Ex-centric Cinema: machinic vision in the Powers of Ten and Electronic Cartography

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Abstract:
A century of cinema provides an account of a cultural form divided between documentation and animation (the real and the magical). Yet the challenge that cinema presented in terms of a relocation of perception from the eye to the machine has become occluded. The shock of cinema in its earliest manifestations resided in the body of the spectator, no longer the site of primary perception, but dependent on an other (the camera, the projector) lacking in human qualities. This article argues that the newly configured body-machine relationship provided by cinema became a marginalized feature of cinematic culture, an ex-centric cinema relegated to the sub-fields of science and educational film. In the mid twentieth century the project surfaces spectacularly in the work of pioneering designers Charles and Ray Eames, most poignantly in their film *Powers of Ten* (1968/77), a journey into the cosmos and back again into the body of a man. Bringing together discourses of space travel, cartography, physics and cinema, the film moves us towards an understanding of visual culture as an apparatus of calculated possibilities, where visualisation replaces representation. If we take *The Powers of Ten* as a non-representational film, an ex-centric cinematic practice, we uncover non-linear and non-representational ways of apprehending the relationship between bodies and matter. This literal line of flight is one path that cinema may have taken. Its presence however is detectable outside of the cinema, in the software programmes of electronic cartography copyrighted as Google Earth. The human body is not made virtual by its engagement with calculated visualisation but is in turn part of the field of enquiry, equally porous, and definable in various scales and in different dimensions.

In the year 1995, and despite certain misgivings and disputes regarding the accuracy of the date, the centenary of cinema was widely celebrated. Whilst a century of cinema suggested the longevity of a cultural institution, the celebration was accompanied by a nostalgia for a passing form of collective cinema-going, now dispersed into numerous viewing practices, and a mourning of celluloid film as it increasingly gave way to digital imaging. In the commentaries attentive to these changes, there ran a certain argument that contemporary cinema was returning to its earlier principles, namely a fascination with movement, with projection as a magical phenomenon and with animation as the founding characteristic of what we call the cinematic. In other words, late cinema circled back to early cinema, defying concepts of technological progress. However, what remains occluded in these reflective accounts on cinema's evolution, is the success with which cinema obscured the relation between a human subject and a mechanical form of seeing (automation), a relationship fraught with questions of alterity, mimetic interplay and control. It is only in the margins of cinematic history, where forms of image-making cross over into territories of computer science, space travel and topography, that cinema as a mode of seeing by technological means presents a radically different and conceptually rich account of bodies, machines and image-making.

This article explores one of the sites of what I will call an ex-centric cinema, a cinema in which machines, images and the human body are put into a productive encounter through which the boundary and definition of each of the terms is challenged. In mid-century America, the work of Charles and Ray Eames became famous in terms of a discourse of design, and yet their particular practice was characterised by an inter-disciplinarity that brought together the disparate strands of computer science, architecture, art and film. Their films present a version of cinema based on the visualisation of information rather than representation, working with the notion of prototypes or experiments in form rather than indexical images. In place of a cinema of psychological realism (the projected interiority of a subject), we are offered a model of seeing within a system of calculated possibilities. Brought to fruition in their most famous film, *The Powers of Ten* (1977), the viewer is offered a mode of perception that is impossible to construe as human as the film embarks on a journey of relative scales. First the direction is towards the outer reaches of space, and subsequently into the layers of human skin. Dependent on the automatism of

machinic vision (Johnston, 1999), the human body is but one material form within a universe of organic matter. In contradistinction to a cinema of subjective interiority, the film decentres human perception as the dominant way of seeing. Instead, it places the human body relationally on a scale of material forms, mapping various correspondences between the body and topography as matter in constant transformation rather than a representation of stable states. This, I will argue, evidences a type of ex-centric cinema, possibly a Copernican cinema that radically undoes the alignment of the cinematic apparatus with human perception.

