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As a filmmaker, Tim Burton has earned a reputation for crafting films that are quirky, visually arresting, frequently dark or gothic, and above all, original. His latest—Sweeney Todd—based on the 1979 Stephen Sondheim musical about the 'Demon Barber of Fleet Street,' is all of those things, and more. Having eyed the property for years, Burton convinced his frequent partner in crime, Johnny Depp, to take on the plum role of Benjamin Barker (aka Sweeney Todd), a man sent to prison under false charges by a lecherous judge who covets his wife and child. After serving 15 years of hard labor, Todd returns to London with not much else but vengeance on his mind, and partners up with the equally unhinged shopkeeper Nellie Lovett (Helena Bonham Carter). The two then proceed to slice and dice the local inhabitants, serving them up as meat pies to unsuspecting patrons.

To help realize his vision for the macabre tale, the director called upon visual effects supervisor Chas Jarrett and The Moving Picture Company, a frequent collaborator on Burton's projects. Chieft among the visual effects challenges was the re-creation of a gritty and squalid Victorian-era London. Burton's initial inclination had been to shoot the live-action using minimal sets and extensive greenscreen—a concept that Jarrett obligingly explored in preproduction. "We began to test with greenscreen techniques," Jarrett recalled, "and the shots were completely convincing.

We produced tests both for daytime and nighttime environments that looked very realistic, and obviously were very controllable, but I think Tim soon found that having his actors in an all green set—especially when they had the added effort of singing—was just a bit too impersonal. The greenscreen stage is a very empty environment, and it can be quite distracting. So once Tim began to rehearse, the movie became smaller in scope in that he started to focus more on interior and quite intimate environments as a way of giving his actors more around them that they could connect with and play off of.

During preproduction, Jarrett worked closely with Academy Award-winning production designer Dante Ferretti to pin down a look for the London exteriors. "It was interesting, because the word 'stylized' was used quite frequently in preproduction. But it soon became clear that we didn't necessarily have a perfect definition of what 'stylized' meant. A really huge cue for that came when Dante was recruited to the show. The stylization that he was keying on was still realistic-looking, but it had a kind of theatrical stagi
A S Ferrer and his crew began construction at Plowell Studios on a thirteen or so full-size sets, Jarrett and MPC digital-effects supervisor Gary Beurich decided the set could be used to test a lot of the visual effects design work — mapped out their own approach to the virtual environments that would expand the real sets on a grand scale. Shots included everything from simple set extensions involving one or two views, through a lot of actual photography, to all-CG photoreal environments. "Ninety-five percent of the time, even our matte paintings were based on photographs of real London buildings that were projected back onto 3D objects, placed into position, given rough lighting, and then worked on top of that. So it was mostly a 3D-based approach." Period photos and paintings provided the visual effects team with its initial frame of reference. "Tim had found a lot of photographs that he felt portrayed the right sense of theatricality — interesting black-and-white images from the turn of the century — and he shared them with us. We took that as a jumping-off point to go out and just photograph London in large depth, because we wanted to use a photogrammetry technique for as many buildings as we could, rather than creating them from scratch. We had very specific requirements for the type of images we needed, and our visual effects photographer, James Kelly, spent months and months trolling through London annoy- ing people who owned houses and buildings, asking if he could photograph them. London still has many of those old buildings from the pre-Victorian era, so much of it was very usable. It was a big data-gathering effort, but that was our main research. We put it all on a filmstrip and go from street to street and choose buildings that we felt were appropriate for the period and for the look. And although those buildings, in reality, weren't next to each other, we would cut them out and stick them next to each other, kind of redrawing streets based on them, and doing rough layouts in CG.

To turn those rough layouts into photoreal CG environ- ments that matched the live-action sets, MPC's research and development team devised a custom lighting tool, "still" that expanded on the photogram- metry approach. "The basic concept is that you take a calibrated camera and you photograph your build- ing from a number of different perspectives — we'd shoot anywhere from two to twelve positions — and with a number of bracketed exposures. Then his takes all of those images and looks for similarities between them; and if finds points that correlate, it will effectively create a 3D point for those details. When you have a lot of images and a lot of this correspond- ing points, the result is that you get a very basic 3D model based on your photographs. The system then allows you to go in and refine the model by adding lots of detail to make it a presentation model. But what you always know is that you have photograph- s that line up perfectly to it. So ultimately, you can take the model and photos combine the multiple exposures from each position into one high dynamic range image, and that's an exact image that we can back onto the CG model you've created, in effect tex- turing it.

