LESS LIKE SCIENCE, MORE LIKE FILM: THE USE OF NON-REDUNDANT IMAGES TO FACILITATE CRITICAL THINKING IN SCIENCE FILM

By

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A thesis submitted in partial fulfillment
of the requirements for the degree

of

Master of Fine Arts

in

Science and Natural History Filmmaking

MONTANA STATE UNIVERSITY
Bozeman, Montana

January 2009

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of a thesis submitted by

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This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citation, bibliographic style, and consistency, and is ready for submission to the Division of Graduate Education.

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January, 2009

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ABSTRACT

It is the tendency of films and television programs promoting scientific subject matter to use semantically redundant images in juxtaposition with expository narration. Producers and filmmakers alike recognize that this powerful combination bolsters the appearance of objectivity in the piece, and thusly the scientific credibility of the presentation. Critics Carl Gardner and Robert Young argue that this type of stylistic self-containment hurts the advancement of science, and call for a new method of presentation that would encourage discourse and openness instead of closure. This essay highlights the atypical science films of Charles and Ray Eames, Errol Morris, and Jean Painlevé to show how the incorporation non-redundant visuals can facilitate a personal, critical reading amongst their viewing audience.

GLOSSARY

Aberrant Conventions – Novel or unconventional formal techniques used to underline directorial authority.

Bazanian Image – From Andre Bazin's notion that film's ability to mechanically reproduce an image can be utilized by the artist to further an aesthetic of reality.

Discourses of Sobriety – Term taken from documentary film theorist Paul Nichols to describe academic institutions that work rigidly and systematically to further our knowledge of the world.

Non-Redundant Image – An image that holds little or no semantic likeness or "conflicts" with corresponding text. In documentary film this would most often be semantic discordance between the moving image and accompanying audio narration (Zhou 25).

Personal Interpretation – A viewer's subjective response to subject matter presented by a film or television program. Gardner and Young call for science programming that allows for the ability of a viewer to draw their own conclusions on presented subject

Punctum – A quality within certain photographs that allows for a personalized interpretation. Term coined by Roland Barthes in *Camera Lucida*

Redundant Image – An image that literally correlates to its accompanying text (Zhou 25).

Studium – The intrinsic language of a photograph that allows us to logically interpret its representational components. All photographs have studium. Coined by Roland Barthes in *Camera Lucida.*

LESS LIKE SCIENCE, MORE LIKE FILM

In their 1981 article “Science on TV: A Critique,” Carl Gardner and Robert M. Young call for a new approach in the presentation of science on television. They claim that the public’s understanding of science is far too important for television studios to be presenting science as series self-contained factoids. After listing over a dozen social issues that hold deep scientific foundations, “education,” “sexuality,” “work, ” etc. the authors argue that television must “alter its approach to these matters in fundamental ways – to move science as cultural consumption to science as critique” (174). The essay revolves around a central concept that scientific presentation should be provocative and have “the effect of opening up issues for public debate, rather than, as at present, leading to closure” (172).

Although over twenty-seven years old, Gardner and Young’s issues with the presentation of science are hardly antiquated. Much of science television today still relies on the same representational techniques that facilitate the type of cognitive closure to which Gardner and Young refer. Within the description of a New York Times review, author Mike Hale describes how a recent program on cosmology still attempts to illustrate scientific theory with overly simplified visual analogies. In the description of Science Channel’s “João Magueijo’s Big Bang,” Hale describes:

> Everything is presented in classroom metaphors, and not very vivid ones: shots of static on a television screen represent cosmic radiation; a stretchy sweater with a lot of extra buttons stands in for the expanding universe. An inordinate amount of screen time is also devoted to shots of the dreamy Dr. Magueijo staring at models of the solar system or lying on a deck chair and gazing at the sky.

Using these types of redundant visuals to match accompanying narration may be the most straightforward and conventional way to assemble a science program, yet, when the film presents them through "common sense," "natural," and "transparent" production styles (Gardner and Young 172), it allows for a deceptively objective front that promotes acceptance and closure instead of query.

Most science films and TV programs hold their ties with objectivity on two different fronts. The first is science's off-screen connotative links with objectivity, empiricism, and epistemology, or as Bill Nichols would refer to it, science's place within the "discourses of sobriety." The second is visual media's (photography, film and video's) ability to appear objective through modes of mechanical reproduction—the Bazinian image, or again, in terms of Nichols, documentary film's "kinship" with the discourses of sobriety (3).

