



C R I T I C A L F O C U S

Brian J. Ford

Shining the Spotlight on Movie Microbes

“Marilyn Monroe was a confused, sweet angel,” said our visitor, as the sun sparkled on his crystal glass of orange juice. “And Cary — did you know he was born in Britain? Cary Grant was so muddled in his mind. He and I became such good friends. Archibald Leach, he was called originally. Poor chap ran away to become a performer when his mother was locked up in a mental institution in Bristol and nobody told him about it. It’s strange what makes people into movie stars.” My dear friend Charles Bennett had been born in 1899, and stayed with us in Cambridgeshire when he was 94. He was Alfred Hitchcock’s first scriptwriter and lived next to Mel Tormé in Beverly Hills. I remember Charles’s desk at his home cluttered with portrait photos and résumés for would-be actors, each eager for fame. “What makes people into movie stars?” mused Charles. “Nobody knows. That would make such an interesting piece of scientific research.”

One thing is certain: Movie stars don’t have to be human to be memorable. Audiences fell in love with “E.T.,” the winsome extraterrestrial. They don’t even have to be cute; people were enthralled by the 20-foot, 2,500-pound great white shark in “Jaws” and even more by those fabulous dinosaurs in Jurassic Park. What links these is the freewheeling skill of their creator, master filmmaker Steven Spielberg. And it was

Movie stars don’t have to be human to be memorable. The microscopic realm offers the most exciting images for filmmakers, but almost everyone ignores it.

Spielberg who created the most unusual film stars of all: microbes. His epic movie “War of the Worlds” features free-swimming microorganisms in the opening scenes. We zoom out from the nucleus of a ciliated microbe to find a water droplet on a leaf that is swarming with protists swimming eagerly about. It is a memorable scene. The film, released in 2005, is one of the few to show microbes as part of the story.

In narrating the closing moments of the film, Morgan Freeman muses that “humans have suffered billions of lives to earn the right to live with these tiny creatures.” That’s so true — microbes are more abundant, more important, more ancient and more varied than human movie stars. So why is it that we so rarely encounter them in the cinema? Hollywood, for all its advanced computer-generated imagery (CGI), is missing out on the chance to create the most captivating and vivid organisms in cinema history. Film producers take us into the cosmos, through the earth, beneath the oceans and across imaginary dimensions of time and space — but without microbes they are missing a trick.

Microscopic life in a horror film is not new. Organisms filmed through a microscope first appeared in the movies more than 90 years ago. In 1921, director Friedrich W. Murnau founded Prana Film specifically to make horror films. Having embraced expressionis-



The archetypal mad professor shows an eager student his “vampire-like polyp” in this montage from “Nosferatu.” It was released in 1922 and ordered for destruction by the courts shortly after. The film is recognized as groundbreaking for featuring microscopic views of *Hydra* devouring a *Daphnia*.



Steven Spielberg’s movie “War of the Worlds” (2005) opened with ciliated protists swimming in a dew drop. These stylized *Paramecium* (with a suctorium in the lower left corner) were meant to symbolize the germs that killed the Martian invaders, though these are harmless pond dwellers. This is a rare example of microbes playing a major role in a movie.

tic cinema, Germany was caught up in spiraling inflation and Murnau was aiming to make real money — convertible currencies from the outside world. The production company’s first (and only) movie was “Nosferatu, eine Symphonie des Grauens” (Nosferatu, a symphony of horror). Murnau retold the story of Bram Stoker’s groundbreaking novel *Dracula*, which had been published in 1897. Because they could not obtain rights to the book, Murnau adapted the story and cast Max Schreck in the role of Count Dracula (re-

naming the character Count Orlok, in an attempt to avoid charges of plagiarism). Florence, Bram Stoker’s widow, decided to sue the company but Murnau’s irresponsible spending had already rendered Prana Film bankrupt. Even so, Florence Stoker pressed ahead, and in July 1925 the German courts ruled in her favor — all copies of Murnau’s movie were to be destroyed.

The few copies that survived were smuggled abroad. Attempts to stage a world premiere in London later that year were halted by the courts, though it was shown in the United States in 1929. When Murnau died in 1943, his film had been forgotten — only more recently has it been recognized as a pioneering classic.

One of the innovations was a sequence filmed through a microscope. In the middle of the film, audiences watched spellbound as a totemic mad professor shows some young enthusiasts his experiments. The silent film caption explains: “And now, gentlemen, here is another type of vampire, a polyp with claws: transparent, without substance, almost a phantom.” He grimaces threateningly before we see the sequence filmed through the microscope — a quarter-inch *Hydra viridis* hanging in a glass phial. Someone drops *Daphnia* from a pipette and it is entrapped by the tentacles of the polyp to be slowly devoured. We watch as it struggles to escape in vain yet is doomed to a gruesome death.

