European Honeybee: Interconnectivity at the Edge of Stillness

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Abstract: *During an artist residency at the Visual and Sensory Neuroscience Group, Queensland Brain Institute (QBI), art/science practitioner Trish Adams observed a range of experiments. Scientists at the QBI describe on the website that they seek to 'better understand how the eye and brain solve complex visuomotor tasks' (Queensland Brain Institute) through investigations into and analysis of the behaviours of the European honeybee. During this residency, Adams' research project evolved in response to her personal experiences in the largest indoor bee facility in Australia. Here, without protective clothing, Adams was surrounded by the honeybees as they flew around freely in the large custom-built space. This article takes the form of a creative discussion of the artist's immersion in this unusual research environment and the emotions generated by such close proximity to non-human others. Beginning with a short overview of the evolution of science as a discreet discipline, followed by a general outline of the field of art/science research, Adams introduces her artwork: machina carnis and the microscopic study of cellular 'life' that led her to the QBI. Subsequently, significant aspects of her artworks HOST and Urban Swarming are examined in the context of art/science practice as a whole and as illustrations of Adams' continuing close engagement with the honeybee.*

Keywords: *honeybee, cellular life, personal experience, creative practice*

Introduction

This paper begins by outlining the emergence of the disparate disciplines of art and science and the protocols that typify scientific practice. This is followed by an analysis of the complexities inherent in the burgeoning field of art/science research practice; in particular the evolving methodologies and inter-disciplinary paradigms that foster productive, collaborative outcomes. As the art/science thematic unfolds, it is linked to practical examples of art/science collaborative methodologies in the artworks *machina carnis, HOST* and *Urban Swarming* (Adams).

During the *machina carnis* project, close observations of cellular behaviours at a microscopic level in a biomedical science laboratory motivated me to undertake an artists' residency at the Visual and Sensory Neuroscience Group, the Queensland Brain Institute. Here, scientists explore cognition in the honeybee in order to 'better understand how the eye and brain solve complex visuomotor tasks'. Honeybee behaviours are closely observed, with particular reference to the collision avoidance strategies they employ. Whilst these laboratory experiments were both informative and fascinating, it was the proximity to the live honeybees that became the focus of my project.

Evolution of 'Science' as a Discipline

The evocative term 'natural philosopher' was adopted in the early modern period to describe groups of investigators with wide-ranging fields of interests in the natural environment. These groups were diverse, including such individuals as provincial manufacturers, professional men and gifted amateurs. In the nineteenth century, this eclectic approach began to lose favour, giving way to the emergence of the separate disciplines that we have come to know as 'art' and 'science'. Scientific research took on a more distinct, epistemological foundation and the term 'scientist' was introduced. Recognized as one who engages in a systematic activity to acquire knowledge, the 'scientist' pursues so-called scientific rigour that privileges objectivity and analysis, thus establishing the universal scientific research methodologies still practiced today.

Developments in technology have fostered the progress of scientific research, with a plethora of sophisticated new machines enabling today's scientists to investigate hitherto impenetrable areas such as the brain. In what might be regarded as an early forerunner of contemporary attempts to quantify humanness through the mapping of the human genome, scientists in the early nineteenth century embraced the arrival of electricity – the new technology of the day – as the tool by which they hoped to isolate and quantify our 'humanness'. A variety of electrically-powered machines were developed with which to probe, measure and record physical responses through galvanics. These radical new pieces of experimental equipment facilitated the detailed exploration and analysis of previously undetermined individual components of humanness and corporeality, collectively known as the 'vital force'. The Italian physicist Carlo Matteucci was one such pioneering scientific researcher. In 1836 he carried out experiments using the newly invented 'kymograph' to measure bioelectricity in the 'rheoscopic' frog's leg (Matteuchi).[1] I created parodies of these early scientific experiments by using a range of discarded scientific machines that combined the obsolete technologies with what was, in 2003, the burgeoning field of the internet. These quasi-scientific interactive installations involved remote participant access, enabling them to engage in the transmission of the non-corporeal 'self' in the form of information flow over distance (Adams). These artworks mark the beginning of my research into the corporeal self in relation to developments in the biomedical sciences, constructs of corporeality and – most significantly in the context of this article – the slippery boundaries between human and non-human.