Science documentaries can exploit both angles to yield products that overwhelm viewers with an enduring sense of objectivity. An ethical dilemma surfaces here if the viewer begins to confuse the representation of science with science itself. Later in their essay, Gardner and Young combine science and the presentation of science as a singular entity. "Science and its telling … convey a sense of authority and the advancing edge of objectivity" (179). If on-screen

science carries the same aura of objectivity that science in the real world possesses, why shouldn't the viewer understand science films as convincingly objective?

Producers of science television hold firm that objective appearance lends credibility to their reports on scientific subject matter. "…Any ambiguity in the representation [of science] is seen as a failure of exposition" (180). And even though their article remains more diagnostic than prescriptive, small hypothetical claims on reform do make their way into the paper. During one such instance they explain, "If the boundary between the substance, context and social relations of science was relaxed, the camera could invite us to draw our own conclusions and make observations on individuals and debates in the same way that it does in other controversial areas" (180). Intrusion by the filmmaker via aberrant convention would no doubt break the spell of impartial portrayal; however, in certain films, aberrant conventions do not always lead to the corruption of exposition. Filmmakers like Errol Morris, and Jean Painlevé make no efforts to cover up the subjective nature of their films, and at the same time present scientific subject matter provocatively ways that encourage viewers to build their own understanding of the subject instead of the film's predetermined argument. Other filmmakers like Charles and Ray Eames create interpretive ambiguity by combining simple images with an abundance of text to create a presentational format that overwhelms the viewer with interpretive potential. It is the purpose of this essay to deconstruct examples of science film that benefit

from the implementation of creative and unconventional uses of the medium, and to explore how these aberrant conventions foster the depiction of scientific subject matter in a thought-provoking manner not dissimilar from the ideas of Gardner and Young.

The "openness" which Gardner and Young allude to parallels Roland Barthes's theory of "punctum," insofar as both ideas hold foundations in the personalized interpretation of the viewer. First introduced in *Camera Lucida,* punctum (in photography) is a unique response by the individual viewer that affects his or her contemplation of the image beyond the portrayal immediately present. The punctum is a personal pensive reaction stemming from any provocative image that compels, or even challenges the viewer to incorporate his or her own personal history and reading frame into the interpretation of the image. This is in contrast to a photograph's "studium" which contains the "coded" (51) elements of the photograph that appeal to our logical ability to identify and place rational order on the subjects the photo depicts (all photographs embody studium to some degree). Punctum goes beyond the studium and exists only in the photographs individual viewers find appropriate to contemplate further. The punctum is a flourish added to the studium—something the viewer adds beyond a first-view, easy interpretation. Not every photograph has punctum. Similarly, like Gardner and Young point out, not every science film encourages viewers to "draw [their] own conclusions" (180). As the films in this paper will illustrate, breaking semantic redundancy between the image and narration creates a

presentational ambiguity that encourages viewers to find cohesiveness and build their own conclusions by filling the gaps of the narrative void.

In print, a caption directly beneath an image implies a natural association too intimate to ignore. In an earlier publication, *Music, Image and Text*, Barthes explains, “The closer a text is to the image, the less it seems to connote it” (26). In other words, the less likely the word is to suggest additional meaning beyond what is present. The proximity of text limits the picture’s ability to promote allusion beyond the words already present, while the image provides a clear and present illustration for the text. Through their intimacy, the word and image solidify an inescapable relationship with one another while their duality hinders further evocation. The text becomes a sign with only one signified entity. The image has just one immediate and confining label.

René Magritte critiques our natural tendency to accept this relationship with his painting *La trahison des images* (*The Treachery of Images)*. The painting serves as a jarring assault on conventional interpretation through a blatant discordance between image and proximal text. The painting consists simply of a wooden smoking pipe against a light brown background. Underneath the picture of the pipe, the caption reads, “Ceci n’est pas une pipe,” translating as, “This is not a pipe.” The end result pointedly deconstructs the text-image relationship in a manner not dissimilar from Brecht’s notion of separate elements. It was Bertolt Brecht’s belief that the artist could only encourage critical engagement of the subject matter if the audience was detached emotionally from

it. Further, the piece of art itself could facilitate this emotional disconnection through compositional dissonance amongst its different components (In opera: dialogue, music, and stage production). A painting like Magritte's immediately forces the viewer to detach from the elements within the painting (the painted pipe), and direct his or her attention towards the artistic assembly of the piece itself (What is Magritte trying to say with this obvious discordance?).

