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The Magnifying Glass and the Macro Lens: Augmented Perception in 19th Century Entomology and *Microcosmos*

Abstract

The difficulty humans have in observing certain aspects of insect life has led several important thinkers of the 19th and 20th centuries to both question the nature of human perception and strive to augment it. As early as 1879 Étienne-Jules Marey (1830-1904) was developing cinematic technology to record the patterns traced by insect wings in flight. At the same time that Marey was tackling the problem of translating the rapid and minute movements of insects into information accessible to the human eye, Jean-Henri Fabre (1823-1915) was translating the behaviors of insects into engaging popular science prose. In order to track the insect's effects on the cinema, both its technology and its assumptions, the work of these two influential entomological thinkers working in the late pre-history of the cinema will be compared to the 1996 insect documentary, *Microcosmos*. *Microcosmos* is a film of stunning macrophotography depicting the daily life of various species of invertebrates. The directors, Claude Nuridsany and Marie Pérennou, set the action of the film within a generic French meadow during the course of one day. The film eschews the expert narrator typical of wildlife documentaries, choosing instead to pair the images only with music and abstract insect noises. This paper demonstrates how *Microcosmos* engages with the apparently contradictory methodologies of Fabre and Marey, producing a documentary that vacillates between narrative and abstraction, anthropomorphism and othering, natural historiography and empirical representation, fascination and repulsion.

In 1996, the wildlife documentary film *Microcosmos* was released to widespread critical acclaim. *Microcosmos* is a film committed to complicating and improving the image of the insect in contemporary popular culture. It depicts the quotidian routines of various invertebrates in fascinating detail. The directors, Marie Pérennou and Claude Nuridsany, set the action of the film within a southern French meadow during the course of one day. They skip the typical wildlife documentary trope of having an expert narrate in order to let the insects speak for themselves.¹ While many insects do communicate (some, like honey bees, even in ways that resemble language), it is hard to imagine how they would represent themselves to humans. The gap between the perceptual worlds of insects and humans prevents communication, but has proved a fecund interval in which entomological thinkers have developed theories and technology. Attempts to gain access to, and represent, the micro-world of insects have influenced both the development of cinematic technology broadly, and the creation of *Microcosmos* more specifically.

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aspects of insect life has led several important thinkers of the 19th century to both question the nature of human perception and strive to augment it. The entomological work of Jean-Henri Fabre (1823-1915) and Étienne-Jules Marey (1830-1904) sheds light on two aspects of *Microcosmos*: its style, and its technology. As early as 1879 Marey was developing photographic technology to record the patterns traced by insect wings in flight.² At the same time that Marey was tackling the problem of translating the rapid and minute movements of insects into information accessible to the human eye, Fabre was translating the behaviors of insects into engaging popular science prose. Fabre's first volume of his *Souvenirs entomologiques* and Marey's *La Machine animal*, both published in 1879, have exerted their influence more than one hundred years later on the production of *Microcosmos*.³

It is useful to look at *Microcosmos* through the lens of the work of Fabre and Marey for two reasons. First, while Fabre and Marey approach their work from very different perspectives, they each share affinities with the methodological and epistemological outlook of *Microcosmos*. Fabre,

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on the one hand, purports at times to merely be transcribing the insect voice into the written word. *Microcosmos* also makes space for the voice of the insects by avoiding human narration. Marey, on the other hand, who was more of an empiricist, viewed insects as less human, more technological. He developed complex systems of representation that registered traces of insect flight in light and dark abstractions. More than one hundred years later, Nuridsany and Pérennou still needed to develop new cinematic technologies to capture insect life on film. Second, released just after the centenary of the cinema, *Microcosmos* serves as a useful tool for exploring the relationship between popular science, cinematic technology, and insects that unites in some small way the end of the nineteenth with the end of the twentieth. This is not to discount the importance of the intervening years; the anachronism merely serves to highlight the ongoing enigma of insect-media-human relations.

In order to get the tracking, macro-cinematographic shots of their insect actors in *Microcosmos*, Nuridsany and Pérennou had to create specialized technologies that, like Marey's studies of insect movement, both clarify and abstract the insect world. Despite this abstraction, *Microcosmos*, like Fabre's enduring *Souvenirs*, utilizes an anthropomorphic style that ensures its widespread appeal. *Microcosmos* participates simultaneously in Fabre and Marey's distinct entomological discourses. On the one hand, it explores the similarities and differences between insect and human behavior; on the other, it flattens its subjects through magnification, shallow depth of field, and slow-motion into abstract movement and color.

