not surrogates for theory; they are not here just to think with. They are here to live with" (p. 5). Indeed for the most part, TCSM traces the co-evolution of dogs and humans. However, TCSM addresses broader concerns: it is a pragmatic, poetic, and occasionally obtuse guide to how "an ethics and politics committed to the flourishing of significant otherness [might] be learned from taking dog-human relationships seriously" (Haraway, 2003, p. 3).

This paper embraces the guide demonstrated in TCSM and the 2008 elucidation of TCSM, *When Species Meet*, to tease out the exciting methodological possibilities opened up by Haraway's writing for understanding the complexities of intra-specific relationships in general, and between *Homo sapiens* and the opportunistic fungal pathogen, *Candida albicans*, in particular. It describes two of Haraway's analytical methods, figurations and the cat's cradle, which are now almost invisibly embedded within her writings. These methods are synthesized with artistic research methodologies which make aesthetic aspects of naturecultures more explicit through affective encounters. A cat's cradle (Fig. 1) performs Harawayan figurations in order to play in the naturecultures of *Candida albicans* and *Homo sapiens* and clarify how "diverse bodies and meanings coshape one another" (Haraway, 2008, p. 4).

[1] "Dog writing" clarifies the "practices and actors in dog worlds, human and non-human alike," telling the story of doghuman co-evolution (Haraway, 2003, p. 3).

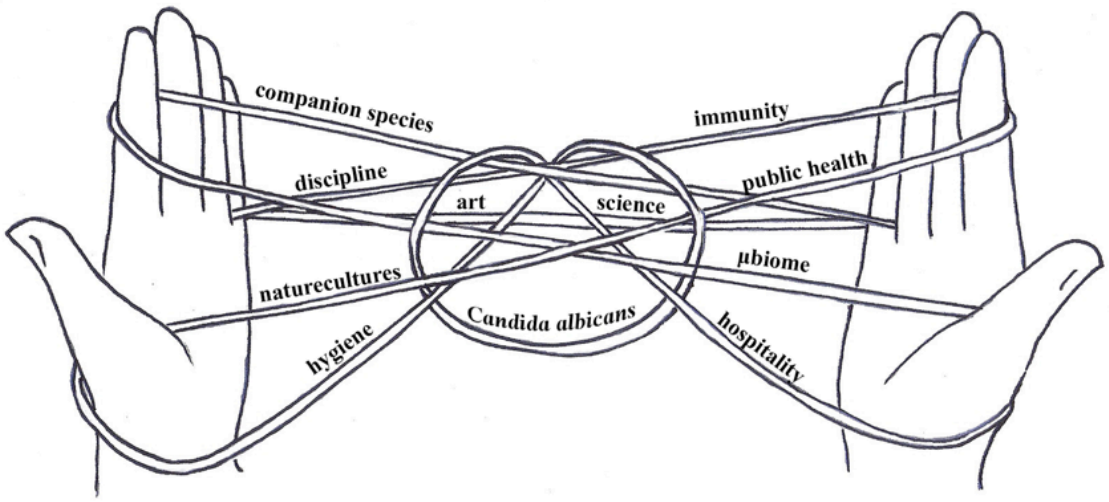

Fig. 1 "The Circle" string game of *CandidaHomo* naturecultures examined in this paper. Adapted from C. Furness Jayne (1906/1962/2009), http://www.stringfigures.info/cfj/circle.html. Licensed under Creative Commons.

Public health, commodity culture, research biomedical science, immunology, and my own artistic research into *CandidaHomo* naturecultures are scavenged and gathered here as knots where the strings of the cradle rub together[2]:

Knot 1: The promise of figuration describes and discusses the potential of Harawayan figuration to resist determination to a certain form.

Knot 2: Cat's cradles—seriously playful/playfully serious discusses the analytical method of the string game introduced in Haraway's 1994 article "A game of cat's cradle: Science studies, feminist theory, cultural studies."

Knot 3: naturecultures and companion species discusses Haraway's neologisms, "naturecultures" and "companion species."

Knot 4: *Candida albicans* and unstable nomenclature describes what *Candida albicans* is and discusses difficulties tracing its historicity due to morphological and linguistic instabilities.

Knot 5: An ideal breeding ground considers the gendered nature of our entanglements with *Candida albicans*.

Knot 6: Uneasy seepage examines the intertwining of *Candida albicans*, leaky human bodies and disgust.

Knot 7: *Cum panis* ruminates the mysterious case of bread leavened with *Candida albicans* and "normal" baker's yeast (*Saccharomyces cerevisiae*), which viewers were invited to eat. Such an artwork does more-than-textual work in the cat's cradle, exploring the viscerality of *CandidaHomo* naturecultures

Knot 8: Resistance diffracts Haraway's analyses of the militarisation of immunology through *Candida albicans—Homo sapiens* medical discourses.

Knot 9: Hosting the trouble is an imminent knot, dissolving in the formation of a new cradle. This knot discusses the possibilities of "hosts" in living as companion species.

[2] Haraway argues that these knots, which she calls tangles, are "necessary to effective critical practice" (1994, p. 69).

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Knot 1: The promise of figuration

Haraway re-visions figurations in her 1992 article "Ecce Homo, ain't (ar'n't) I a woman, and inappropriate/d others: the human in a posthumanist landscape." In its more traditional usage, "figuration" describes how figurative or allegorical representations are formed[3]. In "Ecce Homo," such figuration is obliquely recognised as "determination to a *certain* form."[4] Haraway (1992) then usurps this understanding, offering the promise of feminist figuration to reconfigure such determinations, urging feminists to "resist representation, resist literal figuration, and . . . erupt in powerful new tropes, new figures of speech, new turns of historical possibility" (p. 86). Like the bowers of the male great bower bird, who "builds an avenue of twigs and collects stones, bones, shells and human-made objects… [grouping] different types of objects, he spends time each day arranging and rearranging his collection, renovating his bower" (Phillips, 2008), Harawayan figurations form from gathering, "arranging and rearranging" processes, investments, bodies, histories, languages. They are not allegorical, but reveal the diverse political and moral dynamics embedded within them, and call for renovation of understanding. The "cyborg" is one such figuration, "naturecultures" is another, as is "companion species," as is "*CandidaHomo*."

