WIRED

MATRIX^2

Bullet Time was just the beginning. F/x guru John Gaeta reinvents cinematography with *The Matrix Reloaded*.

By Steve Silberman

I'm sitting in a former naval barracks in Alameda, California, watching the digital assembly of a human face. Bones, teeth, glistening eyes. Layer upon layer. Finally the hair and skin, the creases and tiny scars that make us who we are. The face blinks and breathes. Then it snarls, and my skin crawls.

Agent Smith is back, and he's pissed.


Matthew Welch

You'll be seeing a lot of Agent Smith this year. Neo's man-in-black nemesis returns on May 15 in The Matrix Reloaded, the continuing story of a young hacker who learns that the apparently real world is an elaborate computer simulation. In November, a second sequel, *Matrix Revolutions*, will take up where *Reloaded's* nail-biting climax leaves off.

Things have changed since 1999. In the last shot of the original film, Neo, played by ex-slacker Keanu Reeves, flew up out of the frame, demonstrating that his mental abilities had become stronger than the enslaving delusion of the Matrix. Now he's a full-fledged superhero, soaring over the skyline at thousands of miles an hour and making a rescue as trucks collide head-on. The bad news: Agent Smith, played by Hugo Weaving, is a rogue virus in the Matrix, able to multiply himself at will. And the last free human city, Zion, in a cave near the Earth's core, is under attack.

What hasn't changed is the dark, richly nuanced aesthetic of brothers Larry and Andy Wachowski, a pair of Hollywood outsiders who wrote and directed what became the most successful movie in the history of Warner Bros. The Wachowskis had always conceived of Neo's odyssey as a trilogy, but to release both sequels months apart - plus the videogame *Enter the Matrix* and an anime series called *The Animatrix* - required a year of intense collaboration, as the scripts, sets, and shot designs all evolved together.

The Matrix raised the bar for action films by introducing new levels of realism into stunt work and visual effects. For *Reloaded* and *Revolutions*, the Wachowskis dreamed up action sequences that were so over-the-top they would require their special-effects supervisor, John Gaeta, to reinvent cinematography itself.



With four Academy Award nominations to their credit, the members of the core Matrix team reconvened in February 2000 at a secret location near the beach outside of Los Angeles. There - at the home base of Eon, the Wachowskis' production company - Gaeta, concept artists Geof Darrow and Steve Skroce, production designer Owen Patterson, producer



Matthew Welch
So what does a visual effects supervisor do to follow up the *Matrix* trilogy? Gaeta says his next project will be "some combination of *Akira*, Busby Berkeley, and *Apocalypse Now*."

Grant Hill, and the brothers brainstormed around "the most James Bond table you've ever seen," Gaeta says. Hanging above it were pulldown screens linked to 3-D workstations so that art and designs could be discussed collectively. Over the next year, a river of drawings, storyboards, and stage plans flowed into Eon's asset-management network, which was christened (what else?) the Zion Mainframe.

For visual ideas and inspiration, the group cranked up *Alien*, *2001*, *Vertigo*, *Apocalypse Now*, *Koyaanisqatsi*, and *20,000 Leagues Under the Sea*, along with documentary footage of car crashes, robotics manufacturing, 19th-century submarines, glassblowers at work, the drilling of the Chunnel, the heavyweight bouts of Rocky Marciano, and the explosion of the *Hindenburg*. Madhouse, the makers of *Akira* and *Metropolis*, prepared a custom reel of explosions of various types and sizes for the Wachowskis, who were particularly interested in the ways that natural phenomena - weather, water, flames - are depicted in anime as intelligent obstacles, characters in their own right.

