RENDEZVOUS WITH A COMET: A FEMINIST NEW MATERIALIST ANALYSIS OF THE ROSETTA SPACE MISSION

By
Tamara Szucs

Submitted to
Central European University
Department of Gender Studies

In partial fulfilment of the requirements for the degree of
Master of Arts in Gender Studies

Supervisor: Professor Eszter Tímár

Budapest, Hungary
2015

Abstract

On 12 November 2014 and for the first time in history, the European Space Agency's remotely controlled spacecraft, Rosetta landed a smaller spaceship, Philae on the surface of a comet, 67P/Churyumov–Gerasimenko (in short, 67P/C-G), as part of the quest to find out more about the origins of human life. Practicing a feminist and critical materialist approach, this thesis interrogates the workings of modernity's hierarchical dichotomies within the scientific and public discourses of this space exploration project to reveal not just how this purportedly progressive scientific knowledge-making project embodies intensely gendered and exploitative practices but that – paradoxically – it may also be animated by traces of subversive and transgressive ethico-onto-epistemologies from which feminist and new materialist theory could potentially benefit.

The Rosetta story is presented here as an assemblage of three prongs: the first prong represents the feminised comet being courted by the (mostly male) scientists, the second prong deals with how the media personalities of the spacecrafts are humanised and made relatable, and the third prong considers the #shirtstorm incident of the mission's main scientist as collision of disciplinary power with a 'rebel scientist' persona. These three angles are filtered through a feminist new materialist theoretical framework, building on relevant works of Jane Bennett, Michel Foucault, Donna Haraway, and Karen Barad.

Chapter I provides a feminist commentary by demonstrating how and why the object of the space mission, comet 67P/C–G is narrated by both the mission scientists and the media as a passive lady-like woman, and concludes with proposing alternative conceptions of agency and power for feminist new materialist thought. Chapter II considers how the boundaries ascribed by the dichotomies of human/machine and alive/lifeless become ambiguous in the spacecraft prong of the story. Chapter III analyses the third prong of the Rosetta-triangle: the event known in mainstream media and online communities as #shirtstorm, bringing together and diffracting through the other two chapters, and proposing that #shirtstorm may be used as a productive site for feminist and new materialist theoretical attention.

Acknowledgements

I am grateful to Eszter Tímár for the endless (and non-judgmental) patience and the immensely useful ’hand-holding.’

I would like to wholeheartedly thank Pumpi and Anya for being at my beck and call during the incredibly long months of the thesis writing process. Szeret!

Table of contents

Introduction

On 12 November 2014 and for the first time in history, the European Space Agency's remotely controlled spacecraft, Rosetta landed a smaller spaceship, Philae on the surface of a comet, 67P/Churyumov–Gerasimenko (in short, 67P/C-G). As comets are ancient leftovers from the Solar System formation, examining them is expected to yield clues as to how our planetary system evolved, making cometary space missions an integral part of the quest to find out more about the origins of human life. Practicing a feminist and critical materialist approach, this thesis interrogates the workings of modernity's hierarchical dichotomies (such as the binaries of human/nonhuman, masculine/feminine, alive/lifeless) within the scientific and public discourse of this ongoing space exploration project. Importantly, the exploration of the Rosetta story through a dual discursive-materialist framework is hoped to reveal not just how this purportedly progressive scientific knowledge-making project embodies intensely gendered and exploitative practices but that – paradoxically – it may also be animated by traces of subversive and transgressive ethico-onto-epistemologies from which feminist and new materialist theory could potentially benefit.

The Rosetta story is presented throughout this thesis as an assemblage of three prongs: the first prong represents the feminised comet being courted by the (mostly male) scientists, the second prong deals with how the media personalities of the spacecrafts[1] are humanised and made relatable, and the third prong considers the #shirtstorm incident of the mission's main scientist as collision of disciplinary power with a 'rebel scientist' persona. This three-pronged view is a very particular framing of this case study, and alternative approaches may well yield insights at variance with what is proposed in this thesis. However, since the comet-robots-scientist triumvirate of the Rosetta story appear to persistently assert their individual 'selves' in the scientific and public spheres and echo through the theoretical works consulted for this thesis, I find myself consistently (re)turning to this three-dimensional image of Rosetta. These three angles of this scientific and popular culture story are filtered through a feminist new materialist theoretical framework, which is understood here as indicating a feminist preoccupation with and genuine interest "in the various non-humans on the scene" (Haraway in Gane 2006:136). Using a broad range of academic texts, much of which can be loosely

[1] Although customarily the plural of spacecraft tends to also be spacecraft (no 's' at the end), I deliberately use 'spacecrafts' throughout this thesis to make clear the instances when I refer to both Rosetta and Philae.

grouped under the interdisciplinary aegis of feminist and new materialist theory, I primarily rely on the work of Jane Bennett on thing-power (2010) and Michel Foucault's theories on disciplining bodies (1977), while to a lesser extent I also draw on Donna Haraway's conception of the posthuman cyborg (1991) and Karen Barad's agential realism (2014). The explorations of the three prongs of the Rosetta story, in turn, are presented as discourse analytical examinations of the peer-reviewed scientific results released in early 2015 and the social media coverage of the space mission between mid-2014 and early 2015.

It may at first seem like there is "nothing to see" here (Braidotti 2011:93) because this story appears to be obviously gendered (for instance, we already know that science is overtly or covertly gendered in its discourse and practice) that providing a feminist account of it may not seem like a worthwhile or justifiable endeavour. Indeed, as this thesis tries to take seriously matter as something that is not simply a discursive construction or representation of human culture – arguably in opposition to 'smart' feminist theory, which as some argues acquires its theoretical poise partly from holding onto a rigid and oppressive image of nature and matter (Wilson 2010:200) – my analysis could appear unsophisticated and even naïve. Yet, it is precisely through this (slightly uneasily unleashed) naiveté and this willing suspension of the "disciplining of the senses" (Connolly 2010:187) through which this thesis hopes to move beyond the "usual hermeneutics of [feminist] suspicion" (Bennett 2010:xiv) and the critic's "allergy to 'the real'" (Coole and Frost 2010:5).[2]

In what follows, Chapter I will focus on the first prong of the Rosetta story and provide a feminist commentary on the scientific practice and discourse within the Rosetta project by demonstrating how and why the object of the space mission, comet 67P/C–G is narrated by both the mission scientists and the media as a passive lady-like woman. In interrogating this feminine conception of the comet and the resulting power structures, Chapter I critiques science's enduring reliance on a conception of nature as feminine or as a female body (Keller 1992:34), and in this process also takes the opportunity to productively scrutinise conceptions of agency and power in new materialist thought.

[2] A note on quotation marks: throughout this thesis, double quotes ("...") are used for direct quotations from other (referenced) sources, while inverted commas ('...') are used in a gesture of doubt or skepticism as to what the marked concepts may signify – this is to express discomfort with these words while at the same time taking responsibility for using them.

Chapter II sustains an interest in the anthropomorphic figures of the Rosetta story by turning to the humanised personalities of Rosetta and Philae, the two remotely-controlled spacecrafts visiting comet 67P/C–G. Using Donna Haraway's imagery of the cyborg as a "hybrid of machine and organism, creature of social reality as well as creature of fiction" (Haraway 1991:149), Chapter II considers how the boundaries normally ascribed by modernity's human/machine and alive/lifeless dichotomies inadvertently become ambiguous in the public discourse of the spacecraft prong of the Rosetta story, and will argue that these anthropomorphised entities (re)inscribe traditional patterns of gendered oppression, directed at modernity's others and their 'less than' hu*man* state.

Finally, Chapter III will draw on Foucauldian thought to analyse what the third prong of the triangular of Rosetta: the event now known in mainstream media and online communities as #shirtstorm. This chapter brings together and diffracts through the other two chapters, putting into broader context the sexualised objectification of comet 67P/C-G and the humanised affectivity of the two spacecrafts, Rosetta and Philae. Going beyond mere critique, Chapter III will propose that #shirtstorm may be used as a productive site for feminist and new materialist theoretical attention not only because it is an instructive example of those everyday gendered experiences that are lived by many in contemporary societies and where one persistently comes up against the question of disciplinary power (Foucault and Trombadori 1991:148), but also because this third prong, that is, #shirtstorm intersects with and co-emerges with/in the other two prongs of the story as analysed in Chapter I and Chapter II.

Ultimately, the three prongs of Rosetta – the high-profile comet landing and near-real time scientific reporting, the affectivity of digitally anthropomorphised robots, and the mission scientist's shirt and subsequent emotional apology that suddenly divided an international public in a protracted 'online scandal' – emerge in almost simultaneous unfoldings and subtle but indivisible *intra*-actions. In this regard, Bruno Latour's assertion that "there are no objects and subjects, just events" (in Bennett 2010:27) would appear to shine some light onto the ever-shifting and pluralist agentic/performative/material matrix at the core of this story, so that no single object or subject can be pinpointed as the drive(r) behind the events of Rosetta.

Chapter I – The comet

Feminist research has shown that deeply sexed and gendered norms remain conspicuous in the discourses of modern natural sciences (Martin 1991) (Schiebinger 1991) (Schiebinger 1993) (Keller and Longino 1996), despite the fact that one of science's foundational claims to authority is that – unlike other knowledge-making practices – its methods avoid subjectivity and prejudice. Although scientists earnestly wish for their scientific data and discoveries to 'speak' for themselves (Keller 1992:27) without any human or nonhuman intermediation, information transmission by definition always necessitates mediaries and translations (Bennett 2010a:36), which must, in turn, be accessible for the recipient(s). Consequently, even thoroughly technical discussions are contingent on figuration and symbolism, or in other words, those evidently biased representations of the world that scientific discourse is presumed to eliminate (Keller 1992:28–29). With this in mind, and recalling that most feminist commentary on scientific practices is motivated by science's enduring reliance on a conception of nature as feminine or as a female body (Keller 1992:34), it is perhaps unsurprising that the object of the Rosetta space mission, comet 67P/C–G has often been narrated by both the mission scientists and the media in general as a lady-like woman, and that other humanised figures and norms also infuse this apparently highly prestigious and widely publicised scientific endeavour. It is this feminine conception of the comet and the resulting power structures that this chapter interrogates, as the first 'prong' of the triangular Rosetta story, by mapping a feminist and new materialism informed lens onto the mission's scientific discourse and published results, scrutinising conceptions of agency and power in new materialist thought in the process.

Rosetta to 67P/C–G: Be My Valentine?[1]

The first set of post-landing empirical results from the Rosetta mission were released in the form of nine collaborative research articles in the January 2015 issue of *Science* (Altwegg et al. 2015) (Capaccioni et al. 2015) (Gulkis et al. 2015) (Hässig et al. 2015) (Nilsson et al. 2015) (Rotundi et al. 2015) (Sierks et al. 2015) (Taylor et al. 2015) (Thomas et al. 2015).

[1] This section title takes its inspiration from a technology blog post (Motherboard 2015), where a love letter was penned to comet 67P/C-G on the occassion of the Rosetta spacecraft completing the closest fly-by or approach to the comet on 14 February 2015, Valentine's Day.

These peer-reviewed journal articles subtly but consistently represent the comet as *some-body*, who is sitting for "a detailed portrait" (Taylor et al. 2015) that is being 'painted' by the two spacecrafts, Rosetta and Philae. The unveiling of this portrait that is still a work-in-progress shows a celestial entity that (or rather, who?) has "a head and a body" (Thomas et al. 2015:2), which are "connected by a short neck" (Sierks et al. 2015:1), or as a shape that is constituted akin to an organic brain with "two major lobes" (Thomas et al. 2015:4), and whose surface "insulates" its body like a thick skin (Gulkis et al. 2015:4), preventing thermal forces from penetrating beyond "skin depth" (Gulkis et al. 2015:1), while the comet's "underside" (Hässig et al. 2015:3) – the part of the rock always in the dark – could remind one of an underbelly or abdomen. While these examples from the original scientific texts on the Rosetta mission already show that metaphors and figurations in scientific discrouse are a foundational element, the point of this tabulation is not to deny the virtues of anthropomorphisation. As Jane Bennett points out, objects cannot be comprehended solely as mechanisms or tools (2010a:25), and a core premise of this thesis is that anthropomorphisation can be helpful or even essential in conceptualising matter differently. The aim here is to indicate the subtle pervasiveness and quiet intensity of the comet's anthropoid nature within the scientific atmosphere of the Rosetta mission. Instrumentally for my feminist purposes, although this comet is clearly conceived of as human-like, it is still treated as a passive and not-quite-human object of the scientist's (male) gaze. Consequently, the scopic hierachy of modernity – where the positions of looking and being looked at are gendered in very specific ways – stipulates that the comet may not be accorded the rarified status that comes with being 'man.' Therefore, still in line with the binary logic of modernity, the comet can only be inscribed as a *she*: the feminine that the dominant and patriarchial gender norms keep categorically separate from the hu*man*, that is, the cultural-social classification of the 'special,' whose members' claim to uniqueness is conditional on being the exclusive embodiment of reason, morality, self-determination, and even 'human nature' itself (Keller 1992:16).