Art and Science

British scientist and novelist C. P. Snow is regularly cited for his seminal discussions on the potential intersections of what he referred to as the 'two cultures' of art and science. The debate continues as artists, scientists and cultural critics consider whether, with their separate cultures, approaches and practices, art and science can really intersect and 'talk' to each other (Munster).

Attempts to evaluate art/science collaborations – the question of whether or not artists can actually contribute meaningfully to scientific research – continue. If the role of artist in laboratories is judged using the criteria that govern scientific research processes then it is

realistic to suppose that contributions by artists might be perceived as quite limited. After all, in this context, artists are untrained participants in 'cutting edge' fields of specialist scientific research. Scientific researcher and new media artist Stephen Wilson assessed the extent to which artist-researchers might contribute to techno-scientific debates as follows: 'scientists and technology researchers who have devoted their entire professional lives to educating themselves about topics being investigated might be sceptical … (can) artists learn enough to engage in research at a non-dilettante level?' However, Wilson's judgement does not take into account the fact that art/science collaborations fall into a different category from hard scientific research and therefore should not be evaluated using scientific paradigms. It is necessary to consider the essence of contemporary art/science collaborative practice and assess what the shared methods, experimental focus and outcomes of such projects might be. If one then looks at art/science collaborations from a perspective outside the constraints of 'pure' scientific research – positioning them in a developing field that endorses hybrid outcomes that are unique to art/science collaborations – then spaces immediately open up for artists and scientists to collaborate in novel and fruitful ways.

This point of difference is summarised particular clearly by Victor Nurcombe, my scientific collaborator on the *machina carnis* project. His invaluable response to Wilson's 'dilettante' query was:

> I don't see the collaboration between you and I as anything like as quotidian as 'research at a non-dilettante level'. It could only really be considered as 'research' as I understand it, at a much more esoteric level; I would have thought we set out to do something quite 'other', something more open-ended. Research with other scientists is usually extremely focused and conducted within tight parameters; it's not about possibilities so much as progressively excluding as many possibilities as possible. Our work was conducted much more in the spirit of 'what if?' (Nurcombe)

In the light of this shift in perspective, it can be argued that looking outside the rigid disciplinary constraints that typify scientific research and embarking on the type of open-ended collaborative methodology described earlier by Nurcombe can in fact foster hybridity in both process and outcome which can lead to the creation of 'something quite "other"'. This can be viewed as an entirely different cross-disciplinary engagement, where the artist and scientist are sharing non-

traditional, collaborative methodologies in an investigative and pioneering spirit of 'what if', reminiscent of the erstwhile natural philosophers.

Art/Science Collaborations Evolve

Following on from this brief introduction to the historical origins of science as a discipline and the unconventional methodologies that foster intersections between art and science, this discussion will continue by expanding upon contemporary art/science collaborative methodologies. This will, of necessity, also be a generalized, brief introduction, with a particular focus on situating my research practice and the three artworks under discussion in the wider art/science research field.

It can be a long and complex process establishing the types of relationships necessary to develop the trust and communication that underpin successful art/science collaborations. Fostered by mutual respect, these working collaborations typically demonstrate permeable inter-disciplinary membranes and an awareness of organic processes. SymbioticA, the designated art/science unit at the University of Western Australia, has done much to support such connections. In the contemporary context of experimental art, there are an increasing number of individual artists whose practices now focus on embodiment and biotechnology (SymbioticA) and as a consequence new methodologies have been developed to guide their highly experimental and unconventional research.

Interspecies Entanglements

Whilst it has been suggested that animals, like humans, can be emotional, empathic, and moral beings, an in-depth discussion of animal rights, empathy and ethics is beyond the scope of this paper. However, a pertinent line of enquiry that has acted as a catalyst in the field of art is found in the writings of feminist biological science historian and cultural theorist Donna Haraway. In her highly influential 'Cyborg Manifesto', Haraway proposed the mythical, futurist cyborg as a non-sexed, non-gendered entity-position. The value of Haraway's work to artists adopting a critical stance concerning bio-techno-determinism lies in its emphasis on specificity and

situatedness in relation to fluidity, and the capacity of hybridity to interrogate predominant networks. In *When Species Meet*, Haraway moves beyond the cyborg, which became a landmark, quasi-anthropomorphic, techno- animate icon, to discuss her close relationship with dogs. This new association led her to contradict human exceptionalism with the view that we are all species 'becoming' with each other. Interestingly, there are contrasts and parallels between Haraway's book and *The Others: How Animals Made Us Human* by the ecologist Paul Shepard. Shepard wishes to enter the world of wild animals, whilst Haraway endeavours to bring animals into the domain of human society. Despite various other points of difference, both authors are, in their respective ways, trying to overcome the duality between human and non-human realms.