As the team tossed ideas around for one hellacious fight scene that became known in-house as the Burly Brawl, Gaeta realized that the innovative technology he and his crew developed for *The Matrix's* ultra slo-mo action sequences would not be sufficient to bring the Wachowskis' new vision to the screen. Those oft-imitated shots - now universally known as Bullet Time - required serpentine arrays of meticulously aligned cameras, and months of planning, for a brief scene featuring two or three actors. In the Burly Brawl, super-Neo would battle more than 100 Agent Smiths in an extended orgy of kung fu orchestrated by crack martial-arts choreographer Yuen Woo-Ping.

To develop the technology needed for the Burly Brawl, Eon and Warner Bros. launched ESC, a visual-effects skunk works in an old naval base across the bay from San Francisco. ESC ultimately produced more than a thousand visual-effects shots for the two sequels, and the company has operated in stealth mode until now. The word *Matrix* didn't even appear on the scripts' title pages; instead, they were tagged with a code name, *The Burly Man*.

For *Reloaded's* blowout chase sequence - Trinity and a character called the Keymaker haul ass on a motorcycle to the nearest landline, past carloads of marauding bad guys - ESC constructed a quarter mile of new freeway on the naval base. Eventually, Gaeta enlisted more than 500 digital artists from a roster of cutting-edge effects vendors (including Sony Pictures Imageworks, Animal Logic, Tippett Studio, BUF Compagnie, and Giant Killer Robots) to create everything from shimmering swarms of Matrix code to thousands of vengeful robot "squiddies" burrowing toward Zion.

But the Burly Brawl became Gaeta's personal obsession. Like many in the film industry, he has been talking for years about the promise of virtual cinematography, a confluence of technologies that would allow directors to sculpt actors' performances with the ease of tweaking a CAD file. The traditional ways of doing this, however, reduce the world to the kinds of data that computers easily understand, and the result often ends up looking like a glorified videogame. That wouldn't work for the Burly Brawl, a fight that erupts in a virtual prison indistinguishable from the real world.

"People get really preoccupied with, 'Are you going to top yourselves this time? Are you really gonna come up with a *zinger*?'" Gaeta tells me. "My job has nothing to do with making zingers. The point is not to knock you over with a visual trick. The point is to be able to construct events that are so complex, in terms of what human bodies need to do, that the total 'effect' is *impossible choreography*. 'My God! It looks real, but it just can't be.'"

The showdown is set in a dingy courtyard in the vast cityscape of the Matrix. A sign on a pole says NO BRAWLING. It will not be a good day for that sign.

Neo and Agent Smith face off as crows flutter into the air. Words are exchanged. Things do not go well. The agent makes a bold attempt to load himself into Neo's body, but Neo's powers are too

strong now. What Smith needs is reinforcements, a cavalry. Being a virus, there are potential recruits everywhere.



Warner Bros.
Scene from *Reloaded*: The beginning of the Burly Brawl.

If the dojo fight in *The Matrix* was a kung fu sonata, the Burly Brawl is a symphony. Neo tears the sign from the ground and wields it as a kendo sword, vaulting pole, and battering ram. A woman walking by can't believe what she's seeing; suddenly her body is hijacked, she drops her grocery bag, and another Smith charges into the fray. Whole battalions of Smiths arrive, mount assaults, attack in waves, scatter, regroup, and head back for more. (At ESC, one massive pile-on was dubbed the "Did someone drop a quarter?" shot.) In the thick of it, Neo is dancing, chucking black-tied bodies skyward, pivoting around the signpost, and using shoulders as stepping-stones over the raging river of whup-ass.

Fans will wear out their remotes replaying the scene on DVD, but what they won't see, even riding the Pause button, is a transition that happens early on. When Neo and Agent Smith walk into the courtyard, they are the real Reeves and Weaving. But by the time the melee is in full effect, everyone and everything on the screen is computer-generated - including the perspective of the camera itself, steering at 2,000 miles per hour and screaming through arcs that would tear any physical camera apart.

This is virtual cinematography, but the most impressive thing about the Burly Brawl is that it doesn't look virtual at all. The digital faces of Reeves and Weaving could get past a flank of security guards, and the buildings surrounding the courtyard look dreary and lived-in - the grimy, unmistakable patina of the real.

