

'No More Unexplored Countries': The Early Promise and Disappointing Career of Time-Lapse Photography

• David Lavery

When we were children, and were taught natural history, we were told about bees and how they lived. We looked at the motionless images in our books but all of that was very distant for us, a land open only to the imagination. With cinema, *no more unexplored countries*. No more barriers between us and things! No more barrier between our spirit and truth in its subtlety! Moreover, scientifically, cinema casts upon everything it records a clear light which banishes errors and distortions.

The cinema is an eye wide open on life, an eye more powerful than our own and which sees things we cannot see.

Germaine Dulac¹

The Wonder Of Time-Lapse

The year is 1920, Paris, France. The writer Colette records (in an essay called 'The Cinema') a recent movie-going experience. In a memorable passage, she describes her fascination with slow-motion photography:

Last Thursday at the Musee Galliera, there were two moments when all the young hands clapped, when the mouths exhaled and then immediately cut short their 'Ahs' of respectful ecstasy. In the first one, a 'slow motion' shot rose from the ground, immobilized itself in the air, then held on a sea gull suspended in the breeze. The undulation and the flexing of the wings, the mechanism of guiding and direction in the tail, the whole secret of flight, the whole simple mystery of aviation, revealed in an instant, dazzled everyone's eyes.

But it was time-lapse photography, shown on the same programme, which most captivated her poetic imagination.

A bit later, a 'fast motion' documentary documented the germination of a bean. [. . .] At the revelation of the intentional and intelligent movement of the plant, I saw children get up, imitate the extraordinary ascent of a plant climbing in a spiral, avoiding an obstacle, groping over its trellis: 'It's looking for something! It's looking for something!' cried a little boy, profoundly affected. He dreamed of a plant that night, and so did I. These spectacles are never forgotten and give us the thirst for further knowledge.²

Time-lapse photography, as Colette witnessed it that night, was the product of what intellectual historian Stephen Kern has called 'the culture of space and time'.³ As a prime agent of that culture, motion pictures demonstrate that, as Kern observes,

Any moment could be pried open and expanded at will, giving the audience seemingly at once a vision of the motives for an action, its appearance from any number of perspectives, and a multitude of responses. A man is shot in an instant, but moviegoers saw the event prolonged and analyzed like a detailed case history. The present was thus thickened by directors who spliced time as they cut their film.⁴

Time-lapse photography thickened becoming, made it visible.

The year is 2006 and I am crossing the Atlantic on United Airlines. Before the in-flight entertainment begins on the tiny TV screen on the back of the seat before me, before I immerse myself in *The Corpse Bride* and *The Brothers Grimm* and *Wallace & Gromit: The Curse of the Were-Rabbit*, the United logo is accompanied by a tiny time-lapse image of tulips coming into

bloom. This revisiting of time-lapse's primal scene – intended, I surmise, to introduce the organic beauty of becoming into the heart of the several-mile-high technological – probably went unnoticed by most of my bored and cramped fellow passengers. No ancestors of Colette's young Parisiennes were jumping out of their seats, propelled by wonder. Time-lapse, co-opted for use by modern advertising, had become mundane, commonplace.

According to the influential German economist and sociologist Max Weber,⁵ the ideas that drive institutions like organised religions originate in the 'charisma' of visionary leaders but become, over time, 'routinized' into the ideas governing organizations. The esoteric becomes the exoteric. A comparable process may well have governed the history of time-lapse photography.

Time-Lapse Does Science

In time-lapse photography a process or action, however slow in reality, is captured at a rate more retarded than it will later be projected, resulting in a revelation of motion ordinarily imperceptible to unenhanced human sight.⁶ According to film aesthetician Herbert Zettl, time-lapse as a photographic technique has several distinctive features. Time-lapse has 'relatively few "at" positions'. 'Much like strobe photography', Zettl explains, 'film photography involves taking a great number of snapshots of a moving object. Each of the snapshots, or frames, shows the object at rest, so that when you hold and enlarge a single film frame, you cannot tell whether the object was in motion when the picture was taken or was stationary'.⁷ Every frame of a film – each showing an object seemingly at rest – captures 'an "at" position of the time continuum, a snapshot of part of the motion'.⁸ As 'at-at' positions increase in number, the faster the movement we perceive as viewers. The less 'position change', the slower the movement. The frame density of slow motion is high, but in all forms of accelerated motion, including time-lapse, frame density is low.⁹ Movement revealed by time-lapse is thus more erratic and 'jumpy'. The objects it shows, Zettl

observes, 'sometimes seem to be self-propelled, shooting unpredictably through the low-density atmosphere that offers little, if any, resistance to their movement'.¹⁰

