15 : : **Animating Uncommon Life: U.S. Military Malaria Films (1942–1945) and the Pacific Theater**

BISHNUPRIYA GHOSH

But malarial fever is important not only because of the misery it inflicts on mankind, but the serious opposition that it has given to the march of civilization in the tropics. Unlike many diseases, it is essentially an endemic, a local, malady; and one which unfortunately haunts more especially the fertile, well-watered and luxuriant, tracts—precisely those which are of the greatest value to mankind. There it strikes down, not only the indigenous barbaric population, but, with still greater certainty, the pioneers of civilization, the planter, the trader, the missionary, the soldier. It is therefore the principal and greatest ally of barbarism.

RONALD ROSS, *Researches on Malaria: Nobel Lecture, December 12, 1902*

Malaria (1898)

At the dawn of the twentieth century, a new actor arrives on the global stage. Its agency seems planetary, here before us, and perhaps . . . after us. Human history, civilization, is but a phase in the *longue durée* of the malarial parasite. Not so long ago, nineteenth-century miasma theories named the disease after "bad air," *mal aria*, before germ theory established the primacy of biological agents in states of infection. Bad air over in India, over in North Africa, yes; but then, the British and French colonial forces were *there*, exposed to a resilient nonhuman Other in the tropics. In 1878 Alphonse Laveran had identified plasmodium or sporozoites, little curved creatures swimming in the bloodstream of 148 out of 192 patients struck with cyclic fevers, and in 1897–98, Ronald Ross, studying bird malaria, had located the carrier, an agent perceptible to the naked human eye, in the anopheles mosquito.[1] In his acceptance speech for the subsequent Nobel Prize that he received for this research,[2] the specter of bad air reappeared: it was not just the nonhuman agents, plasmodium, and the anopheles that were responsible for the

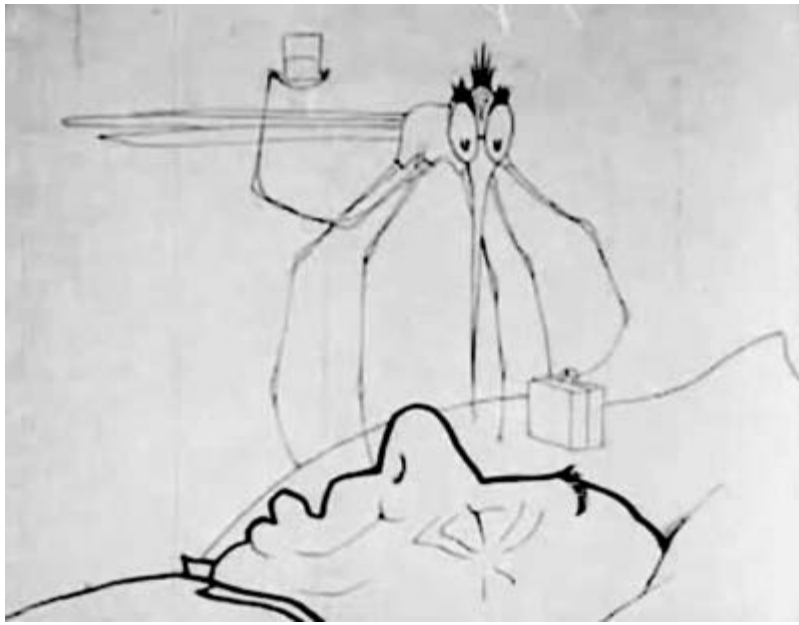

FIGURE 15.1 The first animated mosquito. Frame from *How a Mosquito Operates* (1912). Courtesy of Winsor McCay.

disease, but water, lush vegetation trapping water, humid air, the dim cool of the twilight—in fact, all of nature *over there* in malarial climes. Hence, the scale on which Ross articulates malarial infection astonishes: a planet where humans, the nineteenth-century premiere agents of history, find themselves in an agonistic struggle with nonhuman microbial life, "uncommon" in the sense of life forms antithetical to human survival.[3]

Animating Anopheles (1912)

A giant mosquito wearing a top hat flies through the open window. The outside infiltrates a domestic space suddenly vulnerable to tiny intruders. Casting knowing glances at the audience the anopheles feasts until he explodes. So goes the transformation of the mosquito, the nonhuman enemy par excellence in Winsor McCay's six-minute line-drawn animation *How a Mosquito Operates* (1912) (see figure 15.1).[4] A first in reverse animation (running the animated sketches backward in the latter part of the film), the film preceded McCay's better-known feature-length animation *Gertie the Dinosaur*, placing the mosquito within an

iconography of marvelous creatures—dinosaurs, certainly, but also the winged lizards and sea serpents of McCay's running comic strip *The Land of Wonderful Dreams*. In fact, Gertie first appeared in the comic strip on September 13, 1913, before his appearance on film; and when the film was released, McCay combined live performance *with* the screening, talking to Gertie on stage before a wide-eyed audience when the film first screened at Chicago's Palace Theater on February 8, 1914. As we shall see, McCay's combinatory praxis of juxtaposing graphics, live performance, line-drawn, and, later, cel animation would persist in medical and scientific documentaries on life explicitly marked as *non*human. In turn, the thoroughfare between modes of animating nonhuman life impacts animation as a political technology.

These two scenes from the early twentieth century serve as a link between two seemingly unrelated domains that I hope to engage: (1) scientific animations of infection, a flourishing industry that sells pedagogic films to laboratories, educational institutions, and corporate media platforms at the present juncture; and (2) contemporary globalizing protocols, agreements, and treaties that seek to secure human populations against infection. Scientific animations, plunging us in cellular worlds, nurture the cellular agon of infection, the unending cellular hostilities, as a common human condition. Here the artifice of the self-contained universe, sketched, photographed, or digitized from the advent of single-cel animation (perfected by Earl Hurd in 1914), against which animated actors move, facilitates the act of enclosing us within a single scale of action. We wander in the cellular world, for instance, a marvelous autonomous universe with its own set of rules. We play according to rules of the game that simplify, classify, and differentiate our real enemy as the parasite—and only that. Gone are self-serving human interests that shape the biopolitical distributions of health that we know well from horrifying stories of clinical trials gone bad, *over there*, or indeed from reports on the Trade-Related Aspects of Intellectual Property Rights agreement of 1995 to limit the dissemination of cheap generic drugs for AIDS-related therapies.[5] Consequently, animation can come to constitute a cultural ethos that rationalizes globalizing biosecurity imperatives as benign collective projects. If we reinsert the global as a myth of totality back into the cellular-planetary axis, then the limitations of rules that serve the specific interests of corporations, institutions, and states become clear.