Environmental humanities scholar Michelle Bastian argues that Haraway's

> figurations provide a framework within which everyday decisions might be made differently. They suggest another way of orienting oneself within one's environment by offering possibilities of understanding and acting… figurations are able to perform this work by revealing the underlying assumptions of specific discourses and showing the ways in which these discourses fail or contradict themselves. (2006, pp. 1029-1030)

However, Harawayan figurations do even more important work than Bastian suggests. Not only do they reveal underlying assumptions, failures and contradictions, they have also exposed (and continue to do so) the emergent effects of such discourses; that is, particular orientations are formed from the convergence of scientific, social, historical, physiological, genetic, economic, ethical, religious, spiritual, political, etc., discourses that are not possible singly. Hence, "renovating" these discourses enables their various combined effects (past, present and future) to be understood and re-visioned. This paper attempts such a "renovation" of the relationships between *Candida* and *Homo*, arguing that, like dogs, *Candida* are "in the garden from the get go" (Haraway, 2003, p. 5).

Knot 2: Cat's cradles—seriously playful/playfully serious

I am a scavenger: a feminist, an artist, a scientist. What, how, why, matter to me. Like an ant, I palp and stroke/sniff at the edges to discover what is good to take back to the nest. Like a cat, I bask in the fascinating and disdain the disinterested. Like a dog, I roll in the rotten and run off with thrown sticks. Haraway is an inspirational and generous scavenger. Her writings are laden bowers, bones buried by dogs, and tangled webs that give permission to build cradles as scientist, artist, historian, sociologist and cultural commentator. The string game of the cat's cradle offers a seriously playful and playfully serious scavenging method. It maps the processes, discourses, matter and bodies that form a bower/figuration, attending to both the ostensibly significant and the profoundly frivolous, and tracing the material effects of political and ethical semiotics. Haraway weaves her cradle "not just to read the webs of knowledge production . . . [but] to reconfigure what counts as knowledge in the interests of reconstituting the generative forces of embodiment" (1994, p. 62). This paper weaves a *CandidaHomo* cradle, scavenging from public health, immunology, sociology, anthropology, aesthetics and art, and re-visioning the matter of these naturecultures.

The string of a cat's cradle means that, like all Haraway's figurations, it is both metaphor and matter. The game can only be played through bodily action, and is therefore a dynamic map that cannot trace a

[3] OED http://www.oed.com/view/Entry/70074.

[4] OED http://www.oed.com/view/Entry/70074; emphasis added.

single lineage. Each cat's cradle figure contains the same ingredients but materialises differently. Each knot is a figuration in itself, and they can be arranged and rearranged "to reconfigure what counts as knowledge" about *CandidaHomo* entanglements (Haraway, 1994, p. 62). Each figure is formed from another and is an immanent state of becoming. In fact, a figure is always present but is more-or-less resolved. The partners in these cradles "do not precede the meeting . . . [rather they are] figures that help grapple inside the flesh of mortal world-making entanglements" (Haraway, 2008, p. 4), which makes them particularly useful to trace the entanglements of *CandidaHomo* naturecultures.

Knot 3: Naturecultures and companion species

Feminist theorist Marianne DeKoven (2006) has argued that TCSM presents a "shift in emphasis or perspective rather than a move into a different theoretical terrain" (p. 1695). She supports this claim by arguing that "what is new in this manifesto is… 'naturecultures,' the primacy of ecological and interspecies considerations over ideas about technopolitics" (p. 1695). In fact, the figuration "naturecultures" subtly extends anthropologist Bruno Latour's understanding of "nature-cultures" from his 1993 treatise *We have never been modern*. With the use of the hyphen, Latour challenges the dualistic division of nature and culture that characterised modernism. "Nature-cultures" implies a dialogic relationship between the two notions and the plural suggests multiple influences and interactions. Similarly, Haraway's "naturecultures" suggest multiple understandings of the nature-culture relationship. However, by collapsing the two words into one, Haraway insists that naturecultures are not dialogic, but co-constitutive; mutualistic entanglements of all entailed by each. Although Haraway (2003) appears to agree with DeKoven's assertion that TCSM privileges nature over culture when she writes, "I have come to see cyborgs as junior siblings in the much bigger, queer family of companion species" (p. 11), the oblique power of TCSM (and *When Species Meet*) lies in Haraway's assertion of the entanglement of "biopower and biosociality, as well as of technoscience" (2003, p. 5). She complicates the naturecultures dyad by insisting on biotechnocultures all the way down:

> Cyborgs and companion species each bring together the human and non-human, the organic and technological, carbon and silicon, freedom and structure, history and myth, the rich and the poor, the state and the subject, diversity and depletion, modernity and postmodernity, and nature and culture in unexpected ways. (2003, p. 4)

The figuration of "companion species" (which includes cyborgs) as simultaneously producing and being produced by biotechnocultures is complex and compelling, and has been discussed in myriad ways since its conception[5]. However, Haraway neglects the significance of micro-organisms as companion species, claiming the dog as her model companion species in biotechnocultures. Although she acknowledges the micro-organisms that live within and on the human body as "mess-mates" in *When Species Meet*, they only rate a brief mention in the introduction (2008, pp. 3-4)[6]. The Human Genome Project and the subsequent Human Microbiome Project have shown us however, that *Homo sapiens* evolved because of our complex microbial populations, which continue to evolve in response to its biotechnocultural ecology: us. We are always already profoundly and irrevocably non-human.

