Cosmic Zoom, Powers of Ten and the Contested Politics of Sense

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Abstract

This article develops a comparative analysis of Charles and Ray Eames' *Powers of Ten*, and Eva Szasz and Robert Verrall's *Cosmic Zoom*, seen through the lenses of Bergsonian and Deleuzo-Guttarian philosophy. The author claims that, despite similarities with respect to their subject matter and modes of production, there are significant stylistic differences between these films that are suggestive of divergent ontological, epistemological and political commitments. Of particular importance is the foregrounding of objectivity in the case of *Powers of Ten* and subjectivity in the case of *Cosmic Zoom* – a distinction that is reflected in their respectively quasi-indexical and expressive modes of representation. This fundamental tension similarly conditions their differently inflected approaches to time, space and measure, drawing attention to the strange intertwining of representation, abstraction and affect that is characteristic of much animated film. Ultimately, it is proposed that, in the context of *Powers of Ten* and *Cosmic Zoom*, animation's capacities for abstraction and expression are differently distributed, resulting in a cosmopolitical opposition which can be aligned with the Deleuzo–Guattarian distinctions between major and minor language, and royal and nomadic science.

Introduction

In 1977, the office of Charles and Bernice Alexandra Kaiser (Ray) Eames released their completed version of *Powers of Ten* – an animation which attempted to seamlessly depict the universe across an enormous range of magnitudes. The final version of the film arose out of a rough sketch or prototype, which was developed in 1968 – a year which also gave us *Cosmic Zoom*, a film dealing with very similar subject matter that was produced by Robert Verrall, drawn by Eva Szasz and 'animated' by James Wilson, Raymond Tricket and Yamond Duma. Each of these films was inspired by the Dutch progressive educator, Boeke's (1957) illustrated text *Cosmic View – The Universe in Forty*

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Jumps, which was intended as a means of revealing the structural complexity of the universe, viewed from many different scales, as well as foregrounding our relative place within it.

Cosmic Zoom was produced by the National Film Board of Canada (NFBC), possessed a broadly cultural and educational remit, and was created from the overtly stylised drawings of Eva Szasz. In contrast, *Powers of Ten* seamlessly combined the work of many organizations, aimed for a form of photorealism and was ultimately sponsored by IBM. Whilst both films have been disseminated through festivals and educational channels, *Powers of Ten* was exhibited for a number of years at the Smithsonian Institution's National Air and Space Museum and, in many ways, it can be seen to follow in the tradition of spectacle and corporate sponsorship that is associated with the Eames' other creative documentaries. This perhaps reached its zenith with *Glimpses of the USA* (1959) – a 'sensory and informational blitz' involving 2,200 choreographed images of the American way of life, shown in a 250-foot geodesic dome designed by Buckminster Fuller, hosted in Moscow under the remit of cultural exchange as a part of the American National Exhibition (Colomina, 2001). The Eames' films and multimedia installations, exhibited at numerous world fairs and international expos, have been positioned as propaganda for the mid-20th century American Modernist lifestyle – a position which gains traction when we consider their associations with corporations such as Westinghouse Electric, Polaroid and Boeing Aerospace.

The forthcoming discussion begins by unpacking a set of surface similarities between these films, which primarily concern their subject matter and the processes employed in their production. Following this, there is an exploration of the cosmopolitical significance of their more prominent aesthetic differences, viewed through the lens of Bergsonian and Deleuzo–Guattarian philosophy. In this way, we will examine the way in which the striving for modernist techno-scientific mastery that seems to characterise *Powers of Ten* gives way to the more sensitive enfolding of the subjective and durational dimensions of being in the context of *Cosmic Zoom*. The confrontation between the quasi-objectivity of the Eames' animation, and the subjectivity and implied pluralism of Szasz and Verrall, is explored through the application of the Deleuzo–Guattarian distinctions between major and minor language, and royal and nomadic science.

Some surface similarities

Perhaps unsurprisingly, given their common source of inspiration, there are many similarities between the Szasz-Verrall and Eames' animations. In terms of content, they each begin in a peculiarly pastoral, but nevertheless urban setting and proceed to zoom rapidly out, accelerating in an exponential fashion in accordance with the mathematical progression depicted in Boeke's original text. In the case of *Powers of Ten* and its earlier prototype, the distance travelled is strictly formalised as increasing by 1 power of 10 every 10 seconds and, whilst the exact rate of acceleration remains unstated in the work of Szasz and Verrall, it is clear that it unfolds along a very similar trajectory. The films are likewise reminiscent with respect to their journeys back to earth. In each instance, having reached the outward limit of cosmological understanding, the camera proceeds to hurtle back to its starting position in order that it might commence a comparable journey, beginning at the level of the microscopic, whilst proceeding towards the atomic and, finally, in the case of *Powers of Ten*, the subatomic realms.

The similarity between the films goes beyond content or subject matter and is likewise evident at the level of technique. In order to produce the effect of a seemingly infinite zoom, each of the films employed a similar kinestatic stop-motion process. In the context of animation, kinestasis refers to the process of creating the illusion of movement through the documentation of a series of still images, as when a camera is moved across the surface of a photograph – a technique that inspired the now ubiquitous 'Ken Burns effect'.

With respect to *Cosmic Zoom* and *Powers of Ten*, the kinestatic illusion of an uninterrupted zoom was instantiated through incremental adjustments of the height of a camera's animation stand. The raising and lowering of the stand affected the camera's positioning with respect to a 3-inch foreground image, which was pasted into the centre of another, 10 times larger image that would serve as its background. In the first instance, the animation stand would be lowered, placing the camera in extreme close-up to the smaller of the two images, thus enabling it to fill its field of view. The effect of 'zooming out' was then simulated by raising the stand one increment, performing any necessary adjustments in focus and then capturing a single exposure in the manner of a stop-motion animation. The process would be continued until the camera's field of view contained the outer edge of the larger background image. At this point, both images would be removed and substituted for a set representing the next power and the animation stand would be lowered back into the extreme close-up position. The blend between magnitudes, which served to further integrate the images and to give the impression of an infinite zoom, was achieved through an in-camera cross-fade (Doane, 2021: 254; Horton, 2021: 61–62).