Hydra may be a quarter-inch long in the real world, but on the cinema screen it was the length of a car, and the struggling *Daphnia* would hang in the air above the horrified audience, bigger than a baby as it fought for survival. Murnau had chosen well. The astonishing sights that we see down the microscope are endlessly diverting: sometimes entrancing, usually mysterious, often horrifyingly violent. There is little as fascinating in our daily lives as we can witness through the microscope lens, and few sights are more remarkable than microbes living their complex lives. This would make for marvelous movies, particularly in the era of CGI, yet nobody has shown the possibilities to today’s film directors. They are still lagging behind. They haven’t even caught up with Murnau’s inventiveness back in 1922.

Today’s moviemakers make a fundamental mistake. They imagine that the world under a lens is just like the world we see about us, only bigger. The truth is far more amazing — once you turn a lens on familiar objects they cease to be familiar. Under the microscope, our world explodes into a fabulous concatenation of cells and crystals, fibers and frustules, spores, cysts and cilia. Look at a minute mound of moss or a frag-

ment of feather held at arm's length and you would never imagine what it might be like under a microscope. Telephoto lenses take you close to a distant racehorse, or show you writing that you could not otherwise read, but it shows nothing that you didn't already know existed. Telescopes can only reveal celestial bodies in the night sky, though people always could see that there were stars in the heavens. Microscopes are unique. Only they can show us this strange and captivating universe of haunting beauty, the existence of which you could otherwise never have conceived. This microscopical vista is beyond imagination, out of reach of our conventional comprehension; it is quite the most curious and complex interactive community of creatures anywhere in the world. Yet directors don't know about it and, for at least 90 years, nobody has troubled to tell them.

THE SAME, ONLY LARGER

My interest was attracted by an intriguingly promising film title when I was in school. It was "The Incredible Shrinking Man," directed by Jack Arnold and released in 1957. It had originally been a novel, written by Richard Matheson and adapted by him for the screen. The film told how a businessman named Scott Carey (played by Grant Williams) is affected by a curious cloud that passes over him off the coast of California, and he slowly starts to shrink. The film was a disappointment because wherever Carey went the structure of his world remained much the same as it was to the naked eye. Objects became larger around him, yes, but the infinitely revealing realities of the lens were never shown in the film. This did little to interfere with its success, however, and four years ago it was selected for permanent preservation in the National Film Registry by the Library of Congress as being "culturally, historically or aesthetically" important.

In 1966, a more promising movie appeared and this one proclaimed that it would show everyone the microscopic world. It was "Fantastic Voyage," written by Harry Kleiner from a story by Otto Klement and Jerome Bixby. It was so successful that Isaac Asimov was commissioned to create a novel from the screenplay, and many people believe to this day that the film was based on the book, when in fact the opposite is the case. The film was directed by Richard Fleischer and featured stars including Raquel Welch and Donald Pleasence. It was distributed by 20th Century Fox.

The story told of a Cold War experiment carried



A diminutive Scott Carey (played here by Grant Williams) faced a monstrous world when reduced to minute dimensions in Jack Arnold's 1957 movie "The Incredible Shrinking Man." The detail in the microscopical views of his foes was no greater than can be seen by the naked eye. The opportunity to tackle photogenic microbes and experience the world of living cells was missed.

out by scientists in America and Russia who succeeded in shrinking atoms. The effect wasn't permanent, however, so objects (and people) could be miniaturized for a while and then restored to full size. This was set to change, however, when a researcher in Russia named Jan Benes discovered how to make the process irreversible. He defected to the West and was on the point of revealing his crucial secret when a secret agent leaves him in a coma caused by a blood clot. Here is a chance to put the theory to the test, so a team of Americans is miniaturized to go deep inside Benes's body and destroy the clot. Dr. Charles Grant (played by Stephen Boyd) and projectile pilot Captain Bill Owens (William Redfield) head a team that will travel in a submarine named the Proteus, which can float inside the patient's body.

Once the crew is safely aboard, the entire submarine and its human occupants are miniaturized and injected into the body of Jan Benes. They have to make a detour through a fistula, travel inside the inner ear (keeping silent the whole time) and eventually make improvised repairs to the laser with which the blood clot is to be destroyed. Even when the task is completed, a saboteur tries to crash the submarine, and it is eventually engulfed by Benes' leukocytes, while the crew members are fortunately floating free. With seconds to spare, our heroes escape to the outside world through a tear-duct while the saboteur remains trapped and dies.



In "Fantastic Voyage" (1966), frogmen dodged shapeless masses of plastic drapes in a failed attempt to show life within the human body at a microscopic level. The film, starring Raquel Welch and Donald Pleasence, promised much but delivered only an amateurish sci-fi script without a living cell in sight.



The frogman returned in a TV series version of "Fantastic Voyage" (1968). The producers made no attempt to capture the drama of the microscopic world. Made-up monsters and invented alien beings took the place of real-life microbes, and the result was a poor imitation of the drama we observe down the microscope.



When my book *Microbe Power* was published in Japanese in 1976, this frogman did encounter something closer to life. The jacket designer adapted a line drawing I had made of aquatic algae for this colorful cartoon of the microbial world. Here the diver is surrounded by a world of intricate organisms that reveal a hint of what a microscope can disclose.