Seeing by Technological Means

If animation has a long-standing presence in film theory, automation (that is, ways of seeing that reduce human intervention) may be thought of as an absent presence (Hansen, 2004: Sobchack, 2009). This was not always so. In the early writings on film, before film theory became an established discourse, the response to this mechanical view of the world was marked by a visceral shock to perception. The sensuous and bodily response to cinema is most fluently (and famously) expressed in the writings of Jean Epstein in a discourse of photogénie. The ecstatic beholding of an early cinematic image, the scale of its enormity and apparent presence, is captured in his description of the close up of a smile:

> The lip is laced with tics like a theatre curtain. Everything is movement, imbalance, crisis. Crack. The mouth gives way, like ripe fruit splitting open. As if slit by a scalpel, a key-board like smile cuts laterally into the corner of the lips. (‘Magnification’, 1921)

Both erotic and edged with violence, the description opposes the soft flesh of fruit with the instrument of the scalpel, prefiguring two similarly incision-driven citations to come, the slicing of the eye with the razor blade in Buñuel’s *Un Chien Andalou* (1929), and Benjamin’s description of the cameraman as a surgeon (1936). The work of art essay speaks of aura and of reproduction, yet the notion of mechanical seeing as violent is by the middle of this decade a violence erased, a way of experiencing cinematic shots and cuts already habituated as ‘cinematic language’. The camera penetrates reality, and ‘because of the thoroughgoing permeation of reality with mechanical equipment, [film offers] an aspect of reality which is free of all equipment.’ (1999/1936: 227). This ‘equipment-free aspect of reality’ was of course

the flower in the land of technology, and the camera's revelation of what cannot be seen by the eye became in Benjamin's writing, the optical unconscious.

Epstein, Buñuel and Benjamin register the quake of seeing by mechanical means, located in the shifting scale of the image, its manufacture of the real as trompe l'oeil, and a mode of perception that can be a spliced assemblage of view points. If by the mid-thirties this visceral shock had been transmuted into a relatively seamless narrative, its monstrosity had nonetheless been marked. The relocation of perception from the eye to the machine had risks attached to a new relationality, in which the body of the spectator was no longer the site of primary perception, but dependent on an other lacking in human qualities. If cinema, in its earliest configuration, provoked the question of where we see from, and additionally what we are becoming in relation to a mechanical visual apparatus, the question however evaporates with cinema's institutionalisation. As cinema became consolidated as entertainment industry, its automated qualities of remote seeing became embedded in the rules of narrative form and rituals of an inter-war leisure industry. The strangeness of mechanical viewing was tamed and habituated, the ghostly mobile forms became 'the movies', and the potentially monstrous size of the image became spectacle. The concern with automation and its visceral counterpart migrated elsewhere by mid-century with the advent of the computer and a discourse of cybernetics that appeared to have little overlap with the cinematic.

Recent work on media archaeology (media in its expanded form), has returned to the 'problem' of seeing and communicating with/through machines. Notable amongst commentators are Friedrich Kittler and his account of electronic literacy (1986/1999), Siegfried Zielinski's depiction of forgotten scenarios of body-technology innovation (2002/2006), and Jonathan Crary's accounts of vision and its historical construction traced through the genealogies of optical devices over a course of three centuries (1990: 1999). Whilst Kittler's historical project takes a post-structuralist approach to the impossible translation between evolving inscription technologies (gramophone, film, typewriter), Zielinski's equally provocative writing operates 'cuts' across the surface of media histories to exact correspondences across periods and practices. His assertion in the introduction that '[t]echnology is not human; in a specific sense, it is deeply inhuman', is perhaps misleading given that most of his case studies speak

of a compulsion to experiment with media on the body (2002/2006: 6). For Zielinski, the difference between media and humans is a matter of temporality, of the different time spans of humans and things. He writes, ‘All of the great inventions that form the basis of technology… were developed within a relationship of tension to the relative inertia of the organic and what is possible for humans’ (2002/2006: 6). Technology in this account is not a sign of progress but a matter of dispute, disruption and dispersal of causal arguments in the name of establishing a variantology of the media with attention to the differential rates of change between organic and inorganic matter (Zielinski and Wagnermaier: 2005). The time of technology is not, for Zielinski, the time of humans.

In a somewhat different approach, Jonathan Crary traces the formation of a particular subjectivity through encounters with a range of optical devices. Drawing on Foucault’s archaeological method of digging into the forgotten or unthematised instruments of a past age, Crary elaborates a historical disciplining of the subject through vision. Positioned by optical devices, in particular the camera obscura, the observer is one who sees within a pre-defined set of conventions, in effect observing certain rules of engagement. There are two points that are significant here, the first concerned with the production of a metaphysics of interiority. According to Crary, the camera obscura ‘defines the position of an interiorised observer to an exterior world, not just a two-dimensional representation, as is the case with perspective’ (1999: 34). The separation of the observer from the scene observed was a production on the level of subject-hood, removing the dynamic inter-play of world and subject and laying the foundation for the institutionalisation of cinematic viewing. Whilst the observer is in effect a subject disciplined and made docile by the conventions of seeing technologically, this implied passivity is simultaneously the cause of social anxiety, concern at the detrimental effects of exposure to cultural machines. He writes, ‘just at the historical moment when attentive perception within technological culture assumed increasingly automatic forms, modes of human behaviour deemed “automatic” were being identified as pathological and socially dangerous.’ (1999: 147). The relationship of human-machine through the field of the visual holds the potential of a contagion that can travel from the mechanical apparatus to the human psyche: exposure to mechanized culture may produce an automaton of the human. Machines for seeing or seeing in collaboration with optical instruments, is, according

to this account, both a lure and a threat.