Powers of Ten and *Cosmic Zoom* as expanded animation

Interestingly, it is purely through the incremental movement and animation of the camera itself that the images of the Szasz–Verrall and Eames' animations were brought to life – a point foregrounded in the closing credits of *Cosmic Zoom*, which acknowledges the work of its three 'animation camera' operators. In their inversion of the traditional relationship between the camera and its subject, films such as *Powers of Ten* and *Cosmic Zoom* offer strange and highly distinctive fusions of stop-motion and kinestatic technique. In each case, the animation develops out of the incremental manipulation of the filmic apparatus itself, as opposed to that of the subject being filmed. In one sense, the peculiar stasis of the films' source materials would seem to sit awkwardly with conventional practices of animation. However, it is this very same technical inversion and departure from the norms of practice that give rise to the films' aesthetic novelty and to their very distinctive mode of visual kinesis. Indeed, it is this focused subversion of more traditional forms of stop-motion, coupled with its thoroughly deterministic approach to kinestasis that engenders a distinctively novel form of aesthetic experience, along with a number of difficulties in classification with respect to medium and genre, enabling us to consider such films as pioneering examples of expanded animation. Their status as such is reinforced when we consider the breadth of their impact. The seminal work of Szasz–Verrall and Charles and Ray Eames has resulted in divergent lines of influence, each of which nevertheless demonstrates an affinity with the at once spectacular and affective, alternative lineage of animation that Gunning (2006) has termed the cinema of attractions. The seamless, single-take zoom of these films has served to inform special effects sequences in the context of narrative cinema, whilst also influencing the mode of representation of contemporary mapping and navigation devices (Google Maps/Google Earth), and providing content for more expanded, immersive and affective cinematic platforms – as is the case with the more contemporary IMAX derivative, *Cosmic Voyage* (Silleck, 1996).

Some deeper cosmopolitical disparities

Moving beyond concerns with common subject matter, lineage and production technique, we turn now to the question of difference. As we shall see, the disparities between the Szasz–Verrall and Eames' films, which on the surface may appear trivial or concerned primarily with style, give way to larger questions of ontological commitment and cosmopolitical orientation. That is to say, there

is an important sense in which the stylistic differences between the films suggest radically divergent views of the universe and our place within it.

Films such as *Powers of Ten* and *Cosmic Zoom* walk a line between realism and imaginative visualization, and this impacts in interesting ways upon their respective modes of representation. In the case of *Powers of Ten*, there is a strong leaning towards the conventions of objectivity and an attempt to convey an impression of photographic indexicality. In contrast to this, Szasz and Verrall's *Cosmic Zoom* offers a predominantly hand-drawn, more stylised form of animation, which in some sense acknowledges its own artifice, along with its more subjective status as 'a way of seeing'. The disparity between the ontological stance of the Szasz–Verrall and Eames' films, is captured well by Horton's (2021: 79) description of the former as '[taking] place in a cartoon world that possesses no determinate relationship to real-world physics, perspective, or temporality'. Szasz's drawings take their cue from Boeke's original illustrated text, but they dispense with any geometric signifiers of scale and are in many ways stylistically resonant with the organicisism, multi-point perspective, flattening of the picture plane and rhythmic figurative repetition of mid-period primitivist interiors of Matisse. This is particularly evident in the early, more terrestrial, moments of the Szasz–Verrall film, where, as the camera begins its zoom out, we are taken rapidly from a scene of everyday experience into a more impersonal and yet highly stylised view of cities, lakes and transportation networks. Despite the geometric nature and broadly perspectival orientation of the zoom function itself, Szasz's representation of the city is notably distorted. Its chimneys and spires embody multiple station points with respect to the viewer, as if we were looking at these buildings from different vantages at one and the same time, affecting both the angle of elevation and directional orientation of its architecture, whilst the buildings themselves are slightly warped as a result of a peculiarly organic, almost amoebic, distortion. This, along with radical shifts in architectural perspective that are used to establish different territories or locales, results in a flattening of the landscape, which seems to sit in conflict with the aerial zoom. Such deformations, when combined with the muted blues, greens, yellows and orange-brown rusts of the geographic landscape, collectively bring to mind the primitivist, organic, proto-cubism of Matisse's (1919) painting, *La Liseuse Distraite* (The Inattentive Reader).

The quasi-objectivity of *Powers of Ten*

In stark representational contrast to the subjectivist trapping of *Cosmic Zoom*, both *Powers of Ten* and its prototype foreground a more 'objective' photographic representation of a male figure, who appears to be sleeping in the wake of a picnic. As might be expected, the 1968 'sketch' for the film is rougher in appearance and is shot entirely on monochrome stock. Interestingly, the prototype for the film can also be distinguished from the final release through consideration of its incorporation of drawings of a number of entities at the micro-scale, which forces a departure from the more consistently photographic, objective and realist mode of representation that characterises its earlier stages. It is important to recognise, however, that in reality, the final release of *Powers of Ten* also mixes and incorporates a diverse range of media, including the photographic, the filmic, the drawn and the animated but, in the case of the later film, these disparate elements are carefully integrated and blended into an overarching single aesthetic unity, which not only stays close to the conventions of photographic realism, but which also seems to flaunt the film's technicity.

The later Eames film entirely dispenses with the hand-drawn aesthetic of Boeke's original text, whilst retaining and embellishing its geometric signifiers of scale. In the case of *Powers of Ten*, these geometric lines and vectors, which are tellingly absent from the more organically rendered, primitivist animation of Szasz and Verrall, are perpetually present in the form of rectangular

borders denoting the edges of each respective scalar power, whilst also providing supplementary information regarding the orbital trajectories of our nearest planets. The pervasive sense of techno-analyticity is further amplified by the presence of an on-screen panel of instrumentation providing numerical readings of distance and scale.

