A PARADOX OF CINEMATIC SIGHT: EXPLORING THE RAMIFICATIONS OF HIGH-SPEED DIGITAL CINEMATOGRAPHY IN SCIENCE & NATURAL HISTORY DOCUMENTARY

by

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ABSTRACT

The immense popularity of science and natural history documentaries ensures the genres' influential role in shaping the viewer' relationship with the world. Many scholars and scientists have critiqued various aspects of the genre's overall construction as contributing to the maintenance of the separation between humans and nature. Beyond these structural critiques, there seems to be a more fundamental ideological consequence resulting from the relationship between the cinematic techniques used in creating science and natural history programming and the audience.

The genre's dependence on new technologies of "seeing" is indicative of the underlying epistemology of the medium and suggests the importance of understanding ideological consequences of the cinematic apparatus itself. One of these new ways of "seeing" that is particularly useful for exploring the relationship between the cinematic apparatus and the audience is high-speed digital photography. An investigation of the historical origins of both the photograph and the cinema will show how high-speed photography is representative of the deeply ingrained epistemological foundations of these pictorial technologies. Photography's origins as a manifestation of scientific objectivity position the medium uniquely as a popularizer of scientific and factual information. Exploring the dynamic between the scientific profession and the lay public is integral to teasing apart how the genre of science and natural history documentary film affects the viewer.

Photographic technologies privileged status as an unfiltered representation of physical truth lies at the center of the development of positivist science and the popularization of science and nature. Its privileged status derives from the denial of human subjectivity and the emphasis of mechanically mediated representations of the world. The cinematic apparatus' techno-scientific origins and its implicit promise to supplement our deficient perceptual abilities paradoxically functions to distance the viewer from the world it so acutely represents.

INTRODUCTION

The science and natural history genre of documentary film arose in concert with the cinema itself and it has proven to be an important niche within the modern filmmaking landscape. Not only has it proven to be commercially viable on a global scale, but it also offers a powerful platform for the communication of issues related to the environment and/or science. Consequentially, there has been much scholarship aimed at exploring the genre's presentation of the natural world and science. Both Derek Bousé's *Wildlife Films* and Gregg Mitman's *Reel Nature* explore historical, cultural, and economic reasons behind the specific formulation and construction of science and natural history documentary. While these scholars effectively critique the genre's presentation of the natural world as either overly anthropomorphic, graphic, sentimental, simplistic, imperialistic, spectacular or commercial there is a more fundamental problem than either acknowledge – a problem that arises as a consequence of the cinematic apparatus itself. In this essay, I explore how the cinematic technique of high-speed photography used science and natural history programming affects the viewer's relationship with science and the natural world. By investigating this particular cinematic technique, I hope to uncover the ideological and epistemological underpinnings of the genre and how this in turn this perpetuates the separation of the viewer from the world.

At a very fundamental level, the popularity and construction of science and natural history documentary relies upon the photographic medium's ability to reveal novel and previously unseen "truths" about the material world around us. The camera's

historical development as a scientific instrument is integral to the genre's dependence on mechanically mediated ways of "seeing". Either through the super-human efforts of cinematographers (e.g. enduring extreme conditions such as winter in Antarctica in *March of the Penguins* or waiting patiently for months to document the elusive behavior of snow leopards in *Planet Earth*) or through technological advancements of the cinematic apparatus (e.g. time-lapse and motion control cameras in *The Private Life of Plants,* BBC) the genre promises to reveal truth through visual imagery. This heavy reliance on revealing the invisible closely entwines the genre with technological developments that endow the basic cinematic apparatus with additional powers to resolve either time or space.

The Cinematic Apparatus

High-speed digital cinematography, time-lapse photography, and gyroscopically stabilized aerials are all emergent techniques integral to the latest high-budget natural history shows such as BBC's *Planet Earth* series & National Geographic's *Migrations*. The various techniques utilized each have unique visual and ideological attributes, but they are bound all by the promise to exceed our deficient visual abilities on both temporal and spatial scales. The superior visual acuity offered through advances in the cinematic apparatus connotes a superior representation of material truth and offers viewers of natural history or science documentary programming a closer and more intimate relationship with reality.

Of all the aforementioned techniques, high-speed photography's super slow motion aesthetic, unique historical contributions to the cinema, its continued refinement as a scientific tool and its recent adoption as a popular cinematic style, position it as a powerful nexus from which to launch a critical examination of science and natural history programming. Film theorists, philosophers, and cultural critics, engagement with the history of cinema, time, and technology offer numerous pathways to approach the specific epistemological and ideological attributes of high-speed photography. Jonathan Crary and Mary Ann Doane's interdisciplinary treatment of the development of photography and the cinema as reflective of much larger philosophical and cultural forces provide an important framework of scholarship in which to draw upon. Understanding the historical origins of both photography and the cinema offers great insight into the epistemological underpinnings of high-speed photography and the ideological repercussions for the viewer.

High-speed photography's ability to capture thousands of frames per second positions the technique as a hyperbolic representation of the obsession held by many of cinema's inventors to capture ever-smaller moments in time. As such, the technique has a strong connection to the history of the cinema and the reconceptualization of time and space that occurred during the 19th century. Out of what epistemological tradition does high-speed photography stem from and why? Is high-speed photography merely an extension of previous cinematic technologies or is it a signifier of larger ramifications brought on by changes associated with the information age?

The techniques ubiquitous use in a variety of genre's (from Hollywood action films such as *Sherlock Holmes*, NFL advertisements, blue-chip natural history shows and science programming) speaks to its powerful representational aesthetic. What factors are responsible for the techniques popularity? What does its widespread use in science and natural history documentaries indicate? And more importantly how does this type of footage affect the viewer's relationship with science and the natural world?

Furthermore, the use of the high-speed photography in shows such as *Time Warp* showcases the tools technological roots in industrial and scientific applications. Does high-speed photography's close ties with science and industry grant it additional authority as an objective mediator of reality? How did photographic technologies such as this become inherently endowed with such a privileged relationship to "reality." What are the consequences of denying human subjectivity?

By exploring the epistemological and ideological of this one particular cinematic technique, I hope to more clearly understand how the viewer is affected by the technological medium of the cinema itself. I seek to offer a critique of the natural history genre that is based on an analysis of the cinematic apparatus itself, rather than its narrative formulation or filmic structure. As a genre, natural history and science documentary's overt reliance on novel techniques of "seeing" signals that something is amiss. It is my contention that the epistemological underpinnings of the cinema and the natural history genre contribute to the separation of the human subject from the object of nature. Paradoxically, cinematic representations of science and natural history act to distance the viewer from science and the natural world by denying the subjective

experiences offered by our own human perceptions. Our unfettered reliance on technologies of seeing and the denial of our own subjectivity prevents us from actually knowing the world.

THE ORIGINS OF THE CINEMA: REORIENTATION OF VISION AND TIME

Several scholars have worked to rewrite and amend the history of film's origins, explaining that cinema's birth did not simply lie in the refinement of optical tools like the camera obscura, but a complete reorientation of the observer and a reconceptualization of time itself. For many of these cultural theorists, historians, and film theorists, including Mary Ann Doane and Jonathan Crary, the development of cinema depends on the interplay between several historical, social, and technical developments in the 18th and 19th centuries.