If the epistemology of infection, with its founding cellular agon, makes "worlds" in the name of science, animation media technologies,

in particular, offer ample arsenal. From the moment of inception, the labor-intensive production process (McCay was reputed to draw four thousand sketches a month for his line-drawn work) modeled procedures for visualizing cellular life in the laboratory: for instance, while animation techniques layered image and background in a composite, scientists marked cells under scrutiny with dyes of cells to *foreground* them against the extracellular environment. More important, both scientist and animator obsessively focused on a microunit, a single cel image or an organic cell, *stilled* in action, attending to the minutiae of changes, modifications, and reconfigurations to the unit. McCay's "split system" of using "key frames" in his storyboards, before sketching in the transitional frames, exemplified the scientific effort to isolate snapshots in the life cycle of microbes. Certainly the microunit, copied and multiplied, proliferating and moving between discrete worlds, preoccupied both scientists and animators. In cel animation an image drawn on cellulose acetate could speed across painted or photographed backgrounds, from the tropics to the North Pole in a second. What better technology could one have to vivify uncontrolled *infection* sweeping across the hitherto discrete global environments? No wonder animation came to play a central role in the epistemology of infection by the second decade of the twentieth century. But that was a time of escalating human hostilities. Hence, animating infection would irrevocably become a militarized scientific enterprise at this historical juncture, and therefore instructive for present obsessions with biosecurity.

A fundamental part of the visualization of "life itself" (the prevailing critical shorthand for our biological existence) was cinematic malaria animations made for scientific research (mostly lab microcinematography in the early years) and for public health (military-training films during the Second World War). My underlying claim is that the *epistemology of infection* in mid-twentieth-century film animation was formative to the militarization of biosecurity regimes on a global scale, evolving as they did into "vital systems preparedness" for all catastrophes that are widely prevalent today.[6] If we live in constant terror of the next bioterrorist infraction, as the recent flap over lab-engineered flu viruses for research indicates, a return to the Pacific theater of war, where we see a consolidation of the first infrastructures of preparedness, is timely indeed. There the tropics, those infamous hot zones of rampant infections that haunt global public-health initiatives, appear as a dehumanized milieu that lays asunder human life. There both human hostilities and ecological disequilibria play a role in exacerbating our cellular agon.

My main argument concerns the animation of "life itself" at a moment of crisis, when life faces the possibility of catastrophic annihilation, and the corollary infection topologies constitutive of biosecurity as we understand it today. Animation turns infection, in its double articulation as ontological condition and scientific theory, into a concrete epistemological object, as Hans-Jörg Rheinberger has argued vis-à-vis the gene.[7] The object is concrete because the epistemology of infection is as dependent on laboratory techniques and procedures (e.g., changes in staining, dyeing, or freezing cells), advanced bioimaging technologies (e.g., new microscopes capable of amplifying protein fluorescence), and innovative software (e.g., three-dimensional reconstructions of the cell from sectional images) as it is on shifting scientific protocols and methods, adaptive public-health regulations, and a dynamic popular culture on human and nonhuman collectivities. Yet most scholarship on mediating life itself remains focused on exciting technologies and booming informatics, lightly skirting the *governance* of vital circulations through media technologies. There are complex analyses of molecular and cellular imaging that meticulously elaborate new possibilities offered by fluorescent microscopy, X-ray tomography, and confocal microscopy (mostly in laboratory pedagogy of the life sciences).[8] There is flourishing research on bioimaging as theory and practice (e.g., Christopher Kelty and Hannah Landecker's engagements with the material processes of capturing cellular life over the span of the twentieth century) and on the truth effects of the bioinformatic turn (e.g., Kirsten Ostherr's scrutiny of medical animation as documentary).[9] And there is rigorous interrogation of the globalizing force of prophylaxis, which includes collusions between big pharma, university laboratories, research institutes, local and supranational public-health agencies, policy wonks, and financial investors, in maintaining infection equilibriums (e.g., Melinda Cooper, Joe Dumit, and Kaushik Sunder Rajan's ongoing projects on biocapital).[10] Only on few occasions do theorists of global capital work alongside theorists of science and media technologies ask how imaging and informatics technologies produce value, in order to govern life within ecological networks. Such governance through biosecurity regimes is inextricable from the integrative processes of global capitalism.

The story of malaria, eclipsed when parasites receded before the march of illustrious and resilient viruses, elaborates this hitherto unexplored dimension: a cellular agon, with its specific modalities (its formal grammar, its techniques, and even its genres) manifesting as biosecurity. If war has been the touchstone for the expansion of industrial capital,

what role does the mediation, and specifically the *animation*, of life itself play in this global history? I offer a theory of the cellular agon as a provisional starting point to make the theoretical connections between technological and political projects of securing life against unseen hostile forces within the ecological network. Imaging infection entails the vivification of what was once supplementary to the cell (the customary focal point): its milieu (conventionally construed as the extracellular environment). In cellular animations of microbial forms hostile to value-laden cells that are critical for human survival, such as red blood cells (microbial forms infiltrate, reconfigure, and finally kill these cells), the milieu bites back. A topology—a mathematical structure allowing for articulations of convergence, connectedness, and continuities—of infection emerges, galvanizing medical prophylactics aimed at restoring cellular and extracellular equilibrium. If, as in the case of malaria, that topology extends well beyond the human body and into the world, then we are faced with the politics of "to make live and let die," as Michel Foucault puts it—the backbone of biosecurity. It is thus critical to look at exactly how these cellular wars are vivified, because of what those processes illuminate about the contemporary shadows of biological warfare.

