Dismembering the member: rethinking sexual difference in Maria Fernanda Cardoso's exhibition 'It's not size that matters, it is shape'

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In 2011, Sydney-based, Colombian-born visual and performance artist Maria Fernanda Cardoso exhibited her work in the show 'It's not size that matters, it is shape', at Arc One Gallery in Melbourne, Australia. The exhibition at Arc One Gallery included a range of resin sculptures of male intromittent copulatory organs from the *Opiliones* order of arachnids, commonly known as harvestmen, an insect related to mites and spiders. 'Intromittent' refers to the external organs of a male organism that has a specialised mode of delivering sperm during copulation. Harvestmen generally live in moist conditions and are commonly found under decaying logs or moss in rain forest areas (Hickman 2). While harvestmen can be found all over the world, Cardoso's exhibition only represents organs from species found in Tasmania and from the family *Triaenonychidae*. The harvestmen specimens that served as the models for these sculptures were collected and prepared by biologist and taxonomist Glenn S. Hunt in 1969 and are stored at the Australian Museum (Cardoso). The exhibition also included a number of archival pigment prints of the copulatory organs printed onto cotton rag paper. These prints included images of harvestmen penises as well as the genitalia of the *Phallomedusa* snail, a hermaphrodite that is commonly found in the Sydney Harbour salt marshes.

At 1mm long, harvestmen penises are barely visible to the naked human eye. The organs of the near-microscopic models were enlarged in the sculptural forms to approximately match a human scale. They were represented in a semi-erect state and can extend even further (Cardoso). Apart from the scale, the penises were proportionally accurate reproductions of the harvestmen specimens. The sculptures were made of a semi-translucent vero-white coloured resin and were mounted on metal plinths and encased in glass domes that suggested an oversized condom or the protective sheath of a natural history museum exhibit. The accuracy of the sculptures was achieved using new technologies including a Scanning Electron Microscope (SEM), 3D computer modelling and 3D printing. The labelling of one sculpture entitled 'Intromittent organ of the *Thelbunus mirabilis (*Tasmanian harvestman*) Opiliones*, 2008-09' gives a sense of Cardoso's scientific approach to her subject matter. Her use of technical biological terms and Latin scientific names, followed by the common name in parentheses, mimics a museum exhibit or a laboratory record.

Cardoso's collection of copulatory organs is playful and humorous in its depictions of invertebrate genitalia. It is also deeply serious in its scientific accuracy and the ontological questions that it raises. In this article I will focus on the sculptures of the intromittent organs of the harvestmen to argue that Cardoso's artistic depictions of the heterogeneity of reproductive organs challenge stereotypes about sexual difference and invite us to re-think human-animal-technology relations in the twenty-first century. Through the work's celebration of complexity and difference in this little-known Australian insect species, Cardoso's sculptures upset the deeply embedded gender binaries that underpin the history of philosophy and science.

When Cardoso was young she wanted to be a scientist, but as she developed as an artist she began to identify with the tradition of Renaissance artists such as Leonardo Da Vinci (*Interview with Maria Fernanda Cardoso* 2007). She values such artists' breadth of knowledge across a range of mutually informing disciplines, a practice that declined with the expansion of industrialisation and the specialisation of knowledge and labour. Her work is also closely identified with the nineteenth-century naturalists who sought to understand nature through collecting specimens of different species, observing and reproducing them through drawings and models (Buiani and Genosko np). Cardoso claims that as an artist she tries to be as precise as a scientist. She describes her artistic research as 'investigations' and sees her work as making a contribution to scientific knowledge (*Interview* 2007). In the Arc One Gallery press release for the show, Cardoso is described as an 'artist researcher' and she states: 'My aim is to become a world's expert on animal genitalia' [sic] (Gallery 1). Specifically, Cardoso views the works from 'It's not size that matters, it is shape' as a contribution to the science of the morphology of reproductive organs (Gallery 1), a branch of biology that studies the formal and structural composition of an organism.

Cardoso is best known for her performance art installation *Cardoso Flea Circus* (1996)—purchased by the Tate Gallery—in which she trained living cat fleas to perform a range of circus stunts and magnified the results using video recording technologies. In this work, she used trial and error methods over a period of six years to re-discover the lost art of flea training that was popular in the nineteenth century. She studied the fleas' behaviour and responsiveness to create a live art piece that brought together playfulness, performance, ethology, formal experimentation and new media. Artist and writer Ross Harley describes the *Cardoso Flea Circus* as elevating something 'inconsequential to epic proportions' (Watts).