As society became increasingly affected by modernity's influences (an obsession with the rationalization, standardization, and instrumentalization of time), the reciprocal relationship between technology and society grew closer. Each mechanical invention created ripples within the social and political fabric and the ensuing philosophical and scientific response shaped further techno-scientific developments. Cinema's origin story exemplifies the complex interaction of science, industry and art since the beginning of modernity.

Untangling the various aspects of cinema's origins will show how its technical formulation was dependent upon larger cultural imperatives such as the denial of human subjectivity and an obsession with making time visible. High-speed photography, while a specialized aspect of the cinematographic apparatus, is emblematic of the epistemological underpinnings of the cinema and reflective of the cinema's entanglement with the rise of empirical science. High-speed photography, like the camera obscura, the photography

and cinema of yesterday, is participating in the ongoing restructuring of our relationship with nature and ourselves.

A Technical History of High-Speed Photography

Before delving too deeply into the complex interplay between technology, society and ideology that gave rise to the cinema, a historical review and technical description high-speed cinematography will provide a base from which to launch a more critical, and hence useful conversation about this particular cinematic technique. Laura Mulvey prefaces her exploration of modern cinematic technologies in *Death 24x a Second* by suggesting that "while technology never simply determines, it cannot but affect the context in which ideas are formed" (Mulvey 9). High-speed photography is just such a technology that has had a profound affect on how we "see" the world and is as integral a technique to the modern photographic project as anything else.

The first high-speed photographic experiments began nearly 150 years ago and were intimately connected to the scientific and artistic explorations that produced the first motion pictures. The next section addresses the advent of instantaneous photography and the development of the cinema in greater detail, but suffice to say that imagery of this nature had immediate use in industrial, scientific and entertainment applications.

Peter Fuller's introduction in *High Speed Photography and Photonics*, notes that while there is no agreed upon point at which regular photography becomes high-speed photography, the difference in classification relates to both frame rate and exposure time. In 1948, some 50 years after the first public film projection, the Society of Motion

Picture and Television Engineers (SMPTE) arbitrarily defined that any motion-picture photography beyond 250 frames per second with exposure times at one millisecond or less was *"high-speed photography."* Fuller's updated working definition speaks to the increasingly complex realm of the industry:

> Recording optical or electro-optical information with adequately short exposures and fast enough framing rates for an event to be evaluated with a temporal and dimensional resolution, which satisfies the experimenter (Fuller 1).

The open-ended nature of Fuller's definition seems inapplicable in reference to cinema's use of high-speed photography, but when high-speed devices are recording at speeds that capture individual atomic vibrations in infrared wavelengths, Fuller's definition seems appropriately inclusive.

The recording and playback or projection of film or video at standard speeds occurs at either 24 or 30 frames per second. High-speed cameras function by recording magnitudes of order faster than this (anywhere from hundreds to millions frames per second). Upon review at standard playback rates of either 24 or 30, the recorded "time" slows down and the result is slow motion or as it is often referred to as *slo-mo*. Oliver Sacks who has written lucidly about speed and time suggests that high-speed cameras ability to capture the ephemeral is akin to a temporal magnification that enlarges time just as a microscope magnifies spatial features (Sacks 1).

Much like linear representations of cinema's development along a timeline, the history of high-speed photography is generally reduced to technical advancements and ingenious modifications of the apparatus. Over the last 75 years, military and industrial interests have driven the development of high-speed photography and developed

paradigm shifting technologies that allow for the exponential advancement of the machine. Just as many of cinema's early inventors developed devices to study existing physical phenomena, the refinement of high-speed photographic technology owes much to the work of engineers and scientists who were participating in war efforts to refine weapons systems such as the atom bomb during WWII.

In the 1940's and 50's the fastest cameras developed to image nuclear detonations began pushing into millions of frames per second and nanosecond exposures. Evan Smith, writing for Popular Science, aptly remarks that once you pass beyond "micro-and nanodimensions of time, let alone across exotic picosecond and femtosecond frontiers – the very fast is almost as invisible to us as the extremely small. The eye does not register, and the conventional camera does not record" (Smith, 2).

Wired Magazine published a brief article with a series of images depicting the history of high-speed photography. The first three images of actions stopped in time are vaguely recognizable – at least visually imaginable: a horse running, a bullet slicing a card in two, and the early stages of a nuclear blast. While unfamiliar, these images remain imaginatively conceivable. The last two images showcasing extremely high temporal resolutions of an element at the exact point it melts and the movement of electrons as they enter an extreme UV wave represent abstractions of phenomenon that seem beyond the reach of experiential understanding on any time scale.

In a way reminiscent of the cinema's early days when devices created for research applications were reworked or refined by entrepreneurs, high-speed photography technologies have long been utilized for entertainment applications. Whether it the

imaging of a bullet exiting the guns' barrel in a Hollywood action flick or capturing the beat of hummingbirds wings in a natural history documentary, the ability to slow down time infinitesimally flexes cinema's representational powers and mesmerizes the viewer.

High-speed photography has had occasional use in both fiction and non-fiction settings, but technical constraints and the high costs associated have kept its adoption by the entertainment industry limited. Advancements including the ability to review the footage in a non-linear fashion, control the speed of playback, and use the cameras in uncontrolled situations has resulted in the "technologies" more ubiquitous presence in fiction and non-fiction programming.

While technological advances have certainly spurned an increase in the presence of high-speed photography for popular consumption, a technologically determined understanding doesn't lend much insight into several pressing questions facing the technique's use. We rarely pause to consider how we came to loose faith in our own somatically derived vision and place all of our dependence in the vision presented by technological means. Nor do we think of how this reliance affects our relationship with the objects being represented.

Seeing is Believing

Scholars seeking to reconstruct the technologically determined history of the development of photography and cinema suggest that the paradigm shifting transformations experienced by individuals during the 18th and 19th century reconfigured perception, modes of representation and the viewer themselves. Their interdisciplinary

work seeks to refute the history of the cinema as a refinement of the realistic representation of space initiated by the "Renaissance-based mode of vision." Jonathan Crary's refutation of the oft-repeated history of photography that commences with the camera obscura and necessarily results in the photograph, possesses lessons central to my analysis. This paper's exploration of high-speed photography's use in natural history documentaries and narrative film is not purely a historical review that demarcates major technical innovations associated with high-speed cinematic apparatuses (such as miniaturization, digitization and convergence) that led to the particular apparatus' widespread use. In this way, high-speed imagery is not just a mere advancement of cinematic machinery and the apparatus, but also signifier of social and ideological forces acting upon both the viewer and filmmakers.

Crary offers an account of the development of photography and cinema that does not emphasize a "continuous and overarching Western Visual tradition" ("Suspensions of Perception*"* 25). For him, the camera obscura is not merely a proto-photographic system, but an optical system in its own right with its own set of social practices. Crary argues the visual autonomy that would drive the nineteenth century observer is distinct from the notions of what an observer was in the seventeenth and eighteenth centuries.

Unlike most photographic histories that define the camera obscura solely by its function as an optical device that aided in the rendering of perspective, it also "subsisted as a philosophical metaphor, a model in the science of physical optics, *and* was also a technical apparatus used in a large range of cultural activities" (Crary 29, emphasis his). The camera becomes the "compulsory site from which vision can be conceived or

represented" and for Crary, the device indicates the appearance of a new model of subjectivity" that emphasizes individuation of the viewer and a decorporealization of vision (Crary 39). Citing Newton's Opticks (1704) and Locke's essay on Human Understanding (1690) he concludes that "what they jointly demonstrate is how the camera obscura was a model simultaneously for the observation of empirical phenomena and for reflective introspection and self-observation" (Crary 40).