This undercurrent of social anxiety regarding human-machine relations surfaces in films of the 1920s and 30s, most notably Lang's *Metropolis* (1927) and Chaplin's *Modern Times* (1936), and yet cinema becomes peculiarly detached from the central debate of computer-human interactions as it emerged in the Macy Conferences on Cybernetics (1946-53). In a series of meetings gathering scholars from an eclectic number of disciplines, the conferences approached the question of models of information, energy and matter in neural structures and computers (Hayles, 1999). Whilst anthropologists Gregory Bateson and Margaret Mead were present, and sociologists Talcott Parsons and Paul Lazarsfeld attended, there was no representation of film or the arts more broadly. The exclusion of film and the arts from this debate was, however, productive of an encounter elsewhere of the relationship between film, the computer and automated forms of perception. Charles and Ray Eames, working during the same period, conceived of their office as a 'communications system', and film was central to their practice of explicating the potentiality of computers in domestic life, a project that, I shall argue, they exceeded in many ways. This article is, in the spirit of Zielinski, a cut across the surface of this period of post-war film production, an incision into the liminal place between design, computer science, mathematics and film, specifically realized in the prototype and final 'product', *The Powers of Ten* (1968, 1979). Charles and Ray Eames may be thought of as the protagonist-innovators of cinematic prototypes that failed to make the assembly-line.

In addition to the nexus of discourses named (film, the computer and automated forms of perception), it is necessary to add a further influential 'event' that hovers over and provides a dramaturgy for this period, that of space travel. A semiotically rich topic, space travel extends and increases the dependency involved in human-machine relating: humans are situated inside of a computer guided machine, which navigates through the uncharted extensiveness that is 'space'. Moreover, the prospect and actuality of space travel relocated the place of perception to a literally ungrounded position, not simply in the air but remote to the earth's atmosphere. Whilst each mission was an experiment in the conditions of life outside of the atmosphere and in the documenting of other planets, stars and galaxies, the

fascination with the perception of the earth from space was foundational. Significantly, the journey of humans into the atmosphere was prefigured first by a camera, and second by other species. In 1946, a rocket-borne 35-millimetre camera attached to a V-2 missile had provided the first image of earth from space at a distance of sixty-five miles. The impact of this image of the earth from space was due in part to its diminishing of 'the world', but perhaps more importantly to its reversal of perception. The enticement of 'what we look like from there', was followed by a curiosity of what it means to be 'there looking at us'.

Whilst there is no evidence that the Eames office was influenced specifically by the space missions, there were films concerning astronomy, notably *Copernicus* (1973), and *Kepler's Laws* (1974). The formal connection between space travel and their filmmaking is a fascination with landscape seen from above. From this perspective, the work of the camera is to uncover intimate isomorphisms of scale. The iconographic events and figures of space travel in this period were broadcast throughout the East and West. A dog named Leika, a mongrel recovered from the streets of Moscow, was the first 'star' and collateral in the sequence of missions. Trained and prepared for a one-way journey into space, Leika was to become the icon of an alienated and lost subject, sentient inside the capsule and visible from earth, and yet locked inside of an automated machine steadily navigating its path towards oblivion. As a result of this experiment, in 1961, Russian cosmonaut Yuri Gagarin orbited the earth for 108 minutes in the Vostok_3 KA and became the first man in space. As an indicator of the impact of these events, in a seminar on identification in March 14 1962, Jacques Lacan speculated on the voyage of Gagarin, pitting the soft flesh of the human body against the frail tin container. For Lacan, we are all 'erotic cosmonauts', navigating between the matter of bodies and the computing apparatus of the symbolic order that channels and delimits our desires (Lacan, 1993).