In documentary film and television there is similar congruence with the audio narration and the moving image. Visuals hold an unshakable bond to words the narrator speaks at the time of their occurrence. Proximity between text and image is temporal rather than spatial, so narration holds an unavoidable association with the visuals at the time of their appearance. Similar to the example of Magritte, this seemingly natural association is best recognizable through a conscious attempt to deconstruct it.

A worthy example of this deconstruction takes place in Buñuel's *Land Without Bread* (1932). A satirical ethnographic film, the narrator in *Land Without Bread* depicts a small, impoverished village in the mountains of Spain. Well crafted, to the unknowing viewer there is a steady uneasiness that builds until the viewer reaches a threshold and comes to realize that the narrator's highly personal and harsh critique of the villagers do not correspond with the visuals of the film in a traditional ethnographic manner. The effect of this discordance is an immediate interpretive shift from the residents of La Alberca, Spain, to the filmmaker's agenda. Similar to the effect of *La trahison des images*, the

dissonance between text and image reallocates attention from represented subject matter to the medium itself.

In the examples of Buñuel and Magritte, the starkness of reflexive strategy asserts the medium as the primary focal point. Bill Nichols explains that when reflexive methods are too brazen, they leave little room for the subject matter within the piece.

> Too tight a reflexive loop squeezes [the] crucial social element out. Instead of what can be represented through realism (lived experience) forming the focus of reflexivity, the question of realism itself, or of representation (formal structure), becomes the focus (67).

Indeed, it is not the goal of science film to turn attention inward on itself. It would be inappropriate for science film to go to these lengths in order to enable a participating audience if the primary goal of the film is to relay information about the scientific subject matter. However, as the films of Painlevé, and Morris show, the use of similar reflexive methods in a less direct fashion can facilitate more critical viewing habits.

This is the opposite of conventional science documentaries that use redundant images to keep representational ambiguity at bay. These films and programs rely on a tautological credibility process in which fact and the objective presentation of fact perpetually serve to validate one another. Stylistic realism allows for the seemingly objective presentation of fact, and, like the relationship between a picture and its caption, implementation of a redundant image over facts spoken by the narrator consecrates the validity of both the spoken fact and

image. There is a system of perpetual reaffirmation between scientific fact and the stylistic realism in the medium that depicts it. Each feeds off the other's inherent association with objectivity to help validate its own credibility as an impartial entity. Instead of encouraging the viewer to think beyond the facts the film presents, the duality promotes a passive acceptance of their exclusive relationship to one another. In "Narrative Strategies in Science Television," Roger Silverstone generalizes the text/image relationship in science documentary. "The commentary, where there is one, will argue a case, dominating and reinforcing the perlocutive image and seeking closure as all good arguments do" (389). Like a scientific journal article, science films take on the responsibility to provide a seamless exposition over their subject matter. The use of a self-containing presentational method that utilizes redundant images in combination with factual narrative exposition paints the illusion of argumentative validation that scholarly articles devote thousands of words to explain.

So, if the combination of the redundant image over the narration leads to closure, then a formal skewing of this convention could give viewers the opportunity they would need in order to process science film with a heightened awareness. The works of Buñuel, Magritte, and Brecht employ dissonance between textual and visual components to stimulate a receptive audience into critical engagement. Using similar techniques in a more subtle fashion, Jean Painlevé and Errol Morris both manage to produce cognitively stimulating science films that encourage a personal interpretation from the viewer by first

drawing attention to themselves as the filmmakers. The two filmmakers maintain continuous subjective reassertion through the implantation of non-redundant images throughout their films.

Of the examples I choose to deconstruct in this paper, the use of images in Morris's *Fast, Cheap and Out of Control* (1997) remains most similar to the methodology of Buñuel, Magritte and Brecht. In this film Morris overlays semantically non-redundant visuals to continuously underscore his role as primary interpreter. Because of this, the film may not appear definitively scientific, however, it nonetheless remains as a valid depiction of how a filmmaker can cultivate audience interactivity while working with scientific subject matter.