The subjective viewer is situated within the objective device and acts both as "a disembodied witness to a mechanical and transcendental re-representation of the objectivity of the world" whilst also participating in the "spatial and temporal simultaneity of human subjectivity and objective apparatus" (Crary 41). The camera acts to organize the exterior world and delineate a field of view for the concentrated study of the physical without interference or distraction. However, to suggest that because it functions as a tool of "perceptive knowledge" it thus signifies the beginning of an ascent to nineteenth and twentieth centuries conception of vision is disingenuous and incomplete. For the 18th century observer, vision alone does not hold superiority as "to know something was not to behold the optical singularity of an object but to apprehend of its fuller phenomenal identity simultaneously with its position on an ordered field" (Crary 62).

Crary's original, insightful analysis of observer and the camera obscura demonstrates the simplicity of assuming there is a singular western tradition of vision that drove technological innovations towards the cinema or in for instance, towards representations of nature as now exhibited by high-speed photography. The rise of the

both photography and the cinema would require a revaluation of human perception and the acknowledgement of human finitude and an embrace of a type of objectivity expressed by mechanical forms of representation.

The burgeoning science of physiology would directly challenge the model of vision embodied by the camera obscura and the pre-Kantian world of classical epistemology. These investigations would reveal the human body itself was an active participant in the creation of perception and effecter of the optical experience.

> In the aftermath of Kant's work there is an irreversible clouding over of the transparency of the subject-as-observer. Vision, rather than a privileged form of knowing, becomes itself an object of knowledge, of observation. From the beginning of the nineteenth century a science of vision will tend to mean increasingly an interrogation of the physiological makeup of the human subject, rather than the mechanics of light and optical transmission. It is a moment when the visible escapes from the timeless order of the camera obscura and becomes lodged in another apparatus, within the unstable physiology and temporality of the human body (Crary 70).

For Crary, the recognition that the observer's optical perceptions don't necessarily correspond directly to physical reality (derived from studies of optical illusions such as the retinal afterimage, or the ability of agents other than light to affect the optical experience) provides the point of rupture in which modernity emerges.

The discovery of forces operating outside of human perception and beyond the limits of our sensory experience destabilized the observations of the subjective viewer. In light of these admissions, scientists would seek to normalize and standardize the "real" through the use of instrumentation. It is in this climate that the photograph would emerge as a tool integral to the emerging positivism that would come to define scientific practice of the 19th century. And in many ways the development, use and popularity of high-

speed photography stems from values developed during this transformative period of culture and technology.

The photograph was both an "object of science" created by chemists and physicists as well as a "powerfully modern tool for scientific observation" (Keller, 20). As such, it both influenced and was influenced by scientific practice. As a scientific tool it promised unrivaled representational authority over the material world and quickly came to define the power of "scientific seeing." "The medium offered a radically new kind of image, one that fundamentally challenged the way pictures were understood to depict nature, present evidence, and communicate visual information in short, to *represent"* (Keller 22). Brian Wilson argues that the there is a "powerful argument, grounded in centuries of modern scientific inquiry, for seeing the camera as no more and no less than a device for representing the world of natural phenomena, a device like any other Latourian 'instrument' " (41-42).

Early on in the development of photography, the promise to act as a scientific tool greatly exceeded the abilities of the medium itself. Astronomers who adopted the tool were dismayed at the difficulty of capturing even an image of the moon. Despite the numerous technical limitations, many of the early adopters of photography persevered because of the mediums great potential as an objective tool of representation, as an instrument of science.

Photography provided an access to the world unmediated and untarnished by the subjective viewer. The unintentional bias of the human observer impinged upon the accuracy and fidelity of human created representations. Photography and other

mechanical instrumentation offered the promise to remove these "willful interventions." The type of objectivity that the photograph represents was not only in service of truth to nature but primarily in allegiance to a morality of self-restraint" (Galison and Daston). The work of the century's earliest proto-physiologists, such as Goethe and Schopenhauer, conclude the human observer to be a liability. Seemingly as a response to the subjective and limited qualities of human vision, scientists make it their professional creed to "restrain themselves from imposing their hopes, expectations, generalizations, aesthetics, even ordinary language on the image of nature" (Galison and Daston, 81). In this way, the photographic apparatus served as the ideal for scientists seeking to deny their subjective fallibilities as they searched for positivist truths.

The emergence of the photograph in 1839 and its immediate entanglement with the positivist project of science rapidly endowed the photograph with a privileged connection to the world. The conflation of the photographs indexical prowess with its mechanical objectivity and hence moral superiority places it in a unique position as a holder of truth, an object of reverence, and a signifier of modernity. Bazin's sentiments reflect the privileged relationship endowed to the photograph.

> This production by automatic means has radically affected our psychology of the image. The objective nature of photography confers on it a quality of credibility absent from all other picture making. In spite of any objections our critical spirit may offer, we are forced to accept as real the existence of the object reproduced, actually re-presented, set before us, that is to say, in time and space. Photography enjoys a certain advantage in virtue of this transference of reality from the thing to its reproduction (Bazin, 14).

Oliver Wendell Holmes, in his 1859 writings on the stereograph, hyperbolically suggests that the representational powers are such that the original object once photographed can

be destroyed: "Give us a few negatives of a thing worth seeing, taken from different points of view, and that is all we want of it. Pull it down or burn it up, if you please" (Holmes, 80). While figurative, his statement that with the advent of the stereoscopic camera "form is henceforth divorced from matter" suggests the primacy of the photographic representation over the actual object being represented (Holmes, 80). The notion that object is subservient to its pictorial representations comes to define the experience of modernity. For our image centric society the old adage "seeing is believing" still rings just as true as it did then. Despite our better judgment we have taken this adage beyond just believing and transformed the photographs privilege into "seeing is knowing."

Holmes lauds the stereograph because "there is such a frightful amount of detail, that we have the same sense of infinite complexity which Nature gives us" (Holmes, 71). It is a statement that could be written today about the sharpness and resolution of the latest high-definition natural history production and speaks to the value we still place on "form." The photographs evidentiary role within scientific community ensured that the degree of detail, resolution, and clarity would become akin to the degree in which one could know.

The genre of natural history films rises from this tradition and promises to continually show the natural world in new and inventive ways. This is made explicit in the subtitle for BBC's immensely popular series Planet Earth, which reads, *As You've Never Seen It Before.* The program uses a variety of new techniques, including high-speed photography, to offer viewers the most exacting, detailed, and resolved experience

ever. Implicit in this claim to offer the viewer-privileged access to nature is the idea that its representations are synonymous with knowing and superior to the actual somatic experience of nature.

Suggesting that photographic representations exceed the actual experience of nature is extremely problematic, especially for natural history films with a conservation agenda. Critiques from artists and the philosophers as they reacted to the popularity of the photograph are extremely prescient and relevant to the problems with valuing the reality offered by the photograph. Guy Debord prefaces the first chapter of *Society of the Spectacle* with a quote written in 1843, but speaks powerfully to the issue at hand.