"The aim was to get as much of the textural quality of the buildings from the photographs as we possibly could, because these buildings had enormous history and character to them. A lot of that in the look of the materials they're done that's been weathered for 200 or 300 years, woodwork that's been eaten by woodworm. You can see how that made it feel more real. Rather than have an artist sit there and try to paint in that hist- orical character into these very high-resolution images, then you're a long way there, you had allowed us to do that.

Extensive previz, led by previz supervisor Martin Chomney, also proved invaluable in designing the look of shots and determining the scale and scope of the environmental work. The previz really helped us understand the size of the elements we were going to have to create, and allowed us to choose the best methods. For me, it was also a huge technical resource. We did a lot of technical previz where we would take a sequence that was going to be a CG environment, and create rooms and reams of printouts for the art department on set, so we could mark the floors and figure out what work went where and the around you when you were standing on a greenscreen stage.

Sweeney Todd opens with a dark and moody view of the "unnamed dock," as a sail- ing ship with Sweeney Todd onboard looms out of the fog to dock in the harbor. The opening shot, which came up late in the show and hence was not part of the original previz, was nearly all computer fabricated by MPC. It was one of the sim- pler shots in the movie, but also one of the nicest- looking. The boat itself is fully CG, and the ocean is fully CG, but the wake in front of the boat, where the
water is teeming to the left and right, is real. For that we sent a cameraman down to the Thames and shot boats coming towards camera, then just rotoscoped out the splashy elements and comped those in." Atmospheric effects were culled from reels of smoke and fog elements obtained in a big element shoot. "We used CO₂, incense smoke and various different types of smoke machines and smoke pellets - just to create a variety of different looks because we knew we were going to use set - and we layered those elements as the boat comes through. Things like sails flapping on the boat were actually a 2D warping effect the compositor did to make the static sails appear to flutter in the wind." The camera cuts to a view looking toward London's Historic Tower Bridge, then travels down the riverbank, taking in the dockside activity. Views of the riverbank included digital water and 3D bridge, with greenscreened people composited into the shot, along with mist and fog elements.

As Sweynen decribbs, the camera zips down, claustrophobic streets at an impossibly rapid clip in a quirky FOV shot dubbed "London Assault." The all-CG shot served to establish the look and feel of the film, and provided a convenient way to get from dockside to Fleet Street with minimal exposition. Bookended by seamless transitions in and out of the live-action that were shot without benefit of motion control, the London Assault was one of MPC's most challenging sequences. "It was about 12 months of solid work for that one shot. Not only was it challenging because it's all CG, it also had 27 live-action elements of people that had to be shot motion control and composited in.

The speed of the camera move complicated the task. "We used a Super Cypher rig, which can move faster than any other motion control rig I know of. But even with it at full speed, Andy Bull - who programmed the rig - still determined that we had to film to two frames per second. That meant that all our actions had to be moving at 1/12 normal speed so that when the film was played back at 24 frames per second, it looked like they were moving at the proper speed. Imagine walking up some steps where normally you'd take one step per second, and instead you have to take one step every 12 seconds. That takes enormous control. In fact, most people just cannot do it, because walking up the stairs involves a lot of gravity, and gravity can't be slowed down."

Jarrett recruited a number of mime artists for the greenscreen shoot. "About half of the people in the shot were movement specialists, and our choreographer Francesca Jaynes - who was also our choreographer on Charlie and the Chocolate Factory - spent a couple of weeks working with them, teaching them how to move in slow-motion. We filmed them moving at normal speed, then slow it down on video and show it to them so that when it came to actually doing the shot, they were all very well-rehearsed. Even so, it was extremely hard to shoot. We spent four days doing that one shot, just endless takes over and over again. But I have to say the actors were remarkable. When you watch the shot, you'd never know they're moving in slow motion."

The FOV ends at Fleet Street and Mrs. Lovett's pie shop. For exterior views of Fleet Street, Ferretti and the production art department designed and built a full-size set at Pinewood Studios. Taking the buildings up to two or three stories - as high as the stage could reasonably accommodate, MPC then extended the set both vertically, up to five or six stories tall, and horizontally for several views looking down the long, narrow street. "In this case, we had no real buildings to go out and photograph for our extensions; so very often we would go onto the real set and do our photogrammetry, so that we had all the correct textures."