Knot 4: *Candida albicans* and unstable nomenclature

Candida albicans is one of the myriad species that inhabit the ecology that is the human body. The human microbiome has received a lot of attention in the last ten years, with claims that human cells are outnumbered ten to one by bacteria, fungi, arachnid, and insect cells, and an explosion of scientific research

[5] For example, Tim Jordan (2011) asks, "Are technologies species? and the concomitant: Are species technologies?" and interestingly uses surfboards to prod at the complexities of companion species (p. 266).

[6] Haraway also seems more interested in the transfer of DNA between Homo and Canis, rather than the extravagant polyspecific exchange of microbes and microbial DNA that also occurs. This may have been a tactical methodological consideration, as the familiarity of dogs in human biotechnocultures make the radical figuration of companion species more easily understood.

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into the importance of such micro-organisms to human evolution and health[7]. Although we already knew that micro-organisms lived on and in us, the primary focus was on pathogens, and the relevance of the other critters to human health, wellbeing and identity was not really considered. Monica Bakke (2014) argues that "although [knowledge of our microbiome] usually does not really affect our self-recognition directly and is not a threat to our identity, an awareness of it definitely alters the way we think of our bodies, as they no longer can be perceived as sealed vessels, but rather as transspecies environments. This mode of being-in-the-world reconfigures traditional ontological hierarchies and values" (2014, p. 155). This knot considers how *C. albicans* challenges such ontological understandings.

C. albicans are yeasts, single-celled fungi (Fig. 2), that are both commensal members of the human ecology and opportunistic pathogens. Between 70 and 80 percent of humans are hosts to *C. albicans*, introduced into human ecosystems either at birth, during sex, or via medical devices and prosthetics. We are truly companion species, as *C. albicans* are not found naturally occurring in any other species. *C. albicans* are highly responsive to their environment, switching between benign commensalism and irritating, occasionally life-threatening pathogenicity in response to changes in pH, temperature, sugar concentration, other micro-organisms and immune health. Humans in turn, shift between unawareness of commensal *C. albicans* and irritation, discomfort, and even rage at the inflammation and discharge caused by the pathogen. Highly adaptive, it occupies almost every available ecological niche with the human biome. Formerly considered only "women's business," the species has received renewed biomedical attention due to our increased use of medical implants and prosthetics. It has adapted well to the novel conditions at the interface of moist human flesh, titanium and latex. Forming treatment resistant and often lethal infections[8], it exemplifies the biotechnoculturality of companion species.

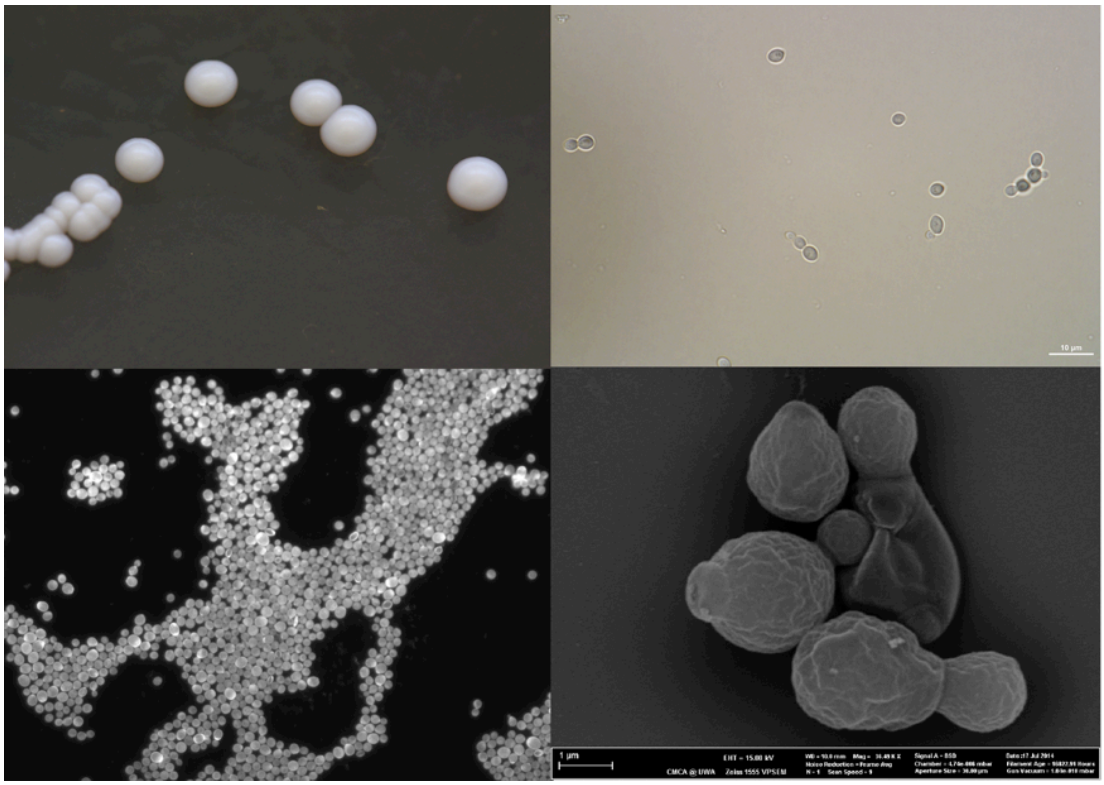

Fig. 2 Scales of *Candida albicans*: *C. albicans* colonies on agar; light micrograph of single cells; fluorescent micrograph of single cells stained with calcofluor white; scanning electron micrograph of single cells. Licensed under Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License: Tarsh Bates (2014).