Effects designers have been swapping CG faces onto the heads of stunt doubles for more than a decade, but typically, these faces were seen for only brief moments, from afar, or were occluded by other effects, like flames or smoke. Previous attempts to render faces with enough verisimilitude so that a camera could linger produced virtual visages that had a plastic, androidal quality, like the all-digital actors in *Final Fantasy: The Spirits Within*. Because the faces of Reeves and Weaving are so familiar to the audience - and because, as ESC's effects supervisor Kim Libreri puts it, "our brains are hardwired from day one to look at human faces and not be deceived" - Gaeta's job was that much harder.

The standard way of simulating the world in CG is to build it from the inside out, by assembling forms out of polygons and applying computer-simulated textures and lighting. The ESC team took a radically different path, loading as much of the real world as possible into the computer first, building from the outside in. This approach, known as image-based rendering, is transforming the effects industry.



Warner Bros.
Scene from *Reloaded*: Trinity slams the door.

A similar evolution has already occurred in music. The first electronic keyboards sought to re-create a piano's acoustic properties by amassing sets of rules about the physics of keys, hammers, and strings. The end result sounded like a synthesizer. Now DJs and musicians sample and morph the recorded sounds of actual instruments.

Instead of synthesizing the world, Gaeta cloned it. To make the Burly Brawl, he would have to build the Matrix.

At the end of a desolate street in Alameda, giant cargo cranes rise out of the bay - the same towering machines that inspired the design of the Imperial Walkers in *The Empire Strikes Back*. When Gaeta and his crew moved here two years ago, there was no heat or air-conditioning, and the hundreds of bunks occupying the main building had been soaked in a flood. Now 270 animators, painters, pyrotechnicians, rotoscopists, and coders buzz around the cinder-block rooms. The hallway between the Trinity Conference Room and the Zion Theater is lined with original prints by the resident artists, 80 percent of them eager ESCapees from other effects houses, notably Pixar and Industrial Light & Magic.

Still boyish at 37, with the scruffy elegance of a rock prodigy who has stayed relevant, Gaeta sports long sideburns that are themselves a kind of visual effect, sculpting his jawline. He speaks with an ironic inflection, elongating vowels so that when he says "*Re-loo-oaded*" or "*Revo-luuu-tions,*" the titles come with air quotes preinstalled.

Growing up on Long Island, Gaeta was a classic high school underachiever until he discovered photography and what he calls a "dark universe perfection" in the films of Stanley Kubrick and Ridley Scott. After graduating from NYU film school in 1990, he became a production assistant on *Saturday Night Live*. Then a friend told him that Douglas Trumbull - the effects guru behind *2001* and *Blade Runner* - was launching a new studio in an old textile mill in western Massachusetts. It was here, at a company called Mass.Illusion, that Gaeta met his mentors and embarked on a quest to seamlessly integrate the digital and the real.

"I was awestruck working with Doug because he was so fearless," Gaeta recalls. "He'd say, 'This camera doesn't exist yet, but we're going to make one. This screen doesn't exist, but we'll build it. Then we'll invent a new format.' Doug was innovating constantly."

Diane Piepol, a digital artist who worked at Mass.Illusion, says Gaeta was equally at home with the camera jocks and the computer geeks: "He brought more long-range technical investigation to his job than I had ever seen. Usually you have the digital people on one side and the camera people on the other, and they don't talk much. But John was fluid in both worlds."

The first step in bringing real objects into the virtual world was to obtain precise measurements of everything in the frame. To render an existing city block, CG artists would seek out blueprints of each building so they could generate wireframe models to scale. When work began on 1998's *What Dreams May Come*, Gaeta and effects supervisor Joel Hynek headed off to Glacier National Park in Montana, the setting of that film's visual centerpiece - a vision of heaven as a luminous, still-damp oil painting. At night, Gaeta hiked into the mountains with a laser-radar rig to survey the rock faces.