Having learned of his family's sad fate from Mrs. Lovett, Todd is reunited with his prized collection of shaving razors in his former flat above the pie shop, and vows to exact a murderous revenge on Judge Turpin (Alan Rickman), the man responsible for his misfortune. In a dramatic pullback, the camera moves through the second-story window, telescoping further and further back to reveal the cityscape from on high. "That was a real one-off shot; and because it was such a specific view, looking down onto the buildings, acquiring all the information we needed for the rooftops was quite complex."

Plate photography for the pullback was captured on the real set, with the camera mounted on a cable is a top. Camera and pulled straight back from the window some 60 feet. MPC then tracked the camera move and rebuilt in 3D everything that the camera could see. "We camera-projected the filmed plate back onto our CG buildings in order to capture all of the textures, and then continued the pullback with our CG camera. As we got into set top-ups - vertical extensions of the Fleet Street buildings - we were on the real sets, added roofs and the pie shop chimney with smoke billowing out. Then, once we had this big pullback camera animated, we hand-placed all of the buildings and when you get about two or three blocks back, it begins to turn into multiple layers of matte paintings, and in the distance just hills and sky."

Dramatic skies added just the right atmospheric

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ouch to the shot. “Anyone doing visual effects for ‘In Burton knows that getting a really good library if interesting-looking skies is one of the most impor-
tant things they can do right at the beginning of the
project. We probably spent more time trying out dif-
ferent skies on shots, looking for just the right compo-
sition and mood that worked, than almost any other
element. In this instance, we ended up having it rain-
ing in the far distance, just off the horizon. If you look
at the right, there are sheets of rain and a little flick
of lightning, just to give it a slightly moody edge.”

I n a stark departure from the dark, moody look
of the London environments, MPC also created
shots for a bizarre fantasy sequence in which Mrs.
family tableaux featuring the couple picnicking un
ner a tree on Hampstead Heath, sitting on a sunny beach
punctuated by soaring birds and painterly skies, and
strol ling along a picturesque pier by the sea. Burton
wanted those shots to have a completely different,
otherworldly feel to them, more impressionistic than
photorealistic, characterized by bright, super-saturated
colors. “It was an element that was challenging for
us because we felt as if we’d begun to really establish
the kind of vocabulary needed for Sweeney Todd’s world—and
so we had to re-create it. Suddenly, every-
thing was different. It was difficult to reconcile that.”

Live-action for the sequence consisted exclusively of
a greenscreen photography of the actors integrated
into all CG backgrounds. “Nothing in those shots was
real, except perhaps a bit of wood the actors were
walking on for the boardwalk. We added the railings,
extended the boardwalk in all directions, and added
all of the people walking on it.”

To save time, Jarrett opted to employ real ocean
photography for the beach scene, rather than create
wholly computer-generated seas. “When we did CG
water on the Thames, we could get away with it be-
cause it was quite calm and dark and misty. But this
was broad daylight, with waves crashing against the
beach. So we took a film camera down to Brighton,
which is on the south coast of England, and shot lots
of water plates off the pier. Then we used a camera
projection technique to project all those water tex-
tures onto a big flat plane, added some displacement
and rebuilt the water in 3D.” The sandy beach was
generated as 3D geometry, with matte paintings
projected onto it.

Clever transitions from the beach to the beach and
back again were filmed as one continuous shot, with
no cuts. “We previewed those quite heavily. The first
one was fairly simple, but the other was more complex, it
starts with the camera looking down at the back of
the couple sitting on a blanket on the beach at sunset,
with the ocean and the setting sun in front of them.
The camera cranes up and over the top of them in a
big arc; and by the end of that, we’re back on the
health and it’s a broad daylight. It was all pure green-
screen, with a lighting transition from sunset look
to broad daylight look halfway through the shot. We
framed it in such a way that as the camera was looking
straight down on top of the actors, the blanket they’re
sitting on completely fills the frame—and that was
our transition point.”