Not being allowed the status of man, comet 67P/C–G – the object of the scientific male gaze – has thus been feminised as a sphinx-like knower of the secrets of "our origins" (Taylor et al. 2015) within the linguistically-materially constructed discourse of the Rosetta mission.[2] 'She'

[2] The image of the comet as a secretive sphinx is reinforced by the fact that the entire Rosetta mission has an ancient Egyptian theme, where not just the spacecraft names make reference to Egypt, but the comet's distinct regions (or bodily parts) are named after Egyptian deities, such as Anubis, Seth, Bastet, and Imhotep.

is narrated as an elusive and desirable lady, who is courted by the "comet-chaser" spacecrafts since their "rendezvous" in early 2014 (Taylor et al. 2015), and who is literally emitting a "mysterious song" (Mignone 2014) akin to a siren's call. This comet-lady was described by Rosetta's lead scientist as "sexy" but not "easy" (Taylor in Bell 2014), and can therefore be seen as worthy of the distinguished male attention she is receiving,[3] particularly so as the scientists courting her can be assured that they are her 'first' (for a compelling illustration, see figure 1). At the high point of the "sexiest mission there's ever been" (Taylor in Gibney 2014), that is, on the day of the comet landing, Rosetta "mov[ed] in for the kiss" (Taylor in Engelkin 2014) in preparation for the consummatory act of the landing, after which Philae plundered the comet to "see what secrets the celestial body can reveal" (Moulson 2014). And when Philae used its Sampling, Drilling and Distribution (SD2) device to "drill into the comet's body" after the successful landing (Bryan 2014) (Cookson 2014), the question that animated scientists and followers from the public alike was whether Philae actually managed to "penetrate into" (Bryan 2014) (Cookson 2014) the "virgin soil" of the comet (Erich in Lakdawalla 2014). Thus, the landing and – in light of the heightened excitement around whether penetration did take place – the drilling in particular could plausibly be seen as an aggressively masculine possession of this virginal feminine body, with the Philae lander serving as a prosthetic penile apparatus. This interpretation of the scientific discourse and practice of the Rosetta mission may become even more persuasive inasmuch as Philae had typically been depicted in the media as a little boy (European Space Agency 2015) who is finally old enough to "leave home [and his *mother*ship Rosetta] to go out into the universe" (Said-Moorhouse 2014), so that the comet-landing and the surface drilling did not simply take the virginity of the feminised comet, but this actual and at the same time imaginary penetrative act initiated Philae into sexual maturity and, ultimately, manhood.

[3] In light of the fact that approximately 90 per cent of the scientists who authored the nine journal articles in *Science* are men, it is quite fair to interpret this here as an almost universal 'male attention.'

Figure 1. NASA's celebration of Rosetta's closest fly-by to 67P/C–G on 14 February 2015. Source: NASA Jet Propulsion Laboratory / California Institute of Technology

As one would expect from a respectable scientific endeavour, Philae's romance with comet 67P/C–G appears to be a committed and chaste affair. The scientists of the Rosetta mission "were dreaming of these moments" for 25 years (Taylor et al. 2015) but when the authors describe their scientific break-through with the restrained comment that "the data thus far have provided a view of this comet at variance with earlier knowledge" (Sierks et al. 2015:1), their "urgently sexualised" excitement is only evident "in the precise language of the engineer" (Bukatman 1991:344). Yet, the broader context of this celestial affair points to violent and incestuous connotations. One could argue that the scientific mission is evidently driven by what Braidotti calls a scopophilic-sadistic "desire and will to know" (2011:90); that is, to see this comet in its most minute detail and then, by surgically drilling and hammering into its body, to "rip it apart physically to master it intellectually" (Braidotti 2011:90). What is more, this desire to violently look and physically possess is admittedly motivated by the wish to "explore our origins" (Taylor et al. 2015), and therefore echoes an incestuous interest in exploring the forbidden site of man's only known origin, his mother's body (Braidotti 2011:90). These adulterous undertones are reinforced in that this feminised body certainly precedes humanity's inception (a logical and biological condition of a mother's body) and that the forcefully exploring "baby space probe" (Gilbert 2015) has a very specific personality – that of a male child, who has just reached his (sexual) maturity.

When the sardine looks back

Since comets are regarded as "the least altered objects that survive from the origin of the solar system" (Capaccioni et al. 2015:1) and are therefore expected to "carry the record" of humanity's origins (Capaccioni et al. 2015:1),[4] it may be paradoxical or even illogical to assign to such an ostensibly unchanging and 'original' object a signifier – *woman* – that is arguably without origins and is always fluid (Butler 1999:45), and which refers to a body whose contours are always "morphologically dubious" (Braidotti 2011:80) not least due to its reproductive cycles. But in some sense, comet 67P/C–G – this purportedly ancient and calculable object – is undoubtedly dubious and fluid. It has "morphologically diverse" terrains and a "highly irregular shape" (Thomas et al. 2015:1–2), which poses a significant "cartographical problem" (Thomas et al. 2015:6) for the scientist's sonar gaze. Surrounding this morphologically problematic comet nucleus is a further layer of plasticity: an ever-changing "cloud of grains" is emitted from the comet's dubiously delimited body (Taylor et al. 2015). Throughout its cyclical trajectory (what astrophysicists refer to as period), the comet discharges these dust and ion grains to varying degrees depending on many known and unknown conditions (Taylor et al. 2015), eerily echoing the cyclical yet often unpredictable female menstrual period (figure 2). Thus, the comet's corporeal indeterminacy is further buttressed by this always changing cometary atmosphere (referred to as coma in planetary science), which is made up in part from atomic bodily material and can "stretch tens of millions of kilometres into space" (Lunar and Planetary Institute 2012). As this coma materialises as ever-shifting entanglements of intra-acting comet particles and solar particles that emanate from the Sun into space (Taylor et al. 2015), one could make the somewhat provocative proposition that the comet's boundaries are inherently indeterminable, since its bodily extensions into space negate the modern conception of embodiedness as a state of boundedness, definability, and concreteness. And if the comet's body is indefinable and can never exist as 'pure' or free from intra-dependence with solar material and other particles in space, who is to say where the comet's body – this otherwise artificially delimited object of the scientific gaze – stops and other bodies and entities, such as the Sun or even space itself

[4] Although comets are also admittedly "rejuvenated at every passage close to the Sun" (Capaccioni et al. 2015:4), so in contrast to the scientific assertion that comets are made up of "primitive solar nebula material dating back to the origin" (Taylor et al. 2015) and the related implication that 67P/C–G is therefore a passive and comparatively unchanged ancient entity, its actual material life appears to support the new materialist tenet that "objects cannot continue to circulate unless they endlessly change" (Trinh in Barad 2014:182). And if this is true, then the Rosetta mission may well be questing for an impossible, 'amnesiac' object – for matter that is antique but is unchanged and is therefore without history; something that was *there* but does not remember.

start? So perhaps the comet is indeed very much feminine, albeit in wholly unexpected and insurgent ways. If this is so, then one may wonder what implications can surface for feminist theory and for scientific practice, since in this case the signifying discourse is plausibly masculinist (as this has been demonstrated earlier in this chapter) and yet the figure of the signification – the comet – is far from "passively awaiting" the "penetrating act" of definition (Butler 1993:4), and instead elides or perhaps even suppresses the patriarchal gendering act *without deliberately or consciously trying to do so*.

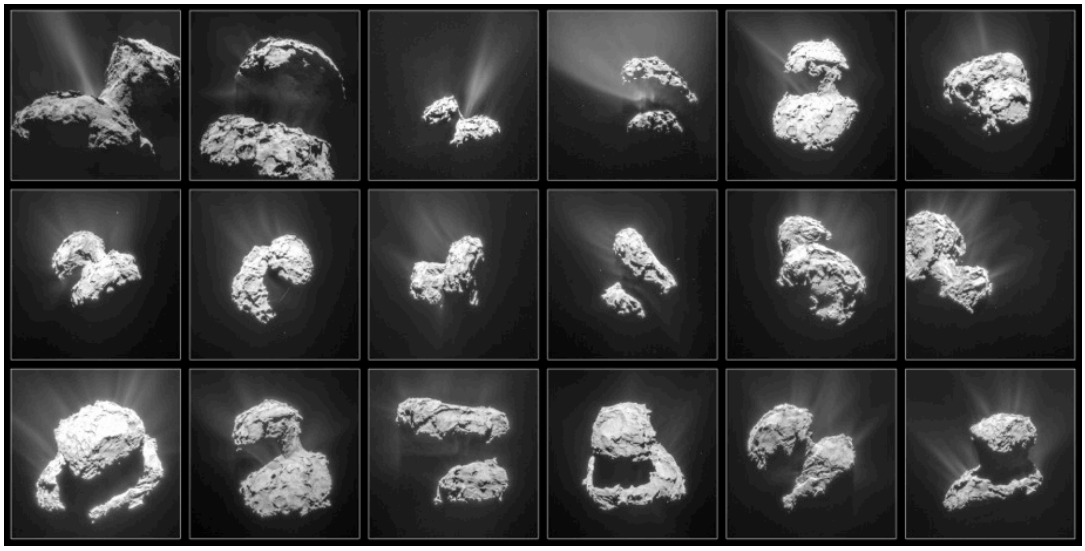

Figure 2. The "morphologically dubious" body of 67P/C–G and its coma extending into space. Source: European Space Agency / NAVCAM

The promise of becoming destroyed

In a new materialist reading, it is possible to discern thing-power in certain notable events of the Rosetta story; there are cases where one could speculate that material vitality flicked its fin. For instance, if material agency can be said to reveal itself in those periods when scientists are passively monitoring matter and waiting for it to act (Pickering in Lorenz-Meyer 2014:88), could we plausibly consider the instance of Philae's hammer instrument breaking during a comet sampling experiment (figure 3) as the result of cometary particles resisting being moved aside and even 'pushing back'? Or, if even a flash of resistance to or independence from us marks thing-power, as Bennett suggests, could we seriously consider the hammer failure as an instance when the metal grains in the hammer's microstructure "respond[ed] to the individual movements of their neighbours" (Bennett 2010a:58) in humanly wholly unexpected ways? In another instance, when Philae's anchoring harpoon

cables failed to fire upon landing on the comet and the spacecraft subsequently bounced back from the comet surface into space (figure 4), could we reasonably propose that this may have happened because some electrons "abandoned their regimented paths" as they were "attracted to impurities in the silicon" (Marks 2002:175), and therefore communicated a digital 'maybe' – a sign *other than* 0 or 1 – to the harpoon system? Such a 'maybe' would have been unintelligible to the spacecraft's digital harpoon-firing system (and thus would have been ignored), since this system was constructed within the logic of modern binaries (of false/true, male/female, active/passive, human/non-human, alive/lifeless), where the in-between and the out-side cannot be comprehended or tolerated.

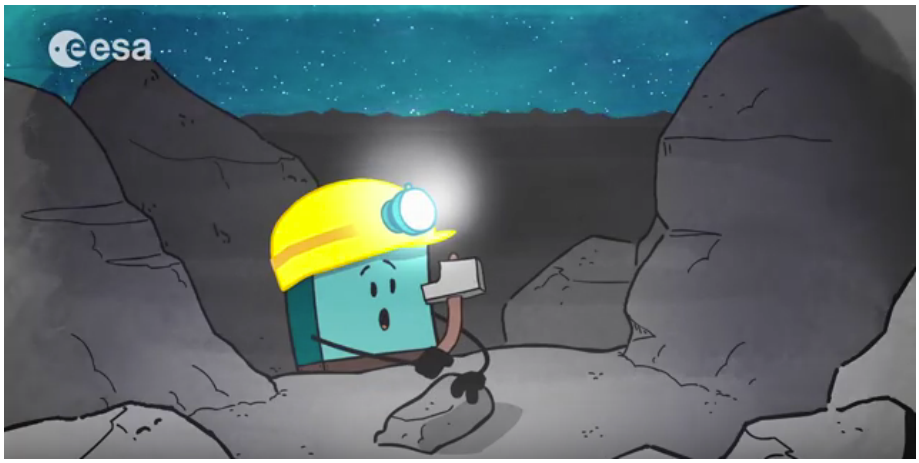

Figure 3. The moment when the cometary material 'pushed back,' breaking Philae's hammer instrument, depicted in the ESA Rosetta cartoon *Once Upon a Time…*
Source: European Space Agency / YouTube