Immanence and our place in the natural world

Despite their stylistic differences, when considered in narrative and spatial terms, Boeke's original publication – and each of the animations in question – are, at least in regard to the voyage outward, closely aligned. With respect to the journey inwards, however, some significant and telling differences begin to emerge. As Boeke's original publication approaches the boundary between the macroscopic and the microscopic, it portrays a mosquito in the act of stinging a child's hand. However, by opting to investigate the inner structure of a nearby salt crystal instead, there is an important sense in which Boeke could be said to avoid or eschew any direct material engagement with our own place within nature.

Offering a more intimate contrast, the Szasz–Verrall animation chooses at this point to diverge from the original text by directly penetrating the mosquito's proboscis before entering a cell that has been extracted from the bloodstream of the child. In this sense, *Cosmic Zoom* might be seen to take a less exceptionalist, cosmopolitical stance, enfolding our species more immanently into the natural world.

It is the Eames' *Powers of Ten*, however, which will prove the most startling at this juncture. Seemingly indifferent to the border threshold of human flesh, the camera appears to simply zoom into the surface of the sleeping man's hand. There is a sense in which, as the film unravels, we unravel with it – melting into vastly different magnitudes of agency and order, in a seemingly sublime revelation of the complexity of material systemic interrelation. We seem to pass through dead and living skin cells, then collagen and capillary, before zooming firstly into a white blood cell and then its constituent DNA.

Artifice and the illusion of continuity

In reality, however, in order to facilitate the continuity of the zoom in the face of both physically and optically resistant surfaces, it was necessary at this juncture in the proceedings for the Eameses to introduce a 'transparency clause' (Horton, 2021: 99). It was decided that inhibitors of the optical dimension of the zoom would in the first instance be rendered as if transparent, and subsequently removed at deeper levels of magnification. Whilst this assisted in creating the illusion of friction-less travel, it also served to occlude an important sense of conflict, inaccessibility and resistance which prevents full disclosure of reality between its various scales, and which is nevertheless present in the natural world. As Janet Harbord (2012) has noted with reference to *Powers of Ten*, shortly following the penetration of the skin, microscopic photography gives way to a series of carefully disguised, diagrammatic constructions. She suggests that the images of collagen, capillary, nucleus, atom and quark, though based on slides derived from electron microscopy, were enhanced through painting in order to create forms that might be more readily recognised (p. 108). A more exhaustive selection of imaging technologies is provided by Doane (2021: 254), who notes the Eames' use of photographs from 'NASA, the Chicago Aerial Survey, time-exposure photography with telescopes, Robert Hooke's Micrographia (1665), scanning electron microscopes, transmission electron micrographs, bubble chamber photos, and so on'. Whilst this diagrammatic dimension is well concealed in the later Eames' film, it is more directly apparent in the context of the film's earlier sketch.

Drawing further attention to the artifice of the Eames' film, Beck and Bishop (2020) have foregrounded the symbolic significance of the location at which the microscopic journey begins, noting that the human hand typically functions as a metonymic symbol for making, designing and creative labour. Beck and Bishop's observation gains further traction when we consider that the hand in question is that of the Swiss designer, Paul Brühwiler, who played the role of the sleeping figure in each of the Eames' films. In this sense, the film might be said to offer a more politicised variant of the trope, common to much animated film, of the visible presence of the animator's hand.

There is an important sense in which the stylistic discrepancies between *Powers of Ten* and *Cosmic Zoom* reflect the different choices, interests and commitments of the films' animators. Whilst, in the grander scheme of things, these point to radically different stances with respect to the objective and subjective dimensions of reality, such discrepancies become further accentuated when attempting to visualise the atomic and subatomic realms, where the additive supplement of imagination must, of necessity, accompany the more subtractive qualities of attention.

The animate imagination of reality

In reaching down to a scale of 10 to the power of −15, *Powers of Ten* is distinctive in its attempt to address the dynamism of the lower levels of physical reality and to present its fundamentally animate qualities. In the closing moments of the film, we are confronted with imagined representations of a series of fundamentally unobservable entities. This begins with the vibrant form of a single carbon atom and the electrons that comprise its outer shell. These entities, still recognizable at least partially as objects or forms, are subsequently subsumed under a more pervasive and chaotic mode of kinesis. As we zoom more deeply into the surface of a shimmering proton, motion encroaches further upon form and the scene becomes more frenetic. Finally, the voice of the physicist Philip Morrison, the narrator of the film, explains that we might be observing 'quarks in intense interaction', as a burgeoning pattern of interference, having already begun to dominate our field of view, finally fills the frame.

Powers of Ten and *Cosmic Zoom* as royal and nomadic science

In recent times, *Powers of Ten* has been criticised by New Materialist thinkers, for its tendency towards anthropocentrism (Latour, 2014; Morton, 2012; Woods, 2014, 2017). Despite its rather animate and chaotic depiction of the atomic and subatomic realms, critics have drawn attention to its broader tendency to present a picture of a consensual, somewhat frictionless universe and for its depiction of science as both the measure and master of the natural world (Di Palma, 2009: 263; Latour, 2016: A.I; Tong, 2014: 200–201). This is most evident in its harmonious blending of material strata, and in what can be seen as its overarching algorithmic relationship to temporality. As we have seen, whilst the film conveys an experience of radical speeds of acceleration in the form of the camera's exponential 'zoom', it remains, in another sense, eerily still – offering a world which is seemingly pinned or frozen under glass (its cars do not move, its rivers do not flow).

With such criticism in mind, *Powers of Ten* and its earlier sketch can be seen to exhibit many of the qualities of what Deleuze and Guattari (1987) in *A Thousand Plateaus* term 'royal' science. For Deleuze and Guattari, royal science, in its concern with the formulation of abstract laws and constants, is focused as much upon legislation as it is upon naturalistic enquiry:

> It is instructive to contrast two models of science, after the manner of Plato in the *Timaeus*. One could be called *Compars* and the other *Dispars*. The compars is the legal or legalist model employed by royal science. The search for laws consists in extracting constants, even if those constants are only relations between variables (equations). An invariable form for variables . . . the constant form of which is extracted precisely by the law. (pp. 369–372)

In the context of Deleuzo–Guattarian thought, there is a close connection between the domain of science and the domain of the state (politics and law) with each of these institutions exhibiting qualities of the identity centric, strongly hierarchical mode of reasoning that Deleuze famously described as 'the dogmatic image of thought' (Deleuze, 2001: 167; Lefebvre, 2008: 71).