W hen Sweeney’s bloodlust reaches critical
mass, what follows is a grisly orgy of murder
and mayhem that literally bathes the screen
in blood as the body count rises. “Round and blood-
spurting effects were, for the most part, achieved in
-camera with the help of makeup effects supervisors
Neal Scanlan and his team. In addition, the prosthetic
crew provided corpuscles for dropping down the
chute to the lakehouse, basing them on scans of the
real actors provided by Gentle Giant Studios. MPC
was called upon to make the blood appear more vis-
ceral and intense, as well as to establish the practical
blood effects in several shots. A digital approach
was also employed for the film’s grim conclusion in
which Sweeney suffers the same fate as his victims, a
veritable curtain of blood gushing from his own slashed
throat. “That scene was a tough call. We were shooting
chronologically, so it was at the end of the schedule,
with all the attendant pressures. We’d discussed the
idea of doing CG blood throughout that scene—on his
neck, on his clothing, everything. But simulat-
ing fluid is complex—is especially if it has to inter-
xist with cloth. So instead, we had the special-effects
team create a rig—a collar that was worn by Johnny Depp’s
neck and that would, on cue, let out enough blood to
really soak into his clothes to give them that kind of
glistening quality. Then we painted out the collar
and completely replaced the blood to give it a CG sound
and look of it. Some of it included blood elements
shot during postproduction on a green screen
and composited in. Some of it was blood elements
projected onto CG geometry and then warped into
place. But the most compelling thing we felt we could get
was a more naturalistic look that way.”

Even more graphic were shots of Mrs. Lovett in
flames, after the crazed and grease-soaked
Sweeney shows her into the very oven the duo have
been using to dispatch their victims. Jarrett and the
MPC crew sought a delicate balance between realism
and a slightly over-the-top sensibility in approaching

Judge Turpin (Alan Rickman)
and his henchman Beadle
in the infamous Old Bailey
courthouse.

Digital artists integrated
the greenscreen and motion
capture photography with an on-
set CG background—one never
attempted by MPC for the show—
which included a highly-detailed
model of Old Bailey able to stand
up to close scrutiny in the full-
frame shot. Burton desired visual
precision for the film’s environment
of blood-soaked, fog-filled
rooms, whose stylicly morose
ambiance was replicated
not only by the realistically
created set designs, but also
by elements of the overall set
and costume designs that
were enough to make most
sets look like a morbid
version of what color
remained.

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the sequence. "We didn't quite know how gory to go. Unlike the other shots, this was not about blood. It was more about blackening and charring. So we shot scenes of reference — sides of beef treated with a blowtorch to see what would happen to burned skin. In early concept images we did of Mrs. Lovett, all the skin was completely burned away, and you could see all the bones underneath. It was kind of comical, but just a bit grotesque, as well. So we steered away from that, and ended up layering in more fire so you just caught glimpses of her face."

Since the oven had no real fire in it, MPC was also responsible for all of the interactive fire effects in the shots. "We ended up shooting lots of fire reference. I had a dummy built — a full size mannequin of Mrs. Lovett — and after we'd shot Helena in the oven with just some interactive lighting, we got a cut sequence from editorial and took our mannequin, which had steel poles attached to the arms, legs and head — on to a blacked-out stage. Then we had the special effects guys pour various liquids and gels onto it and set fire to it, and we puppeteered the mannequin to do the same motions that Helena did, using a looping playback system on the set. We shot lots of that for two days, and ended up with a big library of fire footage that we could comp into the shot. It was nice because you really got the sense that the fire was wrapping around her arms and properly interacting with her."

The key was not to try to shoot all of the elements in one hit. We would set the right arm on fire and puppeteer that to match what Helena was doing in a certain shot. Then we'd set the left arm on fire and do the same. Then we'd set the chest on fire, then the face and the hair, and so on. So we'd have lots of different elements, with nine or ten takes of each for our compositing supervisor Marjan Nadvobic and his team to pick and choose from."

Helping Tim Burton realize the world of Sweeney Todd was, for Chas Jarrett, a dream assignment. "It doesn't get any better than this. When you're working with Tim you always know that it's going to be really meaty, juicy work — full fat kind of stuff — particularly in this movie, because it's such a character-driven piece. Tim was great at keeping it focused on that. And in some ways, the London we created was like another character in the film. Its presence is definitely felt — not too showy or ostentatious, but small and gritty and claustrophobic, and Tim's vision for that was fantastic."

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