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What happens to Thought in a Cyborg Body? On *Brain ships*, embodiment and posthuman gest

Abstract:

This article uses some of the complexities occasioned by the beings Anne McCaffrey envisioned as ‘shell people’ – cyborgs whose inert bodies are encased in titanium shells while the spaceships that surround them become bodies proper – in order to address some key theoretical issues with the relationship between Thought, embodiment and plasticity. It borrows from Catherine Malabou’s work on neuronal plasticity and cerebrality, as well as Deleuze and Guattari’s critical engagement with the brain and their de-hierarchicalized and decentred vision of body-brain/brain-body relations from *Cinema 2* and *What is Philosophy?* It brings these discourses into closer contact with machinic ‘assemblages’ in both Deleuze and Guattari’s sense, and one rather closer to posthuman interpretations of the term. It aims to rethink the ‘gest’ of such assemblages to consider the (oft excluded or repressed) place of the body in these kinds of becomings. It attempts to answer, ‘what happens to thought in a cyborg body?’ while at the same time considering how that thought is materially given greater complexity by the assemblage that constitutes it as something other than a molar unity.

‘Give me a body then’: this is the formula of philosophical reversal. The body is no longer the obstacle that separates thought from itself, that which it has to overcome to reach thinking. It is on the contrary that which it plunges into or must plunge into, in order to reach the unthought, that is life. Not that the body thinks, but, obstinate and stubborn, it forces us to think, and forces us to think what is concealed from thought, life. Life will no longer be made to appear before the categories of thought; thought will be thrown into the categories of life. The categories of life are precisely the attitudes of the body, its postures.

(Deleuze, 1989: 189)¹

You know – technology wasn’t invented by us humans. Rather the other way around.

(Lyotard, 1991: 12)²

Introduction: (cyborg) bodies, brains and thought³

The quotation above is how Gilles Deleuze begins a chapter of *Cinema 2: The Time-Image* entitled ‘Cinema, Body and Brain, Thought’, although this thinking does not reach its full development there, rather in Deleuze and Guattari’s later *What is Philosophy?* in addition to the posthumous *Immanence: a life*.⁴ This article focuses on questions of posthuman technicity and relationships between Thought and embodiment. It does this by taking seriously the beings imagined in Anne McCaffery’s *The Ship Who Sang*⁵ and the subsequent *Brain Ship* novels and stories as thought experiments in order to address Deleuze’s demand to ‘give me a body’. By considering the potential consequences for embodiment and Deleuze’s notion of ‘gest’ of having, or being ‘given’, a very different kind of body, I aim to first explore the consequences for Thought of a cyborg non-anthropocentric body and then fold this back to question presumed universality in discourses about embodiment. Deleuze and Guattari’s reformulations of the relation between ‘Body and Brain’ are the launchpad for this analysis. A point to which we will return shortly.

McCaffrey’s ‘brain ships’ or ‘shell people’ are cyborgs, inert human bodies encased in titanium shells to become ‘assemblages’ with their (space)ship bodies. What is interesting about these

shell people is that they are imagined as severely disabled newborns who are provided with titanium shells to support their autonomic functions, and sensors and mechanical tools to interact with the world around them, eventually becoming integrated into spaceships that then form their bodies *per se*. Donna Haraway famously highlighted *Ship* in her 'Manifesto for Cyborgs' as exploring 'the consciousness of a cyborg, hybrid of girl's brain and complex machinery, formed after the birth of a severely handicapped child. Gender, sexuality, embodiment, skill: all were reconstituted in the story'.⁶ However, Haraway, like many of the critics who have followed her interest in McCaffrey's stories, offers a paragraph of intriguing comment before passing on from *Ship*'s 'prefeminist' mashup to more productive 'feminist science fiction' proper.⁷ Later analyses have tended to find McCaffrey's tale wanting as regards reconstituting gender and sexuality.⁸ N. Katherine Hayles's scepticism on this front and dismissal of McCaffrey's *Ship* stories as a 'cybernetic romance' certainly fit within this 'prefeminist' characterisation; however, beneath the tendency to efface and domesticate how 'human subjectivity [might...] differ from cyborg subjectivity', I would argue that the *Brain ship* stories do provide ways to rethink cyborg thought, subjectivity and especially embodiment.⁹ A key difference between Haraway's reading and Hayles's is that Haraway views the titular Helva as a being akin to an assemblage rather than merely 'installed' in the control panel. While gender and disability have been explored in the years since Haraway's manifesto pushed *Ship* to greater critical prominence, scant consideration has been given to the questions raised for embodiment by the stories. (Indeed, the most focused studies of brain ships have been from the perspective of disability studies). This article will use McCaffrey's tales of beings whose supplementary (technological) ship bodies are far more valuable to them than the remnants of their encased inert biological bodies to help rethink and further explore the plunge into the unthought of which Deleuze writes in the epigraph to this article. To this end, I will fold and refold Deleuze's arguments on body-brains and brain-bodies into and through McCaffrey's stories, using the particular cyborg configuration which the brain ship stories provide to analyse moments of posthuman subjectivity being 'reconstituted' in relation to embodiment and neuronal plasticity.