For Deleuze and Guattari (1987), royal science can be seen to work in a quasi-legal fashion, operating in the service of essence and identity, reducing the fundamentally open, complex, differentially constituted and radically specific qualities of materiality to patterns of abstract and quasi-deductive repetition. To this end, they stress royal science's concern with 'reproduction, iteration and reiteration' (p. 372), whilst foregrounding the way in which 'number has always served to gain mastery over matter' (p. 389). In this sense, royal science is positioned as being broadly concerned with the repetition and imposition of the same, to the detriment of both difference and specificity.

By way of a contrast, Deleuze and Guattari go on to offer an alternative conception of a 'nomad' or 'minor' science, which is concerned instead with fluidity, diversity and transformative becoming:

> But for the dispars as an element of nomad science the relevant distinction is material-forces rather than matter-form. Here, it is not exactly a question of extracting constants from variables but of placing the variables themselves in a state of continuous variation . . . the ambulant sciences quickly overstep the possibility of calculation: they inhabit that 'more' that exceeds the space of reproduction and soon run into problems that are insurmountable from that point of view; they eventually resolve those problems by means of a real-life [or situated] operation. (p. 374)

If royal science is concerned with iteration (or the re-institution of the same) through the employment of abstract processes of mediation, then nomad science is better conceived in terms of itineration – or as a kind of material journey or travel that simultaneously creates or extends its territory:

> . . . itineration, is the sum of the itinerant, ambulant sciences . . . *following is not at all the same thing as reproducing*, and one never follows in order to reproduce . . . One is obliged to follow when one is in search of the 'singularities' of a matter, or rather of a material, and not out to discover a form . . . when one engages in a continuous variation of variables, instead of extracting constants from them, etc. . . . with the ambulant model, the process of deterritorialization constitutes and extends the territory itself. (p. 372)

The emphasis upon heterogeneity, contingency and dynamic material transformation that is characteristic of the formulation of nomad science places it in opposition to overly authoritarian or legislative conceptions of the scientific world view and, by association, to the equally functional state politics of capture, which, as we have seen, become drawn together in the domain of government, or political science:

> This arithmetic element of the State found its specific power in the treatment of all kinds of matter: primary matters (raw materials), the secondary matter of wrought objects, or the ultimate matter constituted by the human population . . . to submit them to the spatiotemporal framework of the State. (p. 389)

Nevertheless, Deleuze and Guattari emphasise the way in which, despite being in many ways opposed, royal and nomadic science do not function in isolation. Indeed, of their somewhat tensile, but nevertheless symbiotic relationship, Deleuze and Guattari state that 'royal science continually appropriates the contents of vague or nomad science while nomad science continually cuts the contents of royal science loose' (p. 367).

When reading Deleuze and Guattari's description of a figure who 'possesses a very accurate appreciation of the irreducibility of nomad science', but who 'sides with the State, to maintain a legislative and constituent primacy for royal science' (p. 367), it is hard not to think firstly of Charles and Ray Eames and, secondly, of *Powers of Ten*'s maintenance of an outward appearance of measure, even while it imagines the most turbulent realms of subterranean reality. For Deleuze and Guattari, royal science serves to promote an image of confidence, measure and scientific mastery, which seems evident in the Eames' cultivation of a peculiarly techno-scientific way of seeing.

The royal and nomadic sciences are positioned, respectively, by Deleuze and Guattari, as forces of (re)territorialization and (de)territorialization. This dynamic is plainly visible in the context of *Powers of Ten*, which could be said to offer a perpetual cycle of vagueness and complexity, followed by determinacy and consolidation, as each order of magnitude gives way to the mystery of the next, before once again becoming subject to capture. Similarly, and perhaps more radically, through a process of juxtaposition, we might observe the way in which the highly personal illustrated renderings of *Cosmic Zoom*, serve to cut loose the more homogeneous and analytic contents of *Powers of Ten* – introducing difference, specificity and a vaguer conception of measure.

Cosmic Zoom as minor language

In an earlier edition of this journal, Eric Herhuth (2016: 6) positioned animation as a filmic form closely related to Deleuze and Guattari's conception of a minor literature. For Deleuze and Guattari, minor literature refers to expressive practices of writing which, in challenging majoritarian, dominant discourses and traditions, could be said to construct a foreign language within their own tongue. The distinction between the major and minor is common to Deleuze and Guattari's (1987) politics and cosmology, and is key to understanding their notion that 'politics precedes being' (p. 203). The Deleuzian scholar, Patton (2006), exploring the political dimension of Deleuze and Guattari's post-structuralist thought, has suggested that *A Thousand Plateaus* is not a work of political philosophy in the traditional sense of the word. He draws attention to the way in which Deleuze and Guattari seem relatively unconcerned with developing a critique of political institutions and processes, preferring instead to formulate an ontological framework for describing transformative, creative and deterritorializing forces and movements (pp. 2–3).

Ultimately, it matters a great deal that Charles and Ray Eames attempt to depict a realistic quasi-indexical vision of the universe, whilst Szasz and Verrall opt for a heavily stylised, slightly defamiliarised, but all the more personal rendering, which is as much an expressive alternative to photographic, or indexical representation, as it is a recognition of another's difference. Every use of 'I', implies a 'thou', or an 'other' that is in some sense differentially present (cf. Cronan, 2014: 220).