When Cardoso came to live in Australia she wanted to work with tiny and less well-known local animals, rather than what she calls the 'clichéd animals' such as kangaroos or echidnas (*Interview* 2007). Her first pieces created in Australia used materials from local sheep and emus. But in 'It's not size that matters, it is shape', Cardoso fulfils her aim to investigate very small Australian native species of invertebrates. Once again, she turns something so small that it is ordinarily considered 'inconsequential' into something epic by creating a work that provokes questions about species survival in Australia, a nation with the highest extinction rate in the world (Flannery, Kendall and Wynn-Moylan 11). Historically, the 'consequence' of a plant, animal species or ecosystem has been judged according to its usefulness to humans, its potential to be instrumentalised for human benefit and gain. Cardoso's work encourages spectators to see the abject arachnid of the harvestman in a new (or perhaps first) light, urging spectators to acknowledge its 'consequence' through its aesthetic beauty and complexity. As in the *Cardoso Flea Circus,* the exhibition draws together zoology, ethology and technology. It brings what is generally hidden from sight to the forefront of human awareness and invites spectators to see the beauty and fascinating complexity in a species that we might ordinarily describe as 'vermin.'

Cardoso's harvestmen penis sculptures are both formally beautiful and terrifying. As a feminist spectator of this exhibition, the collection raises a number of questions. Why does Cardoso predominantly focus on the male genital organ? Are the female receptacles of these species shaped to receive the complex formations of the penises? Does Cardoso's focus on male genitalia further play into the fetishisation of the beauty and power of the male sexual organ or does it playfully critique the patriarchal obsession with the phallic apparatus? Does Cardoso's focus on the penis emphasise male reproductive skills and validate male promiscuity at the expense of the female, or does it reposition the penis in relation to arenas typically gendered

feminine—of embodiment, spectacle, or objectification? As an ecofeminist spectator, however, the harvestmen sculptures raise further questions that complicate and challenge normative views of gender and sexual difference.

By enlarging the penises of the harvestmen, Cardoso invites a comparison to human copulatory organs and sexual activity. As Jane Goodall notes, 'though Cardoso seems cautious about inviting human parallels, adjustments of scale are one of the ways in which these minute studies can be brought into an anthropological perspective' (55). The anthropocentric view of the world has historically characterised animal sex as purely procreative and still often insists on only granting humans (and sometimes other mammals such as dolphins) the rational capacity to engage in sex for pleasure. Describing the harvestmen penises, Cardoso claims that 'these beautiful shapes changed my perception of the world, it makes you realise there's a lot of sex going around you and you're not aware of it' (ABC *Professor Maria Fernanda Cardoso and the Museum of Copulatory Organs*). For the artist, seeing the harvestmen genitalia under the microscope momentarily collapsed the differences between insect and human species, two species generally considered to have little in common.

The groupings and classification of all species are part of a history of male-dominated Enlightenment science that attempts to order, master and control through rational categorisation (Plumwood). Feminist historian of science, Evelyn Fox Keller in particular has noted how taxonomy and the naming of species was a practice that was integral to the formation of Enlightenment patriarchal power structures that attempted to both construct and contain nature (Keller 17). While such orderings and classifications have undoubtedly been incredibly useful to scientific developments and understanding of the natural world over the centuries, their hidden patriarchal underpinnings meant that they also have blind spots that have limited scientific and social progress. These biases have only begun to be exposed by scholars such as Keller and Val Plumwood in the late twentieth century.

Species classification in biological taxonomy relies on groups that are defined by a shared ancestor and by being reproductively isolated from other species (Richardson 828). Feminist historian of science Sarah S. Richardson notes that '[i]n common scientific parlance a "genome" refers to the genetic code specifying a species. Textbooks frequently define a "genome" as the complete genetic "instructions" for a species' (829). The system that humans have devised for species differentiation is therefore based on the membership of organisms to a group that is genetically similar and reproductively capable. Today, as more species' genomes are mapped, what classifies a particular species grouping is becoming more nuanced according to the 'information' found on each organism's DNA. Species membership generally determines the future generational survival of a species.