In the passage cited above Deleuze's gesture is specifically that of a reversal, not an inversion: I would argue that many cognitive interpretations of embodiment, for instance that which has been the dominant discourse in cognitive linguistics,¹⁰ actually invert Cartesian dualism by making the body the source of frames of reference or categories which are then implicitly raised up as transcendental guarantors of meaning.¹¹ From a Deleuzian perspective, it would not be the way in which something like Lakoff and Johnson's 'embodied realism' makes the body integral to thinking that is the issue, rather that raising up this 'forcing us to think' to a transcendental stability which provides a guarantor for meaning via the unidirectionality of neurons would reify the very thinking (and associated language) it is supposed to explain.¹² Deleuze and Guattari repeatedly take (especially structuralist) linguistics to task for 'binary logic and biunivocal relationships' and above all for making pragmatics a 'residue'.¹³ These kinds of critiques are also being made from within disciplines like linguistics and the cognitive sciences; Alistair Pennycook for example argues for the necessity for applied linguistics to deconstruct the 'cognitive sandwich' approach found both in cognitive linguistics and neuroscientific discourse in which 'cognition is the filling between perception as input and action as output'.¹⁴ It is this overarching metaphor for the function and existence of cognition that organises a vision of cognition as a process that travels in one direction, in contrast to the dehierarchialised approach outlined by Deleuze. By focusing on plunges into the unthought and a body that forces thinking, Deleuze unpicks the tendency to unproblematically transcendentalize thought as disconnected from or tangentially located in the body, a tendency that is still present even within what appear to be materialist approaches such as neuroscientific discourse, cognitive linguistics and other cognitive sciences, and indeed within transhumanist versions of posthumanist theory.¹⁵ As *What is Philosophy?* makes clear, however, this 'plunge' is not to privilege the body over the brain, or to find stable forms or frames within the body, for its authors 'There is as much thought in the body as there is shock and violence in the brain. *There is an equal amount of feeling in both of them*'.¹⁶ There is no sublation or *Aufhebung* here, Deleuze and Guattari are trying to destabilize not only a mind-body split in philosophy, but its carryover into biology and the cognitive and life sciences, which tend to displace consciousness onto specific neuronal structures taken as a mysterious

‘black box’, still displaced from the body but transcendentalised *in situ*, as Catherine Malabou has convincingly demonstrated.¹⁷

The aim of this paper, then, is use the *Brain ship* novels to ask ‘what happens to Thought in a Cyborg Body?’ This title evidently borrows from Jean-François Lyotard’s ‘Can Thought go on without a Body?’.¹⁸ However, rather than focusing on the destruction of the Sun necessitating an artificial body if (quasi-human) Thought is to continue, this article considers the modifications to thought implied by the cyborg assemblages envisioned by McCaffrey and her co-authors and shows that, while these future cyborgs may seem farfetched, there is still much to be gleaned about the adequation between body-brain/brain-body and world from their attempts to explore the way in which technicity and technology remake these fictional cyborgs.

On ‘gest’

In order to show why Deleuze’s approach might elucidate some of the radical potential found in McCaffrey’s texts – but often suppressed by a preference for neat narrative resolution or a preference for maintaining continuity between biological humans and cyborg shell people – we have to properly understand what Deleuze is arguing in *Cinema 2*, and for this we need consider his technical use of the term ‘gest’. Deleuze takes the term from Brecht; in *Cinema 2*, he defines it as ‘the link or knot of attitudes between themselves, their co-ordination with each other, in so far as they do not depend on a previous story [...] gest is the development of attitudes themselves’.¹⁹ Thus, gest takes on a similar function to ‘assemblage’ elsewhere in Deleuze and Guattari’s thought, in that it names an economy of attitudes’ becoming as well as the specific presentation of their current configuration.²⁰ The quotation the article started with was working with this relation between the cinema of bodies (for example, Godard) and the cinema of the brain (e.g. Kubrick), in a passage of *Cinema 2* consistent with Deleuze and Guattari’s thinking of the brain in the last chapter of *What is Philosophy?* Deleuze clarifies further:

The brain gives orders to the body which is just an outgrowth of it, but the body also gives orders to the brain which is just a part of it: in both cases, these will not be the same bodily attitudes nor the same cerebral gest. Hence the specificity of a cinema of the brain, in relation to that of the cinema of bodies.²¹

Thus, neither a cinema of the body nor a cinema of the brain should be taken as excluding the other, rather acting as the cinematic exploration of a specific manifestation that privileges one side of a body-brain/brain-body fold. This is arguably one of the ways in which Deleuze approaches the question of the brain being ‘adequate to the world’ through cinema, taken up by Malabou in *What Should We Do with Our Brain?* although we will take a different approach to Malabou’s quasi-Kantian claim that ‘the plasticity of the brain is the real image of the world’.²² On reflection, Deleuze’s elaboration of ‘cerebral gest’ and ‘bodily attitudes’ specifically addresses the complexity of the note on the brain as ‘adequate to the world’ that Malabou highlights. Deleuze sets up a de-hierarchicalized relation between body and brain, folding together the bidirectional orders and presentations between them. It is in this sense that I adapt ‘cerebral gest’ from Deleuze, that the brain may have its own attitudes and postures but inseparably from the body; it evidently also does away with any trace of unidirectionality.