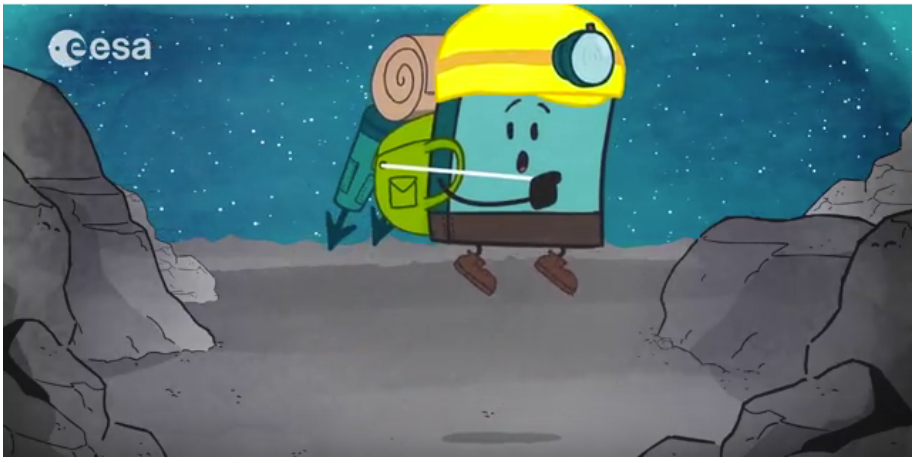

Figure 4. The moment when Philae's harpoon system failed to respond and the spacecraft drifted from the comet surface into space, depicted in the ESA Rosetta cartoon *Once upon a time…*
Source: European Space Agency / YouTube

However, here we may run into some intriguing and concerning questions around how new materialisms tend to define and understand power and agency. Against all expectations and hopes, many new materialist and posthumanist theoretical frames, such as Jane Bennett's conception of thing-power as an "inherent animated vitality or unyielding strength emanating from a material gathering" (2004:365), appear to subtly but persistently reinforce the dominant narrative of power and agency as humanised and masculinised. If materiality is as much force as entity (Bennett 2010a:20) and if there is always an excess, a vitality, a relationality to matter, which in turn renders it active, self-creative, and unpredictable (Coole and Frost 2010:9), but if this force (connoting power and therefore agentic capabilities) is at the same time still predominantly equated with assertion, authority, and coercion, that is, coded as *masculine* modes of power (Grosz 2005:186–187), then the question is: does this new materialist approach not reinforce the very concepts it seeks to renegotiate? Could we conceptualise power and agency in a different way, in a way that unmoors these concepts from their humanised and masculinised imagery?

Mapping this dilemma onto the Rosetta mission, one may note that the mission scientists compellingly (re)present the feminised yet not-quite-human 67P/C–G and its cometary matter as manifestly weak and yielding, painting a picture of lack and submission: the cometary material experiences "fatigue" and "shock" (Thomas et al. 2015:4), it is "porous" and "weakly bounded" (Sierks et al. 2015:2), and it produces 'insufficient' particles that have "low velocity" and are "non-escaping" (Thomas et al. 2015:1). But if we take new materialist thought seriously in that matter's "components may remain unaffected until the level of activity around them reaches a critical threshold when *they may spring into action, be produced, or be destroyed*" (Protevi 2011:385, emphasis added), then the cometary matter's obvious weakness, yielding, and passivity cannot be 'non-action' or 'non-agency.' Is it not agentic and participatory activity after all *to stop* pushing back, to get fatigued, and so *to let* one's cohesiveness or "tensile strength" (Thomas et al. 2015:2) be "overcome" (Thomas et al. 2015:5) by another's pressure, and consequently *to give* pieces of oneself in losing mass and wasting away (Thomas et al. 2015:1)? Why do we insist in our material, emotional, political practices on equating weakness, yielding, or accommodation with negativistic images of feminised submission and powerlessness, in the same move casting these images as pitiful positions that are to be avoided at all cost?

Going further, if "nobody really knows what agency is" (Bennett 2010a:35), how can we accept that the yielding of materiality or force, such as when the gravitational and interparticle forces on comet 67P/C–G are overcome by an internal gas explosion that then ejects boulders or grain particles from the comet's body (Thomas et al. 2015:2), is a non-agentic or powerless process? If we really do not know what human agency is, then how can we take it for granted that agency is exclusive to humans? How can we assume and then act on the assumption that the processes of nonhuman actants and forces are always categorically dissimilar and 'less than' those of whom we qualify as humans? If matter truly "becomes" rather that "is" (Coole and Frost 2010:10), then is 'becoming destroyed' – this "potential to be active" (Thomas et al. 2015:3) through disappearance and non-existence in processes of "mass loss" and "mass wasting" (Thomas et al. 2015:1) – not still an "agentic materialisation" (Coleman 2014:41)? Could we think and talk of matter as yielding to (perhaps even accepting) its own removal and disappearance, and see bodies as agentic in this *giving way*, and in the process succeed in avoiding the seemingly unavoidable relegation of the unmarked to the blind-spot created by our modern distinctions (Bryant 2011:20–21), such as domination versus submission or active versus passive?

Feeling for the (zombie) organism

Another political-ethical conundrum opens up in our treatment of comet 67P/C–G, when one considers the planned destiny of the two spacecrafts. While the Philae lander will eventually stop working on the surface as the comet moves closer to the Sun along its trajectory, the scientists plan to direct the Rosetta spacecraft to 'crash' (or lithobrake, in flight operations jargon) into the comet in an uncannily logical self-destruction at the end of the space mission in 2016.[5] While Rosetta's crashing would take place for entirely logical and profitable reasons, that is, for the good of science as the spacecraft's scientific instruments could collect unique and unprecedented data this way, these ostensibly instrumental reasons reveal just how nonchalant we can be about harming or even "sacrifice[ing] some actant for the sake of ourselves" (Bennett 2010a:104). Although the effect of the crash on comet 67P/C–G and its atmosphere might be admittedly insignificant, no voice can be heard even just contemplating the dimensions of nonhuman consequences of this purportedly justifiable human act. Despite the fact that death is arguably "just another time sequence" of becoming (Braidotti 2010:208)

[5] One might even feel tempted to suggest that the comet-courting scientists will be "literally crashing through boundaries" to finally reach full consummation with their object of desire (Bukatman 1991:345).

– for Philae and Rosetta, that of becoming "zombie media" (Hertz and Parikka 2012:427), a dead-yet-alive electronic waste in space that would for a very long time "leak in many directions" (Parikka 2012:98) – the humans of the comet mission only keep count of time and keep themselves accountable until the anthropomorphised death of the spacecrafts; until these machines and the nature they are in contact with are of use to us.

Although feminist and postcolonial theories have insistently discredited modern science's 'progressive' practice of using and controlling nature (for instance, by mapping it to infinitesimal details), it may not be immediately apparent why such human domination is unethical and even harmful (Keller 1992:34). Indeed, Bruno Latour somewhat sceptically queries: "should we have not tried to become nature's masters and owners?" (1993:9). If, as feminists persistently argue, nature is not a she, then what could be morally wrong with using and controlling the nonhuman 'it' that remains? However, as it was shown earlier in this chapter, the conditions and capabilities that separate humanity and thinghood are less than clear-cut (Coole and Frost 2010:10). Even though the 'it' and the 'we' intricately slip and tumble into each other in the Rosetta mission as the mechanical outgassing of the two spacecrafts measurably intra-acts with the atmosphere of comet 67P/C–G, as alien particles of the comet float into the spacecrafts, and as the "zombie media" (Hertz and Parikka 2012:427) that the machines are bound to become will leak into the comet and space, holding onto the Cartesian-Newtonian notion of matter as something without inherent qualities and values (Coole 2010:94) beyond its immediate instrumentality to humans allows the 'we' to slide into the 'I' of the solitary master. This, in turn, arguably legitimises and sustains some of the most persistently wasteful and oppressively harmful practices (Bennett 2004:366); the indifferent subjugation and consumption of the 'its' of our natural environment or, indeed, "naturecultures" (Haraway 2010). The ethical imperative that instead of wastefully consuming and oppressively taking from humans and nonhumans alike, 'we' should be sparing and sharing *in difference* is not a novel idea in feminist theory and science studies; indeed, some have been advocating a "feeling for the organism" (Keller 1992:32) for over three decades – but the 'we' of the humans of the Rosetta mission do not (yet?) appear to feel for comet 67P/C–G and its environment beyond how *sexy* her body is.

This chapter attempted to show the inherent violence and *in*difference that come with the often taken-for-granted assumptions that (a) some bodies are more passive than others and (b) "some forms of life are more vital than others" (Bennett 2010b:57). While it may be enfolded

in subtly yet powerfully exploitative and oppressive discourses and practices, the Rosetta science also appears to suggest that a view of nature and matter as alive, vibrant, and always already (self)(re)inscribed is conceivably less opposed to modern scientific endeavours than one might assume. Indeed, "envisage[ing] a more complex and indeterminable nature of matter" (Coole and Frost 2010:9) – and therefore perhaps foreshadowing a more horizontal and more generous distribution of value (Bennett 2010a:13) – may have increasing "resonance with the actual experiences and practices of scientists" (Lorenz-Meyer 2014:95). If this is so, then the insistent call from feminists and new materialists to collectively rethink the modern liberal capitalist categories of agency, matter, causality, production, and consumption may in fact be reinforced with/in contemporary scientific practices, especially if we (also) pay attention to the no-so-obvious "tropes and rhythms they suggest" (Coole and Frost 2010:13). However, without looking *at* or looking *for* such reinforcements, they may go unnoticed or even be silenced alongside the persistently louder discourses and practices that reinforce traditional patterns of exploitation and oppression.

Chapter II – The spacecrafts

Influenced by Donna Haraway's imagery of the cyborg, that is, a "hybrid of machine and organism, creature of social reality as well as creature of fiction" (Haraway 1991:149), this chapter critically considers how the boundaries normally ascribed by modernity's human/machine and alive/lifeless dichotomies inadvertently become ambiguous in the public discourse of what I call the spacecraft prong of the Rosetta story.[1] To this end, I will show how the two spacecrafts of the mission, Rosetta and Philae are made into inherently indissoluble assemblages of human and machine; how they become ambiguous associations that are made elusive and, somewhat paradoxically, all the more integrated by being spatially and temporally dispersed in the cyberspace of digital social media and actual outer space. But while I am drawing on the Harawayian conception of the cyborg, it will become apparent that mapping this cyborg imagery onto the spacecrafts is not quite productive for a feminist and new materialism informed analysis, since the particular ways in which Rosetta and Philae are humanised with/in digital media appear to (re)inscribe traditional patterns of gendered oppression, directed at modernity's others and their 'less than' hu*man* state. Thus, it would not provide a radical enough challenge to the humanised and gendered narratives of the space mission, and its politics of hierarchies, exclusions, and silences. This is because I understand Haraway's cyborg as a predominantly organic-human plane, that is, still intrinsically defined with the human implicitly in the centre, which has been overlaid and entangled with technological, mechanistic, and informatics creatures/creations.

Reversing cyborg-causality

What I suggest instead is that the virtuality-materiality of Rosetta and Philae show something of a reversed situation, where Haraway's presumed cyborg-causality is turned inside out, so that the 'pre-existing' technology of the spacecrafts is enmeshed in 'added' humanistic relatibility and personhood. Although constructed by the organic hands of their human makers – who, Haraway would argue, are always already cyborgs themselves (Gane 2006) – in a sense, the spacecrafts are purely artificial entities. As such, the modern humanist discourse

[1] This chapter is a substantially reworked and extended version of a short paper submitted as course requirement for GENS 5461 (2014/15) and a subsequent essay published in *Pulse: A Graduate Journal of History, Sociology, and Philosophy of Science* (June 2015).

would insist on classifying them as non-affective and inert machines, and we would be expected to relate to them as such. However, these inorganic machines are (re)suscitated in digital media into what I tentatively refer to as reverse-cyborgs, where an ambiguously alien but appealing human-ness is melded with the 'original' machine bodies through affective anthropomorphisation. This is not so much a negation of the Harawayian cyborg but a suggestion in the vein of Jane Bennett (2010:36) to consider anthropomorphisation and its potential to perhaps more radically displace the human from its special place in the centre by allowing us to affectively relate to nonhumans. Within this theoretical framework, the following section provides some additional information on the space mission and the social media phenomenon that developed around it, setting the scene for the second half of the chapter, where the machine/human transgressions and subsequent (reversed) cyborgian becomings hinted at shortly are demonstrated through examples selected from the ESA's Twitter accounts and Rosetta mission blog, and from digital news articles and blog posts.

On 12 November 2014 and for the first time in the history of space exploration, the ESA's remotely controlled spacecraft Rosetta sent down a smaller spaceship, Philae to the surface of comet 67P/C-G to investigate its structure. The landing and surface examination were not completely successfully since after the 7-hour free fall from Rosetta, Philae landed in shadow and therefore was only operational for about 60 hours before its solar-powered batteries were depleted, shutting down the robot.[2] Scientists could then only hope that as the amount of sunlight reaching the machine gradually increases during the comet's approach to the Sun during 2015, Philae would come alive again, recalling religious narratives of resurrection. (That the robot did indeed get resurrected in June 2015 is just another intriguing twist of this already highly sensationalised space exploration mission.)