Animating Concepts: Charles and Ray Eames

The question of what new co-dependencies are being forged in the human-machinic relations presented by cinema, computing and space travel, has been addressed sparingly in each site, yet their mutual imbrication in the latter part of the twentieth century can be found in the work of Charles and Ray Eames. A husband and wife

team, who appear in photographs as 'the ridiculously happy Eameses' (2005: 128), they bring together homespun American good sense with a radical belief in design as a democratic force. Trained in architecture and art respectively, Charles and Ray became the most famous furniture designers of an era, specifically through the production of chairs, successful to the extent that Charles Eames is credited with the accolade that he taught America how to sit down. And that from the design and manufacture of stylish chairs, the Eameses go on to manufacture exquisite toys, books, interior furnishings of various kinds, all with a characteristic finish. Whilst their reputation for furniture is renowned, film was a central pillar to their practice. The experimental 'minimum chair' exhibited at the Museum of Modern Art in 1948 was followed two years later by their first film, *Traveling Boy* (1950), in which a mechanical child journeys through a world of toys. Their power was in part a question of translation: information and concepts were visualized to the extent that information patterns increasingly replace indexical representation as our dominant visual form. In this mode of filmic production, we are offered a view of the possibilities of what cinema might have been and what it may yet become.

The film was one in a series that the Eames office made for the computer company IBM, along with dozens of exhibitions and books created over the course of two decades. Corporate America funded much of their output. In addition to IBM, Polaroid, CBS, Westinghouse, Time Inc and Boeing commissioned the Eameses to make cultural models that explained the companies and their products to the public. Conceiving of their office through an emergent systems theory, their career reflects the changing terrain of the post-war period in America, moving from an industrial economy to a post-industrial society of information and knowledge. Such was their reputation as progressive pro-technology designers, that they also received commissions for a series of media projects from the government. The United States Information Agency for example funded the show *Glimpses of the USA*, which travelled to Moscow in 1959 ostensibly to breathe warmth into cold-war relations, and inevitably to exhibit the technological prowess of the nation. The show was a seven-screen film of scenes of American everyday life, prefiguring the multi-screen interface of the computer, the multifaceted perceptual device that allowed competing scenes to appear simultaneously. Cutting from aerial shots of factories, supermarkets and transport systems to scenes of domesticity, the installation

celebrated both the heterogeneity in the new postwar culture, and the visualisation of the combined properties of transportation and perception (Schwarzer, 2004). It was in effect, a version of what Gene Youngblood was to call expanded cinema over a decade later.

The Powers of Ten was one of almost one hundred films made by Charles and Ray Eames and their creative office, based in Los Angeles, the perfected version of a prototype made in 1968. The earlier film was shorter and shot in black and white, containing fewer images and situating the pivotal picnic scene in Florida. In the later film (1977), the scene of the picnic was relocated from Florida to Chicago, possibly due to the dramatic vision of landscape afforded by the great lakes, an image we see as the film rises upwards over the city in the beginning of its journey of relative scales. Drawing on the work of the Dutch educator Kees Boeke, who in the 1950s (in the space of a classroom) worked out such a journey into the cosmos in ten bold steps, the film harnesses this simple idea into an unbroken filmic narrative. Described as 'almost sculptured' in its simple form by scientist Philip Morrison (who provides the voice-over), we travel on a metronomic journey moving along one straight line in space, travelling out from the hand of a picnicker to the distant galaxies, and then back again and into the tiny refuges within an atom of the same hand. Each step either expands or contracts the previous field by a factor of ten. The taut discipline of the calculation is reproduced in the rhythms of the camera's reverse movement, allowing only the same limited time to view each frame.

The second and final version took a year to make. The only 'live' (film) sequence is the picnic scene, forming the first thirty seconds of the film. The most onerous part of the production was the remaining forty images, drawn from aerial photography and images from space travel in collaboration with NASA. The film is patched together from photographs of photographs, photographs of composites of maps and drawings, photographs of paintings based on images from a microscope, to produce an imagined sequence rather than an indexical one. The images that take us into the epidermis, the collagen, the capillaries, cell nucleus, an atom and a quark, whilst based on the slides from an electron microscope, were painted over to simulate what the human eye cannot see but in a graphic form that it may recognise. These pictures of boundary surfaces are given a diagrammatic rendition, for what they

represent is form without stability, structures that are in constant motion (Sawchuk, 2000).