In her recent research, feminist theorist Karen Barad writes that in her view, 'posthumanism…is not calibrated to the human; on the contrary, it is about taking issue with human exceptionalism while being accountable for the role we play in the differential constitution and differential positioning of the human among other creatures' (87). It is this expanded positioning of the 'human amongst other creatures' that has opened the way for me to incorporate both insects and cellular organisms within the gamut of 'living creatures' (88). My responses to observing the apparent sentience of my cardiac cells *in vitro* under the microscope are described more fully in the following section.

Machina carnis

In 2001, a feature article in the journal *Science* highlighted the landmark 1999 discovery that some pluripotent adult stem cells could 'change fates', to employ the scientific phraseology, and become other types of cells. The implication was that this was significant enough to be regarded as the 'scientific discovery of the year' (Vogel, 2238). Curiosity about the apparent potential to modify the human body through biotechnology underpinned the development of my art/science collaboration at the laboratory of biomedical scientist Victor Nurcombe.[2] The intention was to take adult stem cells from my un-screened blood and change them into beating cardiac cells *in vitro* in the laboratory.

In the tightly regulated environment of conventional scientific processes, my innovative research project was problematic. It involved unconventional methodologies and the use of

experimental materials from my own body – an approach that was personal, subjective and highly experimental in both the arts and the sciences. In particular:

1. My first-person methodologies contravened accepted scientific protocols, although there have in fact, over the centuries, been a number of scientific precedents for this (most recently the landmark case of the Australian Nobel Prize winning scientist, Barry Marshall, who swallowed helicobacter to prove that bacteria, not stress, cause stomach ulcers).[3]

2. I planned to experiment on my own unscreened human blood. The University Ethics Committee deliberated for almost a year before eventually granting ethical clearance. In the end, the clearance process was expedited by the fact that the University of Queensland School of Human Movement had protocols in place for doctors to collect athletes' blood on a regular basis. This provided a convenient, ratified place for the collection of my blood sample, finally enabling the experimental *machina carnis project* to proceed (fig. 1).