[7] For example: "Me, Myself, Us; the Human Microbiome" Regunathan (2012); Turnbaugh et al. (2007); Weintraub (2012)

[8] Refer to Cauda (2009) for a review of the increasing importance of *Candida* species in hospital infections.

The first historical mention of thrush is thought to be by Hippocrates in 400 BC who described "mouths affected with aphthous ulcerations" (Edwards, 2015, p. 2879). A patient with "thrush" was mentioned in medical literature in 1665 and again in 1771[9]. Knoke and Bernhardt (2006) claim that surgeon Bernhard von Langenbeck wrote the first description of a candidal infection in 1839. In 1846, Berg concluded that thrush was caused by a fungus, having successfully introduced infections in healthy children. Charles Philippe Robin classified this fungus as *Oidium albicans* in 1853. Between 1853 and 1940, the organism was classified under 12 different genera, including *Candida* by Christine Berkhout in 1923, based primarily on reproductive strategy and phenotype. After Maurice Langeron and Paul Guerra (cited in Barnett, 2004) heralded Berkhout's taxonomy as "the beginning of the rational systematics of the non-ascosporogenous yeasts" (p. 1159), *Candida albicans* was declared the official assignation by the Eighth Botanical Congress. However, 158 synonyms for this clinically important critter are still listed in the fifth edition of the text *Yeasts: A taxonomic study* (2011), and DNA-based studies have shown that phenotypic characteristics often do not correspond to the molecular phylogenetics (Guzmán, Lachance, & Herrera, 2013; Kurtzman & Robnett, 1994). In fact, Daniel, Lachance, and Kurtzman (2014) have recommended that species classified under the *Candida* genera be revised to better reflect the relationship between molecular and phenotypic characteristics. This recommendation relies on the valorisation of DNA as the "code of life." Although it may appear to be useful for the taxonomic classification of phenotypically mutable microorganisms, such as *Candida*, the DNA of these critters is also highly fluid and adaptable[10], making a reliance on DNA for species classification almost as problematic. The instability of our classification systems, their reliance on technology, and our inability to grasp the fluidity of companion species, are revealed by this indeterminate nomenclature. Haraway argues that such nomenclature should rest on the relation between bodies, not on a body itself:

> Companion species is a permanently undecideable category, a category-in-question that insists on the relation as the smallest unit of being and of analysis. By species I mean . . . a kind of intra-ontics/intra-antics that does not predetermine the status of the species as artifact, machine, landscape, organism, or human being. (2008, p. 165)

Knot 5: An ideal breeding ground

> While not many talk about it, thrush will affect 3 out of 4 women at least once in their lives.
> —canesten.com.au

Although much has been written about *C. albicans* from an experimental microbiology perspective, very little anthropological, sociological or even public health research exists[11]. In addition, despite the ubiquity of yeast infections in women, feminist historians and scholars of science have been silent, focusing instead on menstrual blood or breast milk. The historicity of *CandidaHomo* naturecultures is difficult to trace in large part due to the stigma associated with infections, the inconsistent attribution of cause to infections of different body parts, and to the "instability of nomenclature" for yeasts (Barnett, 2004, p. 1142). Infections caused by *Candida* species are called variously candidosis, candidiasis, moniliasis, and oidiomycosis. In the United States, oral infections are "thrush" or "aphtha," penis infections are "candidal balanitis,"[12] and vaginal infections are "yeast infections." In the United Kingdom and Australia, "thrush" is synonymous with vaginal infections. Vaginal infections caused by *C. albicans* may have been subsumed

[9] OED http://www.oed.com/view/Entry/201451

[10] The rapid evolution of vaccine and drug resistance in malaria and *Staphylococcus aureus*.

[11] Two rare exceptions are Jane Southwell (1996) and more recently Alissa Overend (2011).

[12] http://www.medicalnewstoday.com/articles/246615.php

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under the condition leucorrhœa (aka *fluor albus*, the white flow, the whites, or "weakness"), which is an unattributed "thick, whitish or yellowish vaginal discharge."[13]

Candidiasis is overwhelmingly portrayed in popular culture as a "women's disease." On the website of Bayer pharmaceuticals, the company who make the popular anti-fungal product, Canesten®, "[t]hrush" is synonymous with "vaginal yeast infection and "[t]he first warning of thrush is an irritation around your vagina."[14] No mention is made of oral candidiasis, which is common in both men and women, or of candidal balanitis (infection of the penis). Although some medical websites (and Wikipedia) acknowledge that both men and women can get candidiasis (some referring to oral thrush and penis infections), the majority imply a normative association with women, either through the dominant use of images of women, diagrams of uteruses. The terms "male yeast infection" and "male thrush" indicate the metonymy of "yeast infection" or "thrush," and "woman."

In a compelling study of self-identifying sufferers of systemic candida, sociologist Alissa Overend (2011) convincingly argues that there is a distinct gender difference in the way sufferers describe their experience of the illness, which aligns with other studies of gendered experiences of illness. In the last 30 years, "systemic candida" has become a popular "undefined disorder" (Malterud, 1992, p. 305). Proponents of this illness claim that *Candida* overgrowth "breaks down the wall of the intestine and penetrates the bloodstream, releasing toxic byproducts into your body and causing leaky gut" (Myers, 2013). Such overgrowth causes "a wide range of symptoms like digestive problems, headaches and recurrent yeast infections."[15] Attributed to "modern life,"[16] these claims are invariably discussed in association with the offer of a unique and "simple 5-step program for beating *Candida* and eliminating those *Candida* symptoms for good."[17] This program (which can be ordered for only $US37) involves purging sugar and other carbohydrates—not a "simple" matter for most. Although the presence of *Candida* in the human gut has been confirmed experimentally, biomedical practitioners are highly sceptical of chronic, systemic candida syndrome outside of the life-threatening candidema that presents in immunosuppressed patients. The symptoms attributed to *Candida* by advocates of *Candida* syndrome are so varied and diverse that causality is impossible to determine. However, Overend (2011) found that men tend to describe their experiences of systemic *Candida* in discrete physiological terms and in ways that maintain the integrity of their bodies, whereas women are much more emotional and their descriptors suggest bodies that are leakier and more fluid. Please note that I do not want to suggest that these men and women are not ill. Rather, I am interested in the intersections between gender, aetiology and commodity culture that collapse on this critter.