'The majority of its pioneers', film historian David Parkinson observes, 'always envisaged the moving picture as primarily a scientific aid',¹¹ so it should not surprise us that time-lapse photography was first envisioned theoretically by physicist Ernst Mach in 1888,¹² though it was not implemented until a decade later. A century of real world use of time-lapse photography would begin with German botanist Wilhelm Pfeffer's documentation of the eleven-day growth of beans in 1898 (no doubt the film that dumbfounded Colette). In 1902 the Biograph studios captured the demolition of the old Star Theater 'as if it were melting into the ground'¹³ by exposing a single frame of film every thirty minutes. In a mere thirty seconds, the audience watched amazed as the building disintegrated before their very eyes.¹⁴ In 1904, Pizon used a form of time-lapse he deemed 'biotachygraphy' to record the growth and development of a colony of bacteria.¹⁵

In the years since, glaciers, blood corpuscles, blossoming flowers (hundreds and hundreds of flowers in bloom), cell division, sea creatures, cloudscares, celestial mechanics, construction projects, rotting fruit, the sun rising and setting, puddings baking, storm fronts, traffic patterns – these and a thousand other subjects have posed for time-lapse portraits.¹⁶ In the hands of pioneers like the Russian-American biologist Roman Vishniac (1897–1990) and the American inventor John Ott (1910–2000), time-lapse would be used in a variety of practical and scientific ways, simultaneously 'reveal[ing] beauty while serving as a tool for the scientist'.¹⁷

A BBC film unit, for example, recorded *London to Brighton in Four Minutes*, a 760 mile-an-hour trip that helped designers reconfigure carriage lay out and seat design.¹⁸ In a time-lapse astronomical photograph (48 exposures on a single frame of film) which won several major awards and has been reproduced world-wide over ten million times, Dennis de Cicco captured the figure eight – commonly known as an

'analemma' – traced by the sun in the sky over the course of a single year: February 1978 to February 1979.¹⁹ And, in one of time-lapse's masterpieces, Sean Morris of Oxford Scientific Films captured blowfly maggots devouring, in a one minute film at once revolting and astounding, the corpse of a field mouse. (Morris's time-lapse aspirations were not limited to small rodents: 'We ought to do a shot one day of maggots devouring an elephant's carcass'.²⁰)

Contemplating (in *Pilgrim at Tinker Creek*) a 17th century thought experiment in which a mirror shot into space, travelling at the speed of light, would allow us to 'watch all of the earth's previous history unfolding as on a movie screen', Annie Dillard thinks of time-lapse photography.

Those people who shoot endless time-lapse films of unfurling roses and tulips have the wrong idea. They should train their cameras instead on the melting of pack ice, the green filling of ponds, the tidal swing of the Severn Bore. They should film the glaciers of Greenland, some of which creak along at such a fast clip that even the dogs bark at them. They should film the invasion of the southernmost Canadian tundra by the northernmost spruce-fir-forest, which is happening right now at the rate of a mile every ten years. When the last ice sheet receded from the North American continent, the earth rebounded ten feet. Wouldn't that have been a sight to see?²¹

Time-lapse's scientific practitioners have not yet completed all of Dillard's ambitious agenda, but they have hardly limited themselves to roses and tulips. If the cinema has been from the outset 'a laboratory for the twentieth-century imagination',²² time-lapse has been a tool at the disposal of experimenters. Even non-scientific imaginations found ways to make use of it.