In this film of calculated travelling, the conventions of narrative film are mobilised in a number of ways. The use of voice-over gives form to and comments on the action, generating a story in two parts. The first establishing shot of a couple having a picnic, constructs the ground beneath our feet, the quotidian scene of leisure but for the weightily marked mise-en-scène: upon a chequered blanket a clock has been placed along with books on science and time. The man sleeps in the sun, and it is from his body that we take our leave, as though the film may be, and in a trope typical of 1950s Hollywood, inhabiting his dreams. The scene is idyllic, Edenic, and indeed it is Adam who sleeps whilst Eve remains alert to the possibilities of the immediate environment. As we leave the environment and rise further out, the scenes are described in terms of a measurement consistent with the human body (Stewart, 1993), how far a man can run in the space of a minute. But as we pull away from the scene of the picnickers, the explanation strains to find an equivalent human measure. What the viewer is given to experience is the sensory rush of being pulled backwards rather than simply up. Whilst the zoom is a standard device of narrative film, the scale of the action is excessive, conforming to what Lisa Parks calls ‘the cosmic zoom’ (Parks, 2005). Not only the excessiveness of the zoom but the direction in which it travels differentiates it from classical film techniques of the period. The use of a backwards zoom animates the images to produce a smooth line of motion, and yet we are pulled towards something whilst being denied a view of what we are approaching. It is a camera action reminiscent of Hitchcock’s simultaneous back tracking forward zoom (a technique termed the Vertigo zoom), a disorientating combination of movements that brings ‘the past’ into greater focus whilst retreating from the scene. The sense of uncertainty produced in this movement works against the calculation of the controlling explanatory voice. As the film unfolds, the voice becomes a type of incantation.

There are further limits to the way in which this film functions in classical narrative terms. The contours of the film conform to a division of parts rather than a three-act structure of conventional cinematic story. And where story-telling in the traditional

mode situates ‘hooks’ to engage the viewer, at the outer edges of space the movement is suspended. ‘As we approach the limit of our vision, we pause to start back home, this lovely scene, the galaxies like dust, is what most of space looks like’, the voice tells us, adding ‘this emptiness is normal’. It is unclear whether this emptiness belongs to the galaxies or to the viewer, and the question of the limit of our vision is far from straightforward. As the film reverses direction and zooms back towards ‘home’, its ocular enquiry moves beyond the scene of the picnic in a close-up of the man’s hand. The following images, detailing the layers of skin appears to elicit what is ‘beneath’. The order here is however not that of revelation but of magnitude. What we see is not exactly ‘beneath’ the epidermis but within the micro processes of the body, down to the smallest microns, angstroms and fermi. What we may have fantasised as the location of perception, the body of the man dreaming this voyage as he slumbers at leisure, is now the object of investigation. His role as the protagonist of perception is dramatically put into question: can one both see and see inside of oneself?

There are two notable precursors to this extra-ordinary event of moving perception beneath the skin, one delivering revelation and the other a proposal for affinities of forms of human and non-human energy. One of the earliest manifestations of ‘seeing inside’ the body, the X-ray, emerged simultaneously with cinema. Steven Connor has this to say about the objectification of the body, and the making visible of perception:

> Inherently photographic, X-ray vision was linked with photography’s power to arrest and anatomise vision, to get on the inside of seeing itself, making the invisible, the act of seeing, visible…[I]n the case of X-ray vision, I see a kind of seeing that can never be mine, since it is not optical seeing. Here, I seem to be able to see the ways in which I cannot see; I can see my own blindness. (Connor, 2008)

Yet the X-ray is productive of a dialectic of inside and outside, of the visible and the invisible, which exposes the body in skeletal form, a prefiguring of the body as it would become in death. The X-ray seemed to harness magical powers of enhanced vision, and for this reason it had affinities with occult and spiritualist practices of vision attuned to the supernatural. It afforded an idea of the internal body as with holding secrets (of disease or other signs of communication), therefore it offered

something of the order of a revelation (Van Dijck, 2005). The journey through the skin in *The Powers of Ten* performs the opposite revelation, which is in fact that there is nothing to reveal but continuity with and analogy to the environment. The skin of the hand is not a barrier penetrated but a surprisingly porous fabric. Moving from the outermost surface of the epidermis, the journey continues into the inter-related systems within a stratum to find that the body is a place of vibrations, patterns and rhythms as unfamiliar as the outer galaxies. This is the body spatialised, made topographic and brought into relation with other systems of life as a connected entity. And the film ends here, without returning us to the comfortable familiarity of the picnic scene. Our standard bearer of measurement, the human, is only one frame that we pass through to enter into other formations.