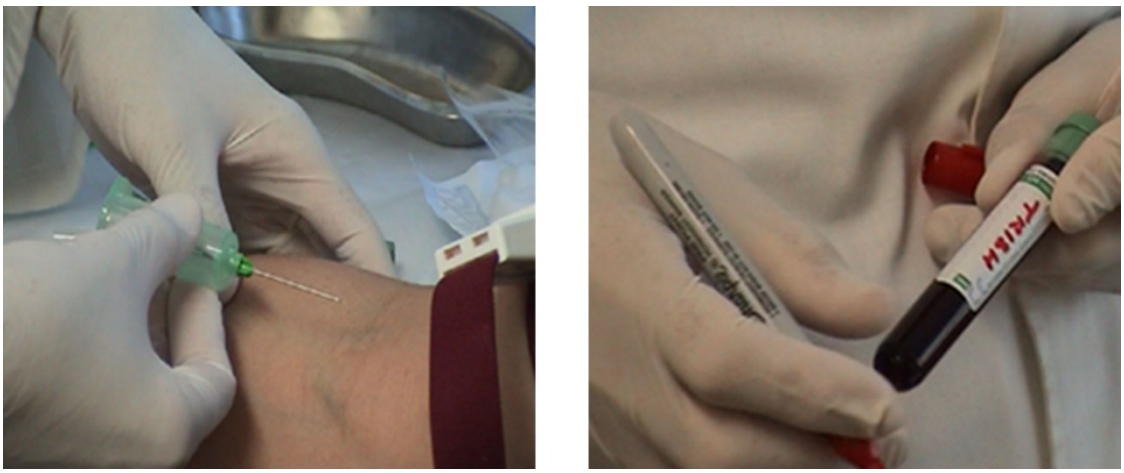

Fig. 1. A doctor in the human movement laboratory takes a sample of my blood

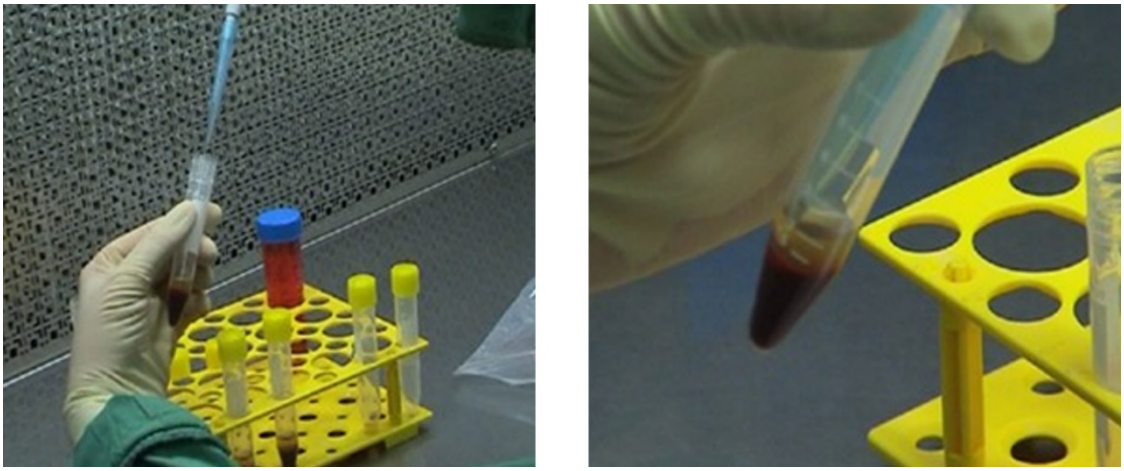

Fig.2. Washing and separating the stem cells from the rest of my blood in the laboratory

After my blood sample was taken, without delay and packed in ice, it was carried across campus to the laboratory in the School of Biomedical Sciences. Here it was washed and spun three times to separate the stem cells from the rest of the blood (fig. 2). When the adult stem cells were first placed in culture they were still disturbed by leaving my body, and also by the washing and spinning process. In response to these disturbances the cells became withdrawn (fig.3 day 1). After three days in culture, however, the adult stem cells had recovered and acclimatised to the different environment sufficiently for Nurcombe's copyrighted chemical mix to be added in order to 'change their fates' from undifferentiated adult stem cells into cardiac cells (fig. 3, day 3). As an artist, gaining access to this specialised technology represented a rare opportunity to work at the cutting edge of scientific research within an art/science, cross-disciplinary context. Nurcombe's chemical mix contained the drug 5'AZT and a mixture of cardiac differentiating factors, with one patented ingredient. When this unique chemical mix was added to the cells they reproduced, matured and began to develop characteristics of heart cells (See fig. 3, days 5 and 7). Each cell has a signature combination of proteins with a fraction of DNA. In the case of heart cells they are drawn to each other to cluster and synchronise their beating. The recognition modules on the cell's surface membranes 'interdigitate' or link 'gap junctions', like 'open portholes'.

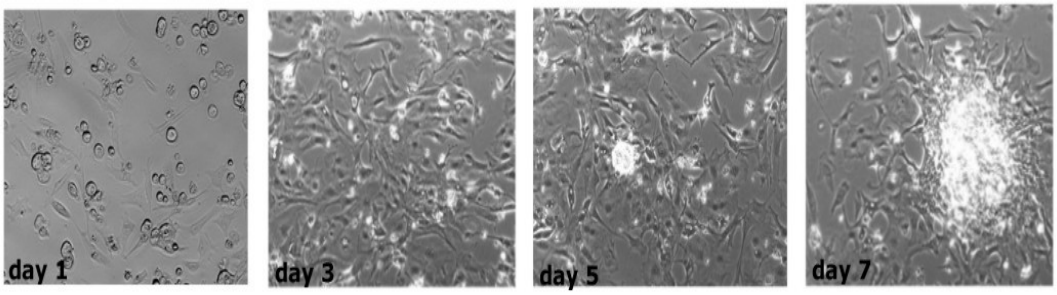

Fig.3. Digital videomicrograph still images of my adult stem cells in culture taken on days 1, 3, 5 and 7. Note how the white cluster of developing cardiac cells forms in vitro over time.

These close observations of my own cells living *in vitro* outside the body gave me a new perspective on 'life' at a microscopic level and provoked my intense curiosity about the apparent sentience of these cells as they reacted to their environment beyond the naked eye.