The ESA, its partners, and the European governments invested much into this mission: Rosetta travelled for over 10 years and 6 billion km with the sleeping Philae on-board to reach comet 67P/C-G, with the international project costing €1.4 billion to date. This mission's scientific and operational performance can decide the fate of future space ventures and will greatly influence whether the European public supports further funding of future projects at a

[2] For an official yet accessible story of Rosetta, Philae and the comet landing, the reader is advised to consult the ESA cartoon titled *Once upon a time... #cometlanding* (accessible on YouTube), which provides a factual account of the mission's operational and scientific milestones, such as Philae's unresponsive harpoons and the multiple landing attempts, the breaking of Philae's hammer during an experiment, and the depletion of Philae's batteries.

time when European states are facing internal issues with already high fiscal pressures. Further more, as over 2,000 scientists and engineers are involved from various space industry firms and research institutions, there are also scientific careers and research funds at stake. Given the importance of securing sustained public engagement, the ESA's press team and the mission's science teams deliberately maintained a significant and centrally coordinated social media presence for Rosetta and Philae in the run up to and during the comet landing in October and November 2014. This media presence was primarily built up via two Twitter accounts (@ESA_Rosetta and @Philae2014), where the spacecrafts were personified and conversed with one another; an ESA blog dedicated to the Rosetta mission; and live streams of interviews with mission scientists. This chapter focuses on the anthropomorphisation of Rosetta and Philae in the ESA Twitter conversations, because it is due to the online presence of the two machines that the press campaign was remarkably successful: Rosetta and Philae became 'media celebrities' literally overnight on Twitter with followers in the hundred thousands (the Philae account had around 27,000 followers the day before the comet-landing but over the subsequent two days this increased to almost 400,000 followers, with the Rosetta account seeing a similar growth in subscribers).[3]

"Heart-meltingly human" – or are they?

Similarly to the Harawayian cyborg but in what I propose is a reversed and perhaps more promising causality, Philae and Rosetta breach boundaries by being both material machines and virtual "heart-meltingly human" organisms (Ruberry 2014), while at the same time technologically integrated humans created and act through them. Crucially, because the spacecrafts presumably 'start out' as machines, they can participate through anthropomorphisation in social media in the intimate enmeshment of non-human/human characteristics *from the other way around*. I suggest that in comparison to the Harawayian cyborg's origination in human subjectivity and subsequent mechanisation, this anthropomorphising approach to the human/non-human imaginary results in a reversed cyborgian becoming of the spacecrafts, and consequently such a 'reversed' causality yet anthropomorphic relatibility may place Rosetta and Philae in a better position to subvert the

[3] For a comparison, the followers of the ESA's non-anthropomorphic Twitter account for a Rosetta-like spacecraft, Gaia (operated under @ESAGaia since early 2009) is numbered under 10,000. Data correct as of 31 August 2015, sourced from www.twittercounter.com.

centrality and 'specialness' of the always masculinised human subject of modernity – that is otherwise also prevalent in the Rosetta story.

By anthropomorphising the robots through social media, the ESA succeeded in coupling hard-to-digest niche science with contemporary modes of (digital) consumption. But as I will show, they also contributed to the virtual creation of the spacecrafts as cyborgs by constructing Rosetta and Philae as feeling, thinking, breathing, and mortal beings. The spacecrafts have humanised-mechanic body parts such as eyes that watch out for each other, arms that sneak into candid pictures, legs that need stretching, and backs that get chilly. They can hear and smell their surroundings, and they feel excited, nervous, tired, or sleepy. They take selfies and send each other postcards, bantering and nudging one another along the way. They jump and bounce and float, and they sleep and dream (perhaps echoing Philip K. Dick's *Do Androids Dream of Electric Sheep*). They have a proper home address (i.e. the comet), where they lead busy and exciting lives. They are mother and child, friends, lovers, and siblings *all at the same time*. Humans and other anthropomorphic creatures (for instance, NASA's Mars rovers as personified on Twitter) care about them and mourn when Philae 'dies' as it runs out of power.

This relatable and lively anthropomorphisation of the spacecrafts also 'rubbed off' on the comet: as the date of the comet landing approached, scientific data that was gathered by Rosetta's magnetometer and ion-analysing instruments were deliberately used to attribute animate and, as it was shown in Chapter I, explicitly feminised characteristics to the comet, such as a siren-like "mysterious song" (Mignone 2014) and a "perfume of rotten eggs and cat wee" (Lakdawalla 2014). But while Chapter I demonstrated that the first prong of the Rosetta story, comet 67P/C–G was anthropomorphised in a way that is urgently sexed and thickly inscribed with(in) gender relations on the one hand but which still maintains this object as not-quite-human, the spacecraft prong of Rosetta story is thoroughly humanised yet it appears to have escaped gendered inscriptions and hierarchies. In line with their similarity to Haraway's (feminist) cyborg that is ultimately genderless (Haraway 1991:150), Philae and Rosetta could – at first – also pass as humanistic entities without gender roles, because no gender is visible on their material surface and their mechanical bodies and scientific functions are not *originally* inscribed with the binary meanings of gender. But, and importantly, as a creature of (human) fiction Rosetta is the *mother* ship; matching a feminine gender role, *she* is the provider of care and emotional support to *him*, the (infantilised) "baby space probe" Philae

(Gilbert 2015). In the mother-child assignment, Philae is the male child "leaving home to go out into the universe" (Said-Moorhouse 2014) while mother hen Rosetta watches over him undertaking his heroic mission (figures 5 and 6) and later as he falls asleep due to his depleted batteries (figure 7).

Figure 5. Rosetta, the mothership, taking a photo of Philae's adventurous descent into the 'unknown.'
Source: European Space Agency / YouTube

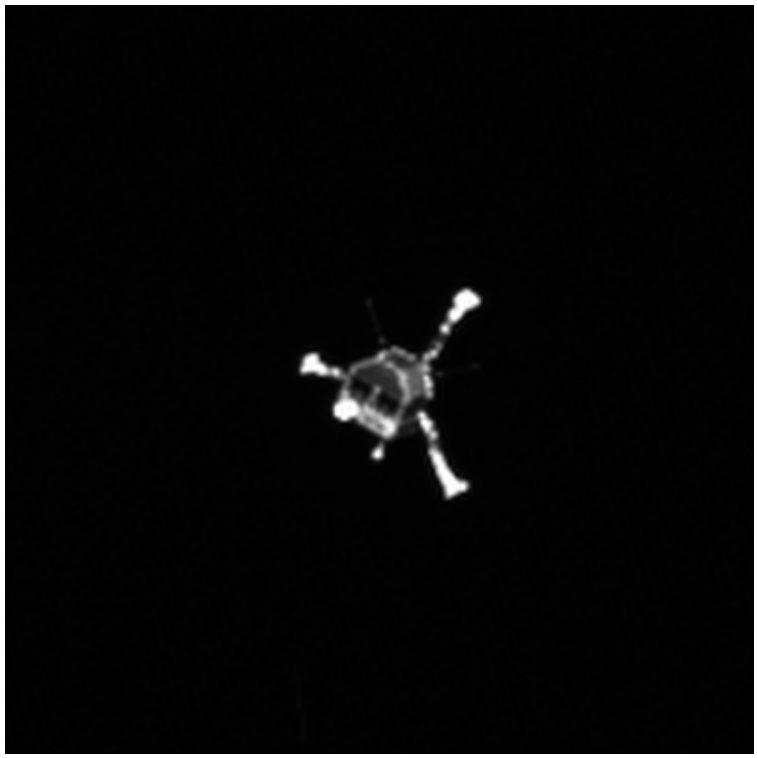

Figure 6. The actual image that Rosetta took of Philae's descent to comet 67P/C–G.
Source: European Space Agency / OSIRIS

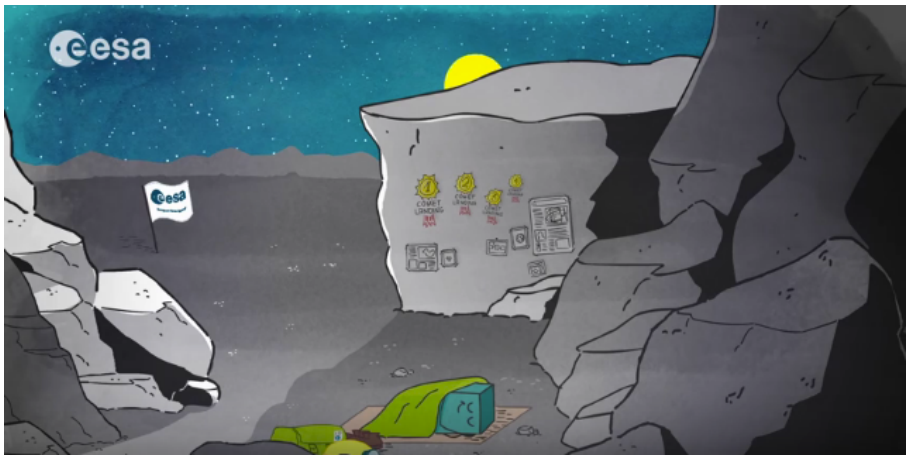

Figure 7. Philae 'falling asleep' after its batteries depleted.
Source: European Space Agency / YouTube

Consequently, although the robotic bodies are not inherently gendered (fittingly for their cyborg-like image), the differential allocation of 'she' and 'he' is based on the social-cultural interpretation of the roles of the spacecrafts, performatively re-creating the spacecraft functions in gendered terms to yield a sexual division of labour. Here, I suggest that due to human discomfort with the ambiguousness of the cyborg, Rosetta's body must be read and inscribed as female because she is the carrier, the one who is 'pregnant' with and subsequently "deliver[s]" Philae to the new world of the comet surface (Taylor et al. 2015). In opposition to Rosetta's feminised care work and support, Philae is coded as male because he is the one who in a scopophilic-sadistic move conducts the masculinised work of discovering and physically conquering the world of the comet; acting as a prosthetic penile apparatus to claim the comet's 'virginity' and inseminate it with the (intellectual) seed of humanity.

Ultimately, the spacecrafts could not become human enough if they remained genderless entities, since if their bodies were to "become viable at all," indeed, if they were to make sense to 'us' as agential and, above all, relatable beings who "qualif[y] for life within the domain of cultural intelligibility" (Butler 1993:2), then gendering them was a mandatory move. Since gender is a pre-requisite for personhood, their very humanness would have been questioned if the spacecrafts were not 'properly' gendered (Butler 1993:8). Therefore, the social images of the scientific and operational labour that the spacecrafts do were used to assign Rosetta and Philae semantically gendered roles, which they were then made to repeatedly perform in virtuality, with the relevant pronouns firmly maintained in their every 'utterance' on social media. So while the robots do not *originate* as gendered, that is, they were not conceived as gendered bodies and therefore gender as a concept would not make

sense to *them*, Rosetta's and Philae's differential genders had to be purposefully assigned and put to work by the *humanist* culture within which they were crafted and immersed, before they could legitimately be(come) enfolded into our social fiction that is clearly still very real in its (gendered) consequences.

However, the relationship between Rosetta and Philae is not simply a mother-child bond. The machines are also narrated as siblings, with 'Grandpa Giotto' (an unstaffed ESA spacecraft that studied Halley's comet in the mid-1980s) telling them a bedtime story (European Space Agency 2014), and they are also often depicted as friends, where Rosetta calls Philae "buddy" and "my friend" (figures 8 and 9). These robots then engage in friendly banter, like two school children on a field trip, throughout the separation preparations for the comet landing, during Philae's descent to the comet, and in the wake of the landing. Perhaps even more intriguingly, there are even incestuous tones between the spacecrafts: Philae and Rosetta are related and are relatable to as lovers, who are going through a "love affair millions of miles away" from Earth (Said-Moorhouse 2014), and their separation for Philae's comet landing was narrated as "the most high-profile break-up" of 2014 (Dutton 2014).

Figure 8. After separation and planned loss of connection, Rosetta can "hear again [her] buddy."
Source: European Space Agency / Twitter

Figure 9. Rosetta congratulates her friend for landing and getting a new home address.
Source: European Space Agency / Twitter

In this anthropomorphisation, the constant writing and overwriting of 'humanly' conflicting and mutually exclusive relations between Rosetta and Philae (friends, mother-child, lovers, and siblings) can be seen as an urgent race to create a human relatibility and personhood for the spacecrafts, essentially *from scratch*. These cyborgian robots do not have a socially acceptable origin story: they were not organically conceived and born but mechanically planned and crafted; they are not 'natural' or 'pure' beings like humanity (is narrated to be) but are artificial, impure assemblages. Unlike a human family, they do not come with a blood-tie based lineage, therefore they may be perceived as lacking any basis for a legitimate claim to personhood to such an extent that this lack can only be turned around and filled in by grafting and piling multiple relational ties on top of each other, so that they become subjects with personal histories and spacecraft-relatives (figure 10), so that one can "care for" them as subjects, rather than only "care[ing] about" them as objects (Durning in Bennett 2004:366).