A second precursor to this sequence of moving beneath the skin is to be found in the discourses of psychology and philosophy, like the X-ray, at the time of cinema's inception. The effects of cinema as a technology that muddles the discrete boundaries of the body, that becomes entangled with emotional and psychic states, was a site of critical investigation into the relation between the body's interior and external objects. Pasi Valiaho, in re-reading this debate, argues 'One must note that the automatic movement of images is just as much organic as it is mechanical in nature, and it also quite effectively blurs the distinctions between these two terms in its operation' (2010: 79). Drawing on the German philosopher Ernst Kapp and his concept of organ projection, Valiaho argues that technologies and the living were conceived as enacting a continuous feedback loop whereby bodies are exteriorised in technical objects. In this curious discourse, the relationship of bodies to machines is one of modulation and interplay, whereby the human form exists in a mimetic relationship to surroundings, including, and even especially, technology. Prefiguring Callois' writings on insect mimesis, organ projection confuses the definition of the body as an internally bounded object. Cinema, according to Valiaho, provoked this confusion in the context of the auditorium. Responding to the rhythm of movement, the scale of images, the grain of the film, the spectator's heart quickened, limbs twitched, facial expression changed. Here, animation refers us not simply to the enlivened image strip, but the enlivening properties of the relations between cinema and the human body. Cinema is not simply that which is animated, but a contagious series of rhythms and movements that in turn animate bodies.

Through the invocation of cinema's automatism (seeing-by-machines), *The Powers of Ten* brings into dialogue modes and formulations of perception that are conventionally kept apart: lens-based entertainment, medical imaging, psychology, and the imaginary prospect of space travel. Moreover, the film does not distinguish between the representational traditions; the images of an electron microscope are also artworks, and the painted images of the earth are also aerial photographs. In a sense, the *Powers of Ten* is a cinematic ur-text, a form that appears to reconstruct a lost original version of a journey into space and into the human body, only there is no original. Taking the animating principle of cinema, that images projected at a certain number of frames per second take on the appearance of life-like movement (Mulvey, 2006), the Eameses animate ideas. The explanatory force of the narration attempts to convince the viewer that it is possible to visualise the calculated properties of the universe, and of the micro processes of the human body. Yet at both ends of the spectrum of 'relative' scale arises a profound question; not only what can be known and visualised and animated, but what in fact counts as life? If the universe opens up onto infinite expanses, what other forms of 'life' may exist to enlarge and decentre a human definition? And along a second axis, if the human form can be traced to vibrating patterns of quarks within a nucleon, where exactly does the human form (individuation) begin and end?

Ex-centric Cinema

In their film and installation work, Charles and Ray Eames deploy a type of expanded animation, a practice that creates correspondences between different surfaces, subjects, scales and disciplines. In this sense their work is accorded a prominent position within the current retrospective readings of cinema as fundamentally an art of animation. This argument concerning the legacy of cinema is by now familiar, re-tracing the magical tradition of image making in the wake of digital production to revise the narrow definition of film as record. Yet the working method and cultural output of the Eames office provides a more challenging model of cinema, a sideways view that fails to conform to the binary of the magical and the real. Animation as calculation on the one hand, and the human-machine collaboration on the other, provide another formulation of cinema that is ex-centric, off to one side. If ex-centric is a version of eccentric, it is notable the root of the term

is derived from Ptolemaic astronomy, a construction of *ek* (out) and *kentron* (centre or point). Its etymology refers us back to the question of what is at the centre of the universe. As we know of Ptolemaic astronomy, the formulation that situated the earth (and humankind) as the centre of the universe was founded on a radical going astray, a mis-calculation of epic proportions.

In the calculating principle of *Powers of Ten*, and in the prioritising of space over time in the journey, the film directs us towards a sense of the image as posthistorical in Vilem Flusser's elucidation of the term. In a characteristically brief essay, 'Photography and History' (1989), Flusser de-couples the titular terms. Photography, it appears, is not the handmaiden of history and all attempts to make it so have misunderstood the radical potential of images to summon a future. Flusser, in a sweeping argument that moves across a compressed seam of image-making practices, posits three image forms: prehistorical, historical, and posthistorical. Prehistoric images are those in existence before the advent of writing, from cave paintings to wall hangings, which are maps. 'Their producers have stepped back from their environment and into their own subjectivity', he writes, continuing '[f]rom this vantage point, they have been able to achieve a panoramic view of their environment' (1989: 126). Whilst the subject memorizes pictures and stores them, this is not the creation of an indexical trace but the workings of a magical consciousness where 'things affect one another'. Unlike the magical consciousness of cinema which posits the image as a type of illusion, Flusser's use of the term designates a relationality between image and environment that enlivens our experience of the world: 'images are not experienced as a function of the environment, but rather the environment as a function of the images' (1989: 126-7).