Knot 6: Uneasy seepage

Monica Bakke claims that knowledge of our microbiome does not threaten our identity, although "an awareness of it definitely alters the way we think of our bodies, as they no longer can be perceived as sealed vessels" (2014, p. 155). However, Bakke's claim ignores a long lineage of scholarship that shows that the perception of the body as "sealed vessel," a "unified self," has always been a fantasy. This is particularly true for women, as Margrit Shildrick (2001) has argued and is evident in Alissa Overend's (2011, 2013) findings. Although not mentioned by scholars of leaky bodies (who focus largely on menstruation or milk), the white discharge and yeasty smell that signals candidiasis persistently disrupts the "sealed vessel" (Fig. 3). Candidiasis shows that a "unified self" has always been threatened by our microbiome, and that this threat is not merely cognitive, as Bakke suggests. Anyone who has had candidiasis under-

[13] https://en.wikipedia.org/wiki/Leukorrhea

[14] http://canesten.com.au/en/symptoms-of/thrush/index.php

[15] http://www.thecandidadiet.com/an-introduction-to-candida/

[16] Which includes: eating a diet high in refined carbohydrates and sugar (which feed the yeast), consuming a lot of alcohol, taking oral contraceptives, eating a diet high in beneficial fermented foods like Kombucha, sauerkraut and pickles, and living a high-stress lifestyle (Myers, 2013).

[17] http://www.thecandidadiet.com/an-introduction-to-candida/

stands immediately that cognition is embodied: the inflammation and uncontrollable itchiness of a *Candida* infection compels not just focused awareness of that area of the body, but intense emotions, and chronic and recurrent infections require urgent response to prevent madness.

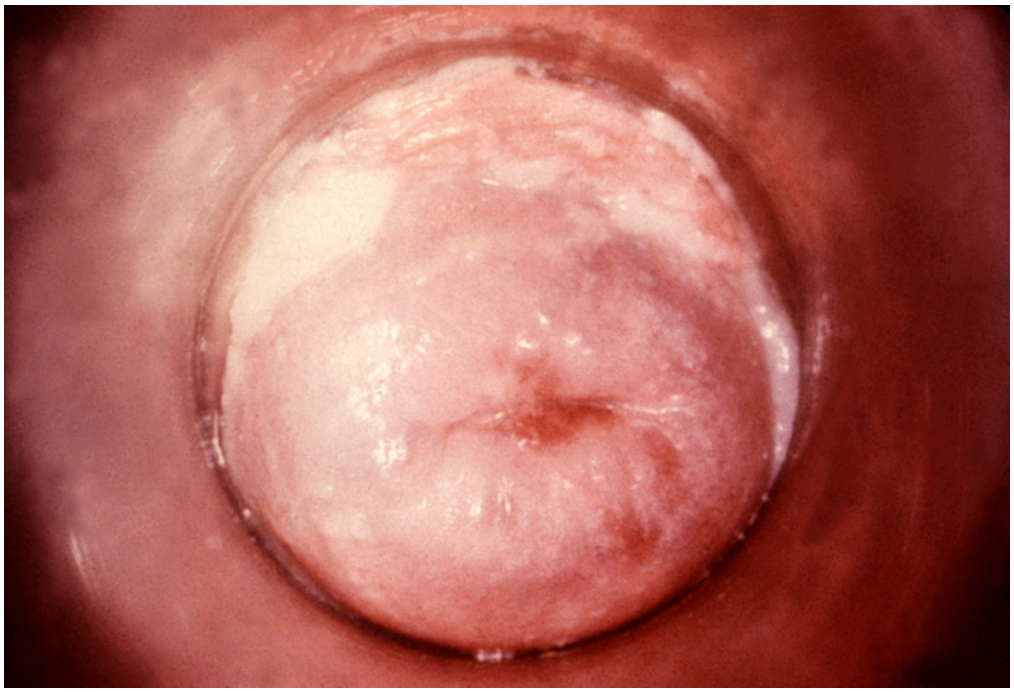

Fig. 3 *Candda albicans* infection of human cervix. http://phil.cdc.gov/phil/details.asp. This image is in the public domain and thus free of any copyright restrictions: Centers for Disease Control and Prevention (1970).

Andrew Shail (2007) notes that in the burgeoning days of public hygiene, menstruation became framed as unhygienic waste that needed to be privately contained and cleansed. It is not unreasonable to conclude that this was also true of *fluor albus* (leucorrhoea). This legacy is evident in the contemporary classification of tampons, pads and similar products as "sanitary pads" and "feminine hygiene products." "Masculine hygiene products" are nowhere to be found, implying that men do not leak, or if they do, it is not a matter of hygiene. Shail convincingly suggests that Kotex was complicit in this framing of menstruation as "women's oldest hygienic problem" during the 1920s, in order to promote consumption of disposable "feminine hygiene products" (2007, p. 79). Overend (2011) argues that the contemporary production of the "everyday liner" by Kotex and other producers of "feminine hygiene products" implies that women seep all the time, not just during menstruation (p. 107). Medical doctor Markus MacGill (2015) confusingly suggests that both poor hygiene and the use of too many cleansing products make candidiasis more likely.