Arguably, the unashamedly subjective enfolding of the cosmos that is presented in Szasz and Verrall's *Cosmic Zoom*, is more attuned to the spirit of animation than its more objectively oriented peer. Whilst *Powers of Ten* attempts a universal framing of the cosmos, Szasz and Verrall offer a rather more stylised and nomadic depiction – enfolding the cosmos from within a strangely alien and defamiliarised subject-position. Interestingly, it was the stylistic idiosyncrasies of Szasz's drawings that more readily enabled an expression of the fractal dimension of the universe, reflecting Boeke's commitment that the universe admitted not only of continuity, but also of a kind of self-similarity at the opposite extremes of scale. That is to say, the distortions and peculiarities of Szasz's drawing style enabled a stronger and more seamless integration of the universe, enveloping its radically different scalar dimensions. Szasz's organicist renderings of the geographical terrain more readily map on to the organic renderings of the body, just as her mosaic representations of our epidermis and DNA, uninhibited by any geometric framing, result in a near

Byzantine rhythmicism, bringing to mind the hypnogogic character of much early abstract anima-tion (Furniss, 1998: 233–234). This sedate, contemplative and at times hypnotic dimension is both reflected and inverted by the swathes of red, white and black which serve to express the vast emptiness of outer space and the similarly expansive interior of an atom in the closing stages of the Szasz–Verrall film, which contains less literal movement, or full-blown animation, than its seemingly 'objective' counterpart, but which is arguably more *psychologically* active in its rela-tionship to durational time.

Movement, stasis and time as a political issue

In the analysis of animated film and the construction of animated worlds, the representation and expression of time is no less important – and no less political – than the representation and expres-sion of space. Despite a number of surface similarities arising out of their very similar technical constraints, *Cosmic Zoom* and *Powers of Ten* resonate with radically different philosophies of temporality. This is apparent in their disparate framings of their respectively frozen worlds. In each instance, their live action establishing sequences – credited in the case of *Cosmic Zoom*, to the employment of an 'actuality camera' – offer a setting which fuses the domestic, the urban and the pastoral. The less organised and directed leisure time of the picnic and the rowing trip, or even the companionable stroking of a cat that serves as the opening for Boeke's original illustrated text, offer a depiction of experiences that are resonant with the layered and many-stranded durational nature of temporal reality that was envisaged by Henri Bergson. In his *Duration and Simultaneity*, evoking what he took to be the complex rhythmic interplay that collectively constitutes reality, Bergson (1999: 52) wrote:

> When we are seated on the bank of a river, the flowing of the water, the gliding of a boat or the flight of a bird, the ceaseless murmur in our life's depths are for us three separate things or only one, as we choose . . . every duration is thick; real time has no instants.

In the context of both *Powers of Ten* and *Cosmic Zoom*, these moments of multiplicitous tempo-rality are, however, relatively quick to pass. Given the technical limitations associated with kine-static animation, their opening sequences are forced to freeze as the camera begins its ascent. It is significant, however, that the films seem to take radically different stances and employ radically different strategies with respect to this moment of temporal arrest. Perhaps in a bid for seamless integration, the Eameses made the subject of their film a sleeping (and thus relatively static) human figure, framed against the neutral, seemingly motionless background of a picnic blanket. The transition into stasis was further concealed by continuing to film in live action for the first several seconds of the ascent. Shooting the beginnings of this sequence from the basket of a cherry picker enabled the sleeping male to twitch and stir very slightly, whilst a female figure, sitting close by, in accordance with the dictates of the domestic stereotype, leisurely turned the pages of a magazine.

In stark contrast to the above, the Szasz–Verrall film makes no attempt to blend its radically divergent modes of temporality and presents its own interruption to the passage of time in a far more jarring fashion. In the context of *Cosmic Zoom*, the boy's rowing action, the flow of the river and the ripples on the water's surface are subject to arrest. They hang suspended in photographic stasis until the scene is transformed into a radically simplified and rotoscoped still, comprised of flattened and simplified fields of colour. This transition is accompanied by an at once layered, temporally convolved and slightly ominous tolling of a tower-clock bell. The individual strikes of the bell first reverberate, then begin to overlap – ultimately merging into a single syncretic

cacophony before fading into the background as the camera begins its retreat and the film's heavily stylised, more subjective renderings of the universe, begin to unfold.

Considered philosophically, the Eames' film, in its bid to convey a continuous sense of temporal progress, despite its 'frozen' visual form, remains strongly oriented by what Deleuze and Guattari will describe as the regimented, sequential time of Chronos (the time of the clock). Conversely, Szasz's *Comic Zoom*, through its layered multiplicity of sound and its cultivation of a somewhat narrativeless, hypnogogic and contemplative mode of perception, leans briefly towards what Deleuze portrays as 'the floating, non-pulsed time' of Aion – a virtual, empty, tenseless time of eternity, 'the time of the pure event . . . which articulates relative speeds and slownesses independently of . . . chronometric or chronological values' (see Deleuze and Guattari, 1987: 263), before embarking upon a more idiosyncratic, subjective journey, which suggests a tensed, but rather more personal – and thus durational – relationship to both time and space.

Philosophically, we can trace these at once subjective, layered and durational concerns back to the work of Henri Bergson, who stands as one of Deleuze's most important formative influences. In the context of Bergsonian thought, the single, uniform conception of clock was contested and confronted with an alternative vision of a multiplicitous, many-stranded and overlapping temporal variation, which Bergson (1999, 2001) termed 'duration'.

For Bergson, our more universal, regular and deterministic conception of time arose out of our tendency to conflate the spatial and the temporal, and out of our desire to subject them each to measure. *Powers of Ten*, oriented by the precision of its algorithmic zoom and its overt presentation of spatio-temporal data in numerical form, exhibits all of these tendencies and can thus be seen to lean strongly towards the orderly linear clock time of Chronos.

Interestingly, from a Bergsonian perspective, the earlier sketch for *Powers of Ten* offers an even more entrenched form of spatio-temporal regimentation. It utilises disparities in the time-keeping of a pair of onscreen clocks in order to convey, in a highly performative fashion, the notion of relativistic time dilation in the context of Einstein's theory of special relativity. That is to say, as the speed of travel approaches the speed of light, the hands of the clocks, which up until this point had remained unified, begin to visibly diverge, falling further and further out of synch in a similarly exponential fashion. In accordance with Einstein's theory, here are no other visible effects and no distortions of the light from the stars. Rather, the hands of the clock representing the traveller's time maintain their regular interval, just as the hands of the clock representing 'earth time' spin ever more wildly. In *Powers of Ten*, the only index of time is its measure.