> But certainly for the present age, which prefers the sign to the thing signified, the copy to the original, fancy to reality, the appearance to the essence,...illusion only is *sacred, truth profane.* Nay, sacredness is held to be enhanced in proportion as truth decreases and illusion increases, so that the highest degree of illusion increases, so that the highest degree of illusion comes to be the highest degree of sacredness. (Feuerbach in Debord, Preface).

High-speed photography and the resultant super-slow motion is just such an illusion. An illusion sold to viewers as a replacement for nature itself. The cost of our dependence on vision is well summarized by Alexander Wilson. He suggests that our over-dependence on vision lacks perceptive dimensionality.

> It provides access to the world in a particular way, and while it gives us much, it also conceals. Vision permits us the luxurious delusion of being neutral observers with the ability to manipulate a distant environment. The gain is objectivity, but the loss is any notion of interrelation between the elements of the visual field. We see only what is, not how it came to be (122).

Time, Cinema and Technological Control

High-speed photography represents a hyperbolic extension of the cinema's ability to fragment time into photographic instants and rectify those instants back into the illusion of motion. The current fascination and popularity of this technique is reflective of both the desire to "visualize time" as well as symptomatic of the information age itself.

Cinema was built upon by the orderly reconstitution of the 'photographic instant' that was made possible by the development of 'instantaneous' sub-second exposure photography. Until photography reduced its exposure time, the mediums "monumental status" as Tom Gunning phrases it, prevented photographers from capturing anything besides static and immobile subjects such as landscapes, buildings and statues (56). In the late 1860's innovations in photo-chemistry allowed the camera apparatus the sensitivity required to capture fleeting moments. Along with other developments such as fast shutter speeds, this refined camera could provide users with unrivaled temporal resolving powers. The rise of instantaneous photography provides the technical and conceptual basis required for the development of the cinema as "the photographic instant becomes the basis for the representability of time as duration" (Doane 209). Paradoxically, the ability to freeze a single moment of time becomes the basis for the representation of movement. The cinema's ability to represent 'actual time' is based upon "division, upon the sequential serialization of still photographs which, projected, produced the illusion of motion and the capturing of time" (Doane 208).

Arguably, of all the founding members of the cinema (Edison, Lumieres, Muybridge, and Marey to name a few) who took the most advantage of the photographs

ability to 'fix' time was Etienne Jules Marey. Inspired by Eadward Muybridge's sequential photographs of a horse running as well as a more sensitive negative product, Marey took up photography as a tool to enhance his abilities to visualize phenomenon invisible to the human observer. For Marey, his use of photography and refinement of many techniques integral to the cinematic apparatus stemmed from a scientific desire to quantify changes in motion at its most infinitesimal.

Marey's efforts to refine the capabilities of the photographic camera were driven by his desire to make hidden time, which Helmholtz called "lost time" visible (Doane 47). It is an asymptotical quest that engineers and scientists have been continually refining since Marey's work with ever-greater precision. High-speed photography emerges not as a refinement of cinematic technologies, but a refinement of the abilities to fragment and analyze time initiated by scientists and artists such as Marey and Muybridge.

In her book, *The Emergence of Cinematic Time*, which uses an inter-disciplinary historical approach not dissimilar from Jonathan Crary's, Doane provides evidence for how this drive to rationalize and structure time reflects a more general imperative associated with the "structuring of time and contingency in capitalist modernity" (Doane 4).

In oft-repeated histories of the cinema, Muybridge and Marey are often conflated as participating in the same proto-cinematic project to capture "instants" of time in a sequential manner for the purpose of scientific research. The superficially subtle, but substantial differences between these two men's work reflects the complex relationship

between the scientific and the artistic, entertainment and edification and the photographic and the cinematographic. While each participated in the fragmentation of time and the study of motion, they did so for very different reasons. Muybridge's photographic records were both the means and the end, while for Marey, the photographic apparatus merely provided an instrumentation that allowed for the quantification of movement itself (Braun, see 228-264).

While Marey created the chronophotographer, an early film camera, he did not have any desire to pursue "avenues of research whose end was duplicating sensory perception, no matter how aesthetically pleasing the result" (Braun 174). As a reflection of his penchant for revealing the imperceptible, Marey's goal to development a projection system was not to replicate human vision, but to help

> mechanically synthesize the results of his analyzer, slowing down some movement and speeding up other. He was not after a machine that would replicate the continuity of perceived movement: such an apparatus would have been no use to him in his work (Braun, 174).

Muybridge on the other hand created work that while many deem scientific is more reflective of traditional notions of photographic representation and the conventions of artistic realism. His images

> adhere closely to what, at least since the Renaissance, a picture should look like. Each frame encloses a single unit of time and space, and an illusion of three dimensions has been created on a two-dimensional surface through light and dark (Braun 254).

He did not possess Marey's scientific background, nor did he have the resources for a true study of motion. His sequence of photos in *Horse In Movement* had scientific applications in so much as it accurately depicted the various phases of

the horses' movement and demonstrated the time stopping power of instantaneous photography. However, because multiple cameras captured the sequence of photos at irregular intervals, his technique's scientific applications were limited. While his work offered an aesthetically distinct and revolutionary representation of everyday activities, his motion studies had much more to do with narrative and artistic realism than science. The true nature of his work has been masked by the perceived objectivity and ordered arrangement of his pictorial representations. However, knowing that Muybridge manipulated his sequence of photos to hide inconsistencies or gaps calls into question his scientific aims.

> [His photographic plates] look as if they are representing a series of movements because the structure in which they are ordered dictates a progression, because any clues that would prompt us to read the pictures more closely have been obliterated by the arrangement on the page, and because we presume that if one sequence is "right" – and many of them are – then the rest must be too (Braun 244).

The continued reading of Muybridge's work as scientific is no accident - several aesthetic cues suggest an empirical legitimacy. This presumptive classification of his work as scientific, speaks to both the privileged status of the photograph as a holder of truth and to Muybridge's arrangement. Braun suggests that

> In spite of the anonymity of the gridlike background in these pictures, the seeming objectivity of the camera and authenticity of results, and even the evident seriousness of the direction under which the work was carried out, these pictures are inconsistent with what we understand to be a scientific analysis of locomotion (Braun 247).

Braun convincingly concludes, "Muybridge, under the guise of offering us scientific truth, has like any artist, made a selection and arranged his selection into his own personal truth" and that *Animal Locomotion*, the work he completed at the University of

Pennsylvania, is a "good example of how vulnerable are our assumptions about the very nature of photography: it demonstrates the dangers of believing what we see" (Braun 229, 251).

High-speed photography's use outside of technical applications delivers the viewer a similar type of scientific placebo. Its mechanical objectivity and powers of representation implicitly suggest a sort of scientific analysis is occurring and impart the viewer with a feeling that knowledge is being transmitted. Muybridge's beautiful arrangement of men and women participating in a variety of activities holds a promise to impart the viewers with scientific knowledge, but ultimately the viewer engages with the photos on an aesthetic level. This is not to suggest science cannot be beautiful, but it does suggest there is a difference between scientific education and aesthetic enjoyment.

The lack of a scientific methodology does not disqualify the technical, artistic, and conceptual innovations attributed to his work. Jonathan Crary responds to the notion that Marey's work was more sophisticated than Muybridge's by suggesting that Muybridge's work decentralizes the viewer's perspective and contributes greatly to the reconceptualization of time.