Yet the idea of membership also evokes the possibility of being *dis*membered – of being partitioned or divided up, expelled from the hierarchies and divisions of rational patriarchal classification, or of having limbs torn or cut off. Cardoso's sculptures of the male harvestmen genitalia dismember the 'members' of these invertebrates as the penises are deprived of their bodily context—a castration that focuses on the removed organ rather than on the body that lacks the phallus. The work not only invites spectators to see the morphological details of various male harvestmen's phallic apparatus, it also disorients our own human relationship to this species through its distortion of scale. By magnifying the penises and severing them from the insects' bodies, the sculptures invite spectators to consider the similarities between male human and harvestmen genitalia, to momentarily identify as members of the various harvestmen species. The semi-erect harvestmen penises also give the insects some agency by

representing an organ that asserts a relatable sexual or procreative desire. In their abstraction, the free-floating 'members' become confrontations that invite spectators to question what it means to position ourselves as members of a particular species group.

Difference in the Singular Animal

The history of philosophy from Plato to Descartes, from Heidegger to Lacan, has differentiated humans from animals by emphasising human rationality and language. Jacques Derrida's response to this history, *L'animal que donc je suis* (2006) *[The Animal That Therefore I Am]*, speaks back to a history of human exploitation and violence towards the animal. Breaking down the concepts that the human species use to rationally divide and differentiate humans from animals, Derrida draws attention to his own animality, his membership of the Animal Kingdom. *L'animal que donc je suis*, translates into English as 'the animal that therefore I am' and 'the animal that therefore I follow'. The latter meaning of the title refers to *Genesis*, which describes God's creation of the world beginning with animals, followed by man, Adam, followed by woman, Eve. Derrida challenges the chains of command in which rational man places himself and his needs at the top and exploits the other animals that, according to monotheistic creation narratives, preceded him.

Derrida begins the book with a description of his daily encounter with his cat. He recounts his shame whilst getting dressed in the morning in front of his cat, which looks directly at him and his penis. Derrida's embarrassment at having his 'member' exposed before another species provokes him to question whether the cat too is naked and whether it feels embarrassed in its self-exposure. He concludes: 'The animal, therefore, is not naked because it is naked. It doesn't feel its own nudity. There is no nudity "in nature"' (Derrida 5). Derrida suggests that by seeing himself naked through the eyes of an 'other' species, he is confronted with his own unknowable nature. As Gerald L. Bruns writes in his analysis: of the same passage: 'when it comes to the nature of the difference between himself and his cat … Derrida does not want to erase this difference but wants to multiply it in order (among other things) to affirm the absolute alterity or singularity of his cat' (Bruns 404). The human-animal other encounter between Derrida and the cat also, as Bruns notes, demands that the human ask the question, 'Who am I? (if I am not one of you, whoever you are)?' (Bruns 407). Derrida's encounter with the alterity of the singular animal other thus prompts a changed relation to self. I suggest that Cardoso sets up and preempts a similar confrontation between human spectators and penis sculptures that invite spectators to recognize the alterity and singularity of the harvestmen in ways that ultimately aim to change how we think about our own species and sexual difference.

Historically, science and philosophy erect a binary division between rational human and non-rational animal in order to preserve human exceptionalism and justify human exploitation of animals. Some critics of exceptionalism describe it as 'speciesism', the hierarchical ranking of species groups. Erika Cudworth describes speciesism as 'discrimination based upon species membership' (37), drawing attention once again to the idea of belonging and the social power of membership. Derrida attempts to break down this rational-non-rational dualism and expose the long history of animal sacrifice, slaughter and experimentation that such reasoning has condoned. Binary thinking has also been of key concern to ecofeminists because historically it has given rise to discourses that, as Derrida notes, always place women and children on the side of the animal (Derrida 57). Yet Susan Fraiman is critical of Derrida's inability to escape the binary dualism in *L'animal que donc je suis*. She writes:

> despite a number of such de-binarizing moves in 'Animal', I am riveted by the image of a self-consciously masculinized human, in his bathroom without a stitch,

> shamed by the gaze of a cat whose femaleness as well as realness is specified early on (see 'A', p. 375). Like the cat, I cannot help looking ('in order to see, with a view to seeing') in the direction of the narrator's 'sex' (Fraiman 95).