This move sidesteps debates between Paul and Patricia Churchland’s ‘eliminative materialism’ and David Chalmers’s attempts to produce a less reductive dualism, but in a different way to Malabou’s complicity between the neuronal and the (socio-)political in *What Should we Do with Our Brain* and *The New Wounded* and that line of thought’s further development via her rereading of Kantian epigenesis in *Before Tomorrow*.²³ While Ian James offers a persuasive reading of Malabou, suggesting that her thought implies a void between the neural and lived experience which allows her to adopt a materialist position without that materialism being eliminative or reductive, this is a move that still seems to focus on the human as self-sufficient subject, whatever the dependence on neurons. For this reason, I will focus my argument via Deleuze and Guattari and McCaffrey rather than Malabou.

McCaffrey's brain ships offer a valuable jumping off point for exploring this relationship between gest and technicity because she envisions beings whose bodies are not simply anthropocentric; brain ships are spaceships *as beings* with their ship bodies influencing their thought and actions, both via the integration of neurally linked databases and processing units but also via the plastic development of their biological brain remnants in relation to a specifically cyborg gest. As we will see shortly, this implicates their ship bodies in the plastic development of body-brain/brain-body in ways that are key for exploring the potentialities of cyborg thought. In contrast, many science fiction depictions of cyborgs focus on augmentation of a still largely human(oid) body as in *Black Mirror's 'The Entire History of You'*,²⁴ the characters in William Gibson's *Neuromancer* trilogy,²⁵ and seventies TV cult classic *The Six Million Dollar Man*,²⁶ or alternatively on an almost complete replacement of a humanoid body by technology, as with *Robocop*.²⁷ Thus, they primarily focus on an amplified *human* gest – and thus amplified human embodiment – rather than the *othering* of the cyborg and that cyborg's *posthumanity*.²⁸ In cinematic terms, Kubrick's *2001: A Space Odyssey* as a cinema of the brain is considerably more humanist, while HAL9000 is the artificial brain of the ship, the ship is not really presented as his/its body; the ambiguity of HAL's decision to kill the crew seems to relate to an uncanny becoming-more-than-tool, HAL inhabits the ship rather than is the ship.

At the other end of the spectrum, McCaffrey's cyborgs are unusual in that the body is not replaced by a humanoid one or augmented *as* humanoid but rather encased in a titanium shell with technological supplements as the only connection to the outside world. Thus, brainship gest will be the gest of a ship body, a technological originary technicity as the outgrowth of the biological brain, but of which that brain is only a part.²⁹ Due to this technological dependence for their relation to the world, analysis of brain ships often slides into 'brains in vats',³⁰ but this effaces even the encased body from the textual scene and by doing so tends to elide the status of ship body as a body and hence also becoming-other or becoming-machinic. Essentially, variations on 'brains in vats' treat the human as a stable entity, unaffected by technics, in order to test notions about being deceived by our senses; however, the interest of the *Brain Ship* novels lies in their exploration of cyborg beings' development. The key premise of the stories is that the parents of severely disabled newborns in the far future are

given a choice: euthanasia or becoming an ‘encapsulated “brain,” a guiding mechanism in any one of a number of curious professions [...] performing unusual service to Central Worlds’.³¹

Unsurprisingly, *The Ship who Sang* has featured in debates in disability studies with considerable controversy over its political message.³² However, for the purposes of my argument, McCaffrey’s recounting of Helva’s happy shell childhood shows a key element of how technicity would plastically reshape cyborg thought. She explains how the encased children would have more synaptic connections to the world added:

Instead of kicking feet, Helva’s neural responses started her wheels; instead of grabbing with hands, she manipulated mechanical extensions. As she matured, more and more neural synapses would be adjusted to operate other mechanisms that went into the maintenance and running of a spaceship.³³

The neural pathways for a body suspended within a titanium shell and cut off biologically from the outside world would develop differently to that of a ‘softperson’, with the neurons of the encased body potentially available to be spliced into electronic interfaces in addition to implants directly into the brain. Those neuronal connections with access to the outside world would become speeded up and reinforced, the pathways for sensing the body within the shell, apart from autonomic functions, would largely die off via apoptosis, or become largely unconscious as with many neuronal pathways internal to the body, and with phenomena such as ‘blindsight’ – where much of the neuronal substrate required for vision appears intact but not accessible consciously.³⁴

Returning to Deleuze and Guattari, the postures of wheels and thrusters, of magnified vision, and hearing and sight across a greater range of frequencies would not have the same ‘cerebral gest’ as a biological body; gest would become not just the form of a cinema of the body or brain, but the expression of becoming through habit of the body-brain-technicity assemblage folded rhizomatically into itself. The life, and unthought, into which such a brain may plunge when the assemblage with the outside world is technological is evidently distinct from that of limbs and (human) biological eyes. Birds’, and many other animals’, vision is not limited to the human ‘trichromatic spectrum’ of humans; consequently, with the ability to fly (through space) in their own (ship) bodies and ultrasonic

hearing, brain ships would be rather closer to knowing what it would be like to be a bat.³⁵ Likewise, the stability of the frames and primary metaphors identified by cognitive science is called into question by both plasticity and technicity, the former via the continual epigenetic restructuring of the brain and the latter via the constitution of individual subjects, and their relation to bodies and tools in the broadest sense, as historically contingent on the specific structure of the sociocultural conditions in that moment; however, it is evident that such frames and primary metaphors would be disrupted further still in non-anthropocentric cyborg cerebral gest. As Deleuze makes clear, this differentiated cyborg gest would equate to a difference in the way in which the body forces such beings to think, a different trajectory for the plunge into the unthought, life.