Time-Lapse Does the Movies

Throughout the first century of the movies, time-lapse has played a cameo role in theatrical and experimental films. Méliès' short *Carrefour de l'opéra* (1898) is purported to be the first theatrical film to use time-lapse. In *Pan-American Exposition by Night* (1901), Edwin S. Porter, best

known, of course, for his *The Great Train Robbery* two years later, altered his camera in order to expose one frame per ten seconds in order 'to create a circular panorama of the illuminated fairgrounds'²³. The blooming flowers of Renoir's *La Petite marchande d'allumettes* (*The Little Match Girl*, 1928), the time-lapse clouds, obeying the commands of a wizard, in Epstein's *Le Tempestaire* (1947), the contrasted gestating flowers and dancers in motion in Swedish documentarist's Arne Sucksdorff's *The Open Road* (1948), the rich time-lapse shots of natural phenomena in Georges Rouquier's *Farrebique* (1948) kept time-lapse in the public eye, while hardly engendering stardom for the technique. Time-lapse has continued to put in an appearance in mainstream fare. George Pal's science fiction film *The Time Machine* (1960) employed time-lapse as a special effect in its depiction of a journey into the future. As the Time Traveller leaves his London home on the eve of the 20th Century on his way to the year 802,701, we witness the rapid passage of clouds overhead and the accelerated transformation of day into night among the signs of the progress of time. The opening credit sequence of *On a Clear Day You Can Say Forever* (Vincente Minnelli, 1970) is comprised of stunning time-lapse shots of blossoming flowers, created especially for the film by none other than the time-lapse pioneer Ott. At the end of John Badham's *Saturday Night Fever* (1977), a time-lapse shot of clouds moving rapidly over the New York City skyline is used at the movie's close to counterpoint Tony Manero's (John Travolta) dark night of the soul after the accidental death of his friend. Philip Kaufman's *Invasion of the Body Snatchers* (1978) implements time-lapse with menacing effect – again in the credit sequence – to show spores from outer space gestating into parasitic flowers essential to the invaders' plot to conquer the earth. In Steven Spielberg's *E.T.*, in its day the top grossing film of all time, a dead flower is brought back to vibrant life in time-lapse by an extra-terrestrial's magical powers. More recently Brian De Palma's box office disaster *Bonfire of the Vanities* (1990) exhibited a Robert Greenberg-designed time-lapse, morning to

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- Koyaanisqatsi

night, panorama of New York, with the Chrysler building's famous gargoyles screen centre, as its credit sequence/establishing shot.²⁴ Time-lapse has even found a place in television narrative. The high concept CBS series *Early Edition* (1996–2000), for example, makes ample use of time-lapse in a story about a man who receives the next day's newspaper 24 hours in advance.

Less mainstream filmmakers have likewise found time-lapse functional. Avant-garde filmmakers, not surprisingly, have sometimes implemented time-lapse techniques. Andy Warhol's *Empire* (1964), for example, telescopes the passing of day into night in an eight hour filmic record of the Empire State Building shot from a single, stationary camera.²⁵ And Michael Snow's *Wavelength* (1967), a forty five minute long, excruciatingly gradual zoom journey across a studio loft, utilises time-lapse to reveal the passage of time in a film designed to demonstrate that 'motion is the only phenomenon that allows perception of time'.²⁶ Using time-lapse, photographer Ted Spagna completed ten years worth of 'sleep portraits': scientifically valuable records of the sleep behaviour of men and women – individuals, couples, parents with babies, and zoo animals – gorillas, flamingos, bears. (His future plans, he claims, include portraits of schizophrenics, sleepwalkers, whales and astronauts.) In the late 1980s, Spagna's work, exhibited in galleries, even came to attract the attention of the art world as well.²⁷ Ron Fricke's mind-boggling time-lapse photography (of storms, the passage of night and day, the circulatory system of a big

city) is central to the method of Godfrey Reggio's indictment of the unsustainable insanity of modern American life in the cult documentary *Koyaanisqatsi* (1983).²⁸