Historic images, in contrast, are identified with the arrival of language as a structure that orders an apprehension of the world into a linear and time-based arrangement. With written language, the eye moves in one direction across the page and in one movement from top to bottom. Images, in the wake of language, are both subservient to the written text, acting as illustrations in books, and contradictions of the linear texts as remnants of a magical consciousness. Attached to writing, images either lose their autonomy or become expelled from everyday life, existing instead as an elite category of 'art'. Photography, for Flusser, is the process of image making

that releases the picture from these constraints, bringing culture and mechanical production together and returning us to a magical consciousness. For whilst images may be ordered as sequences in a film strip, the ability to tear images from one place and relocate them in another through the practice of editing is to act magically rather than historically.

Flusser uses the term photography loosely to include lens-based productions in a similar conceptualisation as Hollis Frampton, as a mode of image-making that leads on to film and video through a shared ontology. What is striking about Flusser's proposal for thinking with photography is its probabilistic premise: photographs are neither records nor representations, but present 'the ability to turn a swarm of possibilities into an image' (1989:129). To photograph is not to imagine, which involves stepping back from the world, but to visualise, an act that instantiates 'the power to concretize an image from possibilities', thus bringing probability together with a magical effect. Photographs seem to display the endlessly variable formations of things in the world, to show us what we have not yet seen or imagined, as though photogenie was not the property of cinema alone but always-already existed in the photographic apparatus. Photographs are multiplicities, 'jamming historical happenings' with their potentiality for acting or thinking otherwise. In this sense, they are posthistorical, detached from the index of what is and multiplying the possibilities of what could be.

Flusser's description of the photographic apparatus as a system located in equations of mechanics, chemistry and optics, embraces the technical aspect of production: to posit artistic production outside of this aspect would not for Flusser make sense. With the photograph, image-making has entered a relationship with 'calculating formal thought' and computation, where 'creation' involves a calculation of the time of exposure, the strength of rays of light, the activation of chemicals on a plate or coated paper. And this is the endpoint of the essay where Flusser delivers his denouement involving a radical misunderstanding of photography 'absolutely characteristic of the present cultural situation' (1989: 130). Beholding the image, the addresees of photography, he argues, mis-recognise photographs as the 'end points of history', a document, a testament to what has been. Photographers are also culpable in this respect. What has been disregarded in this mis-conception is the

calculating apparatus of photography that ‘programmes’ the possibilities of seeing with mechanical tools involving a process of computed possibilities. One need only think of the options for sepia or monochrome effects, or the limits to the lens speed ratio programmed into cameras to understand the point. Yet Flusser’s argument is not a reactive cry against the conspiracy of the apparatus, but a rallying call for photographers to engage in programming, to expand and rewrite the range of ‘dormant utopic virtualities’ that meanwhile lie sleeping.

Written in 1989, over a decade after *The Powers of Ten* is made, in the midst of a western adoption of domestic computers, and on the cusp of the digitisation of image-production, Flusser’s argument bridges these events. The Eamses lay the ground for the computer to enter the home as a principle of design, enabling domestic space to be conceived as a system of communications (Colomina, 2005). In *The Powers of Ten* the scene of domestic plenitude is present in the picnicking couple, their blanket spread with cushions, plates, cutlery, fruit, books on science and a clock. The only scene of filmic time and motion, the man is still in his slumber. Movement, and life, are elsewhere, in less expected locations, as though it is only whilst humans sleep that the animated matter of the universe may become apparent. As the camera draws back from the image, it is as though we step out of time and into the movement of calculation that enables the projection of a journey into space. The film seems to move from Flusser’s prehistoric to posthistorical frameworks, the picnic a scene of magical correspondences as the camera draws back and the scale of relationships changes, becoming posthistorical in the increasing abstraction of distance. We, the viewers, are dependent not on the eye but on the camera, caught in an imaginary machine for space travel, with calculated distances the meaningful milestones. The project of Charles and Ray Eames, we might speculate, was to move us towards an understanding of visual culture as an apparatus of calculated possibilities, where visualisation replaces representation. And the apparatus has become part of the furniture.