The much-cited passage of *Ship* where Helva shows visitors to the shell-person nursery her reproduction of *The Last Supper* on the head of a tiny screw shows both the ways in which magnified vision and the ability to adjust movements on a scale of microns rather than millimetres (and later to flex rocket engines rather than muscles) would affect their phenomenological experience of the world, and the specificity of cyborg gest as differed embodiment. At the same time, the story sets up the recurring focus on the attractiveness of Helva's voice, a key device for maintaining the 'human' autoaffection as presented to others (and herself) in the novel:³⁶

"Why, what a lovely voice you have," said one of the female visitors.

Helva 'looked' up and caught a fascinating panorama of regular, dirty craters on a flaky pink surface. Her hum became a gurgle of surprise. She instinctively regulated her 'sight' until the skin lost its cratered look and the pores assumed normal proportions.³⁷

In this brief excerpt we see ways in which what Derrida called 'originary protheses' would become integrated into the neural substrate of a shell person;³⁸ the technical protheses for 'sight' and 'looking' are adjusted 'instinctively' rather than being an addition to the self-contained biological subject acting through conscious choice. Thus, it is clear that there is an enfolding of technical body and brain in the portrayal of shell people rather than simple Cartesian dualism. The later stories in *Ship* drop the clunky citation marks for shell senses, but what McCaffrey's stories of shell people actually do well

are the mundane details of being a cyborg; though the characterisation of *Ship* as ‘prefeminist’ is probably accurate, details like this domesticate cyborg difference but also puts forward and explores this difference through the narrative. Here, McCaffrey does indeed deal with an aspect of cyborg materiality, if somewhat undercut by the magnification returning to ‘normal’, which implicitly makes purely biological human vision the default measure, even though the stories are supposed to be from Helva’s perspective. However, when one considers that the Kantian mathematical sublime, for example, relies on setting the human figure as measure then that sublime for a brain ship would be quite distinct.³⁹ A shell person faced with Kant’s pyramids would simply change the level of magnification, although they might well experience a different sublime – one dependent on the need to switch between visual modes rather than imagination compensating for the lack of aesthetic comprehension. The body-as-measure of the Kantian mathematical sublime would take on a different gest, both in terms of scale and cerebral postures.⁴⁰ A ship body as measure, or different magnification scales as measure would take the place of human body as the default measure, making the sublime a question of specific visual context rather than universal experience.

Brain computer interfaces – near future cyborgs

To focus on the relation of the brain to body in an instance such as this, in a demonstration of the plausibility of direct neural control of wheels and thrusters, Cullen and Smith⁴¹ are in the process of creating nerve to electronic bridges that rely on splicing the body’s nervous system and, in particular, on brains’ ability to repair and reconfigure themselves, as Malabou notes: ‘Plasticity in the nervous system means an alteration in structure or function brought about by development, experience, or injury’.⁴² Cullen and Smith elucidate that with artificial prostheses, ‘The brain essentially redraws its own internal map of which motor neurons do what, allowing it to eventually gain control of the new hand’, though this ‘require[s] extensive retraining of the brain’.⁴³ Evidently, the complex part of implants for vision would be the retina equivalent, to include variable zoom via motor neurons would be relatively simple. Stanford University already has a program focused on harnessing human bodies own ‘coding’ and feedback mechanisms to produce artificial retinas.⁴⁴

Consequently, while beyond current technology, neuroscientific techniques are already moving to provide such augmentation as found in the novels – of both the neural substrate in order to deal with trauma or degeneration and direct motor control of artificial limbs or other prostheses.⁴⁵ As a result, Cullen et al.'s technique of using microfilaments along with lab-grown long axons would allow a shell person to be connected to their ship and indeed potentially *feel* the connections with the ship's systems;⁴⁶ that is to say, to receive haptic and visual feedback even within their shells. This would be essential for making ship bodies and probes relate neuronally to the brain in a way that makes those prostheses useable. A key research area for prosthetic limb development is connecting feedback nerves that allow the user to sense, not merely see, movement. This is one of the main reasons why a unidirectional source for frames, primary metaphors and other linguistic artefacts of thought is so problematic: the experience of space is never unidirectional but continually changing, sometimes subtly sometimes less than subtly, as bodies move through and in space. Thus, the frames of reference and metaphors for a brainship would be both more complex and more diverse, split between the human scale and sensation of their cabins and human living quarters, the interstitial spaces between that and their hulls, and the interface with outer space or the atmosphere.