Fraiman is particularly critical of Derrida's decision to write about an encounter with the 'feminised animal' of the cat, the 'pussy', (a term that has the same pornographic connotations in French). She argues that while Derrida's cat is granted provisional subject status, it is only afforded a rational human specular gaze, rather than Derrida attempting to truly understand the point of view of the cat outside humanist terms. Fraiman does acknowledges, however, that Derrida might deliberately be framing the cat's gaze in this way in order to show the human inability to ever fully escape dualistic logics (96). This contradiction in Derrida's work is also a contradiction in Cardoso's sculptures that tread a thin line between the their celebration of phallic beauty and power and their critique of it. Yet it is this tension between the riveting harvestmen penises and the absent female genitals that, for this feminist spectator at least, evokes Derridian question: 'Who am I? (if I am not one of you, whoever you are)?'.

Derrida is particularly interested in the role that language plays in upholding binary oppositions and limiting the human conception of the nonhuman animal. He notes that even though the word *animal* exists in the plural, when it is used as an adjective it often describes a vastly heterogeneous group, such as the Animal Kingdom. He suggests that, 'There is no Animal in the general singular, separated from man by a single, indivisible limit. We have to envisage the existence of "living creatures", whose plurality cannot be assembled within the single figure of an animality that is simply opposed to humanity' (47). In thinking about 'the animal', Derrida takes into account heterogeneous creatures. He writes, 'there is an immense multiplicity of other living things that cannot in any way be homogenised, except by means of violence and wilful ignorance, within the category of what is called the animal or animality in general' (48). A categorising term such as 'Animal Kingdom' effaces the immense diversity of animals. Moreover, such a grouping elides the way in which our own species is not only dependent upon but co-existent with nonhuman species, what is sometimes called our multispecies existence. This is evident, for example, in our daily exchanges with other genomes such as the billions of good gut fauna that live in our intestines and keep us alive. Biologists Lynn Margulis and Dorian Sagan note that such exchanges can lead to heritable variation that is essential for adaptation and species survival (205).

The different forms of male genitalia displayed in Cardoso's harvestmen sculptures and prints confront spectators with their remarkable heterogeneity. Some of the penises are long and thin, others short and fat. Many of the penis heads resemble flowers, one with a large orchid-like stamen and smaller hair-like tendrils surrounding it, others like an Easter lily. Some take the shape of a trident wrapped in a petal while others have a hollow bowl-shaped hole at the end surrounded by tiny hairs. Biologists and taxonomists Glenn S. Hunt and Emilio A. Maury, who studied the harvestmen, describe the insect's genital variations in more scientific terms. They refer to the 'dorsal barb', 'dorsal plates' and 'bifurcating lobes' of the penises (Hunt and Maury 553). By contrast, Goodall describes Cardoso's representations as evoking 'the dream forms of a Dali or De Chirico painting' (53).

It's Not Size That Matters, It Is Shape (Intromittent Organs of 9 Tasmanian Harvestman) 2008-2009. Photo credit Penny Clay. Used with kind permission from the artist, Maria Fernanda Cardoso.

While the scale of the penises may invite momentary identification between the male human and insect species, what is most striking about Cardoso's work is its depiction of the wide variation between male sexual organs of species within the same *Opiliones* order. This display of male difference and variability offers an alternative to normative views of male reproductive biology as straightforward. As Goodall notes, 'An essentialist view of gender difference would be confused rather than reinforced by the kind of naturalism presented in Cardoso's works' (52). The essentialist gender differences in popular culture that posit men as 'from Mars' and woman as 'from Venus' are upset by an animal species that shows such a wide variety of differences amongst its own kind.

Recent responses to genomics research into human sex-determining chromosomes suggest that new scientific technologies and the discoveries they are facilitating do not necessarily transcend gender normative characterisations of female 'inscrutability' and male 'simplicity' (See for example: Dowd). When the DNA of the human sex determining chromosomes was fully sequenced for the first time, in 2005, the findings emphasised human gender differences rather than the similarities between men and women. The average human cell has 22 pairs of autosomal chromosomes and one pair of sex-determining chromosomes. Of the sex-determining chromosomes females generally have a like pair of XX while males tend to have a combination XY. The scientists behind the sequenced X and Y chromosomes—Laura Carrel and Huntington F. Willard—drew two significant conclusions from their findings. First, they suggested that one of the female X chromosomes previously thought to be inactive can 'escape inactivation', leading to 'a remarkable and previously unsuspected degree of expression heterogeneity among females' (Carrel and Willard 400). Second, they concluded that 'the female genome differs from the male genome in at least four ways' (Carrel and Willard 403), explaining these complex scientific differences in the technical language of genomics. In the findings, female genetic heterogeneity and complexity were presented alongside the more straight-forward expression of the male Y chromosome. The findings did not determine, however, how these genetic variations influence the phenotype, that is, the observable physical, physiological or structural characteristics/traits of male and female humans.

