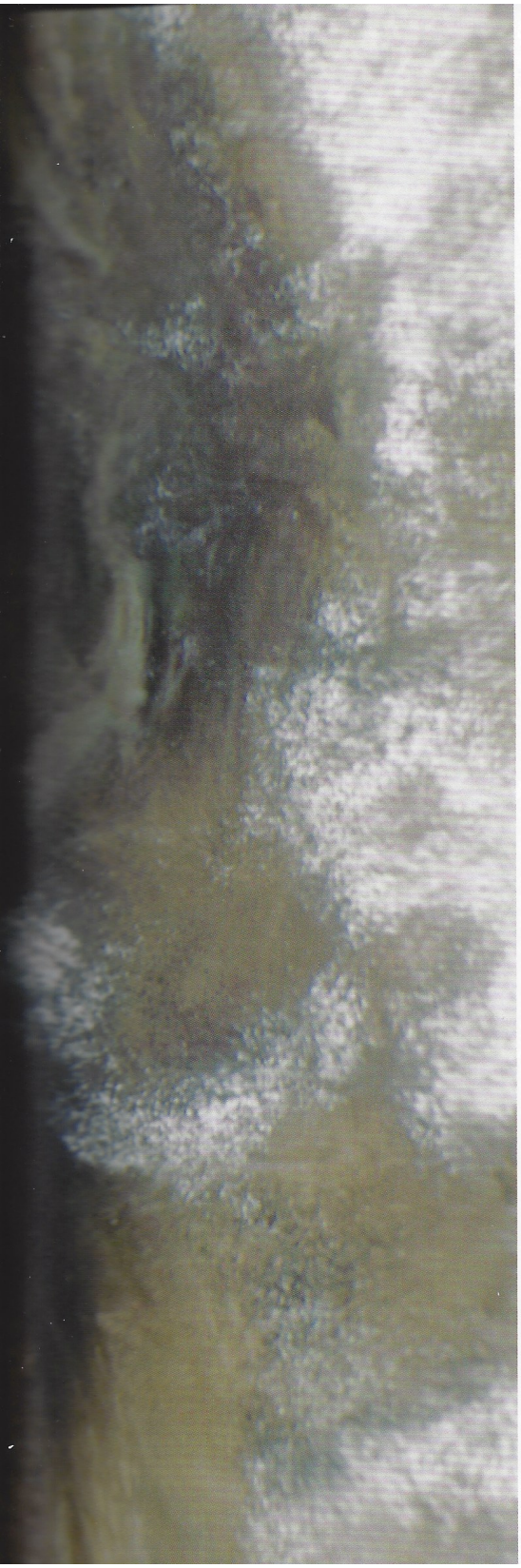

The Data of All Things

BY JOE FORDHAM

Like the strange attraction of particles, some filmmakers naturally gravitate toward a repertory company of collaborators — a trusted cinematographer, a production designer with chameleon-like adaptabilities, the unique ear of a gifted composer, or an alter ego performer. At a pragmatic level, the alliances improve production efficiency and, at best, lead to a unique cross-pollination of ideas.

After the one-two punch of the Oscar-winning artificial intelligence thriller *Ex Machina* and the extraterrestrial mystery *Annihilation*, filmmaker Alex Garland had accumulated a core creative brain trust. "It's not just me," said visual effects supervisor Andrew Whitehurst. "Alex likes to work

with a team of people he enjoys and trusts. That includes his producers, production designer Mark Digby, cinematographer Rob Hardy. There are working relationships he's developed over quite a few years now." Garland and Whitehurst's common interests in science led to heady conceptual banter. "I have an interest in multiverse theory, and I was fascinated by the work of physicist David Deutsch, who wrote an amazing book called *The Fabric of Reality*. Deutsch is one of the biggest proponents of Hugh Everett's 'many worlds' interpretation of quantum mechanics. Alex and I talked through those ideas, and our understanding of the science and philosophy."

Conversations sparked ideas for a science fiction story, *Devs*. "Andrew and I shared information and theories about science and physics," related Alex Garland. "And we had a rolling conversation, through *Ex Machina* and *Annihilation*, about quantum mechanics — how those theories represent the underlying building blocks of everything. I was interested in what quantum computers were able to do, the weird implications of quantum mechanics, and a way of looking at physics that makes the universe deterministic. And I was interested in the capabilities of big, powerful tech companies. That mutated into *Devs*."

Garland's narrative took shape as a high-tech thriller, told over approximately 400 minutes as an eight-part mini-series for FX Network and Hulu. The story revolves around Amaya, a quantum computing campus outside San Francisco run by an introverted technology developer known to all as simply Forest (Nick Offerman). Amaya computer engineer Lily Chan (Sonoya Mizuno) becomes suspicious of Forest's activities after her boyfriend, Sergei (Karl Glusman), joins the secret Devs division and vanishes. Lily's inquiries lead to confrontations with Amaya security chief Kenton (Zach Grenier) and lead engineer Katie (Alison Pill), and eventually unravels Lily's grip on reality.