The roots of imaging infection as a state of war are firmly yoked to the history of film animation. It is in malaria film that a third layer of animation becomes readily apparent: not the bioengineered "making live" of dead matter, not bioimaging and consequent computational reconstruction, but the animation of dying human cells struggling to live (to repair and regenerate) against existing ecological hostilities. That dimension manifest as a cinematic cellular agon stabilized during the Second World War when U.S. forces found themselves *over there*, in the Pacific, where a nonhuman enemy proved to be their greatest threat. In 1943 for every wounded British and American soldier evacuated from the Pacific theater, there were 128 sick with malaria. Given this subliminal war that redrew battle lines between human and nonhuman armies, I focus on military training films made between 1942 and 1945 that contextualize the flourishing cellular agon we find in spectacular scientific edutainment today.

The Cellular Agon; or, When the Milieu Bit Back

Malaria animation has an unforgettable, iconic image: the delicate female anopheles mosquito poised on human skin, pointed proboscis penetrating the surface. Almost every malaria film from the 1940s to

the present visualizes this moment of entry, the bite, as the opening sequence to human infection. Unlike the sporozoites that are only perceptible under the microscope, the anopheles is visible evidence of endemic hostilities. This cel-animated image from *The Winged Scourge* (1943) (see figure 15.2), the first among the educational shorts produced by Disney Studios under the aegis of the Office of Coordinator of Inter-American Affairs,[11] is followed by a series of diagrammatic sketches illustrating plasmodium passages (figure 15.3), static images of potential victims, and then the well-loved seven dwarfs heartily engaged in DDT spraying, assembling door screens, and eliminating pools of stagnant water. The combination of graphic forms and cel animation in this classic exemplifies the repertoire we find in most malaria animations. There are graphs, curves, and diagrams, the language of scientific instruction. There are well-loved cartoon figures, iconic humans as agents within the controlled, playful, cartoon universe. There are cel-animated moving images, as we see in the superimposed frame in figure 15.2, where the shot of the exposed human arm of a sleeping man fades into a close-up of anopheles on skin. There are static images of diagrams explained by the voice-of-god male narrator. There is cinematographic footage of swamps, of coming twilight, of plant-crowded water pools. And there is the inexorable sonic buzz of the coming mosquito before any close-up of the carrier. Such a combination of visual and sonic elements not just vivifies dynamic cellular processes but also codifies observation.[12] Consequently, these combinatory praxes effectively animate theories of the life, rendering them perceptible and intelligible.[13] Even as the sketches and diagrams slow down the processes of infection, reducing movement so we may better understand and calculate incidence, the second layer (the backdrop to the mosquito's antics) changes swiftly, generating the composite effect of speed. The animated mosquito zips across multiple global zones in a minute, conveying uncontrollable spreading infection. The viewer is caught in an experience of slowness and momentum that underscores the mammoth task of infection control that faces scientists, administrators, and the common man.

The combinations that Kelty and Landecker track in early twentieth-century films—time-lapse sequences of live cells writhing in preparations, hand-drawn images, line-drawn and cel-animated cartoons, and diagrams—recur in the military-training films, but with the one important difference.[14] These training films, "prophylactic media" as Kirsten Ostherr characterizes them, heavily rely on popular, culturally familiar cartoon figures to close the deal.[15] As a result, the films socialize us,

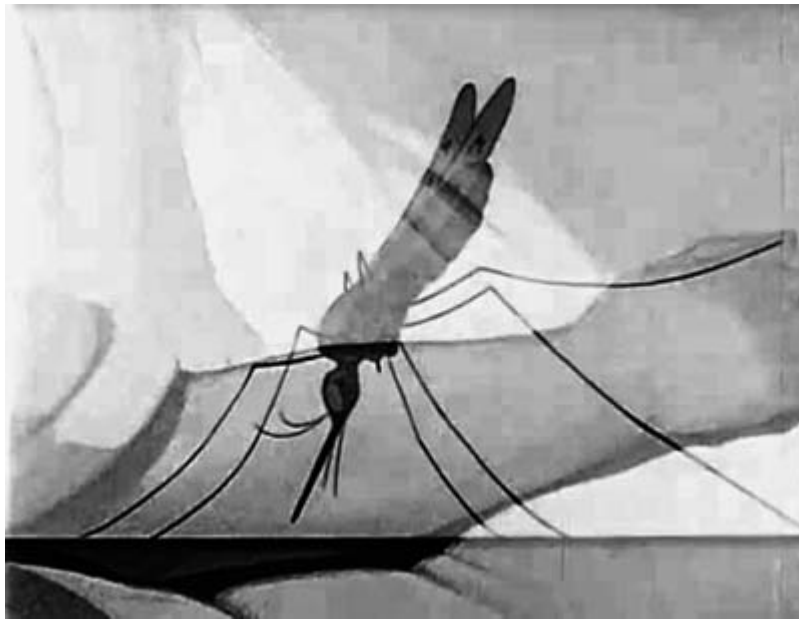

FIGURE 15.2 Cel animation of mosquito on human skin. Frame from *The Winged Scourge* (1943). Courtesy of Walt Disney Studios.

FIGURE 15.3 Diagram of mosquito bite. Frame from *The Winged Scourge* (1943). Courtesy of Walt Disney Studios.

teaching procedures and regulations for securing human life against infectious agents. Most of these films commence with codified scientific observation or realistic footage of the South Pacific, and then they introduce the cognitively estranging cartoon characters to animate what remains imperceptible to the eye: the larvae under water, the single hungry female anopheles too mobile to be visually captured, and the sporozoites within the bloodstream and liver. Ultimately, the cartoons codify the nonhuman world within and around us where the human is no longer the agent of change, of modifying life, even as the cartoon universe simplifies the complex topologies of infection.