The mainstream media's reporting of Carrel and Willard's research used the findings to exaggerate the genetic differences between the sexes. *New York Times* journalist Maureen Dowd reported that 'women are genetically more complex than scientists ever imagined, while men remain the simple creatures they appear', affirming the cultural stereotype that '[w]omen are inscrutable, changeable, crafty, idiosyncratic, a different species' (Dowd). Playing into similarly essentialising gender characterisations, *Newsweek* journalist Fred Guterl claimed that 'women and men differ genetically almost as much as humans differ from chimpanzees' (Guterl 42). Science historian Richardson is critical of the way in which mainstream reporting on Carrel and Willard's research de-emphasised the fact that males and females share 99.9% sequence identity on the 22 autosome pairs and the X chromosome (828). She argues that the exaggeration of human genomic differences as grounds for the classification of male and female as separate species is problematic because it buttresses a 'traditional gender-ideological view of sex differences' (828). It also ignores or discounts the possibility of genetic diversity within a species (Richardson 829). As she points out, the ways in which we interpret the data generated by the genome maps of human and non-human species has ontological implications for how we view ourselves as a species (Richardson 828). I would add to this that the human interpretation of DNA (our own and the DNA of other organisms) also affects our attitudes towards and relations with nonhuman species.

For feminists and ecofeminists, philosophy and science are rooted in a patriarchal history that emphasises and exaggerates differences between men and women (Greer; Keller; Warren; Plumwood; Richardson). While Cardoso's sculptures do not focus on genetic differences, she is interested in showing how sexual difference can move beyond the limited gender binaries to which so much of our culture continues to ascribe. Looking around the 'It's not size that matters, it is shape' exhibition, however, it is clear that not only those of us who have two X chromosomes exhibit an 'unsuspected degree' of heterogeneity, but also that there is room for a great deal of morphological variation in the copulatory organs of many organisms.

Internal Courtship and Gendered Power Relations

The variety of penis shapes of the harvestmen also unsettles normative gendered power relations, which has implications for how we approach ethology, the branch of biology that studies animal behaviour. Hunt and Maury's research into harvestmen, which forms the basis of Cardoso's own inquiry into these species, suggests that the evolution of different penis shapes developed through attempts from the male to attract the female harvestmen. Building on the work of biologist William G. Eberhard, Hunt and Maury note that Eberhard explained the 'extravagant' genitalia of the harvestmen as a result of sexual selection by female choice. They write, 'male genitalia function as "internal courtship", devices to increase the likelihood that females will actually use a given male's sperm to fertilize her eggs rather than those of another male' (555). In this view of the development of the harvestmen penises, female mating choices and sperm competition determine male evolutionary morphological development. Hunt and Maury conclude that hypertrophy in the male harvestmen penises—the increased size of an organ through enlargement of existing cells—'may have evolved as a consequence of sexual selection' (551). They hypothesise that the ovipositor (the place where the eggs are developed) in the female harvestmen seems to have prompted elongation of the 'genital operculum'. They even propose that the 'extravagant' genitalia may stimulate the female prior to or during copulation (555), suggesting a sophisticated sexual foreplay conducted by the male harvestmen in order to entice the female into mating. Foreplay is usually associated with the sexual behaviour of the 'rational' human species or other complex mammals, who are considered by humans to be able to experience pleasure and pain.

The findings lead Hunt and Maury to conclude that the variations in the harvestmen penises are essential to the survival of the species (554). For the harvestmen, as for animals such as birds of paradise or the peacock spider, it is the male of the species who must attract the attention of a female in order to ensure he passes on his genes to the next generation. Cardoso's sculptures are also influenced by Eberhard's book, *Female Control: Sexual Selection by Cryptic Female Choice* (1996), which argues that 'cryptic female choice' in a range of species means that it is the female who makes the genetic selection in the reproductive process. Eberhard explains that sexual selection by 'cryptic' female choice means that the female can store and separate inseminated sperm from different males inside her, thereby selecting paternity according to particularly favourable male traits (7-8). The selection is 'cryptic' for both the scientist and the inseminating male invertebrate since the probability of a single male's reproductive success cannot be determined simply by the number of copulations with fertile females (Eberhard 8).