Significantly, during the experimental processes, both Nurcombe and myself found that we used anthropomorphic terms such as 'like' and 'dislike' to describe the cellular reactions we observed. Enlightening contributions to cellular life and behavior have been made by the Chilean biologists, Humberto Maturana and Francisco Varela, who have formulated a model of life systems in which cognition is understood as a biological process. In their groundbreaking research in defining the self-maintaining chemistry of living cells, they introduced the term 'autopoiesis' to classify the fundamental dialogue between structure (brain) and function (process) (Capra). Systems theorist Frijof Capra points to the importance of the concept of 'autopoiesis' as a central insight within Maturana and Varela's Santiago theory of cognition. Here, Maturana and Varela refer to circular, self-sustaining 'autopoietic' processes of 'self-organisation' which connect the process of knowing with the process of life in even the simplest of cells. Observing the behaviour and apparent sentience of cells at a microscopic level led to further queries about their status as living entities. Research suggested that at every stage, mind and matter, process and structure appeared inseparably connected.

This construct of self-referential biological systems and the processes of a living organism were parodied by the configuration of the *machina carnis* installation itself, where the experimental design of the installation employed contemporary, programmed technology to enable participants to interact in the role of essential components in an autopoietic system. Each viewer functioned as a participant who completed the organism whole through their

engagement. The system consisted of a touch pad under the viewer/participant's head that brought the artwork to 'life' when each participant lay down. When the viewer/participant located their heart with the modified stethoscope, the video of the cardiac cells began to play on a monitor above their face. The short cardiac cell video loop was programmed to beat in time with each particiant's heartbeat, whilst the sound of these heartbeats was heard around the exhibition space (fig. 4).

Fig.4. A machina carnis participant locates her heart with the programmed, modified stethoscope. She listens to its beating and watches the video of the heart cells beating in time with her own heartbeats.

HOST

In the hopes of gaining an increased understanding of cellular 'sentience', I moved from the biomedical sciences to neuroscientific research and became artist in residence with Mandyam Srinivasan and the Visual and Sensory Neuroscience Group, who investigate cognition and community behaviors in the European honeybee.[4] The Visual and Neuroscience Group carry out experiments in largest indoor bee facility in Australia, where protective clothing is not routinely worn whilst the honeybees fly freely all around. Having previously been wary of getting stung by honeybees this experience was challenging at first; however, I gradually acclimatised to this environment. Indeed, my responses to this unexpected interspecies proximity became the subject of the video *HOST.* I was able to utilise the scientific equipment in the laboratory, namely the fast-capture cameras, with which my scientific collaborators documented the bees feeding on the human hand in slow motion, captured at 250 fps.