Nuridsany and Pérennou began their investigation into insect life as biologists, gradually moving towards popular audiences with books of photography, 16mm French television programs, and eventually 35mm films about bugs.⁴ For *Microcosmos*, their first feature length project, Nuridsany and Pérennou teamed up with producer Jacques Perrin (who later went on to direct another immensely popular nature film, *Winged Migration*, in 2001). *Microcosmos* is the product of 15 years of field research, two years of technological development, and three years of shooting.⁵ It premiered at the 1996 Cannes Film Festival and was considered the surprise star of the festival. Though it did not

win at Cannes, it went on to be very successful at the Cesar awards (France's Oscars equivalent), winning for best editing, cinematography, music, and sound.⁶ All of this is to say that, despite its lack of expert commentary and focus on everyday versus extraordinary circumstances, *Microcosmos* was very popular among French and North American audiences. This popularity of *Microcosmos* is doubly surprising considering its focus on unpopular creatures.

Insects inhabit a conflicted space in Western popular culture. They act as both essential pollinators and agricultural pests, as food for some, and disease vectors for others. On the one hand, they are seen as fascinating analogues for the larger human world. Some species are portrayed as representative of the sociality of human beings (like ants, bees, and termites), while others are taken as miniature examples of the radical individuality of the capitalist subject (the black widow spider or praying mantis who eat their mates, for example). On the other hand, insects are presented as objects of extreme alterity. They are framed in ways that highlight their difference from the human subject. Their reliance on instinct over intellect, their strange behaviors, and their alien appearance are foregrounded in some popular media to produce feelings in the viewer of abjection, fear, and wonder. Insects complicate the anthropomorphic and zoomorphic tendency to relate other species to ourselves. That bugs are so radically different from humanity makes our shared behaviors all the more poignant. Both Fabre's *Souvenirs entomologiques* and *Microcosmos* rely on the trope of the familiar within the strange, alternately representing insects as human analogues and as fascinating other.

One of the scenes in *Microcosmos* cited most by both reviewers and scholars presents both discourses of the insect simultaneously (though it in fact depicts a species of mollusk).⁷ The scene begins with a snail sliding along a verdant landscape to the dramatic score of an operatic aria. As the aria increases in intensity the snail discovers a mate, and they begin a slow courtship dance. That the snails mate face to face, combined with the human pathos of the opera music, creates an anthropomorphic scene. And yet there is something disquieting in it as well. The way the moist folds of the snails' feet intertwine and overlap, the searching and recoiling

antennae, the juxtaposition of the human singing voice with the instinctual ritual of the terrestrial gastropod mollusk all produce a feeling of repulsion. The duality of fascination-repulsion is what characterizes these popular entomological texts.

Magnifying glasses and film cameras mediate this fascination-repulsion by allowing amateur entomologists, filmmakers, and audiences to voyeuristically enter “another world” (as the realm of insects is often described). *Microcosmos* enters the world of insects from two angles. Along one vector, in the style of Fabre, the film creates highly constructed portrayals of insect life; stylized, yet self-reflexive narratives of natural history. On the other, with methodologies like Marey’s, *Microcosmos* turns the world of insects into an abstraction. Nuridsany and Pérennou, following Fabre, are natural historiographers, conscious of the benefits and drawbacks that narrative has for crossing the gap between the two perceptual worlds. Marey believed, conversely, in technologies that could represent insects in an abstract, non-narrative fashion. Fabre searches for and reproduces an intelligible insect voice, while Marey produces specialized technologies of representation to study insect behavior abstracted from language. *Microcosmos* is a marriage of these two seemingly contradictory approaches.