Time-lapse plays a central role in the unconventional British director Peter Greenaway's peculiar 1985 film *A Zed & Two Noughts*, in which Oswald Deuce, a zoologist whose wife has been killed in a bizarre automobile accident (on Swan's Way) involving a swan, conducts grief-inspired research on decay. An apple, two fish, a crocodile, a Dalmatian, a zebra – all come before his camera, where their accelerated putrefaction is captured by the researcher's time-lapse camera. Snippets of Deuce's films punctuate *Zed's* bizarre narrative, a typically Greenawayian confounding tale of separated-at-birth twin brothers both pursuing the now-one-legged (soon to be legless) driver of the car in which their wives jointly died.²⁹

Time-Lapse in Theory

The enthusiasm of modernist artists and film theorists, just as rabid if not more so than writers like Colette or scientists like Morris, far outdistanced that of mainstream and experimental filmmakers. The genetic tendency of film discourse 'to over-endow the cinema with utopian possibilities' informs almost all early conjecture about time-lapse photography.³⁰

Remarking on the ability of the cinema to 'extend [. . .] certain of our means of perception and [. . .] throw out bridges beyond the impassable zones of our senses and our skills', the seminal modernist architect Le Corbusier (1887–1965) singled out scientific documentary's 'miraculous films on the growth of seeds and plants' as proof that 'nature and human consciousness are [. . .] two terms of the [same] equation'.³¹ Writing in 1925, Bauhaus designer Laszlo Moholy-Nagy (1895–1946), while praising cinema's aptitude for scientific research into the metamorphosis of 'zoological, botanical and mineral form' and condemning its lazy utilisation for dramatic purposes, spoke most eloquently of time-lapse as a wonderful vehicle for the revelation of character. Imagining a time-lapse

film of 'a man daily from birth to his death in old age', he describes the probable effects of such a film: 'It would be most unnerving even to be able to watch only his face with the slowly changing expression of a long life and his growing beard, etc., all in five minutes; or the statesman, the musician, the poet in conversation and in action; [. . .] Even with a proper understanding of the material, speed and breadth of thought do not suffice to predict all the obvious potentialities.'³² For film theorists, the promise of time-lapse was even more inviting.

With I. G. Farben's *Miracle of the Flowers* – a film he judged to be 'certainly the most fantastic, thrilling, and beautiful ever made' – as his test case, Rudolf Arnheim (1904–), writing in his seminal study *The Film as Art* (1933), would wax poetic about time-lapse, providing a definitive phenomenology of the viewer's experience of the technique:

The swaying rhythmic breathing motions of the leaves, the excited dance of the leaves around the blossom, the almost voluptuous abandon with which the flower opens – the plants all at once come alive and show that they use expressive gestures like those to which we are accustomed in men and animals. Watching a climbing plant anxiously groping, uncertainly seeking a hold, as its tendrils twine around a trellis, or a fading cactus bloom bowing its head and collapsing almost with a sigh, was an uncanny discovery of a new living world in a sphere in which one had of course always admitted life existed but had never been able to see it in action. Plants were suddenly and visibly enrolled in the ranks of living beings. One saw that the same principles applied to everything, the same code of behavior, the same difficulties, the same desires.³³

For Arnheim, ever committed to 'refut[ing] the assertion that film is nothing but the feeble mechanical reproduction of real life',³⁴ time-lapse provided irrefutable evidence of film's meta-mimetic tendencies.

Convinced that 'the modifications of spatial and temporal experience provided by slow, accelerated, or reverse motion will provide fresh access to the true, concealed nature of the

phenomenal world',³⁵ Jean Epstein (1897–1953), French pioneer of the avant-garde, would praise time-lapse as one means of preserving the medium's early, phenomenal sense of wonder against the stultifying development of narrative cinema. But a technique like time-lapse was for him as well the tool for scientific revelation. 'The revisions of perception and judgment impelled by that access', Epstein was convinced, 'would confirm scientific discovery and redirect epistemological inquiry'.³⁶ Despite 'its startling physics and strange mechanics', time-lapse, Epstein hastened to remind, should be understood as 'but a portrait – seen in a certain perspective – of the world in which we live'.³⁷

In her essay on 'Visual and Anti-Visual Films', Germaine Dulac (1882–1942) contemplating the ability of film to 'decompose' movement, thought of time-lapse as a quintessential example.