Goodall warns, however, that the evolutionary advantages of female sexual 'choice' that might be deduced from the variable forms of male penises in Cardoso's exhibition are not simply a reversal of gendered power in human social relations (53). She writes, '"The Museum of Copulatory Organs" is a revelatory study in natural form that confounds human assumptions about which gender is the tempter, which the predator, which the aggressor, and which the partner burdened with a requirement to attract through the excesses of display' (Goodall 53). The forms of male genital variation that Cardoso represents imply promiscuous females and a lot of sperm competition among the males. As noted earlier, the absence of these active females and their reproductive organs from the exhibition is somewhat troubling. Yet, given that the female of a species is often reduced to her reproductive function, her absence forces spectators to focus on the male desire to reproduce.

Furthermore, the sculptures show spectators how other species in the Animal Kingdom have heterosexual courtship rituals that are different from the human species in the modern era when the onus of beautification predominantly falls to the females to stand out from the rest of the female 'competition'. For the human species, however, such beautification has not developed through evolutionary, biological differences but, rather, through gendered *cultural* and *social* expectations and repetitions. Unlike the harvestmen's 'extravagant' penises that ultimately serve the function of species survival, the means of attracting a mate through dazzling displays in the female human species are not bound to the same kind biological determinism. Rather, the artwork's allusions to the morphological evolution of the male harvestmen might remind spectators that gendered human courtship practices are culturally and socially learned and therefore alterable.

Tying the Knot: Organism, Technology and Matter

Common popular characterisations of DNA as a 'blueprint' or 'master plan' privileges the role played by genetic 'code' in an organism's development. Such a view de-emphasises the ways in which an organism or distinct branches of species often develop due to broader interactions with their environment. Donna Haraway is critical of the ways in which 'gene fetishism' can shape human perceptions of living matter as merely 'derivative' of DNA (1997 133). Stacy Alaimo similarly argues that gene fetishism plays into notions of human mastery and human dominance over nature through the notion that scientists can flick on and off desirable/undesirable traits. Privileging the importance of genetic code in biological development also enables humans to ignore the multiple material agencies and the unpredictable transformations that living forces can effect (Alaimo 150). Challenging gene

fetishism, biologist Scott Gilbert argues that all things in the biological world are in a reciprocal relationship with one another, an always-in-process in 'cascades of inter- and intra-action' (in Haraway *When Species Meet* 32). Supporting this view, Haraway describes organisms, including humans, as a 'knot' of species that co-shape one another (*When Species Meet* 42). She notes that geneticists often contribute to the perpetuation of gender binary stereotypes, writing that, 'Partly because of the widespread cultural belief, too often fostered by scientists themselves, the genes-as-code determine everything in biology, just as a program is determined by its code, the complexities of development are given short shrift…' (Haraway 2008 137). On the contrary, Cardoso's sculptures and prints celebrate the 'complexities of development'.

The variety of shapes represented in the exhibition challenge ideas of pure genetic determinism. If Carrel and Willard's discovery of a 'remarkable and previously unsuspected degree of expression heterogeneity among females' (400) could speak to Cardoso's representations of phenotypic diversity in the harvestmen copulatory organs, we might complicate a long history of science that exaggerates sexual difference between men and women, humans and animals, organic and nonorganic.

DNA is not visible to the naked human eye and yet our ability to study and represent the genome is having profound effects on how we see and think about our own and other species. Cardoso's sculptures are also interested in those parts of living organisms that are barely visible to the naked human eye. The use of new computer technologies in biology to store, organise and interpret data is changing how we understand life (Stevens 11). In order to create the works for the show at Arc One Gallery, Cardoso relied on new technologies to see the harvestmen clearly and make visible to the public those parts of the insect that are impossible to see without scientific equipment.