The film initially caught audiences and critics off guard because of its jarring clash of highly stylized erratic visuals that accompany the interview footage of four eccentric personalities. However, the film was nonetheless well received in part for its provocative nature and ability to engage viewers. "… It's the juxtapositions and connections that Morris creates … that sets off intellectual fireworks in your head" (Ansen). Critical reviews of the film spend most of their time on Morris because attempting to understand the filmmaker's intentions is necessary to make sense of a movie with no direct overarching narrative. Additionally, Morris unabashedly asserts his presence through the incorporation of stylized visuals and editing techniques that mix and match visuals from the four different characters whose stories continually interlace with one another.

Almost paradoxically, the more Morris asserts his auteurship, the more the film encourages the viewer to think for himself. "The intellectual notions behind the film are fresh and dazzlingly presented, but viewer response to what is onscreen accordingly remains strictly cerebral" (McCarthy).

The film centers around four eccentric personalities, and Morris intends the audience to listen to and understand these guys not as characters within a contrived plot structure, but as real life people living in the same world as us. It is the purpose of Morris to gather the worldviews of these four men through stories their occupations. Yet, if he had a concrete theme in mind that he wanted every viewer to understand upon completion of the film, he would have assembled a film more akin to Sagan's *Cosmos* (more on this film to follow). There is no evident narrative in a film like *Fast, Cheap and Out of Control*. The only way for a film of this kind to make sense is through an active willingness of the viewer to draw his own connections, and build his own narrative.

Errol Morris has similar qualms with documentary film that Gardner and Young have with science TV. "My gripe isn't with cinema verité. It's the metaphysical claim – the idea that style guarantees truthfulness – which I find repellent" (Ansen). To break notions of 'guaranteed truthfulness' in his documentaries, Morris knows that he must first challenge the stylistic conventions that promote the illusions of "truthfulness." To accomplish this, Morris attacks the image/narration relationship most documentary films rely on.

Fast, Cheap and Out of Control, like his other films, relies on heavily stylized, non-redundant images to affix Morris's presence as auteur.

The film begins with an introduction to its four characters. When the film gets to wild animal trainer Dave Hoover, Morris intersplices a very unusual shot of Hoover as he is telling a story from his childhood. As Hoover relates this story introducing his passion for lion taming, Morris initially opts for b-roll of circus footage (presumably the circus he works with). After this, Morris cuts to the primary interview footage of Hoover talking. After four seconds of interview footage, Morris cuts back to more circus footage, this time four shots of a tiger being moved in its cage by four circus hands. The final and most noteworthy cut in the sequence occurs as Hoover finishes his story. When Morris cuts back to the primary footage of Hoover's interview; however, he chooses a selection of film not of Hoover speaking, but of a slow motion, oblique extreme close-up of his face, his finger rubbing his lips. Hoover has a look of wonderment as his sentence finishes, drifting in from another realm.

For some reason Morris decides that the actual interview footage of Hoover speaking will not suffice. The slow motion shot of Hoover rubbing his lips holds some inherent relevance (it is he who is speaking, after all), yet his choice to use this shots breaks adherence to both general filmic convention in addition to convention within his film as all previous interview shots of Hoover are synced to the words he speaks. By no means is this the first instance of hyper-stylization, in the film (prior slow motion shots of circus animals establish this

tone early on). However, here, with this choice of shots, Morris does establish a formal non-redundancy that last through the rest of the movie. The non-redundant images facilitate the Morris's theme of intertwining worlds, yet he ultimately relies on the viewer to find the common links between the worlds of these four men.

Separate from each other, the interviews of the four men in the film would be a catalog of job descriptions and personal beliefs. By interweaving the interviews and layering one character's visuals over another's story, Morris asks the audience to continue a process of compare-and-contrast through the entire film. He abandons his ability to create a direct and linear narrative, and instead offers the viewer opportunity to assign preferential significance to particular anecdotes. Ultimately it is up to the viewer to determine how Hoover's story fits into the larger meaning of the film as a whole. Similarly, through the nontraditional editing techniques, the science that surfaces though interviews with the four subjects in his film remains definitively provocative because Morris's presence as auteur gives the inclusion of science significance beyond factoid.