This literal line of flight is one path that cinema may have taken, yet it remains a slight trajectory confined to projects of design and educational film. Its presence however is detectable outside of the cinema, in the software programmes of electronic cartography copyrighted as Google Earth. In 1996, software engineer

Mark Aubin used the flip-book of the film as both inspiration and model in the inception of the programme. Animation, based on principles of calculation, was a starting point for the project that uses a range of media to create images of the earth from various distances, from maps and aerial photography created by cameras mounted in balloons, to satellite images. The project of data collection involves calculations of an approximate nature; the images collected are more or less from the same distance and provide an overlap of grid references to avoid absences. The programme functions as a mosaic of different types, qualities and scales of image, a visualisation of information that is operating none the less within the socio-political domain of information 'sensitivity'. In her discussion of remote seeing, Lisa Parks attends to these moments of a political usage of satellite imaging to obscure events or conversely to harness an objectivity in visualisation from space. Acknowledging that satellite images 'share more with abstract expressionist painting' than photographic realism, she continues, 'satellite images have historically been used by state and scientific institutions as an almost transcendent form of knowledge and power, as the most objective view, the most official kind of evidence.' (2005: 165). Within this breach between 'what appears to be' in satellite imaging on the one hand, and the official account on the other, there lies the potential for challenge to the official view, or at least to wield a degree of scepticism. Yet this critique prioritises the 'realism' of the image and its interpretation. An account of the apparatus itself, and its ongoing choreography with perception and the body, is foreclosed.

The critique that Parks presents of the use of satellite images concerns their presence embedded within schedules of televisual broadcast, sutured into established discourses of nationhood and geo-political discourse. A more ex-centric presence of these images however is evident in domestic computers, a site where the image is, arguably, less significant than the apparatus. Programmes for electronic cartography have become standard tools or properties of online culture that privilege the variation of perspective and scale over the propensity for a single image. Movement and modulation (the addition of information) are the affordances of electronic cartography, with applications versioning terrain in a number of standard formats: satellite, maps, traffic, 3D earth. Each format versions the landscape in different textures and dimensions privileging the calculation of different features of the terrain. An analytical cartography, its foundational structure is a digital elevation

model of calculated properties on a grid, onto which images are sampled and scanned. The concept of indexicality gives way to visualisation based on calculated seeing; whilst ‘drawn’ maps retain their traditional authority of measured terrain, each of the formats has an equal claim to representation. Indeed, with Google Earth, the concept of an accruing account of place is at work, with the possibility of adding to the official version through webcams, videos, photographs and wiki-accounts in a thickening of representation.

In this work of geomorphometry, photographic representation gives way to digital surface modelling. Each application is in a sense a prototype, a modelling of information closer to a design process that is infinitely provisional than to a recording medium. The shadow of the Eames office is cast here, in the comparative and incomplete notion of representation as process rather than end point. As topography is rendered more complex, the concept of the surface of the earth, that is the space between the earth’s crust and the atmosphere, becomes less assured. Like the concept of skin in *The Powers of Ten*, the earth’s surface is porous and layered, splintering into an array of features and scales that defy a complete (unified) description. In this scene of increased complexity, perception has become dependent on information that is abstract yet capable of being modelled. Closer in this sense to medical imaging than aerial photography, electronic cartography presents us with an experience of seeing as information visualised. This is not simply remote seeing, but perception as movement between calculated possibilities. In this scenario, *The Powers of Ten* returns as a lesson in ontology. The human body is not made virtual by its engagement with calculated visualisation but is in turn part of the field of enquiry, equally porous, and definable in various scales and in different dimensions. The body, that is, can be situated isomorphically, connected to other objects and properties in the world through an affinity of patterns, rhythms and scale.

We come to Charles and Ray Eames, somewhat ironically, through their ‘representation’, a mid-century, hetero-normative branding of a utopian ideal, bearing the message that design influences and can transform the way we experience the world. Yet the method of working that they meticulously detail provides for something more complex in the form of enquiry into the hidden correspondences and subtle relationships between things, including machines and bodies. If we take *The Powers*

of Ten as a non-representational film, an ex-centric cinematic practice, we uncover non-linear and non-representational ways of apprehending the relationship between bodies and matter. Scale is not simply a question of power and hierarchy between things, but a matter of movement and rhythm that connects forms of animated matter across corporal and conceptual boundaries. To follow Charles and Ray Eames is perhaps to deinstitutionalise and destratify the cinema, to conceive of it as a changing apparatus and an abstract machine with which we may collaboratively formulate calculated projections of the future.

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