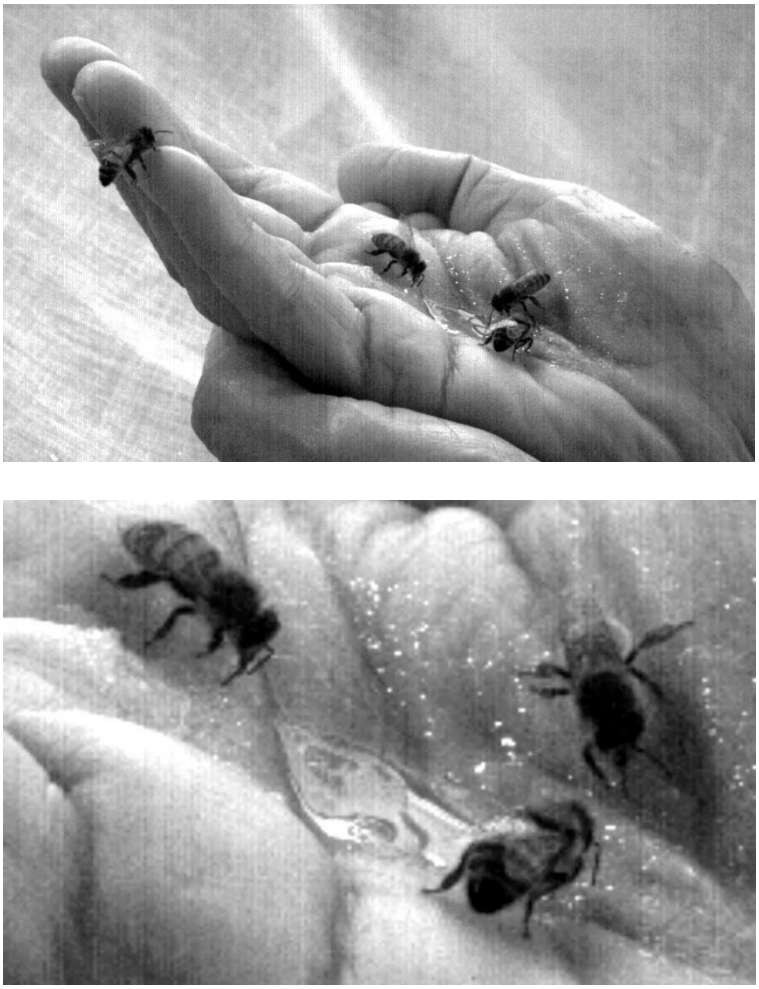

Fig. 5. Video stills from HOST showing the honeybees feeding on sugar water in the palm of my hand.

For this artwork, the scientists trained the honeybees to come and feed on sugar water placed in the palm of my hand (fig. 5). When the bees landed on my hand to eat they entered into an unusual symbiosis with a human being – a poignant example of interspecies contiguity. In close-up shots in the video, *HOST,* my hand looks disproportionately immense in relation to the insects' bodies. Although the human remains vulnerable since the bees can sting at any moment, the bees also appear vulnerable as they stumble over the alien, fleshy terrain of my magnified human hand in search of food. This emphasis on interspecies dependence and mutual vulnerability provides a stark reminder of the current world-wide crisis in honeybee populations caused by Colony Collapse Disorder (CCD) which is taking its toll of honeybee communities

and threatening to wipe out the honeybee altogether (Walsh). Briefly, CCD is endangering honeybees worldwide, although it has not yet reached Australia. The cause is not fully understood but it is thought to be over-farming, use of pesticides, the varroa mite or a combination of all of these three issues. As CCD becomes more pervasive and whole communities of honeybees are being exterminated, human society is finally becoming aware of the vital role honeybees have in the food chain. For centuries, we have depended on the part they play in fertilizing crops and without this we stand to lose numerous foods from our current diet.

Whilst *HOST* does not make direct reference to this situation, it does draw attention to the closely linked, delicate, ecological balance of human and honeybee. During the documentary filming for *HOST,* the honeybees moved over my hand without fear, focusing on the food reward available to them in what media theorist Jussi Parikka refers to as an environmental and affective continuum in which honeybees are apparently able to sense their environment through their bodies (191). This intense interspecies proximity is affecting. In *HOST*, the honeybees are no longer seen as an alien and antagonistic 'non-human other' but as purposeful and also vulnerable co-inhabitants of our shared environment.

Urban Swarming

I have described the characteristics of my close engagement with the honeybees during the creation of HOST, but of course I was also aware that honeybees can manifest aggressive behaviours. As I understand it, such behaviours are defensive, or passed down by an aggressive Queen bee. I was interested in observing these aggressive responses which formed such a stark contrast to my relationship with the honeybees in the first part of my residency and could be viewed as a metaphor for the danger of honeybee extinction due to CCD and ecological damage as a whole.

When documenting aggressive responses, fast capture cameras are employed once again. Observations of these aggressive behavioural responses take place in a laboratory that is isolated from the university campus and housing; obviously the scientists in this facility wear protective clothing.