> The breakthrough of Muybridge's work in 1878 was its deployment of machinic high speeds for the creation of perceptual units beyond the capacities of human vision, and their subsequent abstract arrangement outside the terms of any subjective experience... But the apparent nonhomogeneity and segmentation of his work are actually an opening onto an abstract order of continuities and uninterrupted circuits (Crary 2001 140).

The recognition of temporalities beyond our own perception and the development of technological apparatus to store time as duration would be necessary for the development of the cinema.

The desire to control time in the late 19th century was not just symptomatic of scientists and photographers like Marey and Muybridge, but related to the project of modernity. A whole set of technological developments, including the telegraph, telephone, and locomotive were altering the public's perception of time and space. Doane clearly articulates how time became both rationalized (studied, quantified, and standardized) and abstracted (commodified and divisible). Time becomes in her words "no longer a medium in which the human subject is situated (it is no longer *lived* or experienced in quite the same way), time is externalized and must be consulted…"(Doane 7).

If, as Bazin suggests, photography "embalms time," rescuing it simply from its proper corruption" then high-speed digital cinematography not only has the ability to "embalm" infinitesimally small units of time, it has the power over the rate at which this "proper corruption" occurs. High-speed digital cinematography offers the ability to slow down time, to control the viewers' experience of time and make the invisible visible. The time controlling powers of high-speed photography builds upon the underlying abilities of the cinema to fragment the continuity of time into discrete and equally spaced units, and then reassemble these units into a continuous record of time. This instrumentally mediated experience of time has ramifications for how we relate to nature and the time of inherent to our subjective experience of the world.

High-speed cinematography's development within the discourse of objective science endows the technique with certain characteristics generally not associated with the real-time cinema or television. Embedded within the latest high-speed digital camera technologies is the ability to control and rationalize time that far surpasses our own capabilities. If the use of high-speed cinematography were exclusively a scientific technique, its ideological affects would be limited and this textual analysis would be mute. However, as a popular cinematic technique and a staple of recent science and natural history programming, it shapes the viewers' relationship to the world and helps to determine what the viewer understands to be real.

For Lorenzo Simpson, all technologies (cinematic or otherwise) shape our experience of the world by adversely affecting our relationship to time. In his book "Technology Time and he Conversations of Modernity," he argues that a central goal of technology is to "stop the clock, to de-realize time… [and that] "technology, in its attempt to subdue time's characteristic flux, aims to 'domesticate' time by harnessing the future predictably and reliably to the present" (23, 52). For Simpson, the temporal affects of technology "have profound implications for how we experience our subjectivity, for our understanding of who we are as subjects (3). In his estimation, technologies primary concern is to achieve and end-goal or value as quickly and efficiently as possible. The cost of this "time-contraction" is to lose meaning in the action itself.

In contrasting the distinction between meaning (the process) and value (the goal or end result), Simpson suggests that these opposed notions can be characterized by distinctive and opposing attitudes towards time. To guide his discussion Simpson points

to Kierkegaard's conception of "internal history" and "external history" as two ways of understanding how we experience ourselves in time. These concepts are not only useful in understanding the temporality of technology, but are useful for exploring the ideology of high-speed cinematography.

"External history" is described as understanding time as both obstacle and opponent.

> …time is that through which we must move in order to achieve a goal or realize a moment of significance. Time is that which stands "between" us and our goal. In being that which alienates us from the end of our striving, time is at best dispensable, at worst an obstruction (Simpson 50).

Simpson describes our antagonistic relationship to time as a "viscous medium separating us from what "really" counts, and just as surely threatening to sweep us away from any satisfying haven that we might reach (Simpson 50). At issue here is an uncontrollable temporality that is either slower or faster than we would like.

Internal history, in contrast to this conception of time as alienated

> is tied to immanence rather than transcendence. Here significance lies not beyond, but within; it pervades time. Time is constitutive, and internal history defies spatialization, eschews representation. The passage of time brings us no closer to the thing of significance, for it is, in a sense, already in our possession (Simpson 51).

Technology and the cinema itself, like Kierkegaard's concept of external history, position time as the problem and the only solution is to shrink the distance to the goal. Digital technologies sophisticated time-contracting abilities include the ability to replay events in a non-linear fashion at variable speeds. The technique of "time-ramping" which almost always is used in tandem with the super slow motion footage shows the event starting in regular or normal speed and then rapidly slows down to show the moment of spectacle, to

reveal the moment of *satisfaction*. This cinematic sophistication, while demonstrative of technologies power to control time, removes us from an experience of the world we can relate to.

For Simpson, our desire to cede to the technological promise of freedom from the "unyielding and indifferent natural world" comes with costs. First, if we see time as the obstacle, as the time of external history, then we are "[predisposed] to experience time as the "other" to be subdued or annihilated, [and] technological civilization threatens to marginalize projects of meaningful doing, the stuff of which stories are made" (Simpson 42). Additionally, as we grant technology control, we ourselves become instrumentalized and "our own wants and needs are subordinated to the requirements of the technical complex and, specifically, to time (Simpson 55).

During the later half of the nineteenth century, a variety of new communication and transportation related technologies reorient the public's perception of time. The time constricting properties of these new technologies are generally welcomed but come with jarring side affects.

> Time is no longer the benign phenomenon most easily grasped by the notion of flow but a troublesome and anxiety producing entity that must be thought in relation to management, regulation, storage, and representation (Doane 33).

Cinema's temporal powers offered to "domesticate" the speed and shock of modernity. In some ways this technology, which was a result the scientific destabilization of time, re-stabilizes the experience of time for public consumption. However, as Simpson suggests, the use of technology to control our experience of time is tautologically problematic as technology is the source of anxiety to begin with. As information technologies (the

internet, global communications, computer processing) have increasingly shrunk space and time, we are continually required to reorient ourselves in the world. As the cinema reconstituted the frozen instants into a perceptively normal representation of time, it offered to control the shock of modernity for the audience. The popular use of high-speed cinematography offers a similar sort of stabilization in an age of increasing speed brought about by developments in information technology. Technological developments continually decrease the time distance between us and our end-goals: whether it be on-demand television, ever-faster search engines, or the development of powerful mobile devices, these technologies promise the ability to access anything at anytime from anywhere. The popularity of high-speed cinematography is a manifestation of our instantaneous technocentric culture, but it comes as the cost of depriving ourselves of meaningful subjective experiences.

SCIENCE AND THE VIEWER

Grasping the ideological consequences of high-speed photography requires not only an investigation of the technique's unique historicity, but also an examination of the audience in which this technique is being "delivered to." Visual media such as film and television play a pivotal role in the popularization of scientific information and influence the public's conception of science and nature. Contextualizing the popularization of scientific knowledge lies at the heart of understanding the dynamic that exist between science, the public, photographic technologies such as high-speed cinematography and the world (especially the world as featured in natural history documentaries).

Science's Popularization

Since the beginning of scientific endeavor, discoveries and scientific advancements have been popularized. However, the current rift between the science and the public can be traced back to the social consequences that the professionalization of science itself had. The Royal Society was established in England in 1660 and for the next two hundred years scientific practitioners would lobby for influence, acceptance and seek to delineate natural philosophy from magical and superstitious beliefs (Gregory and Miller 1998).