The trailers were ecstatic, as trailers always are. "The eye of man is ever seeking, leading him ever onward," announces a sepulchral voice. "Fantastic voyage takes you where no film has ever been before: one of the miracles of the universe. No eyewitness has ever actually seen what you will see. In this world of ours, with the most incredible things happening all around us, someday, perhaps tomorrow, the fantastic events that you will see can — and will! — take place."

Two things: First, no, they won't take place. Nobody is going to find a way to shrink entire atoms down to a millionth of their present size so that full-sized people can be reduced to dimensions that are smaller than a *Staphylococcus* and float around in your ear. Secondly, the CGI images are abysmal. Few people have ever contrived to create a less realistic view of the interior of the human body. The strands and bands that festoon the screen, the gloops and globs of shapeless plastic that are supposed to pass for cells ... this is an appalling, ignorant simulation. It looks more like an explosion in a plastics factory than the inside of a human. I wish they hadn't bothered.

For all its contrivances and dubious production values, the idea of this movie was sufficiently appealing to give rise to a spinoff television series that ran to 17 episodes on ABC-TV from Sept. 14, 1968 to Jan. 4, 1969. Produced by Filmation Associates and 20th Century Fox, it was resurrected by Cartoon Quest on the Sci-Fi Channel, and on Nov. 21, 2011, a three-disc DVD set was released in England (though not in America)

by Revelation Films. Not only did these cartoons continue the storyline of the original film, but they retained the disregard for microscopical realism. The opening episode, entitled “Gathering of the Team,” showed bizarre encounters with formless shapes in a drop of water, including vanishing ghosts and a bristly monster (that is mistaken for a plant) with which Commander Jonathan Kidd (voiced by Ted Knight) has to do battle. As cartoons go, this was a typical run-of-the-mill series; but in terms of a missed opportunity to feature genuine microbes, it must rank near the top of the tree.

“The Incredible Shrinking Man” gave birth to a sequel that was released in 1981. It was entitled “The Incredible Shrinking Woman” and it starred Lily Tomlin as Pat Kramer, who uses an experimental new perfume that makes her shrink. Whereas Scott Carey was doomed to keep on shrinking, Pat Kramer is brought back to full size by falling into a pool of household chemicals. “The Incredible Shrinking Woman” was directed by Joel Schumacher and released by Universal Pictures. It didn’t give much opportunity for exploring the microscopic world in which the star could have been set upon by springtails or assailed by aphids. Once again an opportunity was missed.

MORE BIG BLUNDERS

Then there was “Honey, I Shrank the Kids.” It was the first film directed by Joe Johnston and was produced by Penney Finkelman Cox in 1989 for Walt Disney Pictures. For those who don’t recall it, this is the story of Wayne Szalinski who invents a curious shrinking machine. While he is away on business, his children Amy and Nick go up into the attic with their young neighbor Russ and find the device — which promptly shrinks them down to a quarter-inch tall. For the rest of the movie they are beset by a gigantic world of otherwise diminutive creatures: ants the size of horses, scorpions bigger than a bus, weeds as large as oak trees and piles of pollen big enough to smother them all. This is a microscopist’s dream — a multi-million dollar budget that could show people what lies beyond our sight. In the event, it didn’t happen.

The moment the children realize they have been shrunk down to diminutive proportions, we watch them walk across the floorboards in the attic. Just imagine the scene! Rows of sparkling xylem vessels, medullary rays that glisten like a necklace, spores, pollen grains and fibers nestling in crevices — but we see none of it. Their magnified wood looks exactly like a plank at normal magnification; it’s just that there is



Four children are reduced to a size smaller than ants in “Honey, I Shrank the Kids” (1989). Producer Penney Finkelman Cox used sets in which everyday objects were magnified but retained their naked-eye appearance. I have inserted here a fragment of floorboard that reveals the extraordinary microscopical detail the youngsters should have experienced.

more of it. The immediate impact that would strike the youngsters is lost. The real magnified world has disappeared in a whitewash of conventionality.

When their father returns they try to attract his attention by screaming — but they are too small to be noticed and are lucky not to be stepped on like ants. Soon we see the children exploring the lawn. Weeds tower above them, and we watch how they slide down blades of grass to rendezvous on the soil beneath. The grass blades are huge and a yard wide. What would grass look like at this magnification? We would see the meticulously aligned cells, each glistening like crystal and fitting together in a wonderful array. Sharp spicules of silica, each as alluring as a work of sculpture and worthy of a place on anyone’s desk, would mark the landscape. The whole scene would be lustrous, patterned, appealing.

What we see in the movie is just as I have described: The blades of grass are exactly as they would appear to the naked eye, but larger. The youngsters plummet down what looks like ribbed plastic slides in a play park. This is not remotely like grass, and it has nothing of the beauty, intricacy and wonder of leaves when magnified. To gain a better view of their surroundings, Nick climbs a plant stem — a stem devoid of cell structure, and looking like a gigantic ribbed walking-stick. Suddenly it bends, throwing him towards a flower filled with anthers and glistening golden with pollen. “Nick,” shouts Amy anxiously, “Be careful!” It is too late, and Nick plummets



The diminutive young Nick Szalinski (played by Robert Oliveri) in "Honey, I Shrank the Kids" falls into a flower rich in pollen. Perversely, all we see is yellow dust which is nothing like magnified pollen. On the right of this photo I have introduced what he should have encountered — spectacularly sculptured pollen grains which, size for size, would be as big as tennis balls.

into a cloud of pollen in the flower.