Meanwhile, the Wachowskis were struggling to convince Warner Bros. to green-light *The Matrix*. Action-movie mogul Joel Silver was enthusiastic about the script, but with its gnostic allegories, Baudrillardian subtexts, and Philip K. Dick mindfuckery, it was no *Die Hard With a Modem*. To clinch the deal, the brothers hired Darrow and Skroce, two underground comic book illustrators, to draw up art and elaborate storyboards. There was one element in the script, however, that could never be adequately represented with static images: Bullet Time.

This was the Wachowskis' name for a visual effect that didn't exist yet: an action sequence that

slowed time to a sinuous crawl and then cranked it back up to normal speed as the camera pivoted rapidly around it. It was the kind of challenge Gaeta had been waiting for. When he read the script, he pleaded with an effects producer at Mass.Illusion, "You have to get me this gig." Gaeta's prototype was so impressive, it got him the job, and the studio agreed to make the movie.

To make Bullet Time happen, Gaeta merged two techniques with roots in the earliest days of photography.

In the mid-19th century, another group of geeks had wrestled with the task of relating the physical to the virtual: mapmakers.

After the invention of the daguerreotype, a cartographer named Laussedat suggested stringing cameras to kites and lofting them over Paris. By taking multiple exposures of the landscape from different angles and triangulating them with clever algorithms, it was possible to generate a topographical map from flat images, similar to the way your brain generates depth perception from two separate 2-D inputs: your eyes. Laussedat's breakthrough was christened photogrammetry.

Fast-forward to the early 1990s, when another Frenchman, Arnauld Lamorlette, the R&D director for design firm BUF Compagnie, faced a problem similar to Laussedat's. Industrial clients examining buildings for structural flaws needed to see Paris from above. Parisian airspace, however, is tightly controlled; nonmilitary aircraft may fly over the city only on Bastille Day. Lamorlette found that by morphing between two photographs, he could generate a 3-D model: digital photogrammetry. BUF employed the technique to help director Michel Gondry create a music video for the Rolling Stones. Its radical camera moves - zipping through a room full of partygoers frozen in midmotion - caused a sensation in Europe. (BUF also used this method to make a Gap ad called "Khakis Swing" that was most Americans' first glimpse of the effect.)

Gaeta and Kim Libreri pumped up this technique for *The Matrix*: By triggering a circular array of 122 still cameras in sequence, they were able to simulate the action of a variable-speed movie camera that tracked completely around its subject. Because the cameras located on one side of the array were visible to those on the other side, however, they also needed a way to computer-generate photo-realistic sets so they could paint the cameras out of the frame.

Gaeta found the answer in 1997, at the annual visual effects convention Siggraph, where he saw a short film by Paul Debevec, George Borshukov, and Yizhou Yu called *The Campanile Movie*. The film - a flyover of the UC Berkeley campus - was generated entirely from still photographs. Like the 19th-century cartographers, Debevec and his team derived the precise shapes and contours of the landscape by triangulating the visual information in still photographs. Then they generated 3-D models based on this geometry, but instead of applying computer-generated textures to the models, they wrapped them with photographs of the buildings themselves. The trick worked spectacularly well. Instead of resembling something out of *Toy Story*, the buildings and the surrounding hills in *The Campanile Movie* looked absolutely real.

"When I saw Debevec's movie, I knew that was the path," Gaeta told me. To walk that path as far as the Wachowskis needed him to go, he hired Borshukov, who had written the algorithms used to render the images at Berkeley. Borshukov, Libreri, and a visionary effects engineer named Dan Piponi became Gaeta's core posse at Mass.Illusion, a collaboration that continues to this day at ESC.