Unlike *Fast, Cheap and Out of Control*, in the films of Jean Painlevé, science tends to be the predominate focus. Like Morris, Painlevé continuously asserts authorial presence, but does so through the poetics in his narrations. Through fanciful flourishes in the overdubs, Painlevé creates potential for the viewer's personal interpretation partly through the image's inability to semantically match the esoteric words of the narrator.

An early pioneer of science film, Painlevé recognized the consequences of an overly definitive science film. Creating medical films gave him ample opportunity to be fully authoritative and objective, yet his true passion manifests itself in his creations for larger audiences. In these films Painlevé took great liberties interjecting his own whimsical interpretations of the sea creatures and animal subjects, and this intrusion by the directors, in turn, gives the audience the interpretive freedom to do the same. An excerpt from his 1934 film *L'Hippocampe* (*The Seahorse*) illustrates Painlevé's intrusion via subjective narration.

> And what shall the other fish say of these vertical brethren, with their dignified sadness, imprint of ancient gargoyles? What manners they have, too! Not only the female who buries the nipple of her cloaca [sic] into the pocket carried by the male, but the male himself. ... There follows for him a confinement of great suffering, of pained agitation (Maddison 2).

Analogies comparing the sea animals to mythological creatures, and forceful anthropomorphism strip away any idea of objective presentation. Through his lyrical narration, Painlevé paints a portrayal that does not allow for straightforward visual duplication since his poetic abstractions allude first to the thoughts and interpretations of the writer. Painlevé suggests analogies, but for them to actually work, the viewer must take it upon his or herself to make the connections.

Painlevé's writings assert theories that the "poetry" in his films exists primarily in what the film leaves absent.

> Does the complete understanding of a natural phenomenon strip away its miraculous qualities? It is certainly a risk. But it should at least maintain all of its poetry, for poetry subverts reason and is never dulled by repetition. Besides, a few gaps in our knowledge will always allow for a joyous confusion of the mysterious the unknown and the miraculous (119).

By creating interpretive gaps in the exposition, and asserting authorship over his pieces, Painlevé encourages viewers to take on the mental efforts poetry requires. He inserts these poetic overtones via fanciful narration, editing, and cinematography. Speaking generally of Painlevé's popular pieces critic Ralph Rugoff states:

> Starting from clinical matter-of-factness, they seamlessly move to poetically charged whimsy and macabre perversity. They can be droll as well as ghoulish, dreamlike as well as harrowingly detailed. Painlevé's cinematography is also extraordinarily beautiful, boasting images so elegantly composed and strikingly lit that they seem more appropriate to art films than documentaries and lend his films an aesthetic self-consciousness that vies with their apparent educational function (49).

As Rugoff points out, the implementation of 'poetics' forcibly affects the viewer's reading of the film. In academic literature, scientists highly discourage this type of recognizable emotional prevalence, as it detracts from the empirical foundations of the system. Similarly, science films tend to discourage the emotional intrusions of the filmmaker to preserve their own underlying aura of objectivity. Painlevé, however, understanding film's inherent subjectivity, embraces creative techniques that brazenly assert the "synthesis of art, science and of poetry which is the true cinema" (Maddison 5).

The non-redundancy that emerges out of *Powers of Ten* by Charles and Ray Eames, comes from a different place than the previous two examples. The examples of non-redundancy with Morris and Painlevé are much more straightforward because of the countless examples throughout their films where one could deconstruct the spoken word and accompanying image to find semantic discrepancies. This is not the case with *Powers of Ten*, which, at any given moment, the words of the narrator conclusively seem to conform to the images on the screen. Rather, the film gains its non-redundancy through a snowballing, ever-expanding presentational format that makes it near impossible for the viewer to *only* associate spoken text with its accompanying images and vice versa.

First assembled in 1968 and remade for IBM in 1977, both examples remain innovative and deft science films that relay a wealth of scientific information in under nine minutes. Both versions consist of a single continuous 'camera movement' that takes the viewer from a picnic in the city to the edge of the universe in a matter of minutes. Then, tracking back to the park-goers, the camera shrinks down to the atomic level inside a white blood cell in the hand of the man. The end result is a magnificent portrayal of our relative size in the universe.