It might be thought that the relativistic implications of Einstein's theory would prove attractive in the context of Bergsonian thought, given their collective hostility to a singular conception of clock time. However, despite some surface similarities, Einstein and Bergson had a very public and radical disagreement over the nature and passing of time (Bergson,1999; Canales, 2005, 2015). For Einstein, the subjective 'psychological' time of the philosopher was simply 'not real' whilst, for Bergson, the notion that differences in the passage of time, for any frame of reference relative to one's own, could be calculated or deduced in a formulaic fashion served to effectively collapse the relativistic dimension of Einstein's thought, unifying it through the employment of a meta-mathematical strategy. This served to place Einstein's deductive and universalist approach to relativity radically at odds with the more elastic, subjective approach to time dilation and the emphasis upon the unpredictable creative powers of time that were so central to Bergsonian thought.

Bergson's more supple and variable durational conception of temporal experience was associated with more aesthetic, experimental and creative approaches to life, as well as serving to inculcate political attitudes of openness and sympathy to other modes, or rhythms, of existence. Indeed, it is the Bergsonian analysis of the art of Matisse, developed by Antliff (1999) and more critically by Cronan (2014) that has informed the approach to Szasz's *Cosmic Zoom*, that has been

developed in these pages. As the Deleuzo-Bergsonian theorist John O' Maoilearca (previously John Mullarkey) has noted, in their pursuit of life, living organisms tend to 'distort, mediate and virtualise the actuality of others' (Mullarkey, 2004: 488), suggesting that the central ethical and political problems of the day concern the way in which we choose to enfold or be enfolded by other actors, entities and assemblages. With this in mind, there is an important sense in which Bergson's work can be seen to politicise the question of temporality itself, foregrounding the way in which the deterministic notion of regular metricised progression feeds into regulatory and deterministic ideals.

Process philosophy's hostility to deductive capture

Consideration of Torre's (2017) attempt to theorise animation's 'forensic' investigation of actuality in process philosophical terms can help to shed light upon the ambitions and seemingly deductive orientation of *Powers of Ten*, whilst also foregrounding its objectivist and representational concerns. Importantly, such an encounter will prove similarly productive as a means of addressing some significant gaps in Torre's consideration of process philosophical thought – most importantly, the depoliticization of the process perspective that would seem to take place in his writings (Roberts, 2019).

In attempting to address animation's engagement with, and interrogation of, reality, Torre (2017: 216) draws upon concepts from philosophy of science, suggesting that attempts to plausibly integrate animation into the 'real' world can arise either from *inductive* or *deductive* modes of inference. Significantly, these are the two forms of reasoning most closely associated by Deleuze and Guattari (1987: 372) with the methodology of Royal Science. Torre's account of induction, in the context of animation, focuses upon our capacity to extrapolate and 'infer forward' from limited and partial data by utilizing established scientific law, or a more individualistic reflection upon, and synthesis of, personal experience. More severely, his account of deduction is associated with empirical situations where there is little freedom to move or to imaginatively stray – as when two key frames, which are very similar in terms of content, serve to tightly constrain the potentials of the frames in-between (Torre, 2019: 217). Torre's account of deduction is idiosyncratic insofar as it remains empirically inflected, departing slightly from the notion of logical necessity or entailment that features in standard philosophical accounts, and which could in fact be said to condition *Powers of Ten*'s at once algebraic and deterministic camera trajectory (Bird, 2003: 10–15; Harison-Barbet, 1990: 232–233).

The abductive character of animated film

Torre's explanations of induction and deduction are derived from the work of the polymath Charles Saunders Peirce, a process-pragmatist, philosopher of science, who was also lauded by Deleuze and Guattari as the 'true inventor of semiotics' (see Deleuze and Guattari, 1987: 531; Torre, 2017: 216). Whilst Peirce (1931), as a philosopher of science, was undoubtedly invested in the regulatory, integrative and methodological capacities of inductive and deductive thought, it is important to recognise that his real philosophical and scientific innovation lay in his formulation of the more creative and disruptive notion of *abduction* (p. 5.172).

Peirce's notion of abductive inference was primarily concerned with the roles of anomaly and experiential dissonance in the creative (re)framing of ideas. That is to say, there is an important sense in which abductive reasoning is premised upon and oriented by conflict, perturbation and change – as much as Peirce's (1931) distinctive contribution to semiotics, in the form of his notion of *semiosis*, pointed towards the open and unbridled aspects of associative thought (p. 1.339).

For Peirce, the process of abductive inference arises when an experience, which in some way jars with expectation, serves to contest existing frames of knowledge and results in a creative search for alternative hypotheses (pp. 6.469, 7.188, 7.192)

The omission of Peirce's notion of abduction from Torre's process philosophical approach to animation seems odd, particularly given what would appear to be the strangely abductive character of animation per se, and this absence of friction is perhaps symptomatic of the depoliticization of animation that occurs more broadly in Torre's work. Even a film such as *Powers of Ten* with its seemingly unshakeable epistemological confidence and its deductive pacing and development can be seen, nevertheless, to operate abductively upon its audience. Arguably, the real *power* of *Powers of Ten*, despite its anthropocentrism, is exhibited in its ability to trouble preconceptions and to prompt us into reframing any overly conceited sense of ontological independence.

Subtextual and affective communication

The task of deciphering and unpicking the political tensions and thematics of *Powers of Ten* becomes subject to further complexity when we begin to consider its subtextual agendas and non-propositional modes of communication (Beck and Bishop, 2020; Bissonnette, 2014). In one sense, the film clearly works in the service of scientific representation, offering a script which communicates a sequence of facts or propositions and which narrativises and visualises them with mathematical precision. However, this logico-propositional mode of exposition can be seen to work hand in hand with an experientially pedagogical agenda that utilises a more affective register.