The Insect Voice

Jean-Henri Fabre, immortalized as an amateur scientist of little means, eked out an existence by writing popular scientific texts.⁸ His calm and indefatigable observational skills, combined with his engaging prose, eventually propelled his books to international success (though he saw little fame in his lifetime).⁹ Fabre began as a schoolteacher who spent his spare time studying insects in the field. Money was a constant problem and it was not until he was 55 years old that he was able to afford a small piece of land on which he could conduct his entomological studies. His two-acre *Harmas*, located near the village of Sérignan in southern France and covered in thorny plants and rocks, was an insect haven.¹⁰ Here he observed his quarry *in situ*, for he preferred to study their behaviors while they were alive, rather than their anatomy when dead.¹¹

Fabre conducted simple experiments, often without the help of even a microscope, and wrote about the results in a literary style that drew both praise and criticism from his contemporaries. Charles Darwin called Fabre an “incomparable observer,”¹² while others payed him back-handed compliments. Charlotte Sleigh, in her book *Six Legs Better*, summarizes one typical attack: “[Fabre’s] use of juvenile language was defended as ‘the right way for the simple to understand one another,’ a turn of phrase that covers the insect and the observer, as well as the author and the reader.”¹³ Even in criticizing Fabre, his detractors could not help alluding to his ability to communicate with his invertebrate companions. Under these attacks, Fabre implores the insects to come to his defense:

Tell of the intimate terms on which I live with you, of the patience with which I observe you, of the care with which I record your actions. Your evidence is unanimous: yes, my pages, though they bristle not with hollow formulas nor learned smatterings, are the exact narrative of facts observed, neither more nor less; and whoso cares to question you in his turn will obtain the same replies.¹⁴

This quote highlights two themes of the entomological discourse that *Microcosmos* participates in. First, Fabre appeals to the insect voice. He asks them to verify his scientific rigor both by telling of his patience and care in observation and recording and by repeating their observed actions for whomever else might care to look. Fabre’s stylistic devices imply that an overlap exists between the communicative world of the human and that of the insect. This overlap can be discovered through an ethnographic immersion into the world of insects by anyone who cares to put in the time. While both Fabre and his critics drew attention to his communication with the insect world, Sleigh makes it clear that Fabre was not looking to bugs for moral lessons that could be transported to the human realm.

The second theme illuminated by Fabre’s self-defense in the above passage is the affirmation that he has created an “exact narrative of facts observed.” This conception of a narrative of facts blurs the line

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between science and fiction. However, as Sleigh notes, Fabre's main goal was to "make the writer disappear from the text, and then let the reader read nature directly."¹⁵ The tropes of the insect voice and of the self-effacing narrative of facts reoccur in *Microcosmos* roughly eighty years after Fabre's death. Scott MacDonald, in the introduction to his interview of Nuridsany and Pérennou, points to this ideal form of insect representation:

Not only did I find the imagery of insects astonishing, but I was deeply moved by the filmmakers' attitude towards their subjects, and especially by their willingness to allow viewers to see what insects do, rather than simply hear an explanatory lecture illustrated by imagery.¹⁶

For MacDonald, the lack of narration in *Microcosmos* minimizes the distance that the camera imposes between viewer and viewed. It participates in a self-effacing narrative of facts, giving a voice to the insect through a transparent style borrowed in part from the flowing prose of Fabre.

The production of *Microcosmos* closely resembles that of Fabre's *Souvenirs entomologiques*. Both texts required extensive field research, cohabitation with the subject matter, and careful construction and observation of experiments or scenes. Nuridsany and Pérennou spent fifteen years gathering the notes that inform *Microcosmos*' script; they built a 100-square-meter outdoor studio beside their house in the south of France (geographically quite close to Fabre's *Harmas*), and captured for the first time on 35mm film, for example, the rare Argyronet spider constructing its unusual house of under-water air bubbles.¹⁷ In describing this strange spider's project, Nuridsany adopts a tone reminiscent of Fabre:

It's a spider living under water, building its house with air, a material which is immaterial, as you well understand. Our spider had to make this "diving bell" in order to eat his prey, a fresh-water shrimp. In the film it is seen tearing off air bubbles one after the other from the surface to make itself a bubble under water. It may sound quite paradoxical,

and yet our eyes allow us to see, if I may say so, something that seems impossible.¹⁸

Fabre and Nuridsany and Pérennou reject the dry, academic tone of scientific texts and documentary narration. But they do not, despite what critics may accuse, therefore merely produce accounts that anthropomorphize insects for popular consumption. They tread a fine line that wanders at times into depictions of identity between humans and insects and at others towards representations of the radical alterity that exists between the two worlds. As Sleigh notes, "The apparent division of writing into scientific (unsentimental, not anthropomorphic) and merely natural historical (sentimental, anthropomorphic) was, and is, simplistic."¹⁹ Fabre's writings and *Microcosmos* are both texts that attempt a direct representation of nature through a highly stylized form. The anthropomorphism that surfaces occasionally from stylistic representations of bugs is powerful because it temporarily constructs a bridge across the seemingly vast ontological gap between human and insect existence.