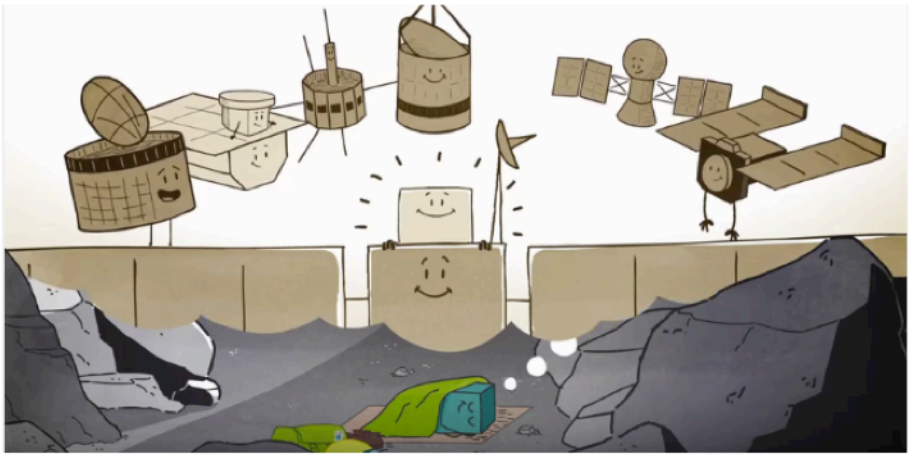

Figure 10. Philae sleeping on 67P/C– G and dreaming of his loving spacecraft-family.
Source: European Space Agency / YouTube

Although these relations between Rosetta and Philae are (im)morally conflicting from a modern perspective, the scientists and the public make an exception to tolerate these conflicts because the robots are made likable *as* humans, that is, not just likable *like* humans but affective in their very 'humanness.' While the scientists and supporters/followers of Rosetta and Philae are admittedly unlikely to be aware of the theoretical conceptions of cyborgs as used here, they unknowingly or tacitly accept and embrace the monstrous perversity of the spacecrafts (which otherwise would have surely been alienating and even threatening to social order) because of a virtual virulency to affectively relate to these charming, fallible and therefore very much human entities, who are simultaneously familiar and foreign so that one can curiously relate to them both as self and as the other. It is because of this relatable

otherness that Rosetta and Philae's engagement in multiple forbidden relationships (mother-child versus siblings; mother-child versus lovers; siblings versus lovers) was not perceived to pose the kind of transgressive, ruinous threat to modernity's dichotomous borders and to social order itself that similar relational becomings between those only familiar to us and to each other as humans would have posed.

Death of a machine

Incestuous and forbidden relationships are not the only striking aspect of the lives of these anthropomorphised spacecrafts. The fact that – like most machinic bodies – Philae and Rosetta were built with finite lifespans was heightened through the willingness of their followers to suspend disbelief (Vertesi 2010:31), and assent to the make-believe of the "as if" – the persistent belief against all odds that something is alive – that is known to "[have done] remarkable work" in scientific thought and practice (Keller 2002:49). Thus, these objects were so "disturbingly lively" (Haraway 1991:151) in social media and by extension in *reality* (although perhaps not in *actuality*) that similarly to the modern liberal 'subjects' who crafted, operated, and befriended them these machines now seem humanly mortal. While the timing is uncertain, anthropomorphised death is a certainty from the perspective of the Rosetta scientists and the followers – even if, as it was argued in Chapter I, death is just another time sequence and thus Rosetta and Philae will continue their existence as "zombie media" (Hertz and Parikka 2012:427) even after they stop working for us.

With Philae, this humanised mortality was particularly compelling and relatable. The machine, which was expected to conduct scientific experiments for months on the surface of the comet, landed in shadow in November 2014 so it could not recharge its batteries through solar panels and shut down after 60 hours of work. Philae's battery depletion was broadcast on social media in near real-time (figures 11 and 12), resulting in the machine being hailed not just as brave for completing the risky landing manoeuvre, but also as heroic for transmitting scientific measurements until his "last gasp" before dying (figure 13). As Philae neared the end of his 'life,' followers flooded Twitter with theories eerily reminiscent of mythical and religious narratives as to how the robot may cheat death by being resurrected through the power of the Sun when the comet travels closer to the star in 2015. Once Philae went into hibernation (figure 14), supporters were said to experience a "period of mourning" (Coyne 2014) for the machine, while still resolutely believing in the coming of the miraculous

resurrection (figure 15). Headlines announcing Philae's actual re-boot in June 2015 in turn made references to iconic sentient creatures, such as Frankenstein's monster and the alien of the 1982 film E.T. in exclaiming that "It's Alive!" (Biever and Gibney 2015) and informing that Philae "phone[d] home after months of silence" (Malik 2015).

Figure 11. Philae checks in with Rosetta and indicates his batteries are depleting.
Source: European Space Agency / Twitter

Figure 12. Rosetta responds to Philae that she has "got it from here" so Philae can "rest well."
Source: European Space Agency / Twitter

Figure 13. Rosetta tweets about Philae doing science until his "last gasp."
Source: European Space Agency / Twitter

Figure 14. Rosetta thinks sleeping Philae "is dreaming about science."
Source: European Space Agency / Twitter

Figure 15. Rosetta updates worried supporters about "little Philae."
Source: European Space Agency / Twitter

The (body) politics of borderlands

Media ecologist Matthew Fuller suggests that paying attention to materiality is most productive at the 'places' that are often regarded as irrelevant to due to their "immateriality" (Fuller 2005:2), such as the incorporeal 'bowels' of digital media that 'evolved into' our lives and our selves (Coole and Frost 2010:17) through their "ubiquitous force" (Connolly 2010:189), which permeates language, impressions, feelings, and attitudes via wired and wireless circuits. What is more, by condensing time, space, and matter(ing), digital media become a life force that "give birth to bodies" (Fuller in Parikka 2011:36), which are always already entangled with/in its digital milieu (Parikka 2011:37). It is these bodies, then, which this chapter takes as its main point of concern – specifically, the digital materialities of the Rosetta and Philae spacecrafts that were 'given birth' through the contracting forces of digital social media. In particular, this chapter takes the stance for granted that digital media and the bodies created with/in it, such as the personified spacecrafts are 'instinctly' cyborgian not just due to their obvious "machinic-digital fusions" (Bukatman 1991:347), but also due to being

immaterial representations which matter in *real* ways (Gill in Coleman 2014:32). That is, digital media do not simply reflect but also (re)construct bodies (Hall in Coleman 2014:33), spawning legitimate and, even more promisingly, illegitimate virtual-material entities, who in turn persist in being experienced in reality and materially (Coleman 2014:36).

As cyborgs, Rosetta and Philae are understood and deployed here as "thinking and reasoning systems with minds and selves spread across" carbon-based bodies (those of the mission scientists and social media followers) and circuitries of silicon-based bodies (those of the machines) (Clark in Lenoir 2002:218), in this way "mak[ing] protein and silicon operate as a single system" (Hayles 1999:2). With the natural and the artificial seeping into each other (Lenoir 2002:217) in the "virtuality-materiality" (Hayles 1999:14) of the spacecrafts, thinghood and human-ness are fused immanently in what Scott Bukatman calls "soft machine[s]" (1991:350). While the intention of the people of the Rosetta mission was to humanise non-humans (the spacecrafts) and make then emotionally relatable to secure public buy-in, the resulting cyborgian entities of Rosetta and Philae perhaps wholly unintentionally and unexpectedly play at ambiguous being – cyborgness – being seriously political, since by refusing to divide and properly classify (their) positions and bodies, these virtual-material spacecraft beings can be seen as enmeshed in the "high-stakes 'border war'" (Bukatman 1991:346) of securing the human core and eliminating *in*human fringes. Surely against all human intentions, Rosetta and Philae are not only 'out of (bodily) bounds' but they *insist* on constant transition and indeterminacy with-in their very existence, effectively "cutting together-apart" (Barad 2014:179) – i.e. cutting together *and* apart in the same move – any division of the safe and the unsafe and erasing any definition of the I/us and other/them (the spacecrafts are neither machines, nor humans, and yet, they are both machines and humans at the same time).

Becoming/being cyborg here therefore does theoretical work that is very similar to what Bennett suggests the affective links created through anthropomorphisation allow us to do (2010:36): by skewing our view to see human and non-human at the same time (this is Karen Barad's cutting together-apart move), we can enter the borderlands or, more aptly, no *man*'s land that move in-between and yet outside of the modern dichotomies of feminine/masculine, natural/artificial, human/non-human, alive/lifeless. Thus, being cyborgian means operating as an insistently anti-Cartesian 'monstrosity,' which subverts entrenched and therefore *safe* definitions of "what is sayable, representable, thinkable" (Boscagli 2014:231), and I suggest

here that although the spacecrafts are deliberately gendered and humanised in the public discourse of the mission, the robotic-discursive selves of Rosetta and Philae can be incendiary and anti-modern in their monstrous cyborgness. It is important to bear in mind, however, that while I proposed and analysed a reality of Rosetta and Philae as cyborgian agents, this is not to claim that they have an *actual* agency or mind, since – as Deleuze points out – the reality and actuality of things are arguably not necessarily identical (in Protevi 2011:390). That said, research and practice in artificial intelligence suggest that the distinction between attributing agentic consciousness to a robot and it *actually* having a mind is not indisputable (Wilson 2010:107) – so perhaps conceiving of Rosetta and Philae as thinking and, importantly, feeling machines may have untapped potentials.

This chapter investigated machine/human transgressions in the pubic discourse of the Rosetta comet mission and suggested that while Donna Haraway's cyborg remains implicitly predicated on a humanist core, the two spacecrafts of this space project may allow us to look at cyborgs from the reverse, and therefore these virtual-material beings could carry a more radical potential for displacing the masculinised human subject from the centre. It was suggested that the spacecrafts do not carry marks of gender, but since they do not make sense to us as genderless creatures, allocating gender to them in digital social media is a pre-requisite of accepting them into our realities. Similarly, while they are deeply embedded in a web of networks, the spacecrafts lack blood-tie based origins and relations (they were not born but made), so in a rush to make them humanly legible, multiple conflicting relations were grafted onto their bodies, so that they eventually acquired not just origins but also mortal ends. The spacecrafts could live within these mutually exclusive relationships because cyborgs are impure, perverse, and alien; and yet, they are also familiar to us in more than one sense. Ultimately, Rosetta and Philae as digital-machinic fusions may have the political and ethical potential to claim a borderland in-between and out-side of modern dichotomies.

Chapter III – The shirt

This chapter draws on Foucauldian thought to analyse what I see as the third prong of the triangular Rosetta story; the event now known in mainstream media and in online communities as #shirtstorm.[1] This prong brings together and diffracts through the other two arms of the Rosetta story, the sexualised objectification of comet 67P/C-G and the humanised affectivity of the two spacecrafts, Rosetta and Philae. In this chapter I suggest that the Rosetta #shirtstorm can be a productive site for feminist and new materialist theoretical attention not only because it intersects with and thereby intra-actively becomes matter and meaning with/in the other two prongs of the story as analysed in Chapter I and Chapter II, but also because it is an instructive example of those everyday experiences lived in contemporary society where, as Foucault suggests (1991:148), one persistently comes up against the question of power.

Stirring up a (#shirt)storm

Echoing the feminist new materialist themes of the previous two chapter, this chapter centres on yet another visual-material object: the shirt that the Rosetta mission's public scientific liaison British astrophysicist Matt Taylor wore during the high-profile comet landing and which featured sexualised cartoon images of women (figures 16 and 17), subsequently generating a protracted and at times violent online debate around the aims and roles of feminism. To briefly demonstrate the social-cultural magnitude of Taylor's shirt: there are over 45 million Google search results for the keyword combination 'Matt Taylor' and 'shirt,' while there are just over 11 million results for the combination 'Rosetta' and 'space.'[2] Not only is there now a 'shirt controversy' section in the Wikipedia article on Matt Taylor, but most major international media outlets, such as TIME Magazine, The Washington Post, The New York Times, the CNN, The Guardian, The Independent, The Telegraph, and the BBC extensively reported on the event. Perhaps even more significantly from a women-in-science angle, the American Astronomical Society, the Royal Astronomical Society, and the Astronomical Society of Australia all released official statements on the controversy, condoning the shirt and the resulting misogynistic atmosphere on and offline (Astronomical

[1] This chapter is a reworked and considerably extended version of an essay that was submitted as course requirement for GENS 6010 (2014/15 AY).
[2] Other obvious combinations, such as 'Rosetta' and 'mission,' 'Rosetta' and 'ESA' or 'Rosetta' and 'comet' all resulted in an even lower number of hits – data correct as of 1 September 2015.

Society of Australia 2014) (Richard 2014) (Royal Astronomical Society 2014). The unfolding of this event and its context in turn became known as #shirtstorm, following the Twitter shorthand (or hashtag) through which it was popularised.