"John, Kim, Dan, and I all have this passion for sampling the real," Borshukov says. "By extracting information from the real world, you preserve all the richness and variation, the noise, the unrepetitiveness, the subtleties - the things that are so hard and expensive for computer graphics to achieve. Eventually, computer graphics will be able to build these things. We're jumping the gun by 10 years."

Creating the Burly Brawl, however, is a taller order than inventing Bullet Time. To portray Neo in hand-to-hand combat with more than 100 Agent Smiths in the old way would have required Escher-like tangles of crisscrossing still-camera rigs and years of compositing. What Gaeta needed was a

virtual camera that could fly through the 3-D scene - as free from the laws of space and time as Neo is from the physical laws of the Matrix.

"The concept of Bullet Time had to graduate to the true technology it suggested," he says. "For *Reloaded*, we had to finish the job so that we could get relentless, uninterrupted, and editable chunks of Neo in the zone."

This virtual camera needed to be able to see behind and around things, and to know what was obscured by any particular angle, so that if the Wachowskis wanted to try different passes through the Burly Brawl, the entire scene would already be in ESC's computers, captured in code, as real as if it was a physical set. Unlike a physical set, however, the scene would be moving - alive with the rage of hundreds of men fighting in top form. Bullet Time squared.

The process of creating multiple Smiths was fairly straightforward. First Gaeta and his crew turned a 250,000-square-foot hangar in Alameda into the biggest motion-capture dojo in the world. The punishment was relentless for Yuen Woo-Ping's army of black belts; between the sequels and the videogame, they did hundreds of takes a day. Buffed out with CG muscle, tailored in simulated suits, and animated with collision data obtained from digital crash-test dummies, the torsos of Yuen's warriors were transformed in postproduction into wave upon wave of attacking Hugo Weaving clones.

Then came the real work.

While the topography of the human face is the hardest to simulate digitally, it turns out to be one of the easiest to map photogrammetrically. It has fewer shadows and occlusions than, say, the city of Paris. The language of the face communicates maximum information through the subtlest inflections. The interfaces of our souls are designed to be read in a heartbeat.

To replace the faces of Yuen's men with that of Agent Smith - while retaining the level of photorealism that the Wachowskis demanded - Gaeta and his team built a system for sampling the real at a higher resolution than had ever before been attempted, dubbing this process universal capture.

Gaeta began by making lo-res laser scans of Reeves' and Weaving's heads in relaxed, neutral poses. These scans furnished the basic geometry upon which succeeding layers of real-world data would be applied.

Then Reeves and Weaving each sat down on a stage in front of five Sony HDW-900 video cameras. The massive datastreams from these cameras - one gigabyte a second - were treated like holy water; even the cameras' color-correction software was disabled to prevent any loss of data. Instead of recording to tape, which requires compression, the cameras were modified to send uncompressed data to a bank of high-end PCs that stored it on a huge disk array. "The scene in that room was surreal," Gaeta recalls. "There's this guy onstage, and his face is surrounded with this fucking *Cape Canaa-averal* backup system."

As Reeves and Weaving acted out a range of facial expressions for their rumble in the courtyard, the cameras captured each twitch of muscle and every change in the blood flow to the skin. This data was then analyzed with algorithms written by Borshukov that tracked each individual pixel as it moved from frame to frame. The tiny irregularities in the actors' faces actually made this job easier, giving Borshukov's algorithms distinctive points in space to grab on to as he reconstructed the actors' features moving through time.

The old Bullet Time rig had produced the illusion that reality was a big CAD file, but it was just an effect, not a three-dimensional world that could be manipulated as easily as if it really *was* a CAD file. The universal-capture rig enabled ESC to smuggle the faces of Neo and Agent Smith across the border between the digital and the real, into Gaeta's Matrix - a zone where skyscrapers, skin, flames, and marauding machines are all re-created equal.

What this means for moviemaking is that once a scene is captured, filmmakers can fly the virtual camera through thousands of "takes" of the original performance - and from any angle they want, zooming in for a close-up, dollying back for the wide shot, or launching into the sky. Virtual cinematography.