Feminist scholars have long established that leaking, diseased and excessive bodies are considered morally deficient[18]. The assumption that a physically unclean body is also morally unclean is deeply culturally embedded and well-articulated by Virginia Smith (2007) in *Clean: A History of Personal Hygiene and Purity*. Elizabeth Grosz's (1994) claim that "women's corporeality is inscribed as a mode of seepage" (p. 203) intersects with Shildrick's (2001) observation that "the outward appearance of an ailing body may be taken as the sign of an inner deficiency of will, or prior moral dereliction" (p. 72). As early as 1830, *fluor albus* was considered a sign of moral weakness. In his 1830 treatise on *fluor albus*, George Jewel explicitly states this, and notes that this phrasing is "an error in practice," meaning that the assignation of

[18] In particular, refer to Julia Kristeva for notions of abjection, Elizabeth Grosz and Margrit Shildrick for notions of volatile and leaky femininity.

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weakness is unrelated to the physiology of the condition, implying instead a moral weakness[19]. As yeast infections are also associated primarily with women's genitals, sexual morality compounds that of the unclean and diseased body, necessitating the common correction. For example, in 2009, a young woman in Pennsylvania was repeatedly called "a bitch and a whore" by her classmates when they found out she had a vaginal yeast infection (North, 2012). Interestingly however, none of the participants in Alissa Overend's (2011) study indicated feelings of uncleanliness or immorality in association with their *Candida* infections, possibly because these were not genital infections.

Of course leaky bodies require discipline. In the case of candidiasis, this usually involves anti-fungal treatments to discipline and contain the bodies of *C. albicans*. Home remedies include garlic or yoghurt pessaries, apple cider vinegar, olive leaves and cranberry juice, and various oils, including tea tree, coconut and oregano. The human body is also disciplined though a range of prophylactics, including diet, hygiene products, and probiotics[20]. However, *C. albicans* rapidly develops resistance to treatment, and systemic infections are often impossible to treat.

Seeping *Candida* infections have a significant disgust aspect, collapsing all three categories of disgust models (Tyber et al. 2009): pathogen, sexual and moral. Recent studies show a clear, embodied relationship between morality, hygiene and disgust, and argue that disgust evolved as an evolutionary adaption for food selection and disease avoidance (Curtis, 2007; Haidt, Rozin, McCauley, & Imada, 1997; Schnall, Haidt, Clore, & Jordan, 2008; Tobia, 2014; Tybur et al., 2009). Although most of these studies acknowledge a social aspect to disgust, it is usually couched in evolutionary terms, which assumes that all human cultures experience disgust in similar ways. However, Haidt et al. (1997) found significant cultural differences in disgust responses. They also inferred that since disgust is rarely experienced by young children, it must, at least in part, be taught, concluding that "[d]isgust may have its roots in evolution, but it is also clearly a cultural product" (1997, p. 111).

Knot 7: *Cum panis*

> In eating we are most inside the differential relationalities that make us who and what we are… there is no way to eat and not to kill, no way to eat and not to become with other mortal beings to whom we are accountable, no way to pretend innocence and transcendence or a final peace. Because eating and killing cannot be hygienically separated does not mean that just any way of eating and killing is fine, merely a matter of taste and culture. Multispecies human and nonhuman ways of living and dying are at stake in practices of eating. (Haraway, 2008, p. 295)

Recently, as part of my artistic research that explores human relationships with *C. albicans*, I used *C. albicans* as a leavening agent for bread, in combination with "normal" baker's yeast, *Saccharomyces cerevisiae*. The bread was then offered to visitors to eat. This artwork, entitled *The unsettling eros of contact zones*, is a knot, a figuration, and a critical methodology, since art is able to navigate the wordless aspects of naturecultures, teasing out affective and tacit strands. The work was both an investigation of the materiality of the organisms and a gentle provocation to pay attention to the organisms that live within us, seep from us, or that we ingest with our food. Yeasts are some of our oldest "messmates" (Haraway, 2008, p. 4), having helped us to produce bread, beer and wine for millennia. In this artwork, "companions of all scales and times eat and are eaten at earth's table together" (Haraway, 2010, p. 54).

This artwork has elicited three responses from audiences that are particularly pertinent to this discussion: firstly, people are hesitant to consume the bread, even though the yeasts, including *C. albicans*, are killed during cooking by elevated temperatures and baking duration; secondly, when I presented bread that had been leavened only with baker's yeast at a recent event (Fig. 4), viewers were reluctant to consume

[19] "for, if we investigate the pathology of leucorrheal discharges, we shall find them, most commonly, to have their origin in local excitement" (Jewel, 1830, p. 2). By "local excitement" Jewel meant what is now called inflammation, a symptom commonly associated with candidiasis.

[20] Alissa Overend (2013) discusses the role of food disciplining in *Candida* infections. Also refer to any of the myriad websites giving advice on eliminating/preventing *Candida*.

it, even though they knew it did not contain *C. albicans*; and thirdly, institutions have been reluctant to support the serving of *Candida*-leavened bread in an art exhibition, although any *C. albicans* are killed during baking.

Fig. 4 Visitors were unexpectedly reluctant to consume bread leavened with baker's yeast at a recent event. Licensed under Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License: Tarsh Bates (2015).