Figure 16. Rosetta project scientist Matt Taylor gives an interview on the day of the comet landing, wearing the shirt that resulted in #shirtstorm.
Source: Nature Newsteam / YouTube

Figure 17. A close-up of the pattern of Matt Taylor's shirt.
Source: Notions of the Feminine in Art / Corrina Eastwood

The Rosetta scientist at the centre of #shirtstorm, Matt Taylor had already garnered some public attention in the run-up to the comet landing between August and November 2014 as a "definitely not boring" and "proper cool scientist" (Knapton 2014), who used colourful

metaphors to illustrate scientific experiments, tended to dress informally (unusually for a 'serious' scientist), and displayed his commitment to the Rosetta comet mission by tattooing images of the spacecrafts onto his body. However, during the comet landing process on 12 November 2014, Taylor wore a shirt that was almost immediately noted by a number of science commentators (primarily on the microblogging site, Twitter) as 'out of bounds' for being inappropriate attire in the given public setting and as an example of a scientific environment that can seem unwelcoming for and towards women (Plante and Duhaime-Ross 2014). This initial critique was not intensive and was clearly not aimed at vilifying Taylor, but was intended to highlight the shirt as an example of larger societal gender issues, such as the persistent objectification of women and the male-dominated environment of the natural sciences (Bell 2014). Yet, it resulted in a widespread and at times violent online backlash against a perceived 'feminist' attack on Taylor and, by extension, the comet landing (Johnson 2014), which was seen by many as Taylor's personal achievement (albeit the landing itself was directed by the flight operations team, without Taylor's involvement). The intensity of this backlash exponentially grew after Taylor provided an unexpected tearful apology during a mission briefing on 14 November (Meikle 2014), which was then interpreted by Taylor's defenders as the direct result of a supposed "feminist bullying" (Hemingway 2014).

Following Foucault in that "the 'truth' consists of a certain relationship that discourse and knowledge has with itself" (Foucault and Trombadori 1991:62) and taking seriously the implication that truths are therefore contingent on different discourses and knowledges, in the following it will become clearer why the truth of #shirtstorm could be so markedly different for commentators with divergent knowledges from various discursive backgrounds (e.g. "feminist bullying" versus "sexist shirt"). I suggest here that many of the #shirtstorm backlash (i.e. anti-feminist) narratives are exemplary of the immense material-discursive power that society confers upon a seemingly uniform and permanent understanding of reason (Foucault and Trombadori 1991:169), while at the same time these concepts are subtly fluid and constantly re-defined to accommodate and support dominant patriarchal discourses. For instance, many of those speaking up on #shirtstorm in defence of Taylor and his choice of attire appealed to "the rule of reason" (Foucault and Trombadori 1991:152) in order to arbitrarily define what matters and what does not matter (Foucault and Trombadori 1991:152) in the Rosetta narrative, when they routinely asserted that the shirt was simply irrelevant in comparison to the spectacular achievement of the comet landing. Ostensibly, since Taylor "landed on a comet," the 'rational' approach was to focus solely on this special human feat

(figure 18), with the 'sexist' shirt being just a mundane detail that is not worthy of rational attention (figure 19). Within this definition of the rational, those who commented on the shirt were subjected to a dual narrative of feminised hysteria (Micale 1991:201) (Showalter 1981:165): instead of 'sensibly' only commenting on what matters, that is, the worthy (i.e. manly) scientific achievement of the comet-landing, the shirt's critics were seen as shallow, frivolous, sensationalist or even "batshit crazy" (Brecheen 2014) for voicing a critical point of view at such a moment of scientific triumph.

Figure 18. Many argued that since Taylor "landed on a comet," his shirt should not be an issue.
Source: Sander / Twitter

Figure 19. Since Matt Taylor "is a really good scientist," his shirt is inconsequential.
Source: www.punditfromanotherplanet.com

The (de)materialised scientist body

Similarly to the materialisation of the docile bodies of schools and armies of the late 18th century, where these bodies were increasingly "constrained, calculated, constructed" (Foucault 1977:135), the modern body of the scientist is to materialise in a way so that he is visible and legible at a glance *as* a scientist. But, paradoxically, his body is also (supposed to) simultaneously *de*materialise through his extraordinary 'will to know,' so that his disembodied scientific mind is not distracted by earthly, bodily concerns and can work in the most rational state to achieve truly objective knowledge about the world (Shapin 1998:23) (Daston and Galison 2007:203). I suggest that this contradiction of de/materiality between the imperatives for bodily presence and disembodiment mind is dissolved by the prioritisation of docility; the idea that the body is mouldable and controllable, and therefore one's self is also wilfully customisable (Foucault 1977:137). In the framework of Rosetta, it is plausible that astrophysicist Matt Taylor conceived of his body as a blank canvass where his mind/personality was to be performatively materialised. Therefore, Taylor's choice of wearing a particular shirt during the comet landing and his earlier sexualised comments with regards to the comet reveal particular (un)intentions with/in the performative materialisation of the scientist's body and self. It may be useful to recall here Judith Butler's thoughts on performativity and bodies.

Butler argues that sex and gender are "part of a regulatory practice that produces the bodies it governs" (Butler 1993:1), and that the materialisation of these bodies is achieved *performatively*, which is understood not as "a singular or deliberate 'act'" but as a constant citational (re)iteration of certain regulatory norms (Butler 1993:2). The necessity of this always ongoing performativity in turn shows that bodies never fully satisfy the norms by and through which their materialisation is induced so that, ultimately, "materialisation is never quite complete" (Butler 1993:2). With this in mind, Taylor's sexualised comments and his 'sexist' shirt may not appear as accidental or even individually separate acts but as repetitions or even copies of existing regulatory norms. In terms of Taylor's own agency or participation in this framework, I argue therefore that what was at stake (what *always* is at stake) was the performative materialisation of a particular personality and, subsequently, of a particular body that confirmed and conformed to some of the existing regulatory norms it cited (e.g. reinforcing the image of the scientist as masculine, but with the unintended/unexpected citation of the trope of the sexist man), and at the same time submitted some norms to an

incendiary treatment (e.g. subverting the stereotypes that scientists are 'boring nerds' and that science is uninteresting, but in the process unintentionally questioning women's place in science and undermining the ideals of gender equality).

It is arguably worth pointing out that Taylor, as a subject, had been undermining the disciplinary apparatus even before the #shirtstorm controversy took place. If scientists are indeed under a permanent albeit implicit "pressure to conform to the same model" (Foucault 1977:182), that is, to the modern model of the scientist developed during the Enlightenment-era scientific revolution: the white, heterosexual and bourgeois or upper middle-class university-educated Western male, who conducts himself in accordance with a 'professional' image of science in being objective, dispassionate and detachedly factual (Shapin 1998:22) (Shapin 2006:179), then Taylor had clearly been working against this "constraint of conformity" and normalisation, so much so that he should in theory belong to the "shameful class of abnormals" within the disciplinary hierarchy of (scientist) subjects (Foucault 1977:183). But Taylor is recognised and even revered instead as a "proper cool scientist" (Knapton 2014), one who refuses to embody and enact the 'scientific' normalcy that would mark him as a member of the "homogenous social body" (Foucault 1977:183) of scientists. He does this by rebelling both in materiality and discursivity: he is passionate about his scientific work, going as far as permanently tattooing images of spacecrafts on his body in a demonstration of ardent commitment; he rebels through inciting sexual desire by declaring the Rosetta project to be "the sexiest mission there's ever been" (Gibney 2014); he rebels by prolifically using social media channels where he is a scientist who is very much embodied in 'selfies' and in publicly shared details of bodily subsistence (e.g. in images of eating, drinking, and sleeping); and he rebels against the normalising mark of the white laboratory coat of the scientist and the suit-and-tie uniform of the professional by wearing shorts, hooded jumpers, and the (in)famous bowling shirt covered in cartoon images of women.[3] It was through these performative acts that – as I argued earlier – Taylor continuously made his self and body available to the disciplinary apparatus as a subject *and* an object who/that is to be regulated.

[3] Perhaps in a manifestation of the disciplinary/performative tenet that "to punish is to exercise" (Foucault 1977:180), part of Taylor's punishment may be the performative exercise of a more traditional image of the scientist. Since #shirtstorm and his public apology in November 2014, Taylor was only televised in ESA-branded clothing or in an actual suit, invoking the very image he had always appeared to disrupt: the uniform(ed) professional (thus boring?) scientist.

While Foucault proposed that there is a double system of gratification and punishment, I would argue that the events of the Rosetta #shirtstorm shows these two elements to be mutually exclusive (since society most often can only make sense of the conventional juridico-discursive conception of power with its either/or situations), as there is a difficulty for many to comprehend situations when *both* elements, that is, both gratification and punishment are present, and when the opposed values of 'good' and 'evil' work simultaneously within the same subject (Foucault 1977:180–181). In the case of Taylor, we know that "he landed a spacecraft on a comet" (Sander 2014), therefore he was to be rewarded for his accomplishment by the appropriate scientific recognition and public fame. On the other hand, Taylor also arguably "acted despicably" (Le Peletier in Foucault 1977:105), when he violated the expectations and interests of a number of intersecting power-networks (for instance, those of feminists, women in science, other male scientists, his employer, and public commentators), thus, he was logically "subjected to infamy" (Le Peletier in Foucault 1977:105). In this way, Taylor embodies both 'good' and 'evil' and, as such, he "no longer fits onto the hierarchy of subjects" (Foucault 1977:183), and ultimately subverts this hierarchy by preventing the disciplinary apparatus from producing a *clear* (i.e. black-and-white) judgment of his nature and value.

Putting sex(ism) into science

With Foucault arguing that the politics of sexuality define sex focused on (re)production as righteous and commendable and sex for pleasure as immoral and even as aberration (Foucault 2012), I would suggest that such an oppositional politics of sex is at work in #shirtstorm. While Taylor's recurring sexualised references to the comet and the Rosetta mission (for instance and as cited in Chapter I, "the sexiest mission there's ever been," "we are moving in for the kiss," and "she's sexy, but I never said she was easy") had originally been left unchallenged because these were within a morally justified production (of knowledge) and conformed to the narrative of a respectable lady (the comet) being courted by her troubadour lover (the masculinised space mission and its mostly male scientists), the shirt Taylor wore on the day of the comet landing demonstrated bodily desirability and sexuality purely for the sake of (visual) pleasure rather than for the morally justifiable purposes of production, and it therefore provided an overt and intolerable challenge to the kind of 'Victorian' sexual morality that Foucault suggests is the basis of modern discourse on sex. I would argue that while putting sex into discourse in these ways, Taylor must have been aware of the implicit

societal expectation that one's speech is to be characterised by "verbal decency" (Foucault 1978:3) and that the simple act of talking about sex would already appear as a deliberate transgression (Foucault 1978:6). Therefore, I propose that Taylor purposefully utilised sexualised metaphors in his narrative of the Rosetta mission to reinforce the image of a subversive and rule-breaking scientific persona. By knowingly being subversive, Taylor attempted to "upset the established law" or, at the very least, move "outside of the reach of power" (Foucault 1978:6) that would have expected him to conform to the image of a 'normal scientist.'

However, we must also remain conscious of who does the speaking and what position this individual speaks from (Foucault 1978:11): Taylor is a highly educated white Western man at the top of his professional career; although his personal image is still an 'oddity' to the normalcy of science, his attributes give him a privileged and authoritative position, where Taylor can repeatedly put sex into discourse. Since his status is socially legitimated and trusted, his narrative remains unchallenged as long as he frames his speech in terms of the 'normal' sexuality of the comet (that is, the courting of a respectable lady for productive and therefore morally acceptable purposes). As soon as Taylor introduces actual sexualised images of women's bodies, his discourse is interpreted as out of place in the public sphere, as replete with "aberrations, perversions, and oddities" and therefore subject to disciplining and punishment (Foucault 1978:53). Since the above workings of disciplinary power hinge on the subject becoming a visible object (Foucault 1977:187), Taylor was readily available as a rising media personality and, due to his 'rebel' individuality, particularly susceptible to the disciplinary apparatus. The media personality role functions as an objectifying parading of the subject, requiring Taylor to immediately appear as "legible" and "docile" to the gaze of the public (Foucault 1977:187). As Taylor was certainly not docile and his personal idiosyncrasies were not legible on the spectrum of normalcy as (implicitly) defined for scientists, in a way he became an unknown element similar to the comet that the Rosetta project targeted. Ultimately, Taylor was a perfect subject for disciplining and punishment since he consciously placed himself firmly in the "infinite domain of the non-conforming" – the very area that disciplinary power works to mark as visible and legible (Foucault 1977:179) and if such marking is not possible, as punishable.

Who's afraid of feminism?