"You're allergic to pollen," Amy shouts, but remember, these children are the size of ants, so Nick calls down: "It's too big! I'm too little to breathe it in!"

What a timely touch — someone has realized the realities of being reduced in size. Or you would think they had, until you see the ridiculous sequences of Nick in his predicament. Pollen grains are among the most aesthetic of microscopic objects, perfectly patterned and delicately decorated with spikes and circular swirls like sequins. If Nick is falling into a pollen-rich plant he will be buried in countless identical orbs of entrancing beauty, like landing on a pile of exquisite Fabergé eggs. He would hold them up, each the size of a golf ball, and marvel at their intricacy — unless he was unlucky enough to be caught on spikes projecting from a pollen grain. There are several plot possibilities in a situation like this. But no, once again Nick has dropped into something that looks as pollen looks to the naked eye, but bigger. He has landed on a mound of cream-colored grits or a snowdrift made of sawdust. Instead of the wonder of being half-buried in beautiful Christmas tree baubles, he emerges blinking from a heap of what looks like industrial waste. When the tiny youngsters walk across the soil, we see them walking on flat sandy ground instead of being surrounded by translucent boulders of quartz and a lacework of leaves interlaced with spectacular fungi and teeming with squirming nematodes. The principle appeal of this

film should have been the marvels of the microscopic world — the rotifers in the water, those springtails in the soil, the myriad glands, hairs, spikes and vesicles with which the vegetation is festooned in a new world of iridescent cells and glistening hyphae. But the chance was missed. Hollywood turned its blind eye to the microscopic view of nature and everyone lost out.

This story of the film was entertaining, and it was ingeniously done. Had they taken advice, it could have been stunning in its impact. "Honey, I Shrank the Kids" won a BAFTA Award in London for the special effects and later gave rise to a spinoff series on television. The programs ran on American TV from 1997 for three seasons, the 66th episode being aired on May 20, 2000. The series did nothing to explore the microscopic world, but contented itself with gigantic chocolate bars and similar enlarged artifacts. Once again, the audience was denied the chance to experience the marvels of the microscopic world — and the producers missed out on a chance to make movie history.

Diminutive stars occurred again in "A Bug's Life" and "Bee Movie" films, where we saw hundreds of dramatic close-up shots of flowers and plants, but without any of the features that you would see in reality. "Bee Movie" has a curious back story. In 2002, Swedish animators Henrik Wallgren and Per Umaerus sent a script of their proposed cartoon "Beebylon" to the Dreamworks studios. In their script, the regimented bees are encouraged by a lone rebel to abandon their working habits and discover the human world all around. The proposal came with a pilot. Dreamworks turned it down as being "too childish." Yet, just a year later, Jerry Seinfeld announced that he was making "Bee Movie" with Dreamworks. The characters are remarkably similar, and both stories are centered on rebels. Seinfeld said that he is "trying not to laugh too hard" and insists that, "Anybody who would make something about bees would use the look of the bee, with the stripes, so, yes, there is that similarity." There have been no further comments about the amazing similarity between the American and Swedish productions, though there are rumors of a lawsuit in the making.

In the end, "Bee Movie" had the most bizarre and ridiculous plot imaginable: The rebellion and failure of bees to pollinate plants in the park led to trees dying where they stood. No matter how much one can regret the lack of microscopic imagery in the world of film, matters reach new troughs of despair when such basic everyday knowledge seems missing from everybody working on the movie. And it gets worse. In "Bee Movie," the female workers were all changed to visibly

masculine pollen jocks on whom the (lesser) females looked with awe. When the movie moguls beckon, it seems that integrity goes straight out the window.

SPERM POINT THE WAY

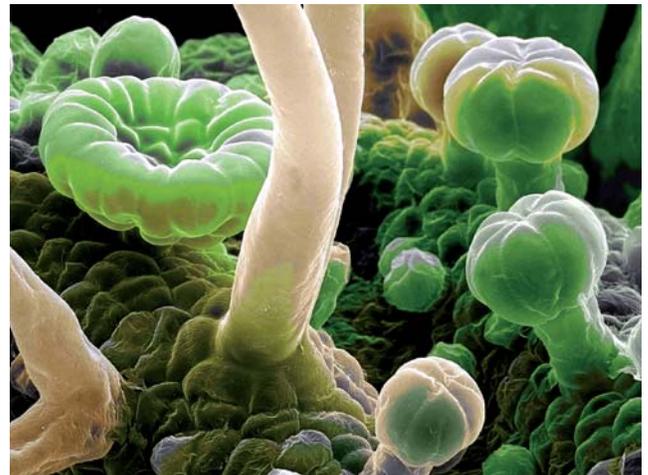
Microscopic images emerged dramatically when John Travolta starred in the 1989 romantic comedy “Look Who’s Talking,” which included a remarkably realistic microscopical scene. The opening title sequence showed the encounter of an ovum with a torrent of spermatozoa that was vividly portrayed. This is how CGI should be used to bring microscopy to an audience. The story concerns an accountant named Mollie (played by Kirstie Alley), who embarks on an affair with an executive who leaves his wife for someone else, leaving her with an unexpected child, and with twists and turns that mostly hinge on instances of mistaken identity. None of this has much relevance to the sperm scene, but no matter — we witness an impressive attempt to create a vivid view of a microscopical subject. Amy Heckerling, the film’s writer and director, deserves credit for pointing the way.