McCaffrey's stories can reasonably (if somewhat anachronistically) be included in what Eugene Thacker calls the 'extropian' strand of posthumanism.⁴⁷ This technophilic version of the posthuman sees itself very much as an upgraded humanism, with the 'technologically enabled subject as an agent of change'. As he points out while referencing Bruno Latour, 'The blind spot of this thread of posthumanism is that the ways in which technologies are themselves actively involved in shaping the world are not considered', or indeed, though Thacker mentions it only tangentially, may reshape 'humans' and brains themselves as part of that world.⁴⁸ Given the plasticity of the brain, the encapsulation suggested by the stories and the ways in which the body-brain/brain-body assemblage would then be individuated and *reformed* actually seems plausible, at least neurologically.⁴⁹ In contemporary neurobiological research, to expand the 'neural substrate' is to artificially expand the brain itself, currently focused on dealing with the effects of physical trauma or neuronal accident.⁵⁰ It appears there is potential to expand the capacity of the brain via links to other brains (animal,

human?) and ‘ectopic neural modules’ – which would act more like the structures of the brain itself.⁵¹

An important point for my aim of folding together brain ships, Deleuze and Guattari and contemporary neuroscience is that Sillito et al. have shown the importance of the feedback loops in the neurobiology of vision, contrary to the mistaken unidirectional connections for stimuli often posited in CNS textbooks and, as a consequence and understandably, cognitive sciences more broadly.⁵² When Deleuze writes of the body-brain/brain-body giving orders to different parts of the assemblage, and forming different bodily attitudes and cerebral gestures, this is consistent with contemporary (incomplete) neuroscience.

The question would be then, ‘how would these prostheses change the adequation of brain to world?’ Deleuze’s development of cerebral gesture can also be seen as the presentation of becoming of specific body-brain/brain-body configurations, with the gesture and attitudes specific to that moment or time-image but implicated in the assemblage between body-brain and world. Malabou elaborates that this is subject to a particular historicity, explaining – via neuroscientist Jean-Pierre Changeux – that one of the key forms of neuronal plasticity is via apoptosis, a form of sculpting in which those neurons that are not utilized die off.⁵³ It is for this reason (apoptosis) that tonal languages can be very difficult to learn as adults.⁵⁴ While infant brains are drastically more plastic, adult brains do retain some neurogenerative capabilities, as well as being able to affect structure through modulational plasticity. As such, all kinds of habit are implicated in the Thought-brain as an assemblage becoming adequate to the world;⁵⁵ for Malabou, Félix Raivaissou’s analysis of habit allows us to reclaim the ways in which willed activities may become automated and potentially unconscious. However, when taken in the context of shell people this development takes on a different complexion.

Compare biological eyes to shellpersons’ ability to view themselves from outside when infants and to later see inside and monitor every aspect of their ship bodies (except their shells) – sensors for the encapsulated body would thus blur the distinctions between knowing and feeling. This rather complicates neuropsychanalyst Mark Solms’s claim that the function of the brain is to mediate between ‘the internal milieu of the body; and the world outside us’;⁵⁶ to what extent could such sensors be said to be expansions of the neural substrate or external to the self? Here the mechanical

body grafted onto the shell is a supplement in Derrida's sense, '[t]he supplement is an addition from the outside, but it can also be understood as supplying what is missing and in this way is already inscribed within that to which it is added', to borrow Robert Bernasconi's gloss.⁵⁷

The stories also suggest that shell people can control their own autonomic functions as a result of being interfaced with the technology which keeps their biological body-remnant alive; they can adjust their own adrenaline levels and balance their nutrient feeds or even add relaxants to their bloodstreams – akin to the 'glanding' of Iain M. Banks's *Culture* novels, though – like McCaffrey – Banks does not fully explore how having conscious or semi-conscious control over an inbuilt pharmacopeia itself might affect subjectivity and indeed affect. A further strand of current neurobiological research explores the ways in which neuronal plasticity itself might be pharmacologically altered,⁵⁸ thus making more plausible additional mechanized supplements or Brain Computer Interfaces (BCIs) as adults or after infancy as well as the addition of new databases that might be directly accessed through the existing BCI connections.

Conclusion: cyborg body-brain/brain-body, on thought and gest in/of a cyborg body

Lyotard's claim that 'technology wasn't invented by us humans. Rather the other way around' is in context rather closer to what Derrida would call originary technicity than technoscience *per se*.⁵⁹ Lyotard's Deleuze-inflected thought experiment ('your transcendence in immanence') questions the conditions necessary for thought to go on without a human body, 'But at the same time the body, our phenomenological, mortal, perceiving body is the only available *analogon* for thinking a certain complexity of thought.'⁶⁰ Deleuze and Guattari might take issue somewhat with the 'phenomenological' here, but we'll let that go for now. Lyotard's choice of the Greek ἀνάλογον rather than simply analogy suggests an interest in paleonymically reactivating the play of 'according to a due λόγος, proportionate, conformable', and 'well-proportioned' rather than just focusing on equivalence or resemblance.⁶¹ This provokes questions about the return to λόγος, a *logos* that here is neither stable nor preordained but dependent on the material conditions that both allow and force thought to occur.