I would argue that Taylor's shirt worked as reflexivity, that is, "the movement whereby that which has been used to generate a system is made, *through a changed perspective*, to become part of the system it generates" (Hayles 1999:8). Thus Taylor, who prior to the shirt incident had only been 'used' (seen) as the generator of the Rosetta scientific project (at the very least, as was 'translated' to the public through digital media), was not just *made to become* part of the system he generated, but was in fact revealed as an actant "neither outside not inside [but] of the diffraction pattern" (Barad 2014:181). More importantly for our purposes here, the shirt as a "reflexive move" (Hayles 1999:9) also (and finally!) brought into perspective some of the invisible (gender) norms and (female) bodies that had been there all along *as invisible*.

If this is so, then the Rosetta story's previous sexualised (re)iterations (notably, Taylor's provocative comments such as "sexiest mission there's ever been," "moving in for the kiss," and "she's sexy but I never said she was easy") represented similarly oppressive and exploitative structures – and yet failed to register anywhere on the spectrum of 'being moved' *prior to* the shirt incident, and remained invisible or only very marginally mentioned as 'provocations' even in the aftermath of the incident. I suggest that this points to a worrying structural problem with how 'mainstream' feminism and gender equality is understood and practiced; it demonstrates a view that the oppression, exploitation, and objectification of female or feminine-gendered bodies (and, by association, of women) is permitted and tolerated as long as this is done 'tastefully' – that everyday sexism goes undetected or is acceptable and even agreeable as long as it is not *too much* sexism. Thus, the critics of the shirt engage in a political act by "disrupting and radically changing what people saw" in the Rosetta story, and especially by challenging the claim of many defenders of Matt Taylor that talking about the shirt was outside of the sayable and sensible (Bennett 2010:105), since this exposed the arbitrary divisions that rendered some things visible (such as the scientific achievements of the Rosetta project) and others invisible (the exploitative sexualisation of the mission and of women). The ethico-political potential here is that the hitherto invisible bodies, that is, women (were) revealed to have been there from the start but as visible only in particular ways (Bennett 2010:105).

In this revelation of those who are always already present, the shirt operated as an intervener or "quasi causal operator" (Deleuze in Bennett 2010:9) in that it "made things happen"

(Bennett 2010:9). Therefore, the events of #shirtstorm happened through humans but not entirely *because of* them (Bennett 2010:17), and the Rosetta scientist is admittedly not the "root cause" of the scandal (Bennett 2010:31). Taylor's ostensibly freely chosen action gave rise to "bastard progenies" (Bennett 2010:101) partly because the "chance meeting" (Bennett 2010:18) of the materiality of the shirt with other "currents of affectivity" (Bennett 2010:32) exceeded the "relations of dimensionality" (Fuller 2005:2) Taylor intended or expected. And while #shirtstorm was always already enfolded in(to) Rosetta (even *before* happening), it would have been impossible to predict (Coole and Frost 2010:14) the "chance interruption" and "suddenness" of the shirt (Brown 2001:4). Taylor's conscious choice of wearing the shirt was never entirely his own making (Bennett 2010:101) and, therefore, while he was responsible, he was not the root cause of the enfolding scandal (Bennett 2010:31). I propose that Taylor did not *want to* behave in a sexist manner (nor did he think of behaving so), but sexist power relations have always already been inscribed (with)in and through his body so that his seemingly subjective preference to wear the shirt is a illusion of personal freedom.

A prominent supporter of Taylor, Richard Dawkins, the notorious British biologist notably twitted in the wake of #shirtstorm that feminists should not be blamed "for the pompous idiots whining about" Matt Taylor's shirt, because "true feminism is bigger and better than that" (Dawkins 2014), reinforcing the "it's just a shirt" mentality that contributed to generating an astonishing 45 million Google hits on Taylor's shirt. Dawkins may of course not be aware of the 'death by a thousand cuts' phenomena, where this shirt is indeed 'just' one of a thousand small slashes. As a *matter of fact*, Taylor's shirt was just a shirt. However, if "reality is not defined by matters of fact" but by "matters of concern" (Latour 2004:232), then the *matter of concern* for Dawkins and others of the 'just a shirt' narrative are the small (and personal) scales on which feminism builds its theory and practice. It would perhaps be worthwhile further exploring why the *matter of fact* that feminist critique takes the mundane and the personal as its *matter of concern* (Butler 1988:523–4) – precisely because larger structures of gender relations materialise partly "through the concrete and historically mediated acts of individuals" (Butler 1988:523) – make so many people uncomfortable and even "ashamed of feminism" (Khoo 2014).

Speaking of 'trouble,' western societies tend to universally regard natural sciences "as arbiters of truth" with physics being the most elite of these arbiters (Keller 1992:22). Yet, feminist research persistently and compellingly argued that scientists, including physics, still often use

"gendered [and] … explicitly sexual … metaphors of dominance and subordination … to describe … scientific knowledge production and its subjects" (Lorenz-Meyer 2014:79). That the recipients of these gendered and sexualised translations can then make sense of what is being related to them suggests that scientists and those engaging with them "share a conceptual universe" (Keller 1992:27), where "the power of language to subordinate and exclude women" (Butler 1999:36) is prevalent. Thus, in the case of the shirt controversy, paraphrasing Loewen-Walker's question of "why did *that* word come from *that* individual at *this* time?" (2014:56) as 'why did *that* shirt come from *that* individual at *that* time?' allows us to examine the 'events' – in the Latourian sense – of the shirt and the subsequent 'it's just a shirt' narrative as "performative utterance[s]" that "conform… with an iterable model" (Butler 1993:13) of the gender relations within the Rosetta story, and an opportunity also opens up to "attend to the 'power relations and emotional investments of the researcher'" (Hinton 2014:101), both of which are instrumental for an "ethico-onto-epistemolog[ical]" understanding of this story, that is, for an approach to this matrix of meaning-matterings, object-subjects, act-events that acknowledges and demonstrates "the inseparability of ontology, epistemology, and ethics" (Barad 2007:409). That it does "matter… to the world how the world comes to matter" (Barad 2007:380), because the way we conceive and (ab)use language, images and matter "have serious implications for how we think of ourselves … and how we treat nature and other embodied selves" (Coole 2010:112).

Ultimately, a lesson of #shirtstorm may be that we need to learn to hesitate more when assigning blame, otherwise we may end up with an "unethical politics of 'good' and 'evil' and an attitude that is solely interested in meting out punishment, which in turn can legitimise violent responses as the first course of action (Bennett 2010:38). Situating autonomy and responsibility entirely within the liberal human subject, here in Matt Taylor or the feminists, is potentially unjust because (human) actions are intrinsically assemblic so that no individual can be singularly accountable. This is not to negate Taylor's agentic role in perpetually sexualising the Rosetta mission, but a suggestion that in order to address the persistent gender(ed) discrimination highlighted by the Rosetta story we must look for cause-effects more widely and more "horizontally" (Bennett 2010:13). At the same time, as Thiele suggests, we should also insist on espousing a stubborn "practice of respect" (2014:23) and compassion as pre-requisites for "staying with the trouble" (Haraway 2010:53) of persistently unequal relations and, ultimately, for "figuring difference" (Barad 2014:170) not *in*differently.

Conclusion

Espousing and practicing a feminist and critical materialist approach, this thesis interrogated the workings of some of modernity's oppressive binaries (such as the dichotomies of masculine/feminine, human/nonhuman, alive/lifeless, and true/false) within the scientific and social media discourse of this ongoing space exploration project. The decision to explore the Rosetta story through a dual discursive-materialist framework, making use of tools of both the discursive and materialist 'turns' was profitable not just because this framework was suitable for showing how and why this purportedly progressive scientific knowledge-making project embodies intensely gendered and exploitative practices but also because – somewhat unexpectedly – traces of subversive and transgressive ethico-onto-epistemologies were also uncovered within the three prongs of the Rosetta story, hopefully contributing to feminist new materialist theoretical understandings of agency, power, relatibility, and responsibility.

The Rosetta story was presented as an assemblage of three prongs, representing the feminised comet being courted by the (mostly male) scientists, the media personalities of the spacecrafts are humanised and made relatable, and the #shirtstorm incident of the mission's main scientist, because the comet-robots-scientist triumvirate of the Rosetta story persistently asserted their individual 'selves' in the scientific and public spheres and echoed through the theoretical works consulted for this thesis. The three angles in turn were filtered through a feminist new materialist theoretical framework, built on the work of Jane Bennett on thing-power, Michel Foucault's theories on disciplining bodies, Donna Haraway's conception of the posthuman cyborg and Karen Barad's agential realism, in order to placed an emphasis on not just the living but also the non-living in the three angles of Rosetta, in an expression of genuine (and perhaps at times naïve) interest in the non-humans of the story.

Chapter I provided a feminist commentary on the scientific practice and discourse within the Rosetta project by demonstrating how is narrated comet 67P/C–G as a passive lady-like woman, who is being courted by the masculine scientists of the mission. Chapter I attempted to move beyond mere critique by providing suggestions for new materialist thought on alternative – not simply humanised and masculinised – conceptions of agency and power. Chapter II followed the original anthropomorphic interest by presenting the humanised personalities of Rosetta and Philae as cyborgian who, while certainly at times re-inscribing

traditional patterns of gendered oppression, may have the potential to be incendiary by dwelling on the borderland of human and non-human. Lastly, Chapter III used a Foucauldian framework to analyse the third angle of the triangular of Rosetta, #shirtstorm. This chapter brought together the other two prongs, and concluded that #shirtstorm could be a productive site for critical theoretical attention because it is an instructive example of everyday gendered experiences and it enacts new materialism by co-emerging with/in the other two prongs of the story. What all three chapters brushed up against but did not quite develop due to space and theoretical constrains was the affective element and emotive angle of the Rosetta story that appears to be a major driver of all three arms, so further research on this case study could start by focusing on the role of affect and emotions within the context of Rosetta.

Bibliography

Altwegg, K., et al. (2015). 67P/Churyumov-Gerasimenko, a Jupiter family comet with a high D/H ratio. *Science, 347(6220)*, no page numbers.

Astronomical Society of Australia. (18 November 2014). The ASA supports members who speak up for a gender inclusive science community. *Astronomical Society of Australia Website*. Retrieved from http://asa.astronomy.org.au/ASA_Equity_Statement.pdf

Barad, K. (2014). Diffracting Diffraction: Cutting Together-Apart. *Parallax, 20(3)*, 168–187.

Barad, K. (2007). *Meeting the universe halfway: quantum physics and the entanglement of matter and meaning*. Durham: Duke University Press.

Bell, A. (13 November 2014). Why women in science are annoyed at Rosetta mission scientist's clothing. *The Guardian*. Retrieved from http://www.theguardian.com/science/2014/nov/13/why-women-in-science-are-annoyed-at-rosetta-mission-scientists-clothing

Bennett, J. (2004). The Force of Things: Steps toward an Ecology of Matter. *Political Theory, 32(3)*, 347–372.

Bennett, J. (2010a). A Vitalist Stopover on the Way to a New Materialism. In Diana Coole & Samantha Frost (eds.). *New materialisms: ontology, agency, and politics* (pp. 47–69). Durham: Duke University Press.

Bennett, J. (2010b). *Vibrant Matter: A Political Ecology of Things*. Durham: Duke University Press.

Biever, C. & Gibney, E. (14 June 2015). Philae comet lander wakes up and phones home. *Nature*. Retrieved from: www.nature.com/news/philae-comet-lander-wakes-up-and-phones-home

Boscagli, M. (2014). *Stuff Theory: Everyday Objects, Radical Materialism*. New York: Bloomsbury Academic.

Braidotti, R. (2010). The politics of "life itself" and new ways of dying. In Diana Coole & Samantha Frost (eds.). *New materialisms: ontology, agency, and politics* (pp. 201–218). Durham [NC]; London: Duke University Press.

Braidotti, R. (2011). *Nomadic subjects embodiment and sexual difference in contemporary feminist theory*. New York: Columbia University Press.

Brecheen, C. (20 November 2014). 20 shirtstorm narratives and what's wrong with them. *Writing About Writing (And Occasionally Some Writing)*. Retrieved from http://chrisbrecheen.blogspot.hu/2014/11/20-shirtstorm-narratives-and-whats.html

Brown, B. (2001). Thing Theory. *Critical Inquiry, 28(1)*, 1–22.

Bryan, V. (14 November 2014). Defying odds, comet lander phones home. *Reuters*. Retrieved from http://www.reuters.com/article/2014/11/14/us-space-comet-idUSKCN0IY14T20141114

Bryant, L. (2011). *The democracy of objects*. Ann Arbor: Open Humanities Press.

Bukatman, S. (1991). Postcards from the Posthuman Solar System (Cartes du système solaire posthumain). *Science Fiction Studies, 18(3)*, 343–357.

Butler, J. (1988). Performative Acts and Gender Constitution: An Essay in Phenomenology and Feminist Theory. *Theatre Journal, 40(4)*, 519–531.

Butler, J. (1993). *Bodies that matter: on the discursive limits of "sex."* New York: Routledge.