Arguably, without the help of a stylistic narrative, the otherness of insects would dissuade the general public from taking any interest in these miniature creatures. As Sleigh notes, "entomologists might have been justified in their frequent complaints that the scant scientific attention their insect subjects received owed to a lack of aesthetic appeal."²⁰ However, when passionate entomologists like Fabre and Nuridsany and Pérennou hold the magnifying glass up for us, certain insects demonstrate their aesthetic appeal with ease. This is evident in one of Fabre's well known studies, which is reproduced in *Microcosmos*.

In Fabre's discussion of the pine processionary caterpillar, he demonstrates that if coaxed into a circle, these insects that walk along in a neat line will perpetually follow each other until nearing death. This is because the processionary caterpillars produce a fine silk thread that they use as a combination of road, map, and communication system. When they set out as a group, the caterpillars form a line with a fortuitously elected leader who, according to Fabre, chooses the group's course instinctually, beset as he or she is "by the lack of any gleam of intelligence

in their benighted minds."²¹ The group follows in single file, contributing their own silk thread to the growing life-line initiated by the leader. Thus, as Fabre describes, it is possible, by eliminating all strands of silk that might lead the group away from a circumferential path, to artificially encourage the caterpillars to form a circle. In Fabre's experiment the caterpillars circumnavigated the rim of an earthenware pot for almost eight days, covering a distance of roughly 453 meters before their hunger and exhaustion caused them to stumble off-course to their safety. Despite his belief that these caterpillars, and insects generally, are stupid (or purely instinctual), Fabre meditates on the social nature of the little road-builders. He states, "The silk thread is something more than a road-making expedient: it is the social bond, the system that keeps the members of the community indissolubly united."²² Despite their apparent lack of intelligence, these metamorphic creatures utilize a system of communication that resembles both a road and a telecommunications network (vibrations along the thread signaling danger). Thus Fabre's account brings to mind both the caterpillars' absolute otherness from, and communicative similarity to, human experience.

While this strange behavior is interesting in its own right, Fabre's invocation of the insect voice and narrative in his description of it is also important. In "The Pine Processionary," he speaks directly to the caterpillars: "Let us make a compact. You have a story to tell. Tell it me; and for a year, for two years or longer, until I know more or less about it, I shall leave you undisturbed, even at the cost of lamentable suffering to the pines."²³ In collecting the stories of caterpillars, Fabre shows himself to be a prescient natural historiographer, acknowledging the constructed, even fictional, character of any scientific representation. He also, again, invokes the potential for communication across the divide between the worlds of insects and humans, as if there might be a thin silk thread that could connect the two disparate realms.

In *Microcosmos*, the pine processionary experiment is repeated and captured on film. The caterpillars are first shown undulating in a straight line that extends out of the frame, then merging with another line, and ultimately forming the circle that Fabre thought fascinating. The cinematic

version holds both more and less information than the original written account. On the one hand, it lacks certain information that Fabre provides (the length of time these caterpillars might stay on the circular track, for example). On the other, it provides a plenitude of minutiae describing the color, texture, movement, and environment of the caterpillars that make and follow their silk network. It also provides photographic evidence of a phenomenon we otherwise had to take at Fabre's word.

While Fabre influenced *Microcosmos* in terms of content and style, Marey's experiments on insect flight have affected the development of cinema in general, and the special technology used in *Microcosmos* in particular.

The Cinematic Insect

That the invention of the cinema is indebted in part to Étienne-Jules Marey's experiments on human and animal locomotion, and more specifically his *fusil photographique*, or photo gun, has been well established by Marta Braun in *Picturing Time* (1992) and François Dagognet's *Étienne-Jules Marey: A Passion for the Trace* (1992).²⁴ Of less interest to date, however, is the role insects played in Marey's study of movement, and thus in the creation of the cinema. In 1879 Marey published *La Machine animal*, which devoted a whole section to the complexities of observing insect flight. While Fabre crossed the boundary between human and insect worlds with little more than a magnifying glass and his determination to cohabit with them, Marey developed elaborate technologies to observe the realm of the invertebrate otherwise off limits to human perception. Certainly Nuridsany and Pérennou's cinematic style can be viewed as a translation of Fabre onto film, but the means by which they achieved this effortless style owes more to a technological craftiness similar to Marey's.