Other filmmakers have failed to capture the moist translucence of living cells, and an example of poor practice features in a film made for television. This was a BBC documentary called “Inside the Human Body,” which provides a timely comparison with the CGI used in “Look Who’s Talking.” Instead of curly, sinuous sperm cells, we saw crudely portrayed objects convulsing instead of gliding and looking more like rusty wires than living cells. Rather than a semi-transparent ovum, opalescent and pure as a pearl, the audience was faced with something like a rusty cannonball. There was a huge budget for the sequences and the producers hired technicians who utilized Pixar RenderMan software to create the CGI images, which is what you would expect for a high-budget Hollywood film. Unfortunately, their reconstructions of cells were based on scanning electron micrographs rather than films taken from life. There were spikes looking like bristles on a toothbrush, between which lurid blue sparks played like lightning, entirely unlike anything that we can enjoy under the microscope. Erythrocytes had been unconvincingly portrayed in “Fantastic Voyage” as loose bags of liquid, but they were worse in this film, for here they became as rigid as if cast in concrete. The softness of life became transposed into the rigidity of engineering. You might as well substitute a bowl of cement for a soufflé.

Television is not the only offender. At the Field Museum in Chicago, there’s an exhibit that I thought

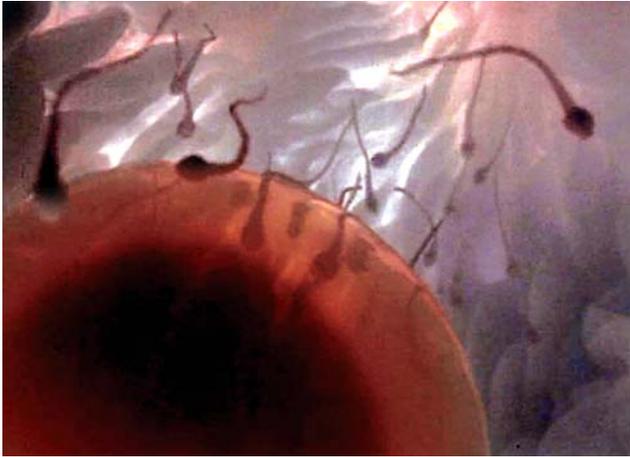


Flik the ant from “A Bug’s Life” (1998) lives among vegetation that looks like sheets of green resin. In reality, his world would be festooned with fascinating arrays of living cells. Here I have compared his imaginary world with a view of leaf cells at the same scale engraved by Robert Hooke in 1663.



Cartoons about minute animals (like ants) offer limitless opportunities to explore the microscopic world. Filmmakers have no concept of what they and their audiences are missing. These are glands on the undersurface of the leaf from *Juglans nigra*, the walnut tree. Most plants show complex and fascinating structures like these when observed through the microscope.

would, literally, break new ground. A revamped gallery called Underground Adventure claimed to take visitors through the soil beneath our feet. Just think of that! You would see jewel-like sand grains the size of sweets, bead-encrusted sculptures emulating glistening root cells, diatoms like glass sieves, fungal hyphae intertwined like bars of shining candy, lacy lattice-



The title sequence of "Look Who's Talking" prominently featured a microscopic view of living cells. The movie was written and produced by Amy Heckerling, whose CGI portrayals of sperm and egg are of far higher quality than the crude computer-generated sperm cells shown in recent television documentaries.



Films made for television include the BBC's "Inside the Human Body," which showed these grotesque simulations of lymphocytes attacking spermatozoa. Lacking the limpid translucence of living cells, the lymphocytes are portrayed as if they were solid and opaque. The sperm cells are angular and brittle-looking, more like rusty wires than living cells.

like fragments of discarded leaves, delicate root hairs like translucent tubes and intertwined mycorrhizae with the intricacy of tangled tassels. The whole scene would gleam like Aladdin's cave.

And what do you see instead? Solid-looking roots smooth as elephant tusks. Brown lumps like coffee-grounds. Animatronic spiders looking like something from a toy store, and the occasional plastic insect plucked from the Rainforest Café. This is a futile fabrication — a false view of non-existent nature with as much relationship to reality as Cinderella's castle cre-

ated by Walt Disney. *Underground World* shows nothing that we cannot see with our own eyes, but larger. There is nothing of the real microscopic world anywhere on view. The Field Museum's attempt to show mycorrhizal associations exemplifies the error, for they show the fungi as large tufts of cotton. No, that is what hyphae look like to the naked eye on a piece of mouldy bread. At the scale of the exhibit, each hypha would be as fat as a pencil and would wind sinuously like a silver snake.