After the introduction, the camera embarks on a continuous movement that doesn't stop throughout the length of the film. Ten seconds after the tracking shot begins, the camera is high enough to reveal a superimposed 100

meter x 100 meter box that encapsulates the majority of the frame. The narrator describes that this length of this box is, “The distance a man can run in ten seconds.” He continues, “Cars crowd the highway. Powerboats lie at their docks. The colorful bleachers are Soldier’s Field.” The task of the narrator in *Powers of Ten* is to get viewers to interact with the picture rather than to understand it as simply a visual representation of the facts. Explaining the distance a man can run in ten seconds encourages the viewer to reassess the picture from another perspective. Addressing the cars, boats and stadium ask the viewer to search for, find, and study their presence during the ten seconds they are visible on the screen. The ‘man’ who can run this distance in ten seconds is not actually on the screen, but it would be difficult not to imagine someone running the span of the superimposed square as the narrator relates this fact. Similarly, cars boats and stadium seats are not visible in the sense that we know them, but appear as simple specks, conglomerations of colors, or not at all. Deductive efforts on the part of the viewer are necessary if he is to understand white dots as boats, the orange and blue blotches as stadium seats, or to conclude that there must be cars -- although practically invisible to our eyes -- on the two stretches of intersecting road in the shot. Although these connections may seem simple, they nonetheless represent a cognitive participation that many other science films can kill immediately through redundancy.

Paul Schrader, after seeing the first release of *Powers of Ten,* writes about this active participation of the viewer as he describes the visual density of the piece in his 1970 *Film Quarterly* essay on Charles Eames. He explains that the brilliance of *Powers* lies in the myriad of information it unleashes.

> All the data must pertain directly to the fundamental idea; the data are not superfluous, simply superabundant. Eames's innovation, it seems to me, is a hypothesis about audience perception which, so far, is only proved by the effectiveness of his films. … The viewer must rapidly sort out and prune the superabundant data if he is to follow the swift progression of thought. This process of elimination continues until the viewer has pruned away everything but the disembodied idea. By giving the viewer more information than he can assimilate, information overload short-circuits the normal conduits of inductive reasoning. The classic movie staple is the chase, and Eames's films present a new kind of chase, a chase through a set of information in search of an Idea (7).

The 'search' for the Idea seems synonymous with Gardner and Young's idea of viewers finding their own conclusions, and like Morris and Painlevé, the essence of this search roots itself in the inability of the image and narration to tell the full story. Schrader alludes to the relationship between the narration and visuals. Images correlate to the words of the narrator, yet what makes the film exceptional is that the words and image never confine one another. The film conveys too much information for this kind of self-contained, definitive referral to ever take place.

The *Powers of Ten* builds increasing complexity as the film progresses due to its unique mode of presentation. Although the images in the film are quite simple individually, compiled together into a single shot that lasts the entire film, each frame relates directly to every preceding following frame.

> From the first frame of this eight-minute film the spectator is at a perceptual fail-safe point; both his mental and emotional facilities are over-taxed. As the viewer backs off from such a fail-safe point, as he has to, he takes with him certain souvenirs—individual data which in each case will be different, but mostly an Idea which in this case is about the dimensions of time and space (Schrader 11).

The main 'idea' of the film is size, relativity, and our place from the edge of the universe to the atomic level. The continuously moving camera emphasizes relationship because previous and forthcoming frames shrink or grow out of the current frame. Inside the film's most prevalent formal mechanism lays a metaphor for its central theme—all frames are relevant and relative to one another. The film could work no other way. Cuts in the footage would render previous frames relatively insignificant, as they would fade exponentially into an obscured subtext of the shots that follow.

The effectiveness of the continuous shot in the film might best reveal itself in comparison to a film that uses jump cuts to accomplish the same goal. *Powers of Ten* never loses momentum in its avalanche-like heuristic approach because of the continuous camera movements. Stagnant ten second shots would devolve the image track to semantically redundant visuals representing only the words the narrator utters during those ten seconds, hindering the type of informational compounding that Eames's film wondrously achieves.

Sequences from Carl Sagan's *Cosmos* are thematically similar to portions of *Powers of Ten.* However, in the show's use of conventional show-and-tell exposition, and evidentiary editing techniques, *Cosmos* remains comparably

insubstantial as redundant images hinder the film's ability to be as provocative cognitively.