In *La Machine animal* Marey sets out to explain the nature of insect flight by observing the frequency, successive positions (or path), and motive force of the wings. This project is made difficult by the fact that many insects' wings move faster than the human eye can perceive. According to Marey, other scientists at the time attempted to ascertain frequency by measuring the sounds coming from insect wings. Marey faults this method by citing the

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influence the Doppler effect has on an observer's ability to consistently observe frequency by sound. Instead, Marey affixes blackened paper to a rotating cylinder, holding a live insect with forceps so that its wings brush against the surface. This produces traces of the insect's wings that translate a movement too rapid for the eye into a format better fit for human observation. It also produces a beautiful abstraction, something Marey had a penchant for (see Fig. 1).

While this experiment proves useful for Marey, he recognizes its limitations. In the same way that the observer affects the outcomes of a sonorous study of insect wing frequency due to their relative position, the wing-trace method of observation also affects its outcome. Marey notes that "the wing that rubs on the cylinder has not its normal rate of motion."²⁶ Thus, the friction produced by the contact between wing and cylinder, necessary for this aspect of the insect world to reveal itself to humans, obscures a transparent recording.

Nuridsany and Pérennou faced similar obstacles in their attempt to photograph insects acting as though unobserved. As Michael Ferraro notes in his article on *Microcosmos* in *American Cinematographer* the shooting of insects is difficult not only because of their size, but also because their habitat is often dense and dark. Thus, in order for Nuridsany and Pérennou to achieve 35mm footage of behavior they had observed occurring "naturally" during their 15-year research period, they had to construct an elaborate studio and camera system. Many of the scenes in *Microcosmos* are therefore shot on artificial sets. Lighting posed a particular problem for Nuridsany and Pérennou when filming insects, for a large amount is needed to achieve depth of field when using "specially transformed Ziess and Leitz microscope lenses."²⁷ The intensity of the lighting produces heat lethal to the bugs, and so special infra-red filters had to be attached to the lights. This highlights not only the difficulty humans face trying to observe insects "acting naturally," but also the great technological innovations the entomologically inclined will produce in order to

enter the world of bugs.

Nuridsany and Pérennou, like Marey, are not ignorant of the effect their observation has on their subjects. They repeatedly refer to the insects they work with as actors, and the narrative that they produce as a sort of fiction.²⁸ In this way they blend the self-conscious anthropomorphism of Fabre with the strict empiricism of Marey. Nuridsany and Pérennou state:

In order to film the inhabitants of that [insect] planet, we wanted to use the same tools used to film actors and actresses in fiction films—traveling shots, cranes, et cetera—so as to give the insects the stature of real characters. For that, we had to conceive new tools, since the ones that already existed could not function satisfactorily at such a small scale.²⁹

These new tools were the products of a collaboration between Nuridsany and an engineer. Together they developed an anti-vibration mount that allowed a specially designed 35mm camera to be remote controlled along five axes from a different room.³⁰ In this way, while Nuridsany and Pérennou openly admit to the constructed nature of the fiction they produce (like Fabre), they also seek a technological method that will efface the trace of the human from the insect representations presented on screen (like Marey).

For Marey was not satisfied with the incomplete and altered traces left by the insect wings on carbon paper. He developed an ingenious new method to ascertain the path of the insect wing, just as cinematic as the *fusil photographique* (See Fig 2).

In order to overcome one flaw in human perception, Marey turned to another. By painting the topside of a wasp's wings in gold leaf and placing it in a sort of *camera obscura*, Marey was able to utilize persistence of vision to ascertain the exact trajectory of the insect's appendage. Marey explains:

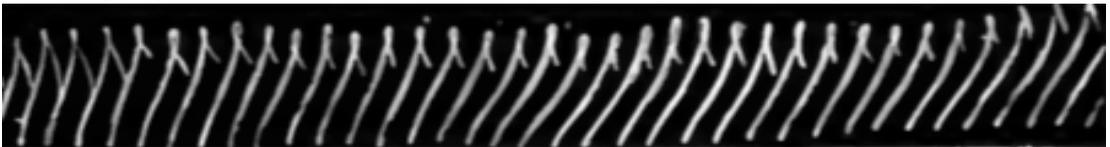


Fig 1: Traces of a wasp wing²⁵

In fact, if we attach a brilliant spot to the extremity of the wing, this spot passing continually through the same space would leave a luminous trace which would produce a figure completely regular, and free from the deformity incident to that effected by the friction on the cylinder.³²

In this way Marey produces a cinematic insect. The golden-winged wasp presents Xeno's paradox of motion. The motion of the wings is broken into static moments, or shots, and reconstituted by the human eye into a luminous trace. In a sense, Marey was aware of the paradoxical nature of the study of motion, for he is careful to specify his desire to learn the "successive positions" of the insect wing. What Marey does not contemplate, however, is that in liberating himself from one perceptual obstacle, namely the friction of the cylinder, he had introduced another. For might it be demonstrating not wasp flight, but the action of a wasp attempting to shake gold paint from its wings?