How deep did the rabbit hole go? A cast of each actor's head was sent to a company called Arius 3D, makers of ultrahigh-resolution scanners employed in 1999 to archive the works of Michelangelo. The Arius scanner is accurate down to 25 microns - the diameter of a mold spore. To get the clothing simulations just right, ESC sent swatches of Reeves' black cassock and Weaving's jacket to a company called Surface Optics, which builds devices to measure a property of light called the bidirectional reflectance distribution function. Surface Optics happened to have one machine on hand scheduled to ship to Lockheed Martin a month later, where it was to be assigned to its usual task: evaluating the reflectivity of paint on stealth bombers.

This ocean of information - combined with even more real-world data about the light levels on the set - was poured into the rendering program of choice at ESC: mental ray. (The German firm that created it won an Academy Award for technical achievement in March.) What emerged is real enough to fool Morpheus: effects that are mind-blowing precisely because they're transparent - a world that looks like the world.

For years, employees at ILM have joked that George Lucas is pushing to create virtual cinematography so that he can do away with living actors. It is a point of pride at ESC that its methods are designed to augment the subtleties of human performance, not replace them.

"We're not interested in making Keanu say things he hasn't said," Borshukov tells me. "Our aim was to preserve the most minute aspects - every smirk, every frown - of how Keanu made Neo real."

The ability to create photorealistic virtual human beings raises unsettling questions, especially in conjunction with the means to cut-and-paste them into any landscape. These questions troubled Gaeta himself so much that, a few years ago, he wrote a letter alerting President Clinton to the fact that such technology could be used for purposes of mass deception. (The letter was never answered.)

As it happens, one group deeply interested in the new breed of hyperrealistic CG is the military. Darpa is fast-tracking image-based rendering and lighting for use in immersive battle simulations. In 1999, the US Army launched the Institute for Creative Technologies at USC, where Paul Debevec - Borshukov's former mentor at Berkeley - is now the head of graphics R&D.

Gaeta recognizes the paradox. "You have these paranoid films about the Matrix depicting how people are put in a mental prison by misusing this technology, and you have the military constructing something like the actual Matrix. Or maybe *our* technology will become the actual Matrix, and we have inadvertently spilled the vial of green shit out onto the planet."

Neo and Gaeta have something in common. In a world of seductive illusions, they became revolutionaries by championing the prodigious chaos of the actual world. It's a role Gaeta accepts with a healthy dose of Wachowskian irony. Before I leave ESC headquarters, I ask Gaeta where the brothers got their codename for the film.

"*The Burly Man* is the title of the script on Barton Fink's desk. We all loved that movie," he explains. "The lesson at the end of it is that after all these ordeals, all this agony, you finally arrive at the culmination of your entire life's work - and it's a wrestling picture.

"That's what *The Matrix* is."

How to Be a Real Hollywood Player

And the Oscar for Best Actress in a Supporting Game goes to Jada Pinkett Smith!
by Evan Ratliff


Warner Bros.

In *Reloaded*, the *Matrix* sequel, Jada Pinkett Smith plays the supporting role of Niobe, a hovercraft pilot. But in *Enter the Matrix*, the spinoff videogame, she's the star. Both will be released on May 15 - a synergistic first for Hollywood. (*GoldenEye 007*, a well-received shooter, came out a full two years after the movie hit theaters.) The movie industry has promised multimedia convergence ever since Atari's *Star Wars* hit arcades 20 years ago. But with minimal participation from actors and directors, franchised game incarnations have largely ended up as flubs that look and play like marketing ploys.

Enter the Wachowski brothers, avid gamers who view the two *Matrix* sequels and the game as a single project. All three titles share the same sets, crews, costume designers, choreographers, and - most crucially - actors. Each of the 25 main characters in the film reprise some version of their role for the game, and none more than Niobe. She and weapons expert Ghost (Anthony Wong) are the only playable characters.