This body then, gives orders to the brain which is only an outgrowth of it, as enfolded together they plunge into the unthought, life. This article has used brain ships as a diving board to take an imaginary leap of thought into the chaosmos of potential cyborg life. Lyotard, along with Deleuze and Guattari, insisted on the complexity of the materiality of thought, and thus a change in the conditions of that materiality on the side of the body, machinic or biological, implies a change in the assemblage that provokes thought. We have seen that the incorporation of prostheses, up to and including an entire prosthetic body, would produce specific changes to that assemblage and the *ἀνάλογον* for thinking associated with it. McCaffrey's work opens up, though does not fully explore, the complexities occasioned by these forms of cyborg technicity. However, in the domestication of brainships' cyborg embodiment we can see how such changes to assemblages might change the enfolding between body and brain, the manner of their adequation to the world and the trajectory of their plunge into the chaos. The necessity of prostheses and prosthetic bodies to incorporate feedback loops, recursion (Hofstadter) and a plastic development of their relation to the brain should finally put paid to outdated claims of unidirectionality in embodiment providing universal stability for frames, primary metaphors and other linguistic artefacts of thought. Instead, such traces of thought must be considered as contingent on the specificity of the material assemblages of brain/body and body/brain as instantiated in a particular adequation of brain to world. The way in which prostheses for perception would change the body-as-measure show that the mathematical sublime, and hence also aesthetic judgement, must be rethought in light of such a change in the material assemblage. It is clear that despite some of the more conservative elements of McCaffrey's brain ship stories that both the premise of the stories and some elements of their very domesticity offer more opportunities to address how cyborg embodiment and skill might unfold.

¹ Gilles Deleuze, *Cinema 2: The Time Image*, trans. Hugh Tomlinson and Robert Galeta (London: Athlone, 1989), p. 189.

² Jean-François Lyotard, 'Can thought go on without a body?', in *The Inhuman: Reflections on Time*, trans. Geoffrey Bennington and Rachel Bowlby vol. 1988, (1991), p. 12.

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- ⁴ Gilles Deleuze and Félix Guattari, *What is Philosophy?*, trans. Hugh Tomlinson and Graham Burchell (London: Verso, 1994); Gilles Deleuze, *Pure Immanence: Essays on a Life*, trans. Anne Boyman (New York: Cambridge, Mass: Zone Books, 2001).
- ⁵ Anne McCaffrey, *The Ship who Sang* (Corgi: UK, 1972).
- ⁶ Donna Jeanne Haraway, *Manifestly Haraway* (Minneapolis: University of Minnesota Press, 2016), p. 61, orig. 1985.
- ⁷ *Ibid.*, orig. 1985.
- ⁸ The original 1961 story and the ‘mashup’ novel of a number of stories about Helva, the titular *Ship who Sang*, have numerous citations, but later stories are rarely mentioned.
- ⁹ N. Katherine Hayles, ‘The Lifecycle of Cyborgs: Writing the Posthuman’, in Jenny Wolmark (ed.), *Cybersexualities: a reader on feminist theory, cyborgs, and cyberspace* (Edinburgh: Edinburgh University Press, 1999), pp. 168–169; Nicole Falkenhayner, ‘The Ship Who Sang: Feminism, the Posthuman, and Similarity’, *Open library of humanities*, 6.2 (2020) argues that Helva is reduced to a technologically advanced ‘American [sic] wife’. There are some interesting analyses of Ship from the perspective of disability studies, but these tend to be predominantly humanist: Ria Cheyne, “‘She was born a thing’: Disability, the Cyborg and the Posthuman in Anne McCaffrey’s *The Ship Who Sang*”, *jml: Journal of Modern Literature*, 36.3 (2013), pp. 138–156; Anne Balsamo, ‘Reading cyborgs writing feminism’ (2000) is a little less harsh on McCaffrey but still tends to view the work as predominantly conservative.
- ¹⁰ cf. George Lakoff and Mark Johnson, *Metaphors we live by* (Chicago: University of Chicago Press, 2003); George Lakoff and Mark Johnson, *Philosophy in the Flesh: The embodied mind and its challenge to western thought* (NY: Basic books, 1999); *Sociocultural Situatedness*, eds. Roslyn M. Frank, René Dirven, and Tom Ziemke (Walter de Gruyter GmbH & Co. KG, 2008).
- ¹¹ Frank *et al.*, *Sociocultural Situatedness*, provides useful round up of the state of the question in sociolinguistics, but as Pennycook argues, this is still some way from the “vibrant assemblages” involved in constituting the materiality of extended or distributed cognition in contemporary posthumanist discourse.
- ¹² Lakoff and Johnson, *Philosophy in the Flesh: The Embodied Mind and its Challenge to Western Thought*, chap. 6.
- ¹³ *A Thousand Plateaus: Capitalism and Schizophrenia*, trans. Brian Massumi (Minneapolis: University of Minnesota Press, 1987), pp. 5, 82.
- ¹⁴ Alastair Pennycook, *Posthumanist Applied Linguistics* (London; New York: Routledge/Taylor & Francis Group, 2018), p. 52; cf. Alexander Hope, ‘The future is plastic: refiguring Malabou’s plasticity’, *Journal for Cultural Research*, 18.4 (2/October 2014), pp. 329–349; Catherine Malabou, *What should we do with our brain?* (New York: Fordham University Press, 2008); Catherine Malabou, *Morphing Intelligence: from IQ measurement to artificial brains* (New York: Columbia Univ. Press, 2021).
- ¹⁵ Malabou, *What should we do with our brain?*; Hope, *The Future is Plastic*; Christopher Watkin, *French philosophy today: new figures of the human in Badiou, Meillassoux, Malabou, Serres and Latour* (Edinburgh: Edinburgh University Press, 2016).
- ¹⁶ *What is Philosophy?*, p. 205.
- ¹⁷ for an analysis of this point see Hope, *The Future is Plastic*; as an example, Jean-Pierre Changeux, *The Physiology of Truth: neuroscience and human knowledge* (Cambridge, Mass.: Belknap Press of Harvard University Press, 2004); cf. Malabou, *What should we do with our brain?*; Catherine Malabou, *The New Wounded: from neurosis to brain damage* (New York: Fordham University Press, 2012); Catherine Malabou, ‘Can we relinquish the transcendental?’, *The Journal of Speculative Philosophy*, 28.3 (2014), pp. 242–255.
- ¹⁸ Lyotard, *Can Thought go on without a Body?*
- ¹⁹ Deleuze, *Cinema 2*, p. 192.
- ²⁰ see J.-D. Dewsbury, ‘The Deleuze-Guattarian assemblage: plastic habits’, *Area*, 43.2 (2011), pp. 148–153 for a useful summary of Deleuze and Guattari’s development of the concept. Deleuze and Guattari, *A Thousand Plateaus*.
- ²¹ Deleuze, *Cinema 2*, p. 205.
- ²² *Ibid.*, p. 317; Malabou, *What Should we do with our Brain?*, p. 39. I have shown elsewhere that Malabou’s elaboration of Deleuze’s idea of the brain being ‘adequate to the world’ offers a way of critiquing some of the overlapping rhetoric and ideology found in both contemporary neuroscience and managerialist discourse.
- ²³ see Ian James, *The Technique of Thought: Nancy, Laruelle, Malabou, and Stiegler after naturalism* (Minneapolis: University of Minnesota Press, 2019), chap. 4; Malabou, *What Should we do with our Brain?*; Malabou, *The New Wounded*; Malabou, *Before Tomorrow: epigenesis and rationality* (Cambridge, UK ; Malden, MA: Polity, 2016); Malabou, ‘Can we Relinquish the Transcendental?’, Paul M. Churchland, ‘Eliminative Materialism and the Propositional Attitudes’, *The Journal of Philosophy*, 78.2 (1/February 1981), pp. 67–90.