Initially, the increased degree to which natural philosophy, medicine and mathematics was seen as influencing daily life was reflected by the tremendous growth in public interest in science (Morton 63). As public interest swelled in the eighteenth century, a complex relationship developed between scientists, their public audience and

industry. Several authors, including Larry Stewart and Jan Golinski chronicle how developments such as public lectures and working demonstrations influenced the popularization of science as well as the development of industry. The public's interest and willingness to pay to attend lectures and demonstrations had the reciprocal affect of encouraging ever more creative ways of capturing an audience's attention. Furthermore, these captive audiences were often sold "experimental apparatus" that would let them conduct scientific investigations of their own. Patricia Fara's article about the role that the development of artificial magnets had both on instrument makers and the public effectively depicts the manner in which natural philosopher's knowledge was becoming proprietary in order for commercial and marketing purposes. Practitioners often limited their communications to lectures as a means of ensuring future attendance and income (Porter 94). Science was a popular recreation, pastime and source of intellectual entertainment.

The popularization of science and public displays of photography in the 19th century were closely intertwined. A revolution of knowledge was taking place and scientists increasingly looked to photography as not only a tool for research, but as tool for the popular communication of scientific discovery. Not only could photography could render the invisible visible or capture fleeting moments in perfect stillness, but the medium lent itself well to reproduction and public display (Tucker 41).

> … from the middle of the nineteenth century on, photography intertwined with other visual devices not simply to record a recognizable world, but also to provide images of a previously invisible one. One could claim that these photographs offered a reassuring anchor for the dizzily enlarged knowledge of forces

> impinging on human life that had been ushered in by scientific change (Gunning 55).

The photograph also aided in a sort of scientific democratization. Many scientists declared that, in properly scientific conditions and with proper training, *anyone* could take a photography that might be valuable to science, especially if (as in many field sciences, including anthropology) they could record and document data that were remote or otherwise inaccessible (Tucker 42).

At the turn of the century science seemed dependent on the public acceptance and even participation. Photography participated in scientific discovery and its dissemination to the public. Jennifer Tucker traces the role that photography played as science became increasingly important as a cultural force.

> Nineteenth-century science was characterized by both the appeal to visual evidence and the need for confirmation by the testimony of eyewitness. The latter explains why scientists pursued public viewings of their photographs by means of illustrated slides lectures, exhibitions, and reproduction in newspapers and magazines.

However, by the end of the nineteenth century "science was a profession, and the institutional trappings that allow convenient distinctions between 'scientific' and 'popular' were almost in place" (Gregory and Miller 25). The root of the current division between the practitioners of science and the consumers of its information began during this period, as scientists themselves retreated from the public sphere. It is not surprising then to note how the "20th century, then, sees scientific communication divided – between disciplines within science, and between science and the public" (Gregory and Miller 26).

During the nineteenth century scientific practitioners were attempting to argue for their own legitimacy as a cultural force for social and economic good. The

commercial products stemming from nineteenth century science affected every aspect of society – from pasteurization and dynamite to photography and the phonograph. These inventions guaranteed science's place as a social and industrial agent of change. At the beginning of the 20th century the popularization of science changed from distilling the particular nuances of scientific discovery to a more general lobbying that the public should support science. The now familiar division between the scientific establishment and the public happened quickly in response to a confluence of factors associated with the professionalization of science.

While the great scientific debates of the 19th century unfolded in the public sphere, scientific discoveries in the 20th century would be published in specialized industry journals and disseminated to the public in separate books. The age of aristocratic natural philosophers exploring general interests ended and was replaced by an increasingly professional and specialized workforce funded by national governments. Furthermore, the boundaries of science and industry became blurred and tools developed for research practices became co-opted by entrepreneurs.

> The reinterpretation of scientific instruments as machines for pleasure and entertainment is not simply financial opportunism but is also indicative of the tensions in the struggle for control of scientific inquiry between the layman and the professional (Punt 355).

The massive changes brought about by nineteenth centuries techno-scientific developments began to be questioned by the public, as WWI made the repercussions of military technologies including tanks and poison gases visible. Scientists no longer communicated directly to the public and journalists began taking on the role of science communicators. Along these lines the emerging field of "science journalism reflected the

growing division between those who felt that science was the answer to all our problems and those who felt that it might be causing them" (Gregory and Miller 27).

The Divide

As the practice science became distanced from public view the gap between the scientific profession and the public widened. Despite science and technology playing an integral component in our daily lives, generally our only contact with science comes directly from the media, both traditional news media and other visual media.

> For most people, the reality of science is what they read in the press. They understand science less through direct experience or past education than through the filter of journalistic language and imagery (Nelkin, 2).

Scientists are imagined to exist as a part of a privileged culture and often treated in the media in heroic terms. Dorothy Nelkin chronicles the portrayal of scientists in the press as lone individuals stoically exploring esoteric and exceedingly complex subject matter with monk like dedication. She writes

> …the distanced and lofty image is useful for a community seeking public funds with limited public accountability. But far from enhancing public understanding, such media images create a distance between scientists and the public that, paradoxically, obscures the importance of science and its critical effect on our daily lives (Nelkin 14).

The reinforcing relationship that the science has with the press has created conditions that have effectively disconnected the public from the scientific process. While press coverage depicts recent discoveries, rarely is the scientific process revealed to the general public as scientific coverage generally focuses upon outcomes. The lack of

insight the public has with the how and why science is done creates conditions that quarantine science to a never-ending stream of facts, rather than revealing what is actually a complex and highly variable process influenced by a variety of sociological and historical pressures. Professor of public understanding of science John Durant suggests there is something fundamentally flawed about this model.

> …. the public needs more than mere factual knowledge…and it needs more than idealistic images of "the scientific attitude" and "the scientific method." What it needs, surely is a feel for the way that the social system of science actually works to deliver what is usually reliable knowledge about the natural world (in Gregory and Miller 91).

The scientific process, when represented to the public by science educators and the media, exists as an orderly method of inquiry that relies on the scientific method. Observation leads to the development of a hypothesis that leads to experimental testing and which leads to either verification or falsification. Henry Bauer, a professor of chemistry and STS scholar argues that the "myth of the scientific method" is ineffective in explaining what happens in science and it is "worse than useless as a guide to what society ought to do about science and technology" (20). Furthermore, in his mind, the misunderstandings developing from the myth of the scientific method

> …encourages the laity to have an unrealistic view of scientists and therefore also have unrealistic expectations of them and of science; and it encourages scientists themselves to be unrealistic about themselves and about science… (Bauer 40).

These unrealistic expectations help to insure scientists are viewed as "dedicated truth seekers" toiling away with both super-human levels of dedication and intellect (Bauer 40). As such, viewing the process of science under a neatly packaged guise only increases the division between the public and the scientific establishment. The various

forces acting within both journalism and the scientific industry create and maintain the division that has substantial repercussions to how the public interacts with scientific information. These repercussions are manifested in the type of media programming that the public watches as well as the specific construction of the programming itself.

The Disenfranchised Public, Facts, and Television

The scientific community, the press, and the public all participate in maintaining the view of science as a distinct and privileged culture. Nevertheless, the structure of communication between these three communities discourages the public from participating as active agents in the social and political discourse about the direction of scientific research and the application of technology. In most cases scientists exist "at the top of the knowledge heap" and "might occasionally aim a few scraps, in the form of popularizations, at the humble and passively receptive public below (Gregory and Miller 87).