To make the work, Cardoso collaborated with microscopist Sue Lindsay at the Australian Museum Electromicroscopy Unit. Lindsay re-imaged the harvestman penises using the latest Electronic Microscope Scanning technology which shoots out electrons and uses the photons bouncing off the specimen to generate 2D black and white images (Buiani and Genosko np). Cardoso then employed a young industrial design studio in Sydney, Vert Design, to make the 3D computer models of the harvestmen specimens. Working with the artist, Vert Design used their 3D modelling technologies in ways they had previously not thought possible. Without these new technologies and Cardoso's collaborations with people trained to operate them, the scientific accuracy of the sculptures and prints would not have been possible. Her use of electronic microscope scanning to create enlarged images of the penises, the computer modelling and 3D printing to create the sculptures and thus re-materialise the object at a different scale, suggests some of the ways in which art and science are both engaging with new technologies and creative thinking to alter representations of the world.

In the twenty-first century, human animals, nonhuman animals and matter alike are enmeshed within technological processes (Parikka). While our lived experiences of environmental change frequently remind us of the impact of human technologies on nonhuman ecosystems, the influence of nonhuman forms, functions and assemblages on technology is less well recognised. Jussi Parikka's study of the relationship between insects and technology shows how insects are influencing the most high-tech developments in contemporary culture—the American military, media, communication and digital design (11). He traces what he describes as the 'cybernetic loops between machines and animals' to reveal how new technologies make use of insect formations of nonlinearity, network-oriented models of action and simulations of swarm behavior (xxxii).

Cardoso's examination and reproduction of insects using new technologies also draws attention to the ways in which species exist within a broader technological environment of genetically modified food, medical science, scientific exploration and the development of new military weapons. In particular, Cardoso's focus on reproductive organs reminds spectators of the role that technology plays today in reproduction in human and non-human animals in IVF, artificial insemination, genetic manipulations, prenatal screenings and designer babies. As Donna Haraway notes in *When Species Meet*, '[W]e are inside the histories of IT engineering, electronic product assembly-line labour, mining and IT waste disposal, plastics research and manufacturing, transnational markets, communications systems and technocultural consumer habits. The people and the things are in mutually constituting, intra-active touch' (6). Haraway suggests that new technologies are not only reconfiguring human-animal relations today but also further consolidating the inextricable relationship of human-animal-machine that she theorised in the 1980s as 'cyborgs' (Haraway 2003). As clear distinctions between the organic and the technological break down, Haraway describes 'the infolding of the flesh that powerful figures such as the cyborgs and dogs I know both signify and enact' (8).

While the history of human-nature relations has tended to use technology to further exploit the nonhuman for human convenience, in Cardoso's artistic practice, the 'infoldings' of flesh and technology might be understood as either subverting or perpetuating such traditions. On the one hand, Cardoso uses the animals, mediated through technology, to create beautiful sculptures for human aesthetic pleasure and to tease out a human curiosity about sex, reproduction and sexual organs. On the other hand, she uses the convergence of animal-technology to educate spectators about this ordinarily abject or invisible living organism using forms that aim to incite human empathy, an attitude of care and ethical responsibility towards creatures ordinarily considered 'inconsequential'.

Cardoso's work uses new technologies to alter our perspective of nonhuman and human species. Her work shows how technology can expand the capacity of human observation and facilitate new ways of understanding ourselves and the biosphere in which we are enmeshed. The materiality of the resin sculptures suggests to spectators that the latest technologies in 3D modeling and printing can bring about new insight and knowledge of the harvestmen species. This new way of seeing harvestmen provides an alternative to the most common and exploitative human-animal-technology interactions in the twenty-first century.

Conclusion

Art and science shape the kinds of narratives that we generate around our own and other species. Cardoso's exhibition invites us to take an intimate look at an Australian animal species that is largely unknown to the general public. It playfully invokes the human animal's cultural obsession with penis size, but in so doing it raises a number of other important challenges to normative understandings of how biology colours ontological perspectives along gendered lines and thus impacts on broader gender relations. As genomics develops, scientists play an increasingly influential role in how we see, document and interpret genotypes and phenotypes. As shown, the results of this research, or their popular interpretations, can often continue to reinforce traditional essentialising gender stereotypes. As technology advances and our understanding of the natural world broadens, Cardoso's sculptures of invertebrate reproductive organs challenge us to be a little more flexible in how we think about membership of a particular species. Human exceptionalism is tested by Cardoso's anthropomorphising of the harvestmen and by her enlarging of the 'members' to a human scale. The sculptures invite us to see what Derrida would describe as the 'naked truth' of each organism's singular alterity.

The intricate, unusual and varied forms of the harvestmen penises offer an alternative to the hetero-normative dualisms of male-female courtship, reproduction and sexual difference.

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