Butler, J. (1999). *Gender trouble feminism and the subversion of identity*. New York: Routledge.

Capaccioni, F. et al. (2015). The organic-rich surface of comet 67P/Churyumov-Gerasimenko as seen by VIRTIS/Rosetta. *Science, 347(6220)*, no page numbers.

Coleman, R. (2014). Inventive Feminist Theory: Representation, Materiality and Intensive Time. *Women: A Cultural Review, 25(1)*, 27–45.

Connolly, W. (2010). Materialities of experience. In Diana Coole & Samantha Frost (eds.). *New materialisms: ontology, agency, and politics* (pp. 178–200). Durham: Duke University Press.

Cookson, C. (15 November 2014). Philae probe drills into comet surface. *Financial Times*. Retrieved from http://www.ft.com/cms/s/0/96dd7d2e-6c15-11e4-b939-00144feabdc0.html

Coole, D. (2010). The Inertia of Matter and The Generativity of Flesh. In Diana Coole & Samantha Frost (eds.). *New materialisms: ontology, agency, and politics* (pp. 92–115). Durham: Duke University Press.

Coole, D. & Frost, S. (2010). Introducing the New Materialisms. In Diana Coole & Samantha Frost (eds.). *New materialisms: ontology, agency, and politics* (pp. 1–43). Durham: Duke University Press.

Coyne, J. (15 November 2014). Philae isn't dead, just sleeping (?). *Why Evolution is True*. Retrieved from https://whyevolutionistrue.wordpress.com/2014/11/15/philae-isnt-dead-just-sleeping/

Daston, L. & Galison, P. (2007). *Objectivity*. Cambridge: Zone Books.

Dutton, L. (12 November 2014). Rosetta and Philae: the most high profile break-up this year. *Channel 4*. Retrieved from http://www.channel4.com/news/rosetta-philae-comet-landing-twitter-separation

Engelkin, C. (12 November 2014). Live Blog: Rosetta Mission Philae Lander On Its Way to Comet Touchdown. *Discover Magazine*. Retrieved from http://blogs.discovermagazine.com/d-brief/2014/11/12/live-blog-rosetta-space-probe-landing/

European Space Agency. (21 July 2014). #RosettaAreWeThereYet – Fabulous fables and tales of tails. *YouTube*. Retrieved from https://www.youtube.com/watch?v=s35Jlwobcqk

European Space Agency. (9 March 2015). Once upon a time... #cometlanding. *YouTube*. Retrieved from https://www.youtube.com/watch?v=33zw4yYNGAs

Foucault, M. (1977). *Discipline and punish: the birth of the prison*. New York: Pantheon Books.

Foucault, M. (1978). *The History of Sexuality: An Introduction, Volume 1*. New York: Random House.

Foucault, M. (12 September 2012). The Mesh of Power. *Viewpoint Magazine*. Retrieved from https://viewpointmag.com/2012/09/12/the-mesh-of-power/

Foucault, M. & Trombadori, D. (1991). *Remarks on Marx: conversations with Duccio Trombadori*. New York: Semiotext(e).

Frost, S. (2010). Fear and the Illusion of Autonomy. In Diana Coole & Samantha Frost (eds.). *New materialisms: ontology, agency, and politics* (pp. 158–177). Durham: Duke University Press.

Fuller, M. (2005). *Media ecologies materialist energies in art and technoculture*. Cambridge: MIT Press.

Gane, N. (2006). When We Have Never Been Human, What Is to Be Done? *Theory, Culture & Society, 23(7-8)*, 7–8.

Gibney, E. (6 August 2014). Rosetta craft makes historic comet rendezvous. *Nature*. Retrieved from http://www.nature.com/news/rosetta-craft-makes-historic-comet-rendezvous-1.15681

Gilbert, D. (24 November 2015). Philae: Bouncing baby probe gives itself another chance. *CNN*. Retrieved from http://www.cnn.com/2014/11/24/world/philae-lander-revival/index.html

Grosz, E. (2005). *Time travels: feminism, nature, power*. Durham: Duke University Press.

Gulkis, S. et al. (2015). Subsurface properties and early activity of comet 67P/Churyumov-Gerasimenko. *Science, 347(6220)*, no page numbers.

Haraway, D. (2010). When Species Meet: staying with the trouble. *Environment and Planning D: Society and Space, 28(1)*, 53–55.

Haraway, D. (1991). *Simians, cyborgs, and women: the reinvention of nature*. New York: Routledge.

Hässig, M., et al. (2015). Time variability and heterogeneity in the coma of 67P/Churyumov-Gerasimenko. *Science, 347(6220)*, no page numbers.

Hayles, K. (1999). *How we became posthuman: virtual bodies in cybernetics, literature, and informatics*. Chicago: University of Chicago Press.

Hemingway, M. (17 November 2014). It's Time To Push Back Against Feminist Bullies. *The Federalist*. Retrieved from http://thefederalist.com/2014/11/17/its-time-to-push-back-against-feminist-bullies/

Hertz, G. & Parikka, J. (2012). Zombie media: Circuit bending media archaeology into an art method. *Leonardo, 45(5)*, 424–430.

Hinton, P. (2014). "Situated Knowledges" and New Materialism(s): Rethinking a Politics of Location. *Women: A Cultural Review, 25(1)*, 99–113.

Johnson, B. (16 November 2014). Dr Matt Taylor's shirt made me cry, too – with rage at his abusers. *The Telegraph*. Retrieved from

http://www.telegraph.co.uk/news/science/space/11234620/Dr-Matt-Taylors-shirt-made-me-cry-too-with-rage-at-his-abusers.html

Keller, E. (1992). *Secrets of life, secrets of death: essays on language, gender, and science*. New York: Routledge.

Keller, E. (2002). *Making sense of life explaining biological development with models, metaphors, and machines*. Cambridge.: Harvard University Press.

Keller, E. & Longino, H. (1996). *Feminism and science*. Oxford: Oxford University Press.

Khoo, J. (19 November 2014). Feminist Criticism On Sexist Shirt Is A Misrepresentation Of Women. *Vulcan Post*. Retrieved from https://vulcanpost.com/81751/feminist-matt-taylor/

Knapton, S. (12 November 2014). Rosetta mission: Dr Matt Taylor shows faith in probe with giant leg tattoo. *The Telegraph*. Retrieved from http://www.telegraph.co.uk/news/science/space/11225579/Rosetta-mission-Dr-Matt-Taylor-shows-faith-in-probe-with-giant-leg-tattoo.html

Lakdawalla, E. (26 September 2014). Rosetta will deploy Philae on 12 November. *ESA Rosetta Blog*. Retrieved from http://blogs.esa.int/rosetta/2014/09/26/rosetta-will-deploy-philae-on-12-november/

Lakdawalla, E. (23 October 2014). The "perfume" of 67P/C-G. *ESA Rosetta Blog*. Retrieved from http://blogs.esa.int/rosetta/2014/10/23/the-perfume-of-67pc-g/

Latour, B. (1993). *We have never been modern*. Cambridge: Harvard University Press.

Latour, B. (2004). Why Has Critique Run Out of Steam? From Matters of Fact to Matters of Concern. *Critical Inquiry, 30(2)*, 225–248.

Lenoir, T. (2002). Makeover: Writing the Body into the Posthuman Technoscape: Part One: Embracing the Posthuman. *Configurations, 10(2)*, 203–220.

Loewen Walker, R. (2014). The Living Present as a Materialist Feminist Temporality. *Women: A Cultural Review, 25(1)*, 46–61.

Lorenz-Meyer, D. (2014). Reassembling Gender: On the Immanent Politics of Gendering Apparatuses of Bodily Production in Science. *Women: A Cultural Review, 25(1)*, 78–98.

Lunar and Planetary Institute (31 October 2012). About Comets. *Lunar and Planetary Institute Website*. Retrieved from http://www.lpi.usra.edu/education/explore/comets/background/

Malik, T. (14 June 2015). It's Alive! Comet Lander Philae Phones Home After Months of Silence. *Space.com*. Retrieved from http://www.space.com/29661-philae-comet-lander-wakes-up.html

Marks, L. (2002). *Touch: sensuous theory and multisensory media*. Minneapolis: University of Minnesota Press.

Martin, E. (1991). The Egg and the Sperm: How Science Has Constructed a Romance Based on Stereotypical Male-Female Roles. *Signs, 16(3)*, 485–501.

Meikle, J. (14 November 2014). Rosetta scientist Dr Matt Taylor apologises for "offensive" shirt. *The Guardian*. Retrieved from http://www.theguardian.com/science/2014/nov/14/rosetta-comet-dr-matt-taylor-apology-sexist-shirt

Micale, M. (1991). Hysteria male/hysteria female: reflections on comparative gender construction in Nineteenth-Century France and Britain. In Marina Benjamin, *Science and Sensibility: Gender and Scientific Enquiry, 1780-1945* (pp. 200–239). Oxford: Basil Blackwell.

Mignone, C. (11 November 2014). The singing comet. *ESA Rosetta Blog*. Retrieved from http://blogs.esa.int/rosetta/2014/11/11/the-singing-comet/

Moulson, G. (14 November 2014). Comet lander starts drilling; batteries a worry. *Phys.org*. Retrieved from http://phys.org/news/2014-11-comet-drill-results-earth-esa.html

Nilsson, H. et al. (2015). Birth of a comet magnetosphere: A spring of water ions. *Science, 347(6220)*, no page numbers.

Parikka, J. (2011). Media Ecologies and Imaginary Media: Transversal Expansions, Contractions, and Foldings. *The Fiberculture Journal, 17*, 34–50.

Plante, C., & Duhaime-Ross, A. (13 November 2014). I don't care if you landed a spacecraft on a comet, your shirt is sexist and ostracizing. *The Verge*. Retrieved from http://www.theverge.com/2014/11/13/7213819/your-bowling-shirt-is-holding-back-progress

Protevi, J. (2011). Ontology, Biology, and History of Affect. In Levi Bryant, Graham Harman, & Nick Srnicek (eds.). *The Speculative Turn: Continental Materialism and Realism* (pp. 393–405). Melbourne: re.press.

Richard, T. (20 November 2014). AAS Issues Statement on "Shirtgate"/"Shirtstorm." *American Astronomical Society Website*. Retrieved from http://aas.org/posts/news/2014/11/aas-issues-statement-shirtgateshirtstorm

Rosetta Orbiter. (13 February 2015). Rosetta Orbiter to Comet 67P: Be My Valentine? *Motherboard*. Retrieved from http://motherboard.vice.com/read/a-valentine-from-the-rosetta-orbiter

Rotundi, A. et al. (2015). Dust measurements in the coma of comet 67P/Churyumov-Gerasimenko inbound to the Sun. *Science, 347(6220)*, no page numbers.

Royal Astronomical Society. (21 November 2014). RAS statement on Shirtgate / Shirtstorm. *Royal Astronomical Society Website*. Retrieved from https://www.ras.org.uk/news-and-press/2538-ras-statement-on-shirtgate-shirtstorm

Ruberry, E. (17 November 2014). Rosetta's Final Conversation With Philae Is Heart-Meltingly Human. *Science Channel: Inscider*. Retrieved from http://blogs.discovery.com/inscider/2014/11/rosetta-philae-twitter-conversation.html

Said-Moorhouse, L. (18 November 2014). A love affair 300 million miles away. *CNN*. Retrieved from http://www.cnn.com/2014/11/18/technology/rosetta-philae-lander-twitter/index.html

Schiebinger, L. (1991). The private life of plants: Sexual politics in Carl Linnaeus and Erasmus Darwin. In Marina Benjamin, *Science and Sensibility: Gender and Scientific Enquiry, 1780-1945* (pp. 124-143). Oxford: Basil Blackwell.

Schiebinger, L. (1993). *Nature's body: gender in the making of modern science*. Boston: Beacon Press.

Showalter, E. (1981). Victorian women and insanity. In Andrew Scull, *Madhouses, Mad-Doctors, and Madmen: The Social History of Psychiatry in the Victorian Era* (pp. 313-36). London: Athlone Press.

Sierks, H. et al. (2015). On the nucleus structure and activity of comet 67P/Churyumov-Gerasimenko. *Science, 347(6220)*, no page numbers.

Taylor, M. et al. (2015). Rosetta begins its Comet Tale. *Science, 347(6220)*, no page numbers.

Thiele, K. (2014). Pushing Dualisms and Differences: From "Equality versus Difference" to "Nonmimetic Sharing" and "Staying with the Trouble." *Women, 25(1)*, 9–26.

Thomas, N. et al. (2015). The morphological diversity of comet 67P/Churyumov-Gerasimenko. *Science, 347(6220)*, no page numbers.

Vertesi, J. (2010). Tweeting Spacecraft: Communicating Space Science in the Age of Web 2.0. *CAPjournal, 10*, 30–33.

Wilson, E. A. (2010). *Affect and artificial intelligence*. Seattle: University of Washington Press.