Viewing the public as receivers of scientific information transmitted by experts is indicative of not only the division between these two communities, but the constitution of the communication itself. Whether a result of the reductive nature of science or particular journalistic constraints, the popularization of science often treats the scientific process as bits of trivia to be consumed – a stream of facts to embed within entertaining visuals.

Overly simplistic solutions to the complex problem of scientific literacy generally call for an increase in the amount of scientific knowledge passed on to the public.

However, knowledge, in the form of facts, does not necessarily lend itself to a type of scientific understanding that can be used to navigate the increasingly complex science based issues affecting society. In other words, scientific knowledge does not necessarily translate into scientific understanding. Without an understanding of the process of science, facts remain disconnected and the explanatory power of science stays veiled.

Ironically, this lack of understanding is not necessarily related to a lack of interest per se. Durant, Evans and Thomas research about public understanding of science in the late 1980's claimed that many people who claim to have a great interest in science feel that they are not very informed. In other words, they "perceive a gap between themselves and a world of learning about which they would like to know more" (11). Unlike other areas such of knowledge such as sports, films or politics where people's interest level positively correlates to their degree of understanding; science seems to be an anomaly. The reasons for the discrepancy of interest and knowledge that Durant, Evans, and Thomas found in their study relates to any number of issues facing the popularization of science. At the very least, there are barriers that stand between the public and their acquisition of scientific knowledge. Ideally, the media, acting as an intermediary between the two factions, can distill information in a way that closes this gap between interest and knowledge.

Each form of media has strengths and weaknesses and much effort has gone into trying to gauge the scientific accuracy of various modes of communication. Unlike the journalistic standards that govern print and news media, television is generally not accountable for an accurate depiction of scientific processes or facts. Despite the

television's specious relationship to factual accuracy, out of all the various modes of communication, television has the most powerful ability to translate scientific discovery into phenomenon accessible to the public. Furthermore, without a visual translation of the scientific process, it remains invisible as well because as Gregory and Miller put it "most science happens inside people's heads, or in small gesturers (122).

Cinema's ability to transform "science" into the visible realm assure television role as a primary vehicle for the popularization of science. Just as photography played an integral role in public displays of science in the 19th century, modern cinematic techniques such as high-speed photography transform the scientific process of discovery into visible phenomenon accessible by the viewer.

> So small things become bigger and big things become smaller – whatever it takes to fit them onto the screen, and into our cognitive framework. Fast thing get slowed down and slow things get sped up – science needs to be slow enough for us to see it but fast enough to tell a story in a mere hour (Gregory and Miller 123).

In addition to the spatial and temporal translations required to "visualize" scientific phenomenon, television plays an integral role in depicting the process of science itself. Ironically, the programs that often impart the most insight about the scientific process are fictional. Gregory and Miller note

> the practice of science may be absent from documentaries, but it is exhibited in the problem solving in science fiction shows such as "Star Trek" or in the tests and procedures of medical soaps such as "ER." These present a vocabulary and rhetoric of scientific life.

The programs that go beyond mere facts and offer insight into the scientific process and the activities (even if they are fictionalized) of a scientist, biologist, or doctor are extremely popular. The public thirsts for a depiction of science that offers them a

participatory stake in the scientific process. Television offers this by creating a fictional and stylized representation of science that is embedded within a larger narrative structure.

Some of the most popular science oriented shows like *CSI* and *Myth Busters* help the audience to feel like they are a part of hypothetic-deductive reasoning and/or the process of scientific discovery. These two shows exist at the opposite end of the cinematic spectrum: *CSI*, a high budget, graphics intensive, narrative crime show contrasts *Myth Busters*, handy-cam non-fiction D.I.Y. aesthetic. Despite their differences, each show offers viewers the chance to partake in science like thinking. It is obvious that the public, who feel marginalized by the scientific establishment, want to feel like they are actively participating in the scientific process.

Science oriented television and its stylized portrayal of reality attract viewers not only because they reveal science or nature's hidden truths, but because they also act in a way that makes the viewer feel a part of the scientific process of investigation. So while high-speed cinematography has the ability to slow-down time to let the viewer explore the particular mechanisms of a high-speed action like an explosion or the flick of a chameleons' tongue, it also offers the viewer a sense of participating in the process of discovery. This may be merely a fictional proxy of true scientific understanding, but the power associated with letting the viewer feel as though they have insights into the elitist culture of scientific practice should not be underestimated. The privileged status of photography as mediator to truth has long been conflated with knowing.

> The faith once placed in the human eye has today been replaced by a near-total dependence on technologically inflected vision, resulting in a disconnect between seeing and knowing so pervasive that it goes almost unacknowledged (Keller 35).

The ability of television to offer viewers insight and a participatory stake in "scientific culture" comes with costs - costs that extend beyond the scientific communities' critiques of questionable factual accuracy and cultural misrepresentation. Gregory and Miller suggest that

> Many proponents of the public understanding of science are concerned that the various scientific establishments have been too much involved with this mesmerizing aspect of public understanding – in which the masses are awed into passivity and unquestioning support for science by the sheer brilliance of modern research – and too little involved with the active, empowering side of the project (Gregory and Miller 97).

Beyond just rendering the viewer as a passive agent, the mesmerizing aspects of science and nature's visual representation affects the viewer's relationship with the world. The spectacular replaces the experiential and the viewer becomes distanced from the natural phenomenon which television so ably captures.

TIME WARP: TECHNICAL PROSTHESIS AND MEANINGLESSNESS

The Discovery Channel series *Time Warp* is based around the premise of using high-speed digital cinematography to reveal the world invisible to us. The basic structure of the show consists of the two hosts preparing subject matter to film and then reacting to and explaining the visual results via an immediate review of the footage. Each "event" is reviewed many times at various speeds in order to investigate the physical mechanisms that determine how the event unfolded.

For the host, Jeff Lieberman, "time-warping changes the way we see the world because it makes the invisible visible" (*Time Warp,* episode 1). The show offers a direct confrontation with the cinema as a prosthetic and as spectacle. Furthermore, the use of the machine as a demonstration of the machine itself, confronts the viewer with a type of representational meaninglessness that cinema's earliest viewers also experienced. The show's total focus upon high-speed photography provides a relevant case study that exemplifies many of the arguments as presented in this paper.

The photographs privileged status, as an indexical representation of reality and objective mediator of truth, is a concept fundamental to the show's premise. It is explicitly stated that the high-speed photography used offers a unique insight into the "truth" of the physical world. On the shows website, there is a series of rhetorical questions about various phenomenon (i.e. "Do you know how your dog uses its tongue to drink? In what exact way a face contorts when punched by a UFC contender? What happens when an egg falls into the pin wheeling blades of a fan?" The questions

demonstrate the ordinary quality of many of the events films, but what is more indicative of the shows premise is the answer they give to this set of leading questions.

> "Likely, with nothing but your naked eye to guide you, you haven't a clue. In fact, there are countless events the world has to offer that our limited senses can't fully appreciate…until now, anyway" (Time Warp, "About the Show").