This highlights not only the difficulty humans have in interpreting insect behavior, but also the potential non-human beings have for effecting meaningful (albeit ambiguous) representations of themselves through human media. At the end of Donna Haraway's chapter on Crittercams (cameras attached to animals by nature filmmakers) in *When Species Meet* she draws attention to an important question. She asks, "What is the semiotic agency of the animals in the hermeneutic labor of Crittercam?"³³ This question applies equally to the insect subjects represented in the texts discussed here. What meaning-making agency can we attribute to the cinematic insects of Marey's experiments? Their expressions of struggle leave traces on blackened cylinders and in *camera obscuras*, expressions that Marey interprets as representative of "natural" movement but can also be seen as abstract art. Fabre is much more open to the idea that insects have representative agency, as his appeals to the insect voice indicate. Nuridsany and Pérennou leave space for insect semiotics as well by avoiding the overdetermining feature of the nature documentary narrator. The insect voice and the cinematic insect, two entomological paradigms that converge in *Microcosmos*, show how the anthropomorphic can

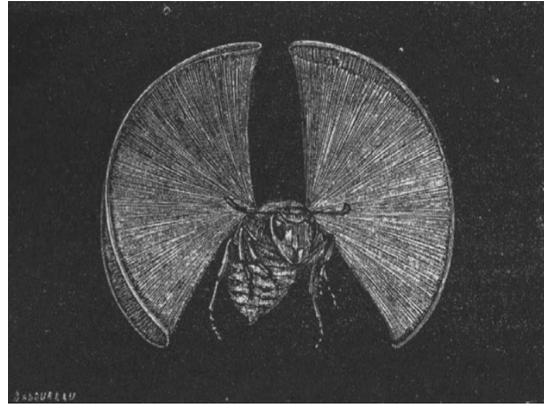


Fig 2: Illustration of a gilded wasp.³¹

become disengaged from the anthropocentric.³⁴ They are styles of scientific representation that leave a little space for the insects to speak for themselves.

Nuridsany and Pérennou, like Marey, utilize cinematic technology to obtain perceptual data off-limit to the unaided human eye. Much of the film is shot with specialized lenses more like microscopes, giving us access to a clarity and detail at a scale normally beyond our eyes' reach. More specifically, however; *Microcosmos* presents two studies of insect flight that, I think it is safe to say, would have delighted Marey.

Both of these attempts to transport the human eye beyond its capacity required specialized technology. The first, several slow-motion shots of ladybugs taking flight, required the use of a high-speed camera capable of taking 500 frames per second. In slowing the shots down by roughly twenty times, Nuridsany and Pérennou create an almost abstract image of insect flight. In this way the film can be grouped into the genre of insect abstractions of which the works of Marey (and Stan Brakhage's *Mothlight* [1963]) are a part. The second consists of a sequence where a camera, that itself flies, follows a dragon-fly. According to Ferraro, the dragon-fly scene was shot with "an ultra-light, 35mm miniature camera mounted inside a remote controlled helicopter."³⁵ This early example of drone technology—appropriately named after a member of the bee community—mimics the insect in order to enter its world.

Fabre, Marey, and Nuridsany and Pérennou all attempt to bridge the perceptual gap between insect and human worlds. Each in their own way

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turns this gap into an overlap with the aid of media. Either, as in the case of Fabre, they reconstitute the behavior of insects into a narrative, a story, but one ambivalent to anthropomorphism and self-aware of its constructed nature; or, as with Marey, they develop specialized recording devices that render data beyond the range of our senses comprehensible, in the form of abstract yet empirical representations. Nuridsany and Pérennou employ the seemingly contradictory methodologies of Fabre and Marey,

producing a documentary that vacillates between narrative and abstraction, anthropomorphism and othering, natural historiography and empirical representation, fascination and repulsion. *Microcosmos* turns the human-media-insect relation into a continuum with overlapping ontologies. It both decentres the anthropocentric gaze adopted by many nature films, and makes a little space for the semiotic agency of the insects themselves.

