

ORIGIN OF THE SPECIES

Renee Dunlop finds out how MPC, Fuel VFX and Weta Digital helped director Ridley Scott follow a star map to a distant world for his long-awaited science-fiction film Prometheus



Ridley Scott's 1979 film *Alien* launched a generation to the stars just as it made a generation of stars into household names, helping to solidify the careers of Sigourney Weaver, Veronica Cartwright, Tom Skerritt, Sir Ian Holm and John Hurt. Scott terrified the world using tension, shadows and props and now, 33 years later almost to the day, he's back with *Prometheus*. The film brings a whole new bag of tricks and terror with it, thanks to stellar FX houses The Moving Picture Company (MPC), Weta Digital and Fuel VFX, and several others. >>



■ The Prometheus flies towards the planet surface – MPC created the foreground using a 3D camera shot from a helicopter, 3D ship with FX trails and a DMP background mountain range



▲ Richard Stammers, overall VFX supervisor from MPC



▲ Charley Henley, MPC VFX supervisor

THE MOVING PICTURE COMPANY

As well as co-ordinating work from all the other VFX studios involved in Prometheus, MPC created 450 shots in-house, including a stormy alien environment

No fewer than 10 visual effects houses worked to create 1,400 VFX shots for Prometheus, under the supervision of overall VFX supervisor Richard Stammers from The Moving Picture Company. MPC contributed the largest share at 450 shots, and its work was internally supervised by VFX supervisor Charley Henley.

The challenges were daunting. “There weren’t many easy ones,” says Henley. “Most of our shots involved projected environments, heavy CG renders of spaceships, lots of FX and usually a live-action plate somewhere in there as well.”

MPC’s shot list covered the space environments, the Prometheus spaceship, environments on the alien planet, a massive sandstorm, the iconic alien spaceship called the Juggernaut, a serpent-like creature called a Hammerpede and a climatic crash

sequence, plus fast-tracking quite a few shots for the trailers.

The planet

According to Henley, a major portion of the setup was to be as flexible as possible: “Ridley [Scott] was into starting off with information that was technically correct, but on any given shot he was keen to adjust the composition and change the scale if it looked better. Everything we built had to be scalable.”

MPC really pushed the early layout. The usual process starts with a plate or an all-CG shot, and decisions are made on where elements should be placed. “It’s basically like a layout pass,” Henley says. “Normally we’d do that with basic greyscale renders; but in order to get Ridley to buy into it, we decided to push the look of our layout pipeline, so we presented all layouts to him with basic colour and depth cueing. We could even

start talking about the lighting design at this early stage, which worked well as I think Ridley sees light and shadow as an integral part of the composition.”

The planet surface required careful planning. “There was a whole journey to find out how the planet surface was going to look and how we were going to approach building it,” says Henley. “It started with small photos that Ridley found on the internet.” Scott sketched his concepts on top of these images of a valley surrounded by mountains in Wadi Rum, Jordan. MPC found the location on Google Earth and used Digital Elevation Maps to generate a basic landscape in 3D. Working with Scott, MPC did flythroughs of the digital landscape, deciding what camera angles Scott liked – all without having to trek a large crew to the location.

This process was also used for a shoot plan. Travelling with a small unit, MPC



▲ The Wadi Rum mountains and Iceland foreground were combined for this scene. The ship's foot is all-CG

went to the location and, using a camera mounted on a Huey helicopter, shot BG plates and modelling passes, which they tracked so they could generate a mesh to use as the basic geometry for the builds. Using a GPS and a guide, they travelled to the locations during different times of day, shooting HDRI images.

The team combined the images of Wadi Rum with landscapes they shot in Iceland that offered spectacular volcanic terrains. MPC spent two weeks shooting foreground plates – ground-level landscape textures and pinnacles of volcanic rock that Scott was particularly drawn to and wanted to cover the landscape with like a petrified forest.

Scott's earlier ideas were of a planet enveloped in a stormy atmosphere. He

spoke to Nasa experts and came back with information to apply to the film. "Our first reference as always was to look at real sandstorms, but they seemed rather slow and unexciting because they just drift," says Henley. "We needed something more violent." Reference material switched to volcanoes erupting and collapsing buildings, and the dust and debris that's emitted. All the sand storms were created in 3D using Scanline's Flowline for the sims, visualised with MPC's proprietary volume tools and rendered using PRMan.