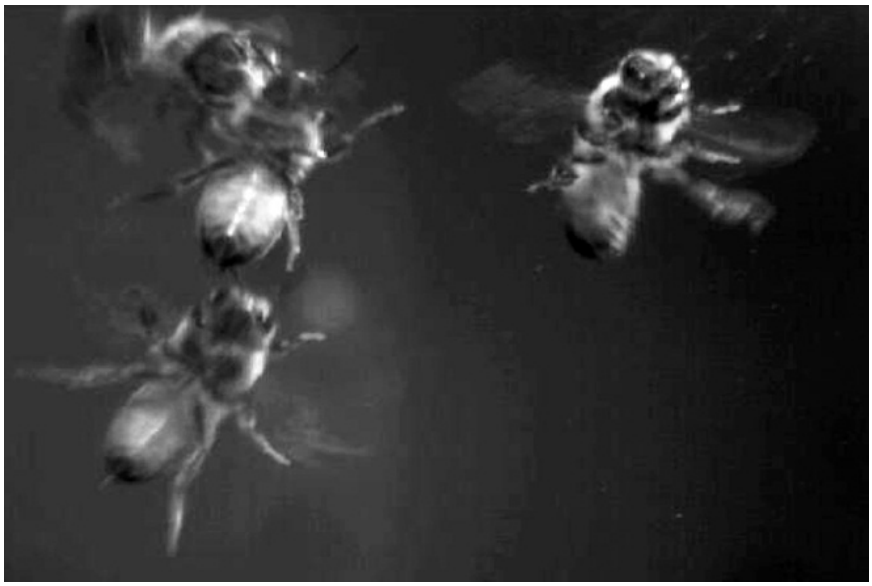

Fig. 6. A still from the documentary footage of the aggressive bees. Note the stinger protruding from the end of the abdomen of the bee at the bottom left.

From my perspective, the aggressive honeybee behaviours were also reminiscent of inner-city crowds. For me, the desperate honeybee behaviours evoked images of the crowded mass of the urban population, scurrying hither and thither at rush hour; both humans and honeybees exhibiting mindless – possibly doomed – behaviours.The artwork *Urban Swarming* evolved as a metaphor for this construct, a comment in what for many has become an alienating, unnatural metropolitan environment.

In order to enable viewers to explore these issues in a busy inner city environment the artwork, *Urban Swarming,* is situated outside the gallery context. The artwork contains the video *a space to cross* (fig. 8), created using footage of aggressive honeybee behaviours, which is accessed via the ubiquitous technology of the QR Code (fig. 7)

Fig. 7. The active QR code

Once the artwork has been accessed via QR Code, scanned from signage, the video and sound are downloaded onto the viewer's iPhone, or any other 'smart' device. This creates an intimate, intense viewer experience as the participant experiences the work on their personal small screen and headphones. In this way participants become immersed in viewing and listening to the video whilst in an urban environment. In addition, when viewed on a small screen, the images of the bees give the impression that they are actually being held in the viewer's hands.

Fig. 8. Video stills from a space to cross

Conclusion

After a brief overview of the divergence of art and science as disparate disciplines, some developing methodologies for art/science collaborations have been outlined in the context of the experimental creative format of the three artworks discussed. The main focus has been on quantifying strategies for fruitful intersections between art and specialist scientific research that, in turn, generate multifaceted and productive cross-disciplinarily, hybrid outcomes. Considerations of what it might mean to be human and the nature of corporeality have also included an expanded concept of inter-relationality and interspecies connectivity within both the biomedical sciences and neurosciences. Observations of the behaviour and apparent sentience of cells at a microscopic level have led to a realisation that many living organisms share basic characteristics and living systems. From this perspective, beginning with cellular behaviours, the boundaries between different categories of living species become increasingly blurred and entangled. In response to these observations, inter-relational pathways and connections moved beyond customary categorizations and environments and traversed the increasingly permeable membranes revealed by experimental art/science research practice. Paradigms for meaningful collaborative intersections between art and science have illustrated the importance of open-ended methodologies and the concept of hybrid outcomes in this field of experimental, contemporary cross-disciplinary art/science research practice.

Notes

[1] 'Rheoscopic' literally means: 'current flowing fluid'. In the case of the frog's leg, Matteuchi was able to trace and record on the kymograph the bioelectricity flowing through the frog's tissues which was making the frog's leg twitch even though it was dead (Matteuchi).

[2] I am deeply indebted to Professor Victor Nurcombe for his expertise and support during my 'machina carnis' project. Without his participation and direction I could not have undertaken the project. He has left the University of Queensland and now works in Singapore.

[3] In the nineteenth century dentists began the practice of self-experimentation and this experimental approach has usually been adopted by scientists in extremis, who carry out research on themselves in order to prove a point. In the case of Barry Marshall, who swallowing the bacteria himself was his only recourse to break through the hegemony held by the drug companies, who stood to lose large amounts of money if his theories were proved correct ('Nobel for Stomach Ulcer Discovery').

[4] Professor Mandyam Srinivasan provided me with invaluable access and support during my part-time residency with the Visual and Sensory Neuroscience Group, The University of Queensland. In addition I would like to thank scientists Carla Evangelista, Peter Kraft and Niko Leibsch for their support and assistance during my research at the Visual and Sensory Neuroscience Group.

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