The exhibit is a calamity, and I cannot see why it should be. When museums build, they bring in builders just as they have accountants for their finances. Next time they turn to microscopic subjects, they should ask someone who knows. Any qualified microscopist would do.

One benefit of film is the way we can reveal truths that are otherwise inaccessible. Size comparisons are difficult for the public to grasp, indeed they are fairly hard for microscopists. We become so accustomed to working at high magnification that one can lose sight of how this compares with the dimensionality of the real world. In 1963, I attempted to address this by putting together a poster display of photographs mounted on a card. The first one showed a dinner plate with a coin resting on the rim. The next image showed the coin (now the size of the dinner plate) with a centric diatom frustule visible. Then we saw the centric diatom (itself as large as the plate) with bacteria nestling within the complex perforations of the frustule. The next picture was of a bacterium (shown as big as the dinner plate, of course) with a phage virus attached to its surface. The intention was to allow us to visualize exactly how large was a cell compared to everyday objects. It worked well, though I would quickly criticize my efforts now by emphasizing that I had used the glassy frustule of a dead diatom, instead of a living cell.

A book that set out to place the world in its context with the universe was *Cosmic View* by Kees Boeke, a Dutch educator. The book, published in 1958, had vivid monochrome illustrations. Ten years after it appeared, the book inspired a largely forgotten movie entitled "Cosmic Zoom," directed by Eva Szasz and produced by Joe and Wolf Koenig for the National Film Board of Canada. Starting with a movie of a rowboat, the image freezes and becomes a cartoon image that launches our journey to the edge of the universe, before we zoom back in, through a mosquito biting the hand of the person in the boat, until we see red blood cells and the molecules that lie within. The erythrocytes appear as simple red circles, so there is no impression of life in this pioneering film. As the cartoon zooms inside the

erythrocytes, we come across DNA stacked inside the nucleus — an unfortunate lapse, because these are the only human cells in which such features are absent.

ZOOMING PAST CELLS

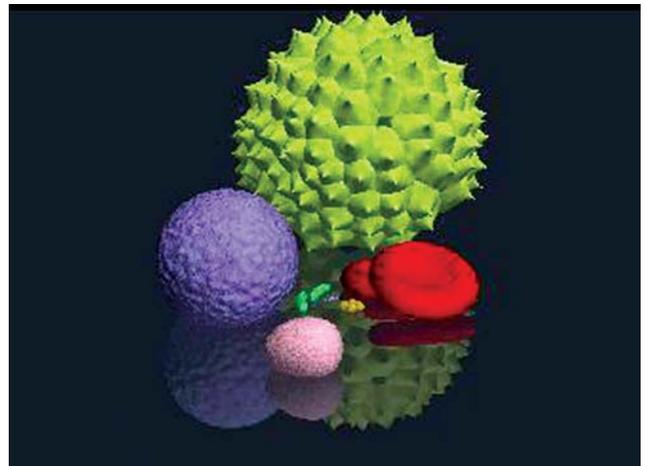
At the same time, American filmmakers Charles and Ray Eames were working on a parallel project — and instead of using cartoons, they resorted to high-quality photography and meticulous editing to create a smooth and seamless zoom ranging from the smallest subatomic particle to the fringes of space. Their original treatment was produced in 1968 as an experimental film, “A Rough Sketch for a Proposed Film Dealing with the Powers of Ten and the Relative Size of Things in the Universe.” That film was narrated by Julia Bronowski, and it used the zoom technique with a starting point in Miami. It was largely filmed in black and white. The movie that was later released in 1977 was “Powers of Ten: A Film Dealing with the Relative Size of Things in the Universe and the Effect of Adding Another Zero.” This time it was all in color, and the starting point was the back of the hand of a man picnicking with his young family near Soldier Field in Chicago.

Narrated by Philip Morrison, the new movie became famous as “Powers of Ten” and remains a classic. Like “The Incredible Shrinking Man,” it was selected for the U.S. National Film Registry by the Library of Congress for permanent preservation. Philip and Phylis Morrison went on to produce a volume from the film, published by Scientific American Books, and with stills from the movie as illustrations. The sequence when we travel down to the man’s hand and on through his tissues towards his genes is a disappointment. Once again, we see no hint of living cells. The scaly skin is well portrayed, using scanning electron micrographs of human epidermis, but we whisk straight through to the chemistry that lies within.