A grain of wheat sprouts; it is synthetically, again, that we judge its growth. Cinema, by decomposing movement, makes us see, analytically, the beauty of the leap in a series of minor rhythms which accomplish the major rhythm, and, if we look at the sprouting grain, thanks to film, we will no longer have only the synthesis of the moment of growth, but the psychology of this movement. We feel, visually, the painful effort a stalk expends in coming out of the ground and blooming. The cinema makes us spectators of its bursts toward light and air, by capturing its unconscious, instinctive and mechanical movements.³⁸

And in 'The Essence of the Cinema: The Visual Idea', Dulac again returned to time-lapse in a



• *Wavelength* (Michael Snow)

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consideration of the 'educational and instructive power' of film as a 'sort of microscope'.

In a documentary, in a scientific film, life appears before us in its infinite detail, its evolution, all that the eye is normally unable to follow.

Among others, there is a slow-motion study of the blooming of flowers. Flowers, whose stage of life appear to us brutal and defined, birth, blooming, death, and whose infinitesimal development, whose movements equivalent to suffering and joy are unknown to us, appear before us in cinema in the fullness of their existence.³⁹

Even two decades later, in *Theory of Film: Growth and Character of a New Art* (1952), the Hungarian cineaste Bela Balazs (1884–1949) would still find time-lapse fascinating, noting that while 'only pictures of nature without men bear the convincing stamp of unquestionable, authentic reality', such films 'often appear fantastic'. And 'nothing could be more like fairy tales', writes Balazs, with time-lapse photography in mind, than 'the scientific films which show the growth of crystals or the wars of infusoria living in a drop of water'. He even goes on to briefly develop a theoretical explanation of the uncanny nature of such cinematography:

[T]he farther away the existence presented [. . .] is from the possibility of human interference, the less is the possibility of its being artificial, faked, stage-managed. [. . .] For although what we see is a natural phenomenon, the fact that we can see it at all strikes us as unnatural. [. . .] In watching such things we feel as if we had entered a territory closed to man.⁴⁰

When a technique like time-lapse photography shows us 'something that human beings cannot see in normal circumstances', Balazs concludes, suggestively, 'then, as we nevertheless see it, we have the feeling of being invisible ourselves.'

For the French film theorist Edgar Morin (1921–) 'scientific' techniques like time-lapse lie at the heart of all contemporary controversies about how we are to 'read' movies. In *Le Cinema ou l'homme imaginaire* (1958) Morin shows how, in the words of Dudley Andrew (on whose account of Morin's book I have relied heavily),



• Germaine Dulac

'the cinema began as an instrument of popular science, as a perceptual machine he calls the 'cinematographe', whose function was to provide views of things formerly unseen or unseeable. Hence the fascination with slow and fast motion, with extreme close-ups and unlimited repetitions giving our eyes access to the world of nature'.⁴¹

But almost simultaneously the movies became an entertainment industry 'catering to a voracious public appetite for "curiosities"', and, in the hands of filmmakers like Georges Méliès, the semiosis of the movies was rapidly transformed: 'the cinematographe quickly became that phantasmagoric language we know as the cinema'. The 'tension between perception and signification' which still lies at the heart of our experience of film began.⁴² But in the process, the cinematographe's capacities for revelation have been largely forgotten.

Time-Lapse as Material Ghost

In the imaginal science of Leo Lionni's delightful *Parallel Botany*, we learn of a type of plant which 'grow[s] in the rhythm of our subjective time and eventually take[s] the form of a long and intricate conceptual process'. Having long ago lost their existentiality, these plants can now be perceived, Lionni explains, only by 'the principles and methods of phenomenology'.⁴³ The revelations of time-lapse photography are, of course, quite real, technologically enhanced visions of temporal realities, and yet for the viewer, at least, it would be easy to believe they share a family resemblance to the chimeras Lionni describes.