There are roughly 10 shots of the storm barreling down a valley 4km wide and 800m high. MPC broke the storm down into caches, starting with about 25 to fill the landscape. "That actually

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Charley Henley, VFX supervisor, MPC

looked like a realistic earth sandstorm, but Ridley and Richard [Stammers] pushed for more and more detail," says Henley. In all there were about 100 caches, each with 136 million voxels adding up to 13,600 million voxels for the entire sandstorm, plus particle effects for the close-up shots, sprite sims and volumetric sims of dust blowing. PRMan was used for all the rendering. >>



▲ The CG ship with FX thrusters, planet DMP and projected basic geometry

CREATING THE PROMETHEUS

The human protagonists travel in a spaceship that bears the film's name. The Prometheus has four legs for landing, each with four feet. One foot was built practically, which MPC recreated digitally and used as a basis for the remainder of the design. Only area lights and no shadow maps were used to light the geometry, and shadows were computed through raytracing.

The ambient illumination was done with raytracing image-based lighting (IBL) and importance sampling, where more rays are fired where they're needed. For example, if there's a cloudy sky with a bright cloud, the shader will fire more rays to the bright elements, resulting in less noise than using the same number of samples without importance sampling.

When the light rays are bouncing around in the shader, sometimes a surface will return more illumination than it would in nature. MPC has a system that assures the addition of diffuse and specular response never goes above the sum of the source light.

FUEL VFX

This Sydney-based studio created complex interactive graphics and a map of the universe



▲ Paul Butterworth, VFX supervisor at Fuel VFX

Fuel VFX enjoyed the opportunity to be one of two FX houses that provided several original designs for their sequences. "In all other cases [these] would have been designed and approved by the art department," says overall VFX supervisor Richard Stammers of MPC. Fuel delivered over 200 shots, including the Orrery, the ghostly alien apparitions called Engineers, scanning probes, several holographic effects including the holotable, the Orrery's control desk effects and screens in Meredith Vickers' suite, and several set extensions – all under the guidance of VFX supervisor Paul Butterworth.

"We were awarded key sequences that required some very important design development," says Butterworth. "Ridley [Scott] and Richard [Stammers] gave us a lot of scope to introduce our own design ideas into the process."

In the film, Engineers are recordings of events and day-to-day life from thousands of years prior. Sourcing inspiration from futurism, MRI scans and early televisions for image distortion and break-up, the studio decided to depict the Engineers as recorded images riddled with broken lines and ripped away particles.

"We looked at 50s-era TV to get a sense of what TV pixels would look like if they were burning in air," says Butterworth. Fuel did a full 3D scan of the actor portraying the Engineer. The motion was derived from motion capture work done at Centroid in London, then Fuel applied that data to the Engineer digi-double. The resulting images were deteriorated by using various levels of particle and noise break-up so the results would be more macabre.

The legibility was played with too, so sometimes the Engineers would be fairly defined and other times more of a ghostly apparition. Maya was used as



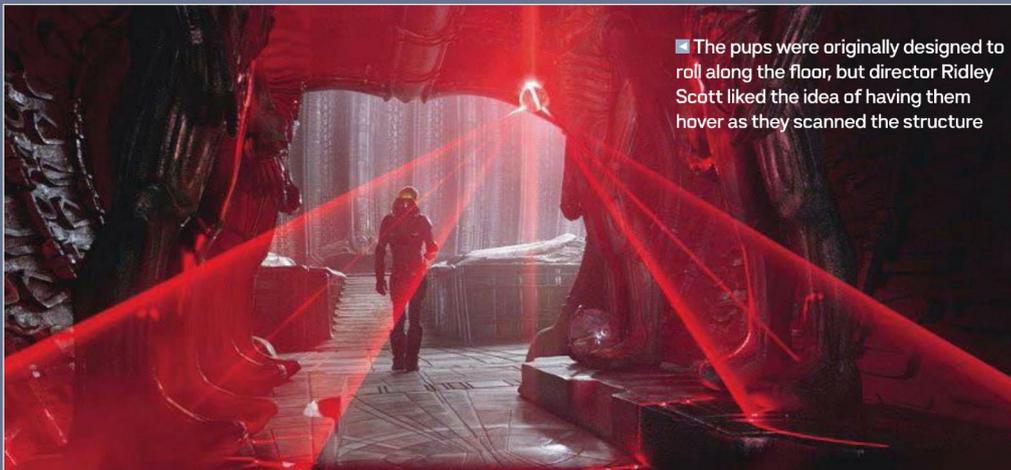
the principle software for the particle systems and Houdini for the pixel break-up using a special rig.