While the typical spinoff might require actors to reread a few lines or submit to a scan, Pinkett Smith worked as hard on the game as on the movie that spawned it. She had to memorize game scripts several times longer than their film equivalents. She's starring in an additional hour of the movie, which will appear not in theaters but as cut-scene interludes in *Enter the Matrix*. And to get the gameplay right, she had to endure six months' worth of extra motion capture, face mapping, and full-body scanning. The result, she says, was maddening. "You had first unit, second unit, third unit, and then the game stuff."

That's a first for videogame production. "I could have hired some cheap actors to do it," says David Perry, whose company, Shiny Entertainment, developed the game. "But the Wachowskis didn't want to hear that. They were like, are you kidding me?"

For actors, shooting on a game set can be a trying experience: Game producers have to film from all angles to create realistic action. The motion capture set also required pretend-driving foam-and-wire cars, reacting to nonexistent explosions, and fleeing from make-believe agents. "It was like being a kid again," she says. "Everything had to be created through my imagination."

It wasn't easy, but the result, she predicts, will vault game acting into Hollywood's next big thing. "People are going to wanna be down," she says, noting that husband Will Smith is already investigating a game tie-in for his next movie. "That's the way you are going to have to do it from now on."

That's fine for Pinkett Smith - as long as she's working with the masters. "I know that if the Wachowskis made another game," she says, "it would be something that's never been done before."

The 10 Movies That Rocked My World
by John Gaeta

1. 2001: A Space Odyssey (Kubrick)
The ultimate application of visual effects by the director who has most inspired my industry.

2. Metropolis (Lang) Metropolis (Rintaro)
Fritz Lang's visionary approach to architecture and set design is as contemporary today as it was in 1926. The 2002 remake written by the anime master responsible for Akira is the most sophisticated merger of 2-D and 3-D animation methods I've ever seen. Plus, antirobot rebellion is supercool.

3. Alien (Scott)
Ridley Scott is a god when it comes to setting a tone. H. R. Giger's textures and atmosphere in this film are among the strongest and strangest visual backdrops you'll ever find. (A close second: Blade Runner.)

4. Koyaanisqatsi Powaqqatsi (Reggio)
These movies make me hallucinate, literally. I am obsessed with the visuals and consult them endlessly. Stylized culture, nature, and surreal patterns of this world - it's all there.

5. Vertigo (Hitchcock)
The vertigo effect is completely original. If Alfred Hitchcock, Stanley Kubrick, or Orson Welles were alive, they would transcend today's virtual cinema in ways we could never imagine.

6. The Seven Samurai (Kurosawa)
This is a truly immense story and perhaps the greatest action film ever created. I first saw this when I was 15, and no Hollywood film I've seen since quite tops it.

7. The Mirror (Tarkovsky)
Symbolically charged imagery, autobiographical memory, and an inherent sense of the spiritual nature of simple things will keep this work provocative forever.

8. Godzilla, King of the Monsters (Honda)
OK, so I like to see massive destruction delivered by gigantic, unforgiving monsters. What's wrong with that? Humans need some competition.

9. SlaughterHouse-Five (Hill)
Any film that displays the mind-bending technique of "telepathic schizophrenia" - the ability to shift through time and space as a means of accepting absurd realities like war and death - has got to be useful to the average Joe. Vonnegut is a madman.

10. Brazil (Gilliam)
If George Orwell did stand-up comedy, it would be like Terry Gilliam predicting the future. Hilarious.

BONUS PICK: The Omega Man (Sagal)
I threw this film into the mix because it seems relevant right now. Gun freak number one, Charlton Heston, plays the only uncontaminated man left standing after a biological attack on America. Observe as he "deals" with the protests of the germed-up mutant citizenry. Has Dick Cheney seen this?

Contributing editor Steve Silberman (digaman@wiredmag.com) wrote about bacterial communication in Wired 11.04.