But how do these films animate a cellular agon? Here it is constructive to return to Kelty and Landecker's argument regarding the status of bioimages in relation to knowledge. Less concerned with the ontological status of bioimages, the scholars sketch the scientific debates over the accuracy of capturing life in its dynamism that erupted after Julius Ries's famous film on the sea urchin in 1909: arguments over histological dyes that "killed" living cells; over the problem of fixing preparations that could sustain a cell through all its cycles; over the stitching of several different cells, shot at different moments of cell cycles, to represent one cell cycle; and over the compression of the life cycle in time-lapse photography. It is more important that such conversations testify to the denaturing of life itself under the microscopic gaze. Hence, argue Kelty and Landecker, there is greater continuity than we think between early twentieth-century microcinematographic manipulations of cellular imaging and the seemingly more artificial algorithmic reconstructions of cellular life at the close of the century. My interest is in articulating these perspectives on cellular life in terms of the imaging of infection or the colonization of a host organism by a parasite. If cellularity is the epistemology of *an* organism as the sum of discrete, repetitive parts, as Aristid Lindenmayer theorized it in 1968, what is the impact of imaging infection on animating cellularity?[16]

After all, the microcinematography of infection emerges over the same span of time, dating as far back as 1912, when commercial houses such as Pathé, Edison, Gaumont, and British Instructional Films, as well as laboratories at the University of California, Berkeley, and the University of Rochester in New York, produced scientific animations of malaria. The 1928 *Life History of Mosquito Aëdes Aegypti*, an Eastman classroom film made at the Kodak Research Lab, for instance, deploys time-lapse photography to track the life of the mosquito and shuttles between static and mobile images to make a case for the necessary res-

toration of ecological equilibrium. In this regard, unlike cel animations, an urgency pervades these projects of securing human life against the vicious carrier of malaria. There is already a strong perception of an elemental agonistic war, necessitated by malaria and yellow fever outbreaks among U.S. and British military units during the first two decades of the twentieth century. And we already see the beginnings of a cellular agon, the war within the cell, planetary in proportion, demanding public-health interventions. By 1927 W. Allen Daley, a British medical officer, coauthored a book on the efficacy of film as a public-health tool.[17] By 1933 President Roosevelt had funded the Tennessee Valley Authority and charged it with controlling malaria, which was impeding regional economic development; and between 1934 and 1940, corporations such as the German Bayer AG pharmaceuticals company (which developed the antimalarial chloroquine in 1934) and the British Shell Corporation had begun to produce malaria animations. The forces marshaled against the parasite were on the upswing when the war in the Pacific broke out.

I will turn to the public-health documentaries during the Second World War shortly. But what does this history of malaria animation reveal? Certainly it makes the unfolding of a cellular agon constitutive of cellular epistemology. Originally understood as a struggle for victory in the Olympic Games, the Greek term *agonia* underwrites the notion of the cellular agon that I theorize here, a war that unfolds in states of infection. If one confines oneself to biophysical or biochemical analyses of cellular processes, the term might seem a stretch. After all, cells are irrevocably porous and changeful; they routinely divide, separate, multiply, reconfigure, and die. But I am after an epistemological moment when the scientific gaze differentiates unicellular and multicellular biological organisms that live off human cells from value-laden human cells, and externalizes them as enemies engaged in hostile takeovers of a human host. Such a gaze is called forth by the frenetic activity of living organisms that catalyze mass human-cellular death. Animation not only theoretically reanimates the state of affairs before death but also remains integral for the mediation of this external object. The production of a composite layered image central to animation, multiplying and superimposing a single microunit (say, a mosquito) upon different background layers, enhances the possibilities of creating the sharp foreground-background distinctions attractive to scientists interested in differentiating, freezing, and then calculating cellular processes. The composite image further enables visualizing infection as a topographical assemblage, as cellular exchanges transpire between insect, human, and

parasite. The nonhuman agent (parasite and mosquito) is differentiated and jettisoned as belonging outside the human cell but still threateningly close, in the *milieu intérieur* (as Claude Bernard named it) or in the extracellular environment that ensures stability for multicellular living organisms. Of course, we have been long disabused of the notion of the human body as a separable "organic edifice," because contemporary science routinely positions the human within a network of organic and inorganic matter.[18] The idea of a dynamic network is resonant in Georges Canguilhem's elaboration of the milieu as the dynamic *medium* within which living organisms exist—an ensemble of actions rather than a passive environment.[19] Hence, the moment of the cellular agon is also when the milieu comes alive. It reveals itself in combinations of interacting agents: parasites and carriers but also water, plants, temperature, humidity, and bad airs.

In the recursive and highly symbolic icon of the hungry pregnant anopheles of the mid-twentieth-century malaria films, the milieu bites back. The instructional animations vivify the struggle between human and nonhuman cells that have irreconcilable differences, even as scientists, doctors, public-health specialists, and medical officers theorize the potentiality of cells to repair and regenerate against uncommon microbial life. In this regard, these animations are speculative technologies, warnings and predictions of rising infection. Calculations arise: What are the levels of the external agent within the milieu intérieur? How does the agent penetrate and reconfigure the cell? What is its lifespan? How can we secure its multiplication in order to stave off human-cell catastrophe? Interventions follow: What panacea is at hand? And, in the absence of a panacea, what medical prophylactics can be advanced? These questions jettison us back to the mid-twentieth century when infection topologies and security measures became inextricable, the one unthinkable without the specter of the other.

Securing Life; or, Once upon a Time in the Pacific, 1942–1945

The images still transfix. The sultry, blowsy Annie, the most dangerous criminal at large and on the lookout for lonesome U.S. soldiers on their patriotic sojourn over in the Pacific. In 1943 the U.S. armed forces commissioned Ted Geisel (Dr. Seuss) to do an educational pamphlet for American troops serving in the Pacific theater. The result was the "This Is Ann!" pamphlet, which introduced the cartoon femme fatale just dying to drink "your" blood in her sojourn *over there*: "She's at home in Africa,