The idea was borrowed by the Smithsonian Institution in 1996 for their Imax movie “Cosmic Voyage.” The script, intoned with due gravitas once more by Morgan Freeman, asks: “Will the universe go on expanding forever? Exactly how did life arise? Will there be other universes beyond our cosmic horizon — and are there others, elsewhere in the universe, asking the same thing?” And then that great, swooping zoom sequence carries us from the outer reaches of space through teeming stars, rather too quickly to our own galaxy and down to the world, flashing through the atmosphere to a residential suburb (this time on the banks of a Dutch canal) and down to a field by the

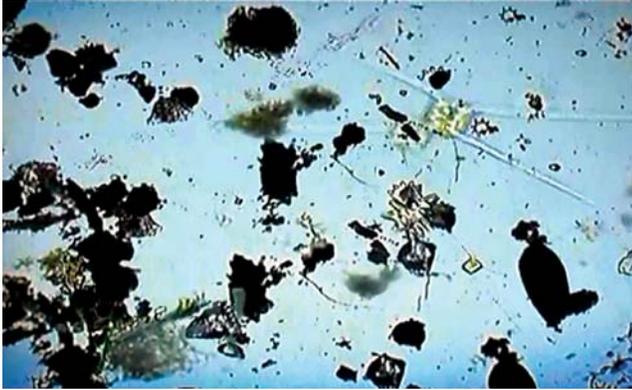


The 1977 movie “Powers of Ten” featured a zoom sequence from the fringes of space to the sub-atomic realm — but it missed out living cells altogether. When the Smithsonian Institution copied the concept in 1996 for their movie “Cosmic Voyage,” they paused for a moment on a raindrop, just as “War of the Worlds” was to do in 2005. This *Paramecium* in the droplet was a highlight of the film.



The CELLS Alive! website has graphics designed to show the scale of cells. Although the comparisons are valid, there is nothing “alive” about the images. The ragweed pollen grain and the solid erythrocyte are shown with a lilac lymphoblast and some green bacteria near a single yeast cell that looks like an egg. Scanning electron micrographs are typically used as references for such images.

water, where children are happily playing, until we zoom in on a blade of grass on which lies a droplet of dew (this is precisely the view that Spielberg utilized for “War of the Worlds,” only he zoomed out rather than in). Inside the water droplet — yes, there is no mistake this time — a group of ciliates is swimming around. We close in on a single *Paramecium* and then



"Miniature Britain" was a series of films for television designed to reveal the microscopic world. Microbes were almost entirely absent. In this scene, after an expedition to capture phytoplankton, the producers resorted to filling the screen by overlaying different video sequences of water rich in mineral dirt particles with *Chaoceros* faintly visible (and out of focus) to the right.

penetrate its own DNA to close in on the atom itself. We home in on the nucleus of an oxygen atom, burrow within a conveniently color-coded proton and end our journey with a field of flashing quarks. This time the concept works beautifully, and precisely at the right place in the sequence there is a genuine, unmistakable living cell. This is a triumph. It hasn't been repeated.

The endless zoom through space was cleverly parodied in episode 327 of "The Simpsons" on March 14, 2004. It starts with the cartoon cast returning home and — once seated on the couch — the camera zooms out dramatically to show the group, then the house and their neighborhood. As the zoom encompasses the whole of the U.S. it reveals the Simpsons' hometown (and yes, it clearly is Springfield, Illinois, in spite of rumors to the contrary) until the view embraces the whole of America, then the earth, solar system and the entire galaxy, and on to the outer reaches of space. At this point, each celestial particle emerges as an atom, then molecules of DNA, until we see a close-up of Homer Simpson's scalp, then zoom out to see his head, and finally the whole family on the couch, precisely where we began. The crucial moment is when we scale up from DNA to the scalp, for the once-again essential component of the cell is skated round. So well received was this introduction that the producers of the Simpsons reprised it in episode 346 on March 6, 2005, and again in episode 409 on Dec. 16, 2007. It is a witty and ingenious introduction, technically marred by the many rapid fades in the sequence that prevent it from being seen as a smooth and con-

tinuous zoom — and, of course, by the fact that the crucial key to the Simpsons' existence, the living cell, is strangely absent.

For most authorities, images of dead cells remain the convention even when they lead the viewer to expect finding living cells. There is an online sequence in the CELLS Alive! website that similarly sets out to demonstrate relative scale. However, when we pass the crucial living cell stage, the cells are very much dead and stylized and not "alive" at all. We are presented with a ragweed pollen grain in lime green, a scarlet and solid-looking erythrocyte, a lurid lilac lymphoblast and some grass-green bacilli lying alongside a single yeast cell that looks like a hen's egg. The scale is fine — but these are not suitable objects for a site claiming to show cells when alive.

From Florida came a movie entitled "From Quarks to Outer Space," which trudges along through atoms and molecules, through DNA towards the cell nucleus — and shows only a scanning micrograph of a dead and dried nucleus. You might as well exemplify a living pig with a slice of grilled bacon. As the field widens they include a micrograph of plant tissue captioned "individual leaf cells," which contrives to show everything *except* individual cells. There are clear signs of stomata, the breathing pores through which leaves transpire, but of individual cells nothing can be seen. We zoom out into space (this time starting from Tallahassee, Florida) without seeing any cells at all.