The tension between mastery, control and creative freedom that is characteristic of the Eames' approach, can be seen to likewise inform its affective operation. The warmth of *Powers of Ten's* future embracing, but nevertheless hand-crafted and largely analogue form of modernism, is narrated in an at once homely and authoritative tenor. Morrison's voice follows the conventions of soft public information/educational film. It is warmly assertive, stable in tone and almost entirely self-assured, conveying a sense of expertise to accompany, and in some sense master, the film's strange fusion of the mathematical and dynamic sublime. In stark contrast, Szasz and Verrall's *Cosmic Zoom* is entirely devoid of narration, being accompanied instead by a pastoral musical score for pan flute and harp composed by Pierre F Brault.

Animation in its many and diverse forms is rarely so invested in notions of objectivity or straightforwardly veridical representation and it is distinctive in its power to present radically divergent and anomalous modes of experience. We have seen how the more expressive and stylised approach of Szasz gestures in this direction, offering a contrast to the quasi-objective scientism of the Eames' film. More radically, the at once abductive and political power of animated film is more typically revealed by its foregrounding of subjectivity (Wells, 1997, 1998: 27, 32, 2002: 24), its celebration of diverse, transformative and metamorphic ways of being (Batkin, 2017: 89–112; Gunning, 2013; Napier, 2005: 177) and its ability to both critique and subvert dominant norms and values through its Bakhtinesque mode of carnivalistic display (Lindvall and Melton, 1997).

Animation and differential presence

Perhaps the most distinctive character of post-structural process–philosophical thought has been the turn towards difference as the constituent quality of reality and a consequent shift in emphasis from the integrative ontology, which would seem to largely condition films such as *Powers of Ten*, to a more tensile and differential picture of the constitution of the world and our identities, as a confluence of differential forces and affects. Post-structural materialism, in its valorization of kinesis and materiality, can be seen to have turned away from the humanities' concern with language,

whilst embracing a material conception of performativity that is receptive to a more disorderly, playful and vital conception of matter (Bennett, 2010; Bryant et al., 2011). With this in mind, it seems apt that one of the most distinctive critiques of *Powers of Ten* has emanated from the domain of performance, whilst arguably embodying the mischievous abductive spirit of animation.

Performative critique of *Powers of Ten*

Superpowers of Ten, by Andres Jaque and the Office for Political Innovation was curated by Bruno Latour and Christophe Leclercq as part of the *Reset Modernity* exhibition at ZKM Germany. Jaque's performance recreates *Powers of Ten* on stage, utilizing caricatured and cartoonish props, frames, cut-outs, costumes and hand-made models, in order to introduce high levels of friction, difference, resistance and contingency into its performance. Players interact in a scripted but vaguely chaotic fashion, walking or running backwards and forwards towards the hand-made framing devices that are held aloft by other members of its cast. The effect is one of an at once turbulent, shambolic and slightly disorderly zoom. *Superpowers of Ten* questions and ironically flaunts the original film's anthropocentrism, whilst alluding to a vast human and non-human network of differential agency. Following its recreation of *Powers of Ten*, the performance goes on to dramatise some of the political events surrounding the film's production.

Given the scale and reach of Charles and Ray Eames' collaborative enterprises, the political milieu of *Power of Ten* is perhaps necessarily complex and sometimes at odds with the Eames' purported ecological agenda. Charles Eames protested that 'we are fouling our nest' (Schuldenfrei, 2015: 140) and attempted to draw attention to the way in which 'the problems of environment have become more and more interrelated' (Ostroff, 2015: 383). However, it has often been noted that these proclamations sit rather at odds with Philip Morrison's close involvement with the development of the atomic bomb. Morrison, who was the narrator of and scientific adviser for the Eames' later film, not only helped to assemble the first atomic bomb, but also drove its plutonium core from Los Alamos to the test site in the back seat of a Dodge sedan (Cathcart, 2011; Jaque and The Office for Political Innovation, 2016: 81). Later he would help to load the explosives that devasted *Hiroshima* and Nagasaki onto the planes that carried and later released them.[1]

Jaque's *Superpowers of Ten* (2016) addresses Morrison's complex relationship to the bomb whilst likewise alluding to other material events of catastrophe, discord and dissensus, such as the polio virus that affected Morrison as a child. In opposition to *Powers of Ten*, the extended narrative of the production foregrounds the amount of conflict and dissensus that characterises the universe and the tensile materiality of everyday life. Thus, discussion of agency, technology and normativity focuses upon the instrumentality of Kodak, firstly in terms of supplying the film stock for *Powers of Ten* but, secondly and rather more sinisterly, in terms of their role, in a broader material–political context, in the suppression of darker skin tones through the chemical composition of their film stock. Kodak's 'Shirley Card' – the white-skinned, Caucasian model whose image was used to calibrate the appearance of skin pigmentation in Kodak's development process appears as an emblem of normativity in the context of Jaque's performance. Conversely, Saundra Williams, who was crowned Miss Black America out of protest in1968 and the transgender drag queen and activist Flawless Sabrina, who, in 2012, was ordained as Miss Drag America stand as figures of alterity, serving to foreground the way in which we are 'configured by otherness' (Jaque, 2016: 88). In this fashion, *Superpowers of Ten* can be seen to both extend and radicalise the context of difference that is implicit within the idiosyncratic stylization of Szasz and Verrall's *Cosmic Zoom*, whilst applying it satirically to the Eames' *Powers of Ten*.

Jaque overtly positioned *Superpowers of Ten* in pluralistic terms as a means of 'reclaiming multiverses' and as a way of introducing a sense of contested politicised being. In this sense, it

urges a more agonistic conception of states of affairs that might be applied to materiality, the socius and the cosmos alike.

The social scaleability of post-structural cosmopolitics

Superpowers of Ten's intermingling of ontological levels can thus provide a bridge or springboard into more familiar terrestrial political territory as human actors take on the roles of entities at massively divergent scales and levels of organization.