- ²⁴ *The Entire History of You*, (18/December 2011).
- ²⁵ William Gibson, *Neuromancer* (London: Voyager, 1995).
- ²⁶ *The Six Million Dollar Man*, (23/October 1974); Martin Caidin, *Cyborg* (New York: Ballantine Books, 1972).
- ²⁷ *Robocop*, (1987).
- ²⁸ Philip K. Dick's 'Mr Spaceship' is one of the few other tales to focus on a machinic spaceship body *Mr. Spaceship* (28/February 2018); however, in that story the 'brain' is indeed envatted.
- ²⁹ Arthur Bradley, 'Original Technicity: Technology and Anthropology', in Arthur Bradley and Louis Armand (eds.), *Technicity* (Prague: Litteraria Pragensia, 2006), pp. 78–100.
- ³⁰ see, for example, Balsamo, *Reading Cyborgs, Writing Feminism*, p. 146; Damien Broderick, 'Entering the Mainstream', in Damien Broderick, *Consciousness and Science Fiction (Science and Fiction)* (Cham: Springer International Publishing, 2018), pp. 85–99.
- ³¹ McCaffrey, *The Ship who Sang*, p. 7.
- ³² Cheyne, "She was born a thing": Disability, the Cyborg and the Posthuman in Anne McCaffrey's *The Ship Who Sang*; Karen F Stein and Louisa MacKay Demerjian, "When she woke she was the ship" Disability and Cyborg interdependency in Anne McCaffrey's Brainship tales', in *Future humans in fiction and film* (2018), pp. 32–48; Falkenhayner, *The Ship Who Sang: Feminism, the Posthuman, and Similarity*.
- ³³ McCaffrey, *The Ship Who Sang*, p. 2.
- ³⁴ Dylan M. Fox, Melvyn A. Goodale, and James A. Bourne, 'The Age-Dependent Neural Substrates of Blindsight', *Trends in Neurosciences*, 43.4 (April 2020), pp. 242–252.
- ³⁵ Thomas Nagel, 'What Is It Like to Be a Bat?', *The Philosophical Review*, 83.4 (October 1974), pp. 435; Jay Withgott, 'Taking a Bird's-Eye View... in the UV', *BioScience*, 50.10 (2000), pp. 854.
- ³⁶ cf. Jacques Derrida, *Speech and Phenomena, and Other Essays on Husserl's Theory of Signs* (Bloomington: Indiana University Press, 1973).
- ³⁷ McCaffrey, *The Ship Who Sang*, p. 9.
- ³⁸ Bradley, *Original Technicity: Technology and Anthropology*.
- ³⁹ Immanuel Kant, *Critique of the Power of Judgment*, ed. Paul Guyer, trans. Paul Guyer and Eric Matthews (Cambridge: Cambridge Univ. Press, 2009); Jacques Derrida, *The Truth in Painting*, trans. Bennington, Geoff and McLeod, Ian (Chicago: University of Chicago Press, 1987).
- ⁴⁰ cf. Derrida, *The Truth in Painting* esp. 'The Colossal'.
- ⁴¹ 'Bionic Connections', *Scientific American*, 308.1 (2013), pp. 52–57. 55.
- ⁴² Malabou, *What Should we do with our Brain?*, p. 5.
- ⁴³ *Bionic Connections*, p. 57.
- ⁴⁴ 'Approach' [<https://med.stanford.edu/artificial-retina/research/approach.html>], accessed 26/7/2021.
- ⁴⁵ Mikhail A. Lebedev, Ioan Opris, and Manuel F. Casanova, 'Editorial: Augmentation of Brain Function: Facts, Fiction and Controversy', *Frontiers in Systems Neuroscience*, 12 (12/September 2018), pp. 45.
- ⁴⁶ D. Kacy Cullen, John A. Wolf, Douglas H. Smith, and Bryan J. Pfister, 'Neural Tissue Engineering for Neuroregeneration and Biohybridized Interface Microsystems In vivo (Part 2)', *Critical ReviewsTM in Biomedical Engineering*, 39.3 (2011), pp. 241–259; D. Kacy Cullen, John A. Wolf, Varadraj N. Vernekar, Jelena Vukasinovic, and Michelle C. LaPlaca, 'Neural Tissue Engineering and Biohybridized Microsystems for Neurobiological Investigation In Vitro (Part 1)', *Critical ReviewsTM in Biomedical Engineering*, 39.3 (2011), pp. 201–240.
- ⁴⁷ Eugene Thacker, 'Data Made Flesh: Biotechnology and the Discourse of the Posthuman', *Cultural Critique*, 53.1 (2003), pp. 72–97. 76.
- ⁴⁸ *Ibid.*
- ⁴⁹ see Mijail D. Serruya, 'As we may think and be: brain-computer interfaces to expand the substrate of mind', *Frontiers in Systems Neuroscience*, 9 (2015) [<https://www.frontiersin.org/articles/10.3389/fnsys.2015.00053/full>], accessed 6/3/2021; as well as the development of cochlear implants that connect directly to the brain itself or brainstem; Édouard Bouquillon, Marie-Suzanne Le Gac, and Benoit Godey, 'Cochlear implant in children', *La Revue Du Praticien*, 68.8 (October 2018), pp. 870–873; Alistair Mitchell-Innes, Shakeel R. Saeed, and Richard Irving, 'The Future of Cochlear Implant Design', *Advances in Oto-Rhino-Laryngology*, 81 (2018), pp. 105–113; James G. Naples and Michael J. Ruckenstein, 'Cochlear Implant', *Otolaryngologic Clinics of North America*, 53.1 (February 2020), pp. 87–102.
- ⁵⁰ Serruya, *As we may think and be*.
- ⁵¹ cf. Malabou, *Morphing Intelligence*.
- ⁵² Adam M. Sillito, Javier Cudeiro, and Helen E. Jones, 'Always Returning: Feedback and Sensory Processing in Visual Cortex and Thalamus', *Trends in Neurosciences* 29, no. 6 (June 2006): 307–16, <https://doi.org/10.1016/j.tins.2006.05.001>; S. Murray Sherman, 'The Neural Substrates of Cognition', *Trends in*