This heavily coded statement is reflective of the positivist scientific sentiment that grew strong during the 19th century and has dictated scientific practice ever since. Positioning the observer as having limited perceptual abilities mirrors the rise of the use of scientific instrumentation and photography to serve as our mechanical proxy into the real world. The show not only makes explicit that this use of this technology is to help the viewer see things that were previously hidden, but also how little we understand until we are able to see things how they "really are." Much of the first episode in the series is devoted to explaining the high-speed cameras they are using to make the show. Jeff Lieberman, the host of the show, explains

> The human brain and normal television cameras are just not that good at picking up what's going on around us. Even if we slow regular video pictures way down we still miss out on a lot of things…

Paradoxically, Lieberman's statement mirrors how Etienne-Jules Marey felt about the cinema. While Marey had developed machines that provided the technological basis for the commercial cinema, his efforts were always directed towards the analysis of time and he had no desire to reproduce what the eye could already see (Braun, 150).

> Cinema produces only what the eye can see in any case. It adds nothing to the power of our sight, nor does it remove its illusions, and the real character of a scientific method is to supplant the insufficiency of our senses and correct their errors. To get to this point,

> chronophotography should renounce the representation of phenomenon as they are seen by the eye (Marey *in Doane* 53).

Doane speaks to this paradox underlying cinema's technical origins, suggesting "we are faced with the strange consequence that the cinema, as a technology of images, acts both as a prosthetic device, enhancing or expanding vision, and as a collaborator with the body's own deficiencies (Doane 3). *Time Warp* acknowledges the deficiency of our vision and of the regular cinema and then suggests that a more refined version of the camera can rehabilitate the cinema into a tool for a scientific understanding of the world. Science and natural history shows heavy reliance upon extra-sensory techniques such as time-lapse, aerials, and high-speed speak to the need to use the cinema as a prosthetic device – to show viewers something that there eye alone cannot possibly see.

For the viewer to desire to see the world as presented by natural history programming, they must admit that their own self-generated experience is limited and deficient. Our internalization of this perspective distances us from the material world and requires that we experience the world through a technological mediator. The unmediated world becomes uninteresting and unimportant and most problematic "untrue." Guy Debord's *Society of the Spectacle* offers a variety of articulate expressions that reflect these sentiments. His writings offer particularly penetrating insights into a show like *Time Warp* that relies heavily on the spectacle derived from a "new" way of seeing.

> Where the real world changes into simple images, the simple images become real beings and effective motivations of hypnotic behavior. The spectacle, as a tendency to make one see the world by means of various specialized mediations (it can no longer be grasped directly), naturally finds vision to be the privileged human sense which the sense of touch was for other epochs; the most abstract, the most mystifiable sense corresponds to the generalized abstraction of present-day

> society. But the spectacle is not identifiable with mere gazing, even combined with hearing. It is that which escapes the activity of men, that which escapes reconsideration and correction by their work. It is the opposite of dialogue. Wherever there is independent *representation*, the spectacle reconstitutes itself (Debord 18).

The show's main host often refers to the power of the apparatus to control time. With phrases such as "bending time" or "warping time" the show makes explicit reference to the power of the apparatus to control time. The hubris associated with such claims "represents our quest for security against novelty, through control and order, while presupposing the possibility of novelty" (Simpson, 53). Furthermore, the series offers interactive features available online that allows the user/viewer to control the experience of a filmed event for themselves – allowing for the scrolling through of a slow motion video showing a bullet hitting a banana. This type of technological control, which stems from our uneasiness with times unpredictability, reflects the overall construction of technology as "an outcome of our attempt to secure ourselves in an indifferent world" (Simpson, 51).

Doane's analysis of the earliest manifestations of cinematic technology is useful in understanding the meaninglessness of *Time Warp*. Doane argues that the early films "could risk banality in their subject matter" because of their novel representational powers (62). *Time Warps* reliance upon new tools for seeing allow the show to feature a variety of asinine content including water balloons popping, a dog lapping up water, a variety of explosions, a guy getting punched in the face, and circus tricks. A large component of the show is showing how "ordinary" things, when viewed through the "time warping cameras" look extraordinary – in other words the show exists to reveal the

spectacle. As such, the mechanical prowess of the apparatus becomes the sole focus and *Time Warp reveals* the "tautological character of the spectacle [which] flows from the simple fact that its means are simultaneously its ends" (Debord 13).

In its reliance upon the novel representation of time and movement, *Time Warp,* reflects the early cinema as exemplified by Lumières' actualities. Doane suggests that the only thematic consistency in the activities featured in the Lumiéres' diverse catalogue of films is their ability to be filmed – the same could be said about the activities filmed in *Time Warp.* And just as *Time Warp's* hosts focus their dialogue on the power of the camera, "much of the rhetoric accompanying the reception of the earliest films is a sheer celebration of the cinema's ability to represent movement" (Doane 22).

While high-speed photography has long been a tool of science and industry, its recent widespread adoption in television is aided by its digitization. The non-linear access to the filmed material allows a viewer instantaneous access to the moment of interest. Film based cameras produce a great deal of material extremely rapidly and require users to sort through the footage in real time. New digitally based cameras offer the user the ability to access the resulting data instantaneously. In the case of *Time Warp*, this instant access allows for the hosts to offer commentary on the revelations delivered by the images immediately after the filmed event takes place.

Many philosophers and critics in the late 19th and early 20th century reacted to the flood of images created by cinematic technology. Doane notes,

> …. one characteristic of the cinema set it apart from earlier processes of representing time, such as writing and music, and associated it with the ever-present and consistently disturbing potential of

> meaninglessness, of providing the spectator with *nothing to read.* And that is the camera's capacity to record indiscriminately (Doane, 63).

Time Warp films events that do not have any inherent meaning or context. That is they are not part of a larger narrative structure. Just like the early cinema whose future popularity required narrative, the events featured in *Time Warp* require the presenters to give structure to otherwise unrelated and meaningless events.

Among the critiques of the cinema's ability to represent the world was one of France's most well-known and popular philosophers. Henri Bergson adamantly opposed the cinema as a truthful mediation of the world. While not explicitly speaking about Marey's work, much of his intellectual efforts were based on critiquing the photographic sequence and the empirical reduction of time into fixed moments. As Doane notes, for Bergson, the indiscriminate recording of the cinematic apparatus creates a time that is "banal and meaningless. Any moment is as "exemplary" as any other and hence none provides the privileged "flash" or spark of knowledge" (Doane, 63).

CONCLUSION

While the paradox of cinema's representation of movement through the projection of individual frames has been thoroughly discussed in many contexts, little work has engaged with how the techno-scientific drive that created the cinema in the first place formed the visual aesthetic that is now integral to film and television. The 21st aesthetic of hyper-realism is a sophisticated and digitally mediated extension of philosophical and perceptual developments that occurred during the 19th century. Notions of time's rationalization precluded the development of the cinema and were thrust into acute focus by the development of "instantaneous" photography in the 1870s. Paradoxically, the ability to "freeze" time allowed for the necessary technology and conceptual framework in which to represent movement. The asymptotic quest to slow down time through high-speed photography is reflective of two competing desires: the desire to photographically represent the "instant" and the desire to see movement emerge out of this instant. Exploring this fertile territory between the photographic instant and cinemas movement is necessary for understanding the ideological ramifications of the cinematic apparatus.

As long as the medium's evidence-centric instrumental ancestry dominates, viewers will see nature in a way that Alexander Wilson suggests is "both impossibly close and impossibly distant (125)." Privileging the experiential and artistic over the scientific is a necessary step for science and natural history documentary to take to escape the conception of nature as other.

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