the Caribbean, India, the South and Southwest Pacific, and other hot spots!" ran the accompanying caption, at once binding "Enemy Number Two" to the tropics. The cultural codification of an experienced, even rapacious, sex worker salaciously eyeing young American men would stick, making its way into animated medical instructional films for military training. In 1942 Colonel Frank Capra was already at the helm of the Armed Forces Motion Picture Unit, with Geisel in charge of the animation branch. The upshot was the memorable Private Snafu animated instructional films, featuring a boyish, hapless soldier bumbling along (through multiple snafus) in forgivable ways. Shortly after Capra created Private Snafu, mainly for a biweekly newsreel just for the armed forces, the Armed Forces Motion Picture Unit decided to let Disney Studios have the first crack. The results are unforgettable, especially with regard to developing a formal grammar, the *langue* of the cellular agon. With a "trail of broken men" in her wake, Ann / Annie surfaced in *Private Snafu: "Its Murder She Says"* (1945), educating younger sex workers by recounting her glorious sexual past (see figure 15.4). The campy voice-over turned nonhuman biological drives into human motives, even as the humor of the cartoon form defanged the hostility; moreover, the customary fun of violent clashes, chases, crashes, explosions of the toon universe absorbed the *ur-trauma* of the mosquito penetrating human skin. Even in scientific animations of anopheles, the voice-over often underscores a voracious *female* appetite, as the pregnant mosquito goes for a "blood meal" before laying eggs. Life itself, unleashed biological drives, becomes the motivation for the hostile act; hence, both reproduction and the sexual drive provide culturally recognizable rationales for nonhuman action. The human figure, embodied in the raw, young soldier, also has a healthy sex drive, an ungovernable youthful vitality that "opens" him, as the mosquitoes often murmur while licking their chops, to nonhuman penetration. The female anopheles seduces Snafu, while Malaria Mike (see figure 15.5), an older man who eyes Snafu's baby butt (calling it his "filet mignon") in *Private Snafu and Malaria Mike* (1944), penetrates the *unsuspecting* soldier as he takes a dip. Both the seduction and rape are featured as acts of sexual hostility, personalizing infection trauma and localizing threat to the prostitute and the war profiteer; and yet, in this characteristically homophobic codification, it is suggested that while Annie might snare a willing Snafu, Mike's imagined rape is unalterably sex without consent.

Dreaming of scuttling American victories in the Pacific, Malaria Mike fantasizes the appropriate answer to his son's plaintive question "what

FIGURE 15.4 Annie recounting her sexual adventures to younger colleagues. Frame from *Private Snafu: "It's Murder She Says"* (1945). Courtesy of Warner Bros.

FIGURE 15.5 Malaria Mike targeting Snafu's butt. Frame from *Private Snafu and Malaria Mike* (1944). Courtesy of Warner Bros.

did you do in the great war, Daddy?" to be "I did my share!" Here the iconic sexually threatening figure becomes a saboteur who lays American bravery to waste, preying on the young, the future of the nation. This mobilization against America associatively grows across the ensemble of the animated cartoon films, with *The Six-Legged Saboteurs* (1940), an early short made by the U.S. Department of Agriculture, first introducing the idea. The spectator is privy to a secret meeting of the "Insect Axis," made up of mosquitoes, boll weevils, and fruit flies that hope to inflict $150,000 in economic damage to America; at the head, of course, is the anopheles as Hitler, complete with his *Mein Malaria*. With these warnings, mosquitoes are perceived as heralding not just military defeat but massive economic catastrophe (from crop failures to the shutting down of factories), solidifying links between disease, capital, and war. By the close of the war, in films such as *Criminal at Large* (1945), the blowsy Annie has morphed into a global female terrorist hunted by a young foreign correspondent on the lookout for new battle zones.

The cultural iconography around the mosquito as the visible, if minute, malarial agent is critical to the orientation of infection as agonistic struggle. I begin with these symbolic codifications, intentionally, in order to critique the assumption that the study of media materiality—media technologies, instruments, institutions, and infrastructures—need not involve a rigorous scrutiny of representation. Cellular materiality is to be found in preparations, tissue cultures, technological instruments, and software programs, *as well as* in signifiers (images, sounds, and words). All these media practices contribute to animating the cellular agon as the epistemology of infection.

The cartoons codify in order to socialize, strategically securing American bodies against the abnormal as nonhuman. The cartoons form a part of a vast audiovisual repertoire of the cellular agon that includes instructional films for clinical training and for preparedness drills, such as *Malaria: Cause and Control* (1942) and three documentaries from 1944: *Malaria*, *Personal Health in the Jungle*, and *Clinical Malaria*.[20] Of these, *Clinical Malaria* offers the widest range of animation techniques and strategies and serves as the paradigmatic instance. Made for medical instruction on identifying malaria symptoms, the film commences with a live-action shot of a scientist peering through a microscope as the voice-over introduces malaria as the "greatest invader in history." Then there is a cut from the observing scientist (an image that makes us anticipate a cut to what he sees, the slide under the microscope) to a rotating

globe, while the narration catalogs all the regions (Asia, Latin America, Africa) that fall under the shadow of the anopheles. Cut to the iconic mosquito on skin, a line-drawn image, before moving to static sketches of a patient infected with malaria; then a zoom under the skin, cutting to a line-drawn animated diagram of the artery's interior where sporozoites swim. For the next fifteen minutes of this documentary, with a total running time of twenty-five minutes and thirty seconds, a "slide" of mobile sporozoites coursing through infected blood shot in time-lapse photography runs along the bottom of the screen. In the meantime, a part on the top of the screen features several other animated forms: a rising and falling temperature graph (the primary image), a line-drawn static cartoon of a patient, the diagram of the human body with arrows marking the liver (where the merozoites develop), and sometimes cel-animated enlarged versions of the parasite in its many avatars (sporozoites, merozoites, and gametocytes). The combination effectively explains malaria to the common viewer, with the laboratory microcinematography acting as an authenticating trace despite everything we know about sectioning, preparations, imaging, and motion capture. The running slide at the bottom of the screen further signals the motility of the nonhuman agent, its silent movement through vectors of transmission (open drains, mosquito saliva, human bloodstream). All this is mixed in with cinematographic footage of tents, landscapes, doctors, and medical assistance, mixtures of live action and animation that we see in almost all the instructional documentaries. The image production of malaria, then, arises at the intersection of live action and animation, and therefore prompts the question: do these modes act in concert to enact the calculative rationality behind militarized biosecurity? Or are the relations between them more complex? It would be difficult to generalize, given the diversity of the combinations we encounter in these instructional documentaries. But, by and large, graphic, line-drawn, and cel-animated forms, together with indexical microcinematographic footage in these documentaries, tend to reduce movement, slowing and stilling action, even freezing moments for further analysis. Against such efforts, cinematic live-action footage and a soundscape tailored for each milieu produce a sense of flux: of perceptions of speed, of changing scales (switching between body, social space, and environment), and of meteorological and geological differences. The world is not the same everywhere, and what happens elsewhere will inexorably come home to roost, goes the story of uncontrollable flux. Hence, quixotically, in these scien-

tific animations of life itself, live action implicitly emerges as a beneficent media.[21]