Neurosciences 29, no. 6 (June 2006): 295–97, <https://doi.org/10.1016/j.tins.2006.05.005>; Lakoff and Johnson, *Philosophy in the Flesh: The Embodied Mind and Its Challenge to Western Thought*. Lakoff and Johnson's attempt to solve the problem of what Quentin Meillassoux calls 'correlationism' via the stability and universality of unidirectional neuronal connections therefore falls at the first hurdle.

⁵³ *What Should we do with our Brain?*, p. 19.

⁵⁴ Patricia K. Kuhl, Karen A. Williams, Francisco Lacerda, Kenneth N. Stevens, and Björn Lindblom, 'Linguistic experience alters phonetic perception in infants by 6 months of age', *Science*, 255.5044 (1992), pp. 606–608.

⁵⁵ cf. Catherine Malabou, 'Addiction and Grace: Preface to Felix Ravaisson's *Of Habit*', in Félix Ravaisson, *Of Habit* trans. Clare Carlisle and Mark Sinclair (London: Continuum, 2008).

⁵⁶ Mark Solms, *The Brain and the Inner World: an introduction to the neuroscience of subjective experience* (New York: Other Press, 2002).

⁵⁷ Robert Bernasconi, 'Supplement', in Claire Colebrook (ed.), *Jacques Derrida: Key Concepts* (New York: Routledge, 2014), pp. 19–22.

⁵⁸ Lebedev, Opris, and Casanova, *Editorial*.

⁵⁹ Lyotard, *Can Thought go on without a Body*, p. 12; Bradley, *Original Technicity: Technology and Anthropology*.

⁶⁰ Lyotard, *Can Thought go on without a Body*, pp. 13; 22.

⁶¹ Henry George Liddell, Robert Scott, Henry Stuart Jones, and Roderick McKenzie, 'ἀνάλογος', in *A Greek-English Lexicon*, (Oxford: Clarendon Press; Oxford University Press, 1996).