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Notes

1 Scott MacDonald, "The Natural World as Parallel Universe: *A Divided World* (1948) and *Microcosmos* (1996)," *Film Quarterly* 59.3 (2006): 13-21.

2 Étienne-Jules Marey, *Animal Mechanism: A Treatise on Terrestrial and Aerial Locomotion* (New York: D. Appelton and Company, 1879).

3 Jean-Henri Fabre, *The Insect World of J. Henri Fabre*. Trans. Alexander Teixeira de Mattos (New York: Dodd, Mead & Company, 1949).

4 Scott MacDonald, "Interview with Claude Nuridsany and Marie Pérennou," in *Adventures of Perception: Cinema as Exploration: Essays/Interviews* (Berkeley: University of California Press, 2009), 184.

5 Neff Renfreu, "Buying and Booking Guide: *Microcosmos*," *Film Journal International* 99.9 (October 1, 1996): 41.

6 Francois Meaux Saint Marc, "Microcosmos, Ridicule Share Cesars Prizes," *Screen International* (February 14, 1997): 8.

7 Brendan Christie, "Wildlife's Greatest Hits," *Realscreen* (Sept/Oct., 2007): 66-71; Brendan Kelly, "Microcosmos," *Variety* 363.3 (May 20, 1996): 33; MacDonald, "Interview," 2009; Billy Bud Vermillion, "The 'Wondrous Truth' of *Microcosmos*," *16:9 in English* 21 (April, 2007).

8 Edwin Way Teale, "Introduction," *The Insect World of J. Henri Fabre*, by Jean Henri Fabre, Translated by Alexander Teixeira de Mattos (New York: Dodd, Mead & Company, 1949).

9 Fabre's *Souvenirs entomologiques* were translated into Japanese as early as 1922. The books have never gone out of print since, and were some of the only foreign texts not banned during WWII. Even more strangely, the *Souvenirs* were allegedly one of two books kamikaze pilots were allowed to possess. Mary A. Knighton, "Becoming-Insect Woman: Tezuka's Feminist Species," *Mechademia* 8 (2013): 3-24.

10 Teale, "Introduction," *The Insect World*, xi.

11 Charlotte Sleight, *Six Legs Better: A Cultural History of Myrmecology* (Baltimore: The Johns Hopkins University Press, 2007).

12 Teale, "Introduction," *The Insect World*, xiv.

13 Sleight, *Six Legs Better*, 123.

14 Fabre, *Insect World*, 3.

15 Sleight, *Six Legs Better*, 124.

16 MacDonald, "Interview," 184.

17 Michael Ferraro, "Angles on Insects," *American Cinematographer* (Jan. 1997): 78.

18 Ibid, 78-9.

19 Sleight, *Six Legs Better*, 128.

20 Sleight, *Six Legs Better*, 6.

21 Fabre, *Insect World*, 23.

22 Ibid., 14.

23 Ibid., 10.

24 Marta Braun, *Picturing Time: The Work of Étienne-Jules Marey (1830-1904)* (Chicago: University of Chicago Press, 1992); François Dagognet, *Étienne-Jules Marey: A Passion for the Trace*, trans. Robert Galeta with Jeanine Herman (New York: Zone Books, 1992).

25 Marey, *La Machine animal*, 192.

26 Ibid., 184.

- 27 Ferraro, "Angles on Insects," 78.
- 28 Georgina Evans, "A Cut or a Dissolve?: Insects and Identification in *Microcosmos*," In *Animal Life and the Moving Image*, eds. Michael Lawrence and Laura McMahon (London: British Film Institute, 2015), 111.
- 29 MacDonald, "Interview," 190.
- 30 Ferraro, "Angles on Insects," 78.
- 31 Marey, *La Machine animal*, 187.
- 32 Ibid., 186.
- 33 Donna Haraway, *When Species Meet* (Minneapolis: University of Minnesota Press, 2007), 261.
- 34 James Leo Cahill, "Animal Photogénie: The Wild Side of French Film Theory's First Wave," In *Animal Life and the Moving Image*, eds. Michael Lawrence and Laura McMahon (London: British Film Institute, 2015).
- 35 Ferraro, "Angles on Insects," 79.