But there is another significant effect of this combinatory praxis worth noting in these efforts to create an image of life itself: the curious emergence of an insect vision, to see as the mosquito does in order to know it better. This is profoundly present in the complex observational mode of the documentaries. If we take *Clinical Malaria* as our example, observation is one of the four procedures (techniques and protocols) for animating life; codification, vivification, and translation are the others. Observation includes microcinematographic footage of the mosquito and parasite life cycles. Sequences of the cellular change are foreshortened in time-lapse photography in order to artificially produce these life cycles for running durations of three to six minutes; the temporality of life, in this instance, requires artificial splicing for scientific intelligibility. In virtually all the films, the visual temporality is recast as prediction: while the voice-over prolepses constantly look ahead to what is to come ("these tiny sporozoites will one day . . ."), the indexical images anchor predictions to an authoritative scientific calculus. On the other hand, there is live-action footage in wide pans of marshes, swamps, puddles, ponds, and pools; of troops marching; of planes swooping down; and of verdant trees, bushes, and water plants. The back-and-forth cuts, within this observational mode, assemble this tropical geography into the field of the microscopic gaze, and the scale switching turns cellular infection into an ever-widening gyre. A critical part of this observation is what cannot be seen—"the jungle you can't see," as one film remarks—but what registers as the sonic trace of the enemy, an unrelenting buzz. The mosquito approaches, unseen but heard. A roaming speculative eye, poised against abstracted indexical images of life itself, can only inductively calibrate an image of the mosquito. The ensuing image is a composite culled from multiple images and sounds, a calibration that makes the viewer see like an insect. Insects register multiple images of a single source in the compound eye, and these are subsequently neurologically processed into one image for the brain; the multiplicity of images characteristically enhance the sense of motion important to perceiving danger. The combinatory praxis of these instructional films effectively induces such insect vision, even as other graphic elements attempt to arrest speculative processing through codification. This observational mode is complemented by the signaling of a social *and* scientific theory of infection. Arrows, graphs, curves, and

other scientific markings indicate what our focal point should be (often the tiny parasite differentiated as the catalyst for catastrophic cellular decay), while the cultural iconography of the cartoons spurs us to hold common human interests dear against uncommon life.

While observation and codification work toward intelligibility, uncommon life (mosquito and parasite) becomes perceptible (sensory and affective) in a series of vivifications that "bring to life" the imperceptible. Vivifications enlarge, magnify, zoom in, distend, and amplify: there are close-ups of hand-drawn images that superimpose the specter of the mosquito over realist footage; shots of massive physical models of the mosquito towering among trees; amplified images of parasites under the microscope; and the magnified buzz of the mosquito indistinguishable from the drone of attacking airplanes. More than any other technique, vivified sounds and images are most successful in the affecting agon in these audiovisual transcriptions of an identifiable enemy. Finally, the instructional films recursively translate a set of key messages—enemy, danger, preventive action—through flexible translations of content in multiple formats: the cinematic image is vivified in static hand-drawn images, then sketched on a blackboard, and, sometimes, transcribed into a cartoon character. The iterative structure turns mosquito and parasite into a multiheaded hydra: the enemy is a cellular terrorist, an economic drain, a military saboteur, and a social deviant. The attack comes at many levels, on multiple scales. In this way, these processes animate the cellular agon, mobilizing sight, sound, slide, footage, artwork, models, camera speeds and apertures, dyes and stains, and biological preparations. By the close of the films, Enemy Number Two has become intelligible, legitimizing the move toward biosecurity.

That move is accomplished by a topological articulation of malaria, which establishes an enduring link between the preservation of human life and the military control of territory made urgent during the Pacific War. Malaria outbreaks were already a recognizable security threat during the U.S. actions in Panama, Puerto Rico, and the Philippines, and with the acquisition of new military bases in the Caribbean. By the time the Tropical Disease Control Section was established in 1942, malaria had become *the* premiere threat to the U.S. military. Consequently, the Malaria Control in War Areas was formed to prevent malaria infection in wartime areas, and later to prevent civilian infection as the troops demobilized. After the war, the U.S. Public Health Service saw the need to create an organization whose primary charge would be biosecurity, leading to the formation of the Communicable Diseases Center in 1946

(renamed the Centers for Disease Control in 1980). By 1950 the center had developed the Epidemic Intelligence Service, and the wartime scientific films became valuable archival material for further strategic interventions. Between 1947 and 1951, malaria was eradicated in the United States after the successful mass manufacture of DDT and less toxic antimalarial drugs.[22] The eradication was so successful, in fact, that U.S. models for malaria prevention, including audiovisual pedagogy, became transposable interventions across the world, and the World Health Organization launched a global campaign against malaria in 1955. The history tells us that the struggle over malaria, cellular or otherwise, is inextricable from the rhetoric of war. A war that, in the 1960s, had been won—at least, so it was thought in the historical West. That myth would persist, as Melinda Cooper has shown, until the eruption of ungovernable viruses (e.g., Ebola, HIV, West Nile) in the late 1970s to the early 1980s.[23]