Post-structural social theorists such as Chantal Mouffe have illustrated how the tropes of the differential constitution of identity most typically associated with materiality can be played out at the level of the social. For Mouffe (2000), the condition of seeming democratic consensus is one of cacophony of conflict, in what she describes as the political condition of agonism. In diagnosing this situation, Mouffe employs a useful post-structural distinction between *politics* and the *political.* Politics, for Mouffe, concerns the ensemble of practices, discourses and institutions concerned with normative governance, which reinforce the prevailing contingent modes of hegemony. In contrast to this, the *political* stands as the agonistic foundational noise of dissensus – the tensile condition of pluralistic and differential interests and investments that Mouffe sees as the permanent and foundational condition of society, as well as the differential ground of democratic order and unity (p. 101).

Mouffe's distinction between politics and the political points towards a valuable extension to Herhuth's approach to political animation. In his introduction to the recent special issue of *animation* which addressed its political contexts, Herhuth (2016) made his own useful distinction between 'the politics of animation' and 'the animation of politics' – positioning the former as appertaining to relatively parochial disciplinary disputes and the latter as addressing the medium itself, as a politically expressive and transformative agency.

Whilst there is an important sense in which Herhuth's distinction enabled him to touch upon the power of the animated film, he struggled to reconcile his concern with animation as a broadly minoritarian practice with the discipline's participation in more majoritarian, or politically reactionary contexts – as when animation is used in the service of propaganda, or in the cultural lauding of a select few (mostly white and mostly male) animators (p. 6). However, by incorporating Mouffe's distinction between politics and the political into Herhuth's original framework, we might more straightforwardly accommodate both the active and re-active capacities of animated film.

The design theorist DiSalvo (2012), applying Mouffe's position to the context of critical design, distinguishes between a 'design for politics' which works in the service of social order and system, reinforcing the perception of democratic consensus and perpetuating the status quo, and a 'design for the political' which seeks to bring to the surface, or to in some sense activate the conflict and dissensus that lie beneath (pp. 8–13).

For DiSalvo, the majority of design practices operate in the hegemonic realm of politics and cases of design for the political stand as minoritarian exceptions to the rule. Interestingly, in the context of animation, a similar dichotomy would seem to hold, whilst the ratio of normativity to alterity would seem to be reversed. With this distinction in mind, *Powers of Ten* and its earlier sketch, in their hegemonic and consensual depiction of the universe, stand as exemplars of an *Animation for Politics*, whilst Szasz–Verrall in a recognition of difference that is further radicalised in the context of Jaque's *Superpowers of Ten*, might be said, conversely, to bring the political to the surface.

We saw in the introduction to this article, how the quasi-propagandist concern with normative governance that is manifested in the techno-scientific trappings of *Powers of Ten*, also extends into the politics of the Eames' collaborations, their attraction to the technologies of information-consumerism, their work for government agencies and their frequent sponsorship by technological corporations (Jacob, 2015: 165).

The political milieu of Szasz and Verrall's *Cosmic Zoom* may, in comparison, seem a little more pedestrian, but it is no less significant for this. Most importantly, as is often the case in the context of animated film, there is a concern with authorship and attribution. Significantly, there is no directorial credit for the film featured in its closing titles. Perhaps because of this, it is sometimes credited to Szasz (who certainly produced the drawings) and at other times to Verrall (who was certainly the producer of the film). There are similar ambiguities surrounding the role of animator. The closing titles list a number of 'animation camera' operators, and yet the role of animator is frequently attributed to Szasz. Here, Herhuth's category of the politics of animation, looms large – the film was produced by the animation department of the NFBC and it is perhaps for this reason that roles are not so easily delineated. In the context of this article, I have chosen to credit the film directorially to Szasz–Verrall, as a gesture towards the ambiguity surrounding the situation. *Cosmic Zoom* was the first film with which Szasz was involved. However, in the context of later animations, also produced for the NFBC, she is credited as editor, writer and ultimately director. The prevalence of kinestatic animation techniques and the heavy visual stylization of films such as *The Trout That Stole the Rainbow* (1985) and *The Prophet: A Passover Celebration* (1995) might incline us to believe that Szasz's involvement with *Cosmic Zoom* was more pervasive. Equally, however, it might simply be evidence of a particular house style. External to the organization, there is a similar issue that appertains not to the attribution of roles, but rather to the recognition afforded to the film itself. More specifically, it relates to the archival politics of the astrophysics department of Harvard University, who, having considered the merits of both films, decided that they should purchase two copies of *Powers of Ten*, and to pass over the closely related, more subjective and expressive work of Szasz and Verrall (Eames, 2013: 250)

Conclusion

This comparison of *Powers of Ten* and *Cosmic Zoom* has attempted to reveal the disparity between their respective cosmopolitical stances by evidencing their stylistic decisions as modes of political expression. *Powers of Ten* and *Cosmic Zoom* serve to illustrate the distinctive intertwining of representation, subjectivity and affect that is characteristic of animated film, whilst enabling an exploration of the way in which animations that address essentially the same subject matter can be imbued with radically different ontological, epistemological and political commitments. We have seen how Charles and Ray Eames, in making *Powers of Ten*, constructed an at once representational, propositional and techno-scientific frame, whilst also rallying the powers of affect in order that their audience might vertiginously feel the film's pedagogic message. Conversely, we have seen how Szasz and Verrall's *Cosmic Zoom* dispensed with photographic realism, providing instead an index to differential subjectivity that is every bit as important as any connection to the 'objective' world. Although both animations can be seen to employ representational, expressive and affective strategies, it is evident that the weightings and priorities of each might be said to differ. Ultimately, this draws attention to the pervasive influence of politics on the realm of the aesthetic, and to the precedence of the political with respect to (animate) being – offering a palpable reminder of the way in which practices of animation, much like practices of politics, are both givers and takers of life.

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Note

1. In fairness, Morrison would ultimately become a member of the team that assessed the damage wreaked upon Hiroshima and, following this investigation, he began to actively campaign against its use.

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Filmography

Cosmic Zoom (Eva Szasz and Robert Verrall, 1968)

A Rough Sketch for a Proposed Film Dealing with the Powers of Ten and the Relative Size of Things in the Universe (Charles and Ray Eames, 1968)

Powers of Ten: A Film Dealing with the Relative Size of Things in the Universe and the Effect of Adding Another Zero (Charles and Ray Eames, 1977)

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