Concepts spun off the idea that quantum computing, an evolutionary step beyond binary computing, allow developers to mathematically reveal multiplicities of past or future events. "There were a lot of 'what-if's,'" noted Garland, "but the story took a scientific principle and ran with it. The idea was that we have binary computers, but we exist in a quantum mechanical world. When you use a binary computer to model a quantum mechanical system, there's inevitably a 'lost in translation' aspect to that. But, if you use a quantum mechanical system to model a quantum mechanical state, then you might be able to visualize, or model images accurately. I hoped that particular part of the sci-fi would stand up to scientific scrutiny. I was interested to test those ideas out on Andrew. We knocked those concepts back and forth and tried to come up with visuals that felt like a reasonable proposition."

To explore ideas of quantum imagery, depicting mathematical expressions of the fabric of reality, Andrew Whitehurst experimented with visual effects techniques using a prosumer camera and a commercial motion sensor device, which he developed with DNEG TV into digital expressions of the series' unnerving conceit. "Our visualizations of the multiverse were aesthetically-driven," Whitehurst said. "There's no real way in our everyday three-dimensional universe of visualizing many worlds other than to say: there are a lot of very similar things piled on top of one another, but we can only perceive one of those worlds. I did a bunch of early tests in my backyard with my Sony A7, shooting repeated actions, or very similar actions, against greenscreen. I bought Microsoft Kinect on eBay, worked out how to get that to talk to Houdini, and did depth-capturing and point-mapping effects that articulated the idea of rendering 3D volumes. I tried different ways of layering images, and created some Francis Bacon-like effects by varispeeding — chopping out frames and then respeeding footage to normal speed — which produced interesting smeary shapes. Some of those were beautiful and did suggest multiple events happening in the same space. But the results were not controllable, and they lacked mystery. We knew our quantum imaging effects would require a very high level of art direction."

While Whitehurst and DNEG continued to develop quantum imaging tests, the U.K.-based production selected Stateside locations of the Amaya campus at University of California, Santa Cruz, which provided a rural setting of futuristic glass and concrete buildings surrounded by Redwood forest. Mark Digby's art department added signage and set dressing. DNEG furnished one of the series' signature images, a gigantic statue of a young girl — Forest's deceased daughter, Amaya (Amaya Mizuno-André) — as a towering figure standing in the campus quadrangle with its head and shoulders above the trees.

The filmmakers derived the statue's pose, a wide-eyed beseeching gesture, from a photogrammetry shoot during early photography of flashback scenes of Forest's family life. "The VFX team brought in a mobile scanner rig as a 360-degree array of Canon cameras," Alex Garland recalled. "Amaya stood in that space while I chatted with her and guided her eyeline. She made that posture completely by chance. She had a funny expression on her face with a little bit of wonder, and a kind of concentration as she cupped her hands into a beautiful shape, like she was trying to get her head around

an abstract idea. One of her thumbs was tucked into the shoulder strap of her dress, and I asked Andrew and his team to use visual effects to untuck that and restructure her hand. It was a mixture of technical processes and the unselfconscious behavior of a lovely little girl."

DNEG CG supervisor Tom Hales and his team explored look development for the statue, which is seen repeatedly through the series. "It was our single most difficult asset," noted Andrew Whitehurst. "It had to have a sense of hyper-reality, and we had a lot of conversations about whether it should be painted, or cast concrete. The scans of the little girl were useful for her dress, arms and face, but she had very long, fluffy hair, which didn't produce useable lidar or photogrammetry." DNEG modeler Dafina Hristova refined the Amaya model referencing statuary of the Baroque Italian era. "We studied how Bernini sculpted hair, and Daffy modeled all that hair from scratch. We repositioned the statue's hands to be more symmetrical. Then we created a paint job based on photo reference, and flattened out the colors. Weathering always helps sell scale, but this statue was a representation of Forest's dead daughter, so we reasoned he'd have it cleaned regularly. That drove our aesthetic decisions — how shiny it should be, how colorful — before we settled on our first instinct that it should suggest pop-culture, with the feel of an enamel sheen."

DNEG compositing supervisor Giacomo Mineo layered the Amaya statue into plates, which were often shot by drones hovering over the forest, and added foreground trees to help nestle the statue into the environment and reinforce the campus' isolated setting.

For exteriors of the Devs lab, a short walk from the Amaya campus, Mark Digby erected a bunker entry, with gold-plated sentry columns and clusters of fiber optic lights, in a meadow location. DNEG then created the bunker. "We found a meadow pretty close to the U.C. Santa Cruz campus," said Whitehurst. "We had a representation on the ground of the building's size, with posts in the ground to help D.P. Rob Hardy frame shots. We then added the entire structure, which got redesigned part way through postproduction. The original bunker design featured rotating, shifting tiles on a very simple structure, but when we viewed that in context, it didn't tie in with the rest of the architecture. So, we redesigned that as a much more solid, concrete, Brutalist-like bunker."

DNEG CG supervisor Tom Hales' team depicted the bunker with canted concrete slabs and a roof that housed a shallow, liquid pool, suggesting technology that isolated the installation from penetrating radiation. "Andrew suggested the liquid roof idea," said Alex