The Pacific War theater was one of the historical junctures when the scientific and the popular intelligibility of life itself became bound to its ontological preservation through what Foucault characterizes as the "apparatuses of security." Much has been said regarding the famous Foucauldian formulation in his Collège de France lectures, so my allusion to that genealogy will be rather cursory.[24] In those lectures, Foucault offers a third articulation of power, the apparatus of security, which does not punish or kill (as sovereign juridical power does) or correct, survey, or observe (as the law dies) but calculates and intervenes in the vital circulations of human life. Security apparatuses adjust balances and check overflows, quantifying the risk distributions in a population. The target is not this body or that population but a form of life itself, our very biological existence without which there would no longer be any human societies; the target is a modification of the biological destiny of the species. Looking at smallpox-inoculation campaigns of the eighteenth century, Foucault argues that security is manifest in the logic of inoculation where the pathogen is not eradicated but its levels in the body are maintained at a minimum. Security is a calculative rationality that speculates on probable infections in the near future. A part of the calculation is estimating internal borders within populations and separating certain social aggregates (high-risk cases, such as the elderly) from others (low-risk, healthy individuals). The latter, as productive subjects, are central to our biological destiny, to social reproduction. In the cartoon animations discussed here, we see the recursive figures of the young soldier, the teenage girl (her neck exposed to the mosquito),

and the hard-working father as the potential victims; no middle-aged woman past her child-bearing years or elderly citizens make an appearance. In this way, the cartoons effortlessly link economic productivity, social reproduction, and biological equilibrium.

More important perhaps is that security always territorializes, Foucault insists, and we see such a move across the mid-twentieth-century military-training films. The topology of infection becomes culturally codified as a particular topography of (malarial) infection. The cellular agon is unmistakably territorialized: the organic edifice of the body initially violated by the mosquito on skin is immediately secured through a series of boundaries visualized in close-ups of protective clothing (socks, uniforms), mosquito nets, tents, and screen doors. These prophylactic surfaces act as deterrents, lines of militarized control, against a perversely porous natural landscape booming with sonic disturbances of unseen presences. Sometimes diagrammatic idioms such as arrows and circles highlight imperceptible flows and flights, directing our gaze to hidden vectors of disease transmission. The difference between live-action footage and graphic forms creates a disjunctively layered visual space, making a quotidian milieu palimpsestically live, in active ferment. The live-action sequences are where we find a nonhuman world as changeful, mutable, and impossible to contain; the graphic elements and cel-animated forms freeze particular moments, such as entry into the body or the movement into the liver. We can only access the nonhuman enemy (mosquito and parasite) if we inductively calibrate a composite image, carefully directed by diagrammatic forms. In several films, live-action footage also features men or machines at war against the nonhuman enemy, painstakingly dousing the hostile milieu with chemicals (aerosol cans and equipment for spraying DDT) as if to keep nature at bay. Voice-overs underscore these agonistic acts as necessary calculative measures intervening in the balance of life itself, which is now a vast ecological network of nonhuman agents. We are told *how much* DDT should be sprayed, what *grade* of mosquito net is best, how *many* tablets to take, how *much* insect repellent to rub, how *high* the fevers can get, how *often* the sweat breaks—a calculative rationality at the heart of security measures. Security does not kill, to echo Foucault, but strives to restore equilibrium; security divides, contains, and territorializes to distribute quantified risks—this time, across global regions. Globes, maps, and shots of newspaper headlines (reporting malaria in India and China) territorialize the natural world into global zones ready for biosecurity interventions, even as the films reinforce incommensu-

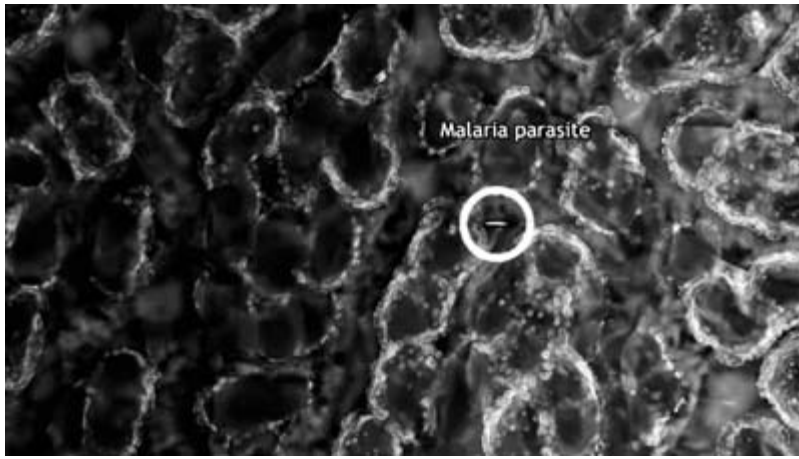

FIGURE 15.6 The malaria parasite identified as luminescent microbe. Frame from *Life Cycle of Malaria: The Human Host* (2011). Courtesy of Howard Hughes Medical Institute.

rable differences between the "godforsaken hole" of the outpost (as Private Snafu puts it) and the home front. The hot spots where "Anopheles Annie" rules the roost, slugging back her martinis, recede into the jungles, into the verdant tropics. Within the narrative of security, calculations and intervention pay off as those wild regions, the sketched or photographed backdrops to the antics of the animated mosquito, are steadily brought to order by the onward march of the U.S. armed forces. And so the cellular agon becomes expressive as topography marked by division, segregation, and containment. The cellular agon unfolds as unending antagonism, immortalized in the recursive image of the anopheles treading human skin.

And yet our *knowledge* of the mosquito remains partly speculative, always a composite projection cobbled together from multiple sources that signal an unseen enemy. Animation freezes, stills; but its artifice—its multiple forms and its radical estrangement from realistic footage—also brings home the impossibility of capturing life itself.