• *Empire* (Andy Warhol)

The world of the movies, Gilberto Perez reminds us, is filled with 'material ghosts'. 'The images on the screen carry in them something of the world itself, something material, and yet something transposed, transformed into another world. [...] Hence both the peculiar closeness to reality and the no less peculiar suspension from reality, the juncture of world and otherworldliness distinctive of the film image'.⁴⁴ In the course of its history, time-lapse photography, once thought of as a window on the momentousness of nature, once poetic, has lost its 'otherworldliness' – become prosaic. With the countries all explored, or so our now jaded film consciousness now assumes, the sense of wonder that aroused time-lapse's early promise may now be gone.

Notes

- 1 Germaine Dulac, 'The Essence of the Cinema: The Visual Idea', in P. Adams Sitney (ed.) *The Avant-Garde Film: A Reader of Theory and Criticism*, trans. by Robert Lamberton (New York: New York University Press, 1978), p. 39. My emphasis.
- 2 Collette, 'The Cinema', in Alain and Odette Virmaux (eds) *Collette at the Movies*, trans. by Sarah W. R. Smith (New York: Ungar, 1980), p. 61. Collette was not alone among the literati in her enthusiasm for the then still novel technique. As I have detailed elsewhere, poets like AE, Blaise Cendrars, Paul Valery, Rainer Maria Rilke, and Hart Crane found inspiration in time-lapse. See David Lavery, 'Poetry as Time-Lapse Photography', *Essays in Arts and Science* 17 (1988), pp. 1–27.
- 3 'From around 1880 to the outbreak of World War I', Kern shows, 'a series of sweeping changes in technology and culture created distinctive new

modes of thinking about and experiencing time and space. Technological innovations including the telephone, wireless telegraph, x-ray, cinema, bicycle, automobile, and airplane established the material foundation for reorientation; independent cultural developments such as the stream-of-consciousness novel, psychoanalysis, Cubism, and theory of relativity shaped consciousness directly. The result was a transformation of the dimensions of life and thought'. Stephen Kern, *The Culture of Space and Time: 1880–1918*. (Cambridge: Harvard University Press, 1983), p. 2.

- 4 Kern, *The Culture of Space and Time*, p. 88.
- 5 Max Weber, *Economy and Society* (Berkeley: University of California Press, 1978).
- 6 Although time-lapse is sometimes spoken of as a form of fast or accelerated motion photography, I will not do so here. The effect on the viewer of the latter process, which normally hastens, often with comic effect, actions we are accustomed to viewing at normal pace, is distinct from time-lapse.
- 7 Herbert Zettl, *Sight, Sound, Motion: Applied Media Aesthetics*, 2nd Edition (Belmont, CA: Wadsworth, 1990), p. 259.
- 8 Zettl, *Sight, Sound, Motion*, p. 260.
- 9 Zettl, *Sight, Sound, Motion*, p. 270.
- 10 Zettl, *Sight, Sound, Motion*, p. 271.
- 11 David Parkinson, *History of Film* (New York: Thames and Hudson, 1995), p. 7.
- 12 Jon Darius, *Beyond Vision: One Hundred Historic Scientific Photographs* (New York: Oxford University Press, 1984), p. 18.
- 13 Ian Christie, *The Last Machine: Early Cinema and the Birth of the Modern World* (London: BFI, 1994), p. 33.
- 14 K. Macgown, *Behind the Screen: The History and Techniques of the Motion Picture* (New York: Delacourte, 1965), p. 16.
- 15 Darius, *Beyond Vision*, p. 18.
- 16 Scores of time-lapse films are now available for viewing on the Internet at websites such as the following: <http://www.haworth-village.org.uk/nature/time-lapse/thumbs.asp> and <http://www.timelapse.com/>.
- 17 The 1980 *Nova* episode 'Moving Still' (New York: Ambrose Video, 1981) offers an excellent overview of time-lapse's many uses. I quote here from the transcript of 'Moving Still', available from WGBH Boston ('Moving Still.' WGBH Transcripts. *Nova* #717, 1980).
- 18 This short film is included in 'Moving Still'.
- 19 Darius, *Beyond Vision*, p. 178–79.
- 20 'Moving Still' transcript, p. 8.
- 21 Annie Dillard, *Pilgrim at Tinker Creek* (New York: Bantam, 1974), p. 145.
- 22 Christie, *The Last Machine*, p. 27.
- 23 Cook, David A., *A History of Narrative Film* (New York: W.W. Norton, 2004. Fourth edition.), p. 18.