The holotable

Fuel VFX also worked on the holotable. Scott provided some sketches of how he envisaged it, but Fuel handled much of the design. The concept is similar to a Lidar (light detection and ranging) system: scanning probes called pups are released into the air and fly down the corridors of the alien structure, emitting red lasers that scan the surrounding environment and then send the data back to the holotable, a large volumetric representation of the structure for the Prometheus crew to study.

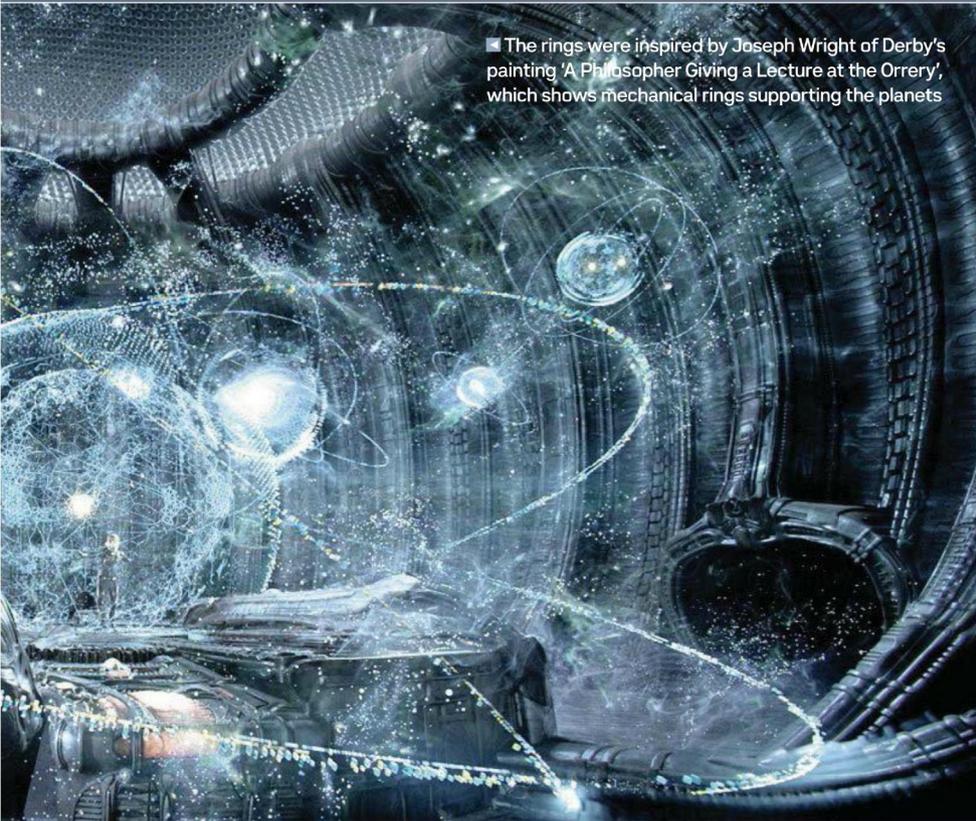
The lighting and design teams worked together for some of the more graphical elements of the holotable. "With the pups, we needed to design a light effect element that could react with the original plate photography," says Butterworth. "To do that, we needed to model an accurate virtual set that matched the on-set photography to the pixel, so that when the light hit, it revealed surfaces that weren't on the original plate."

Fuel's biggest sequence by far was the Orrery, a 3D holographic virtual map of the universe used by the Engineers to study the galaxies by pinpointing a planet or star and dragging it to the centre of the Orrery where it can be studied. The Orrery was built in Houdini,



■ The pups were originally designed to roll along the floor, but director Ridley Scott liked the idea of having them hover as they scanned the structure





■ The rings were inspired by Joseph Wright of Derby's painting 'A Philosopher Giving a Lecture at the Orrery', which shows mechanical rings supporting the planets

referencing Hubble telescope imagery from Nasa. Fluid systems were used to generate the nebula gas. "[At 80-100 million polygons] it took a huge amount of energy to render and was among the most complicated shots we've ever built at Fuel," says Butterworth. "We started designing in mid-October 2011 and were rendering through to March."