In a scene from "Episode Two" (1980), Sagan takes the viewer on a "journey to the nucleus of a cell." Like *Powers of Ten,* the scene transports the viewer from a 'normal' perspective to that of the atomic level. It starts with a close-up of a drop of blood Sagan draws from his own finger, and transports the viewer to the center of the cell through ever-increasing magnification. Unlike *Powers of Ten,* the filmmakers use cuts and dissolves instead of a single zoom to get us there.

Another significant difference is how the narration and images completely encapsulate one another. There is no break in Sagan's narration, and every word he speaks conforms perfectly to the concurrent image. This containment helps Sagan maintain a firm grasp of the narrative by telling us exactly what we are looking at.

As the trip into the cell continues Sagan notes, "Plunging through the membrane, we find ourselves inside the cell. Here, every structure has its function. Those dark green blobs are factories where messenger molecules are busy building the enzymes which control the chemistry of the cell." As the viewer progresses further into the cell, the images get increasingly abstract yet they nonetheless possess a definitive purpose because of their coherence to Sagan's narration.

While *Powers of Ten* allows the viewer to pick and choose information to include in their personal interpretation of the film through a bombardment of information, *Cosmos* restricts the viewer's interpretational leeway as the redundancy between narration and corresponding image keeps the presentation definitively self-contained. The show strives for the phenomenal significance of *Powers of Ten*, yet redundancy encumbers the film's ability to get to the interactive level *Powers* achieves. For example, the scene ends inside the nucleus of the cell on a strand of DNA. Sagan again tells the audience exactly what they are looking at.

> These necklaces, these intricately looped coils and strands are nucleic acids—DNA. Everything you need to know on how to make a human being is encoded in the language of life in the DNA molecule. This is the DNA double helix, a machine with about a hundred-billion moving parts called atoms. There are as many atoms in one molecule of DNA as there are stars in a typical galaxy.

Like the latter half of *Powers of Ten,* Sagan strives to emphasize how important, yet inconceivably tiny, the governing biological forces within our bodies are. A statement like "There are as many atoms in one molecule of DNA as there are stars in a typical galaxy," could be provocatively grand, but only if the audience gets the cognitive room to ponder its significance. When a film couples an assertion like this with a computer-generated segment of a DNA molecule, the association of the image to the narration hinders the viewer's ability to go beyond the image. In the end, the picture of the DNA effectively suffices for the thought-provoking potential a wondrous statement like this alludes to. Even though the animated balls and sticks could never fully represent the grand statement the film

situates them with, they do function perfectly well as a stand-in allowing the viewer an easy alternative to a ponderous investment.

Data in *Cosmos* are not overabundant as they are in *Power's of Ten* because evidentiary editing techniques confine the images to being sufficiently representative of what is being said. Dissolves and cuts between different images mark beginnings and ends, each snippet aligning to the coinciding words of the narrator.

Despite the examples of Painlevé, Morris, and the Eamses, the natural tendency of science filmmakers is to incorporate images in a manner that more closely resembles the redundant implementation *Cosmos uses*. The non-redundant image in the realm of science film and television holds a tenuous relationship with the medium because of its flagrant disregard for the film's ability to appear objective. As this paper points out in the introduction, Gardner and Young recognize the reluctance of science filmmakers and producers to embrace techniques that underscore the filmmaker's role within the production because of subjectivity's antagonistic relationship with the scientific process. Through creative uses of the medium, filmmakers like Painlevé, Morris, and Charles and Ray Eames show that artistic presentations and the valid depiction of scientific material are not mutually exclusive from one another.

These filmmakers all offer elements of mystery and ambiguity to the viewer through their depictions of science. As Painlevé proves, 'poetry' is a wonderful metaphor to describe the filmmaker's artistic intrusion within nonfiction

film because the word illustrates the subjective nature inherent within the medium. When filmmakers deviate from convention, like poetry, they point back at themselves, and as filmmakers like Morris, and the Eameses, and Painlevé show us, this may be the first step towards implementing a style within science film that facilitates the 'openness' for which Gardner and Young call.

Although artistic intrusion may not always be appropriate (in medical films, for example), many science films have the ethical leeway to implement artistic devices that help cognitively stimulate and challenge the viewer while in the process help distance the film from the aura of objectivity inescapable from real world science. In general, science may pride itself on riddance of bias, but the depiction of science to general audiences need not rely on the fallacy that the depiction of science must embody an overwhelming objective appearance in order to maintain sufficient credibility.

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