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- 24 Elizabeth Brevitz, 'Title Design: Robert Greenberg', *Premiere*, February 1991, pp. 44–45.
- 25 According to Gregory Battock, Warhol speeded up the action at this point in his documentary, despite the film's overall commitment to distorting time by not distorting it in expected ways, so that 'the major "event" in the film' could be 'summarily disposed of in order to clear the way for the timeless 'real' time of the unchanging image of the building'. 'Four Films of Andy Warhol', in Gregory Battock (ed.) *The New American Cinema: A Critical Anthology* (New York: Dutton, 1967), p. 236.
- 26 Eugene Youngblood, *Expanded Cinema* (New York: Dutton, 1970), p. 122.
- 27 For a full discussion of Spagna's work see J. Leonard, 'Dream Catchers: Unleashing the Genies in the Sleeping Mind'. *Harvard Magazine* May–June 1998 <<http://128.103.142.209/issues/mj9/dream.html>>.
- 28 For an extended discussion of *Koyaanisqatsi*, see David Lavery, *Late for the Sky: The Mentality of the Space Age* (Carbondale, Southern Illinois University Press, 1992), pp. 150–55.
- 29 Greenaway has been described as '[a] filmmaker who has constantly displayed a fascination for the organizational and the classificatory in a body of films that have themselves retained an art-house individuality within the broader criteria of popular success'. S. Frampton and R. Edelman, 'Peter Greenaway', in Andrew Sarris (ed.) *The St. James Film Directors Encyclopedia* (Detroit: Visible Ink Press, 1997), p. 198.
- 30 Robert Stam, *Film Theory: An Introduction* (Malden, MA: Blackwell, 2000), p. 25.
- 31 Le Corbusier, 'Spirit of Truth', in Richard Abel (ed.) *French Film Theory and Criticism: A History/Anthology*. Vol. II, (Princeton: Princeton University Press, 1988), pp. 112–13.
- 32 Laszlo Moholy-Nagy, *Painting, Photography, Film*, trans. Janet Seligman (Cambridge: MIT Press, 1969), p. 36.
- 33 Rudolf Arnheim, *The Film as Art* (1933; rpt. Berkeley: University of California Press, 1966), p. 115.
- 34 Quoted by Stam, *Film Theory*, p. 60.
- 35 Annette Michelson, 'Introduction', in A. Michelson (ed.) *Kino-Eye: The Writings of Dziga Vertov*, trans. Kevin O'Brien (Berkeley: University of California Press, 1984), p. xliii.
- 36 Michelson, 'Introduction', p. xliii.
- 37 Quoted in Siegfried Kracauer, *Theory of Film: The Redemption of Physical Reality* (New York: Oxford University Press, 1960), p. 53.
- 38 Germaine Dulac, 'Visual and Anti-Visual Films', in P. Adams Sitney (ed.) *The Avant-Garde Film: A Reader of Theory and Criticism*, trans. Robert Lambertson (New York: New York University Press, 1978), p. 32.
- 39 Dulac, 'The Essence of the Cinema,' p. 39.
- 40 Bela Balázs, *Theory of Film: Character and Growth of a New Art* (1952; rpt. New York: Dover, 1970), 172–73.
- 41 Dudley Andrew, *Concepts in Film Theory* (New York: Oxford University Press, 1984), p. 22.
- 42 Andrew, *Concepts in Film Theory*, p. 22.
- 43 Leo Lionni, *Parallel Botany*, trans. Patrick Creagh (New York: Knopf, 1977), pp. 13–14.
- 44 Gilberto Perez, *The Material Ghost: Films and Their Medium* (Baltimore: Johns Hopkins University Press, 1998), p. xx.