There is a similar video, "A Measure of Everything," made by Paskal Productions, which this time zooms down to earth near Maja Jezercë, Albania. It has one image captioned "A Cell" though in fact it shows about 30 cells of *Eudorina*, a colonial chrolophyte.

The same idea was picked up by the Fazedordevideos channel on YouTube, which produced a sedate but fascinating sequence moving from a molecular model of water and out to the edge of the universe. It is a fine film for an amateur, and cells make a fleeting appearance — but they're not *living* cells. There is a scanning electron microscope image of an erythrocyte as though cast in coarse cement, and a lymphocyte that has been freeze dried and gold coated and looks more like a dropped ice cream that was frozen in time rather than something that was ever alive. The key point is that there are cells in the sequence; that is not always the case. A producer called The Person From Earth issued a video that similarly zooms out from the visible to the galactic, this time showing nothing alive at all. It starts with an aerial view of a sports stadium in France and moves out from there.

OUR MICROBE FRIENDS

Once in a while, a documentary project truly does stand out. One of my favorites is a captivating series called “Intimate Strangers: Unseen Life on Earth,” produced by Baker and Simon Associates of Pasadena, Calif., for the American Society for Microbiology. The first film aired on PBS in November 1999 and contains riveting images of protists exploring their aquatic world and living their busy lives. “Microbes are far more friends than enemies,” explains the narrator. “They underpin the health and wellbeing of the entire biosphere. An earth without microbes would be barren and lifeless.” The scope of this film is impressive. It not only shows the organisms that recycle wastes or browse in ponds, but microbes in the ocean that release sulfur compounds that stimulate the seeding of clouds and those from Yellowstone National Park that mass produce DNA polymerase. In this movie there are more people than microorganisms — less than 10% of the running time is made up of film taken down a microscope. That is unfortunate, as is the main drawback with this movie: Not one of the organisms is named, and nowhere is their role explained. To the viewer they are just pretty pictures to counterbalance the words — but what superb images they are.

Compare that with the most recent film on the subject we have seen. “Miniature Britain” set out to show BBC television viewers the microscopical appearance of the world around them, though it was a conspicuous failure. It was claimed that a revolutionary new microscope was making the film possible, though the instrument was a conventional digital microscope originating with the design of pioneering gadgets like the QX3 for which I wrote the experimental manual back in 1999. A sequence devoted to marine phytoplankton showed a biologist collecting samples with a fine meshed net but the results were embarrassing. To make up for their inability to capture living cells, the producers eventually superimposed three separate video micrograph tracks on each other in an attempt to fill the screen, but all viewers saw was a selection of dirt with a single *Chaoceros* cell (and that was out of focus).

Elsewhere, it is not all bad news. In the past year, living cells have begun to appear in television films, though often in the shortest imaginable sequences. A TV commercial advertising services to combat illicit drug use by Olympic athletes in London last year contained a glimpse of circulating blood cells, as did a humorous satire made by a British TV comedian, Harry Hill. Fibrocytes in culture were glimpsed in a

commercial for a cancer charity in London and in the title sequence for a Spanish science show. In each case, the living cells appeared for a second and in some cases even less. But at least they were there.

Among these, the “War of the Worlds” title sequence stands out as a beacon of enlightenment. The organisms shown were loosely based on *Paramecium*, a common freshwater ciliate. I used a graphical image of a similar type on the jacket of my book *Microbe Power*, published in 1976. The microbe sequence in “War of the Worlds” was meant to show that microbes would eventually destroy the invading aliens, though that’s grossly misleading, because such ciliates are harmless grazing microbes that live innocuously in ponds. Showing them as deathly pathogens is about as sensible as casting a vole in place of the killer shark in “Jaws.” But no matter — the movie featured microbes, which is a move in the right direction.

The film trailer for “Fantastic Voyage” in the 1960s had said: “The past, the future; all have been subjects for the camera. But now, our film has broken through in an unexpected direction to create an adventure of astonishing suspense and beauty — one of the miracles of the universe.” The sense of wonder and amazement is justified, though that film contained none of the revelations that the trailer had promised. And this is the central conundrum: Movies have explored every aspect of the known world and of many worlds unknown. What they have not managed to do is find out about the vast microscopic universe that is just waiting to enthrall audiences everywhere and which could give everyone a dramatic new perspective on the realities of our existence. This is the last, great untapped frontier that filmmakers need to address.

Back in December 1975 I published a leading article in *Nature*, which said: “Society has a blind spot for microorganisms ... in vitro technology is unlikely to resolve issues unless it is complemented by that rare art, the microscopy of living cells.” Wind the clock forward to 2012 and I wrote in *Biologist* that: “CGI reality is contrived, and sight of the real cells is nowhere to be seen. It is curious that this most important aspect of our lives is so crudely misrepresented...”

I think Hollywood should now show us the way. There are millions of dollars to be made — not as many as there are microbes in your meal, of course, but a huge fortune nonetheless. The new microscopical movies I have in mind would feature a unique bonus: sights on the screen that take your breath away. What’s more, they would be cinematic sights that nobody has seen before. Just think, a chance to make money *and* history. Not bad for the box office.