Much of the process was handled using Deep Image technology, a new technique being developed at several FX houses which uses rendered layers as flat elements that are combined in compositing. Butterworth explains: "Say you had a cloud of dust, you had an object that you rendered in the middle of it but the director wants to move the

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Paul Butterworth, VFX supervisor, Fuel VFX

object to another location. Normally you'd have to re-render all the gassy cloud particles again." Rather than having flat layers you almost have a cloud of data that can be locked off, so you can adjust assets or animation within the cloud. "Without Deep Image we probably wouldn't have been able to deliver the show given how heavy the renders were," says Butterworth. >>



■ The control desk is an alien interface to control the pilot chamber. Fuel developed an interface that used hand movements

FUEL VFX'S STEREO PIPELINE

Fuel VFX needed to ramp up its stereo pipeline significantly for this film. "The biggest challenge was tracking the 3D cameras," says VFX supervisor Paul Butterworth. Some shots would track well while others would take five or six weeks. "If the left and right eye cameras were even slightly out it could pose alignment issues for those shots," he adds. To handle the discrepancies, tools were written to correct the view down to a quarter-pixel accuracy. "It just came down to how good the alignment of the camera was at that moment. Cameras are sensitive to vibration and being bumped, so if alignment was out we would have to reconstruct one eye view from the other eye view."

The film was shot with the stereo camera rigs set up in parallel as opposed to converged, and the frame was wider than a normal 2K frame with an extra 80-plus pixels on either side. From a VFX point of view, this was easier to work with and allowed for the convergence of each shot to be adjusted at the end of the post process. It was also shot at 24fps. "A lot of times Ridley likes to shoot at 48 and then drop frames, because he likes the sharpness of a shorter shutter," says Butterworth.



■ A fine star pass was generated so every one of the stars represents a solar system that can be highlighted for a close-up view



■ The holotable was rendered using RenderMan, chosen for its fast render times in handling dense geometry, transparency and DoF

■ In order to handle shadows and lighting of the actor onto the digital Trilobite and vice versa, the Engineer digi-double had to exactly mimic the actor



WETA DIGITAL

For Prometheus, the New Zealand studio took on a challenging opening sequence that unlocks the secrets of the film, and refers back to 1979's Alien



▲ Martin Hill, VFX supervisor at Weta Digital

Prometheus opens with a barren landscape that reveals a spaceship leaving behind an Engineer – a tall, humanoid character with pale white skin. “Ridley [Scott]’s reference was the Statue of David: godlike, fantastic physique, pale skin like alabaster,” says overall VFX supervisor Richard Stammers of MPC. “He performs a ritual suicide by drinking a pearlescent goo that initiates a cellular decay within his body so he can donate his DNA to create new life on this desolate planet.”

“This was a very important sequence to Ridley,” says Stammers. “We started this very early on in pre-production as a detailed pre-viz, so Ridley could work out the important story beats and how the disintegration effect would develop.” The sequence begins with a live-action

character in prosthetics and, at the point of him ingesting the liquid, he starts to transition. “We go from a series of wide and close-up live-action shots of our actor to full close-up CG of his face to see the details of the decay continuing across his temples, down his neck,” says Stammers. “Fissures and holes start to appear in his skin then, in extreme detail, we see his veins collapsing.”

For live-action takes, Stammers shot clean plates of the setups so Weta Digital could recreate a digital version of the actor’s performance. Weta roto-animated the actor’s performance and generated a digi-double for the disintegration shots.

“Ridley really likes to shoot everything practically as much as he can,” says Weta VFX supervisor Martin Hill. “We

needed to match a prosthetic rather than what we’d normally do, which is to make it look as anatomically real as possible.” The silicon prosthetics were made from a white translucent material that allowed light properties to penetrate much deeper than human skin.

“We had to match that perfectly digitally,” says Hill. “That created a series of problems in terms of how you do the skin shading, the musculature, the motion. We made a full digital replica of the character. We then had to replicate the prosthetics, making sure his musculature worked and looked real but still looked like it was consistent with the silicon.”