Why are people reluctant to consume bread leavened with *C. albicans*? The bread looks like "normal" bread, and there is no chance of getting an infection. Despite this, most common response has been immediate and intense disgust. Clearly, this is not just a case of an evolved pathogen disgust, as the bread does not possess any of the "visual, olfactory, tactile, or auditory cues that reliably indicated pathogen presence in our ancestral past" (Tybur et al., 2009, p. 105). Rozin and Fallon (1987) argued that the prospect of ingesting an offensive object causes revulsion and disgust, regardless of its pathogenicity (p. 23). They found that even brief contact with an offensive object causes normally acceptable food to be rejected—a corruption effect. Haidt et al. (1997) agree, suggesting that some "essence or residue is transmitted" (p. 110). *Candida*-leavened bread is an example of this "sympathetic contagion magic," where "things which have once been in contact with each other continue ever afterwards to act on each other" (Frazer, 1890/1959, p. 35). The bread, having been in contact with an "offensive object" (living *C. albicans*), elicits a disgust response, even though the bread itself does not look disgusting. However, in keeping with Haidt et al.'s (1997) insistence on the naturecultures of disgust, an offensive object is more than just the immediate physical object. It is, to use Haraway's term, material-semiotic and must be conceptually/socially/culturally offensive as well as materially offensive. Hence, the disgust experienced when faced with *Candida*-leavened bread is tightly woven with "sexual" disgust due to the metonymy of *Candida* and women's genitals.

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The reluctance to consume bread leavened only with baker's yeast is a more subtle manifestation of the material-semiotics of disgust. The bread was offered in the context of research about *C. albicans*, in an art gallery with other artworks about (although not containing) *C. albicans*, and the visitors knew that I intended to make other bread with *C. albicans*. It is possible that the proximity of the other artworks and my own experimentation with *C. albicans* caused a sympathetic contagion response as described above. However, I believe that the disgust response was not just about proximity, but the subtler, although just as affective, imaginative reaction triggered not by sensory cues or by contact with an "offensive" object, but by "ideational concerns about what it is" (Haidt et al., 1997, p. 109). Or put more simply, the possibility that *C. albicans* could be present in the bread brings about an immediate awareness of all living organisms within all bread. Our suspension of disbelief that we ingest fungi, bacteria, molds, etc, and that we are in turn consumed by such creatures, our messmates, fails in this moment, and all bread, possibly all food, becomes "unacceptable."

Knot 8: Resistance

Of course, *CandidaHomo* naturecultures necessarily require a discussion of immunology. Both our innate and adaptive immune systems engage with *C. albicans*. Much has been written about the persistent conception of the immune system as a war zone, including by Haraway herself[21]. In "The Biopolitics of Postmodern Bodies: Constitutions of Self in Immune System Discourse," she asserts that "[p]re-eminently a twentieth-century object, the immune system is a map drawn to guide recognition and misrecognition of self and other in the dialectics of Western biopolitics" (1991, p. 204). "Self" is crucial to immunological discourses, where "self" is understood to be any identifiable and necessary part contained by the stable boundaries of an individual and without which that individual could not exist. Consequently, "non-self" is that which disrupts these boundaries and must be defended against to maintain existence. The "good" immunological cells of "self" recognise and defend against "bad" colonisers and invaders. The metaphor of the immune system as a war zone has proven extremely persistent, naturalising conceptions that war and "survival of the fittest" as part of what it is to be human (Jamieson, 2015, p. 3).

Pop culture, public health and research science papers about *C. albicans* abound with militaristic phrases such as "immunological shields" (Gow & Hube, 2012, p. 408), "escape mechanisms" (Netea, Brown, Kullberg, & Gow, 2008, p. 74), "*Candida* evades the host defense armory" (Cheng, Joosten, Kullberg, & Netea, 2012, p. 1304), and "host defenses are essential for eradicating the infection" (Mima et al., 2010, p. 392). However, the cold war and nuclear imagery discussed by Haraway in 1991 has evolved into a more contemporary semiotics of terrorism and surveillance. "Clandestine sleeper cells" lurk, hidden, ready and waiting, necessitating constant vigilance: "[t]he ultimate outcome of fungal colonizations…is determined by the rate of elimination through host immune surveillance versus the fungal proliferation and dissemination into organs and tissues" (Bourgeois, Majer, Frohner, Tierney, & Kuchler, 2010, p. 401), "fungal pathogens have developed sophisticated means to evade . . . or even persist in the host despite normal surveillance" (Bourgeois et al., 2010, p. 401), and "*C. albicans* have developed strategies to mask . . . their detection" (Bourgeois et al., 2010, p. 402). Even papers discussing the complex, dynamic and interconnected nature of *Candida* infections persist in war rhetoric: "the fungus . . . must be able to counter the effects of the sentinel activity of mucosal immunity mechanisms, to compete with other microbes for space and nutrients" (Gow & Hube, 2012, p. 410). Similarly, Rizzetto and Cavalieri (2010) initially argue that "[i]nnate immunity . . . is a complex network of interconnected pathways depending on many factors" (p. 762), but later state that "[f]ungal infections are the result of a coordinated battle between the fungus and its host" (p. 763).

As Haraway (2003) suggests, "[i]mmune systems are not a minor part of naturecultures; they determine where organisms, including the people, can live and with whom" (p. 31). Sociologist Myra Hird (2010) argues that "human cells must actually cooperate with the bacteria that enters the body:

[21] In addition, refer to Tauber (1994) and Cohen (2004). Also refer to Sankaran (2012) and Jamieson (2015, p. 3) for excellent analyses of the history of critiques of immunology.

immunity turns out to be a conversation between bodies and microbes" (p. 740). I disagree: it is not a "conversation between bodies and microbes," but intra-actions of "self" with "self," as "bodies" and "microbes" do not pre-exist one another and are in constant flux[22]. Immunologists Carol Kumamoto's and Jessica Pierce's (2011) model of *C. albicans* as "farmers" and "adventurers" attempts to reconceptualise immunity relations in cooperative, or at least responsive, terms. In this model, most *C. albicans* cells within a human body are commensal "farmers" who "farm" their ecology by pacifying its immune response. "Farmers" become "adventurers" through "immunosensing"—sensing a change in the immune system of their host, "farmers" respond switching into "adventurers." "Adventurers" interact more aggressively with the host, and are better able to adhere to and invade host cells. However, "adventurers" also stimulate an anti-*Candida* immune response and are more susceptible to this response than "farmers." Describing *C. albicans* as "farmers" or "adventurers" engaged in less aggressive encounters with human bodies frames the metaphorical and material worldings of these companion species as more nuanced and responsive than merely combatants in a war zone. However, this framing is embedded in a historical tradition of "farmer" and "adventurer" as European, masculine colonisers of nature, which is still problematic for a companion species figuration. Additionally, both combatant and farmer/adventurer models are embedded within a neo-liberal capitalism that valorises individualism and sees social and cooperative assemblages as mindless, marauding hordes.