Coda: The Coming of the Cellular Fantastic

If in mid-twentieth-century films, a strong sense of incommensurable differences between the vital interests of parasites, mosquitoes, and humans endures (and with it the unhomely topos of hostile nature) past the late twentieth-century ecological movements, then that cellu-

lar agon is now recast as inevitable, even pleasurable, incommensurability. We live with viruses; we depend on synthetic technologies to play the game within our cellular systems. The cellular agon now manifests not as spectral terror but as a domain of the marvelous: the cellular fantastic (to echo Akira Lippit's "optical fantastic" in the first half of the twentieth century) emergent in present-day scientific edutainment.[25] Advanced imaging technologies and software enable immersive 3-D animations of cellular and extracellular environments in film shorts that take us on voyages reminiscent of intergalactic passages. Malaria animations still commence with eschatological narrations of parasites that once brought the world's most valorous (Genghis Khan, Alexander the Great, and George Washington) to their knees; the imaging techniques and software for image transcriptions are, however, radically different.[26] Cells glow while lit with luminescent proteins, sectional images become three-dimensional, and a mobile camera surfs the cellular galaxies. Still, the focal point in the immersive field remains the nonhuman (see figure 15.6; the tiny sporozoite is diagrammatically circled), the dark passenger of our extracellular environment. The cellular agon arrives zoning the fluid 3-D universe. Incommensurable differentials appear in our field of vision, and epic journeys turn into war games. The film's abiding pull "worlds" once more, securing the human as the premiere subject of history.[27]

Notes

1. Malaria infection has double articulation in the human host (which experiences cellular catastrophe) and an infected mosquito, the carrier. The bite of an infected mosquito passes the plasmodium in the mosquito's saliva into the human bloodstream; there the plasmodium travels to the liver, where it multiplies and differentiates into merozoites in human liver cells. These leave the liver to reenter the bloodstream and enter and explode red blood cells, replicating and multiplying in the process. They eventually develop into male or female gametocytes. When a mosquito bites an infected human, a blood meal necessary for the pregnant female anopheles, the mosquito absorbs the gametocytes from the infected human; these further develop into gametes (new plasmodium) within the mosquito. When the infected mosquito bites again, the cycle begins anew.
2. There is a great deal of controversy over the patrimony of malaria research: Alphonse Lavern certainly, but also Patrick Manson and Italian malariologists, led by Giovanni Battista Grassi, described in the 1890s how human malaria was transmitted by the anopheles mosquito. Because Ross was a colonial administrator, malaria was an endemic problem in his view, a genocidal force in the

tropics (as early as 1852, a malaria epidemic had wiped out the entire village of Ula in Bengal, where Ross conducted much of his research).

3. In his provocative essay "Uncommon Life," Eugene Thacker pursues the new ecological collectives where microbial and human organisms are placed in equivalence.
4. The short is also known as *The Story of the Mosquito* and comprised of six thousand cel drawings. An early innovator, Winsor McCay's contributions have been eclipsed by cultural figures such as Max Fleischer and Walt Disney. Before his animated films, McCay published comic strips in the Sunday section of newspapers: *Little Nemo in Slumberland* in 1905 and, later, "Dreams of a Rarebit Fiend" (both were published under a pseudonym, Silas); he later gained renown for traveling with his animated shorts and accompanying screenings with vaudeville acts in which he held out his hand to his animated creations.
5. For details on the agreement, see "WTO and the Trips Agreement," World Health Organization, accessed February 12, 2012, http://www.who.int/medicines/areas/policy/wto_trips/en/index.html.
6. See Lakoff, "Preparing for the Next Emergency."
7. Rheinberger, *An Epistemology of the Concrete*.
8. Rogerio Amino et al., "Imaging Parasites in Vivo," in Shorte and Frischknecht, *Imaging Cellular and Molecular Biological Functions*, 345–64.
9. See Kelty and Landecker, "A Theory of Animation." For more on epistemologies of life itself, see Landecker, *Culturing Life*; and Rheinberger, *An Epistemology of the Concrete*. Regarding Ostherr, I am referring to an unpublished essay that she is crafting for *The Blackwell Companion to Contemporary Documentary Studies* (forthcoming in 2014), titled "Animating Informatics: Scientific Discovery through Documentary Film," as well as her monograph *Cinematic Prophylaxis*.
10. The cluster of works include Cooper, *Life as Surplus*; Dumit, *Picturing Personhood*; and Sunder Rajan, *Biocapital*.
11. The Office of the Coordinator of Inter-American Affairs, a U.S. agency appointed by Roosevelt with Nelson Rockefeller at its head, was formed to promote inter-American cooperation during the 1940s, especially in commercial and economic areas.
12. Kelty and Landecker, "A Theory of Animation," 38.
13. Kelty and Landecker, "A Theory of Animation," 33.
14. Kelty and Landecker, "A Theory of Animation," 40.
15. Ostherr, *Cinematic Prophylaxis*.
16. The biologist Aristid Lindenmayer developed the formal grammar of plants that came to be known as L-systems: see "Mathematical Models for Cellular Interaction in Development," *Journal of Theoretical Biology* 18 (1968): 280–315.
17. Daley and Viney, *Popular Education in Public Health*.
18. Landecker, *Culturing Life*, 62–63.
19. Canguilhelm, *Knowledge of Life*.
20. Right after the war, a few prophylactic films continued to be made to prevent malaria infection in the U.S. South, particularly in humid Tennessee (e.g., *Mosquito Proofing for Malaria* from 1949, a documentary that ran for ten minutes

and eighteen seconds and was made by the Tennessee Valley, Malaria Control in War Areas, and the U.S. Public Health Services). When malaria was eradicated in the United States, similar documentaries were made for dissemination all over the world (for example, *India's War against Malaria* and *Malaria Prevention* in the late 1960s).

21. I am indebted to Karen Beckman for encouraging me to attend closely to the cultural work of live action in these documentaries.
22. DDT (dichlorodiphenyltrichloroethane) is a pesticide once widely used to control insects in agriculture, especially insects that carry diseases such as malaria. Its use in the United States was banned in 1972 because of damage to wildlife, but it is still used in some countries.
23. Cooper, *Life as Surplus*.
24. See Foucault, *Security, Territory, Population*.
25. Akira Lippit's account in *Atomic Light (Shadow Optics)* of the "optical fantastic" triangulates the development of X-ray technologies, the splitting of the atom, and psychoanalysis.
26. For more on new imaging technologies, and therein a newly transparent body, see Dijck, *The Transparent Body*.
27. A recent diptych of malaria documentaries—the *Life Cycle of Malaria: The Human Host* (four minutes and seventeen seconds) and *Mosquito Host* (three minutes and fifty-nine seconds)—was funded by the Howard Hughes Medical Institute, a nonprofit organization advancing biomedical research. The institute spent as much as $825 million on research in 2011, which included $60 million for a film-production unit.