The layer of silicon in the actor was so thick that light bled through much further than it would through normal skin. Weta needed to create extensions to allow for deep surface sub-scattering with internal light blocking features. To handle this, Weta extended the TQD subsurface algorithms that were developed for The Adventures of Tintin, which was an extension of the point base subsurface created for Avatar.

“Normally we’re dealing with a scatter radii of about one centimetre – here we were looking at four or five times that,” says Hill. “And if you just increase the scale of the subsurface you don’t get a sense of the underlying structure, where the bones would be; he looks too waxy, like there’s nothing underneath the surface.”

To get an accurate depiction of the character’s disintegration, Weta’s texture department used silicon similar to what was used for the Engineer. They carved out vein patterns then pumped through different types of liquid, like oil mixed with water, filming the interactions so they could study the natural motion. Weta derived animated textures from the filmed elements and



■ The deacon baby form, similar to the original Alien, used reference from the goblin shark, which can dislocate its jaw and launch it forward to catch prey



■ Weta Digital had to find the sweet spot honouring the practical on-set alien with digital effects to create something spectacular for the film

used them to drive the displacement and the changing material properties and colours. "We were cognisant of making sure that all the effects, whether they were textures or shading, part of the musculature or even the atrophying, were driven by the same inputs derived from the practical elements," explains Hill.

Engineering decay

The Engineer's skin dries up in patches, his skins rips open and cracks, his spine opens up, his head collapses and his brain is exposed. Weta filmed time-lapses of paint drying and cracking to use as driving elements for many of the textures and displacement maps and shading perimeters. The disintegration continues until he collapses, falls into a river and over a waterfall, and collapses at the bottom of the river.

The Engineer is dead by the time he falls in the water, and a different process begins to take place. The DNA design needed to be more organic and earth-like, warming the colour tones to give the feeling of rebirth rather than the darker, sinister colours of the Engineer's death. Three different versions of DNA were developed: the Engineer, the Engineer as it is infected, and the Earth DNA. The Engineer's DNA design was inspired by fish bones and spines. "We needed it to look quite alien, sinister, and we needed room to infect it and make it look even more messed up," says Hill.

Towards the end of the film another Engineer is discovered, played by an actor in a prosthetic suit that was digitally augmented. This Engineer battles with an adult Trilobite, a creature that was fully realised in CG by Weta. The actor was suspended in the air to

represent the Trilobite grabbing hold of him, waving his hands about in mock battle. Weta had to matchmove the Engineer so he could be recreated digitally. Hill explains why the shot was a challenge: "We needed a lot of reference cameras to get a perfect matchmove. This was complicated by the fact that the film was shot in stereo, in long takes, and the entire sequence took place under strobe lights firing in a random sequence. Every frame had to be relit."

Weta Digital on-set supervisor Matt Sloan rewired the onset lighting to be a 12-second loop, then made HDRI balls of every combo that existed in that loop. Weta lighters recreated the 12-second loop, then for every shot they only needed to offset the lighting loop to match the frames. ●

Prometheus is in UK and US cinemas now



■ MPC's Richard Stammers: "Ridley wanted the decay to have an unusual quality... a sense of life and motion"

"WE NEEDED [THE DNA] TO LOOK ALIEN, SINISTER, AND WE NEEDED TO INFECT IT AND MAKE IT LOOK MORE MESSED UP"

Martin Hill, VFX supervisor, Weta Digital



▲ The chair was rubbed with graphite giving it a retro reflective effect, less intense but similar to fluorescent bands

THE ICONIC PILOT'S CHAIR

There was a practical version of the pilot's chair on set but it didn't articulate, so Weta Digital recreated it digitally for the big reveal, designing how it moved and how the Engineer would seat himself. "Digitally, we created the elephantine space jockey suit that envelops the Engineer," says VFX supervisor Martin Hill. The material of the chair and suit had an interesting quality to it. Many of the sets had been rubbed with graphite powder, which gave a distinctive retro reflective quality that Weta needed to recreate. The inside of the helmet was made of silicon casts of cabbage leaves and loofah, which were created digitally to match it. How do you cast a cabbage leaf? "Oh, you just freeze it first," says Hill.