Philosopher Ed Cohen (2004) argues that the dichotomising premise that the immune system distinguishes "self" from "non-self," may be applicable to infectious diseases that must be defended against (p. 7). However, it falls apart in the face of autoimmune disorders and *C. albicans*, which is both commensal and pathogenic, "self" and "not-self." Immunologist Polly Matzinger's (2002) "Danger Model" suggests that "the immune system is more concerned with damage than with foreignness, and is called into action by alarm signals from injured tissues, rather than by the recognition of nonself" (p. 301). The "Danger Model" does not deny "self"/"non-self" discrimination, but allows for a broader conception of "self," where "self" includes "non-self" in "a shifting, signal-mediated definition of danger" (Weasel, 2001, p. 40). However, Matzinger's model is still embedded in notions of a healthy unified body dependant on "balance" and "equilibrium," similar to the ecological conception of "resilience" as the capacity of an ecosystem to rapidly return to its original state following disturbance. As Haraway argues, "[w]hat counts as a 'unit', a one, is highly problematic, not a permanent given. Individuality is a strategic defence problem" (1991, p. 204).

Although *C. albicans* has been shown to be present in 70 to 80 percent of the human population, usually from birth, these hosts rarely know the organisms are there. We have co-evolved; human bodies are the ecological niche of *C. albicans*. As a commensal of mucosal surfaces and the gastrointestinal tract, it benefits from us without damaging us (Gow & Hube, 2012, p. 406). Infection occurs only if conditions change and life-threatening disease occurs only in immunocompromised hosts. The complexity of the human immune system still evades us and the host-disease relationship between *Candida* and *Homo* is contentious and uncertain. Does the human immune system consider *C. albicans* "the commensal" to be "self"? Does *C. albicans* trick us into ignoring it, or is a ravaging beast kept at bay by a robust immune system and other microorganisms, as suggested by Gow et al. (2012) and the majority of experimental research papers? In fact, recent studies have shown that commensal *C. albicans* cells produce different proteins than cells that actively cause disease (Rosenbach, Dignard, Pierce, Whiteway, & Kumamoto, 2010; Thewes et al., 2007), suggesting a more active *C. albican*s than Gow et al. and others allow for. After all, engaging with a host's immune system is highly resource intensive for both parties, and why not just hang out if you can?

Knot 9: Hosting the trouble

> I'd been fighting this candida issue in my throat and I had to really change my diet and use different medication and it sort of seems to pop up and its [sic] kinda hilarious. It's like I have this new neigh-

[22] For discussions of intra-actions, refer to Karen Barad (1996).

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> bour that I have to sort of learn to live with. And obviously you know this fungus is inside all of us and it's never about eliminating it. You have to kind of just live with it.
> — Björk (2011)

In this paper, a *CandidaHomo* figuration has been formed by playing a cat's cradle string game with some of the complex material-semiotics between *C. albicans* and *Homo sapiens*. Scavenged from public health, art, immunology, sociology, gender, and biological science, amongst others, this figuration has gathered and thickened some knots in the troubling cradle of *CandidaHomo* naturecultures. It has made explicit Haraway's analytical methodologies of figuration and the cat's cradle, and integrated them with the affective research methods of contemporary art, weaving a methodology for exploring naturecultures. It responds to Donna Haraway's compelling 2003 treatise, T*he Companion Species Manifesto*, arguing that *Candida albicans*, opportunistic pathogens of humans, are "not here just to think with. They are here to live with" (p. 5) and that our "being depends on getting on together" (p. 50). It has traced the tangles of bodies, nomenclature, diet, discipline, seepage, discomfort and resistance to pay attention to and acknowledge response-ability as an ecology of companion species[23].

This cradle has vibrated with the ambiguous figuration of "host." A host is the animal or plant that is the environment for or sustains the life of a parasite or commensal organism. It is a marauding and invading swarm. It is one who provides food and shelter, and the sacramental bread of the Eucharist. Hosting entails a response-ability to the stranger. We are the environment for and sustain the lives of the commensal *C. albicans*, and the parasite *C. albicans* is a marauding swarm (although from the perspective of a *C. albicans* cell, our immune system is the marauding swarm); we provide food and shelter, and bread leavened with *C. albicans* is broken and shared to know and feel more, "including scientifically, about how to eat well—together" (Haraway, 2008, p. 295). In French, a host is simultaneously "host" and "guest"—are we host or guest? Which is *C. albicans*? In imminent dissolution, this cradle of *CandidaHomo* naturecultures is a provocation to "stay with the trouble," to break bread with our microbial messmates, and consider "how might an ethics and politics committed to the flourishing of significant otherness be learned from taking [*Candida*-human] relationships seriously" (Haraway, 2003, p. 3). If an ecology is the processes by which "home" is formed, then surely *Homo sapiens* are home to *Candida albicans*.

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[23] Here I adopt Astrid Schrader's (2010) notion of response-ability as both ethical responsibility and a practice that allows space for an organism or object of study to respond.

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