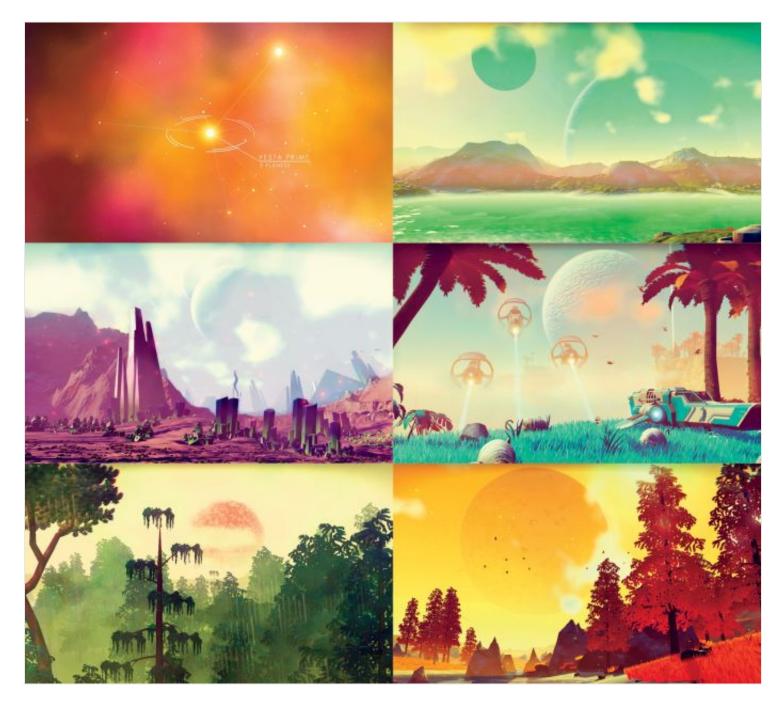# WORLD WITHOUT END

No Man's Sky will let virtual travellers explore eighteen quintillion full-featured planets. Credit Hello Games

The universe is being built in an old two-story building, in the town of Guildford, half an hour by train from London. About a dozen people are working on it. They sit at computer terminals in three rows on the building's

first floor and, primarily by manipulating lines of code, they make mathematical rules that will determine the age and arrangement of virtual stars, the clustering of asteroid belts and moons and planets, the physics of gravity, the arc of orbits, the density and composition of atmospheres—rain, clear skies, overcast. Planets in the universe will be the size of real planets, and they will be separated from one another by light-years of digital space. A small fraction of them will support complex life. Because the designers are building their universe by establishing its laws of nature, rather than by hand-crafting its details, much about it remains unknown, even to them. They are scheduled to finish at the end of this year; at that time, they will invite millions of people to explore their creation, as a video game, packaged under the title No Man's Sky.

The game's chief architect is a thirty-four-year-old computer programmer named Sean Murray. He is tall and thin, with a beard and hair that he allows to wander beyond the boundaries of a trim; his uniform is a pair of bluejeans and a plaid shirt. In 2006, frustrated by the impersonal quality of corporate game development, Murray left a successful career with Electronic Arts, one of the largest manufacturers of video games in the world. He believes in small teams and in the idea that creativity emerges from constraint, and so, in 2008, he and three friends founded a tiny company called Hello Games, using money he raised by selling his home. Since then, its sole product has been a game called Joe Danger, about a down-and-out stuntman whose primary skill is jumping over stuff with a motorcycle. Joe Danger, released in several iterations, earned a reputation for playability and humor. (In one version, it is possible to perform stunts as a cupcake riding a bike.) But it was hardly the obvious predecessor to a fully formed digital cosmos. No Man's Sky will, for all practical purposes, be infinite. Players will begin at the outer edges of a galaxy containing 18,446,744,073,709,551,616 unique planets. By comparison, the game space of

Grand Theft Auto: San Andreas appears to be about fourteen square miles.

From the moment Murray unveiled a hastily built trailer for No Man's Sky, in late 2013, on the Spike TV network, anticipation for the game has taken on an aspect of delirium. For a big-budget franchise like Grand Theft Auto—what people in the industry call a triple-A game—an "announcement trailer" typically features carefully scripted, action-filled vignettes that present a simulacrum of actual play. The No Man's Sky trailer, which was homemade, featured a minute or so of the actual game: a recording of Murray exploring a planet, beginning undersea, then boarding a ship, flying into space, and engaging in combat. The footage communicated nothing concrete about the game play, but the graphics were rendered with an artistic finesse rarely seen in games, and the arc of Murray's journey—the unbroken sweep from ocean to land to heavens—implied an unprecedented range of possible discovery.

Other video-game developers advised Murray not to release the trailer, fearing that it was too vague and unconventional, and for days he deliberated. But Murray is not short on self-assurance, and he believed that the footage evoked a near-universal childhood experience: gazing up at the stars and wondering what space might be like. He decided to fly to Los Angeles and present the trailer himself, on the air. "Sean strikes me as incredibly driven and ambitious, but he is also polite and sweet about it," Joe Shrewsbury, whose band, 65daysofstatic, is writing the game's soundtrack, told me. Murray, who describes himself as an introvert, says that studio lights terrify him—in keeping with a habit of self-effacement that another colleague described as "the nervous-guy shtick."

On the Spike TV set, Murray looked downward, as if shielding his eyes, but he also projected fanboy enthusiasm. "It is a huge game," he said. "I can't really do

it justice. We wanted to make a game about exploration, and we wanted to make something that was real." Nearly all video games rely on digital façades, drawn by artists, to give the illusion of an explorable world that is far larger than it really is, but No Man's Sky will contain no such contrivance. Murray's trailer featured luxuriant scenes of crashed ships on arctic terrain, giant sandworms—a galaxy of exotic dangers. "That planet on the horizon, which you see on the trailer, that's a real place," he said on the set. At the time, Murray was working on the game with only three other people, and when he told the show's hosts they reacted incredulously. "If it is nighttime, and you are in space, and you see stars, those are real stars," he added. "Those are suns, and they have planets around them—and you can go and visit them."

When I first met with Murray, at his studio, earlier this year, he had just flown back from the North American headquarters of Sony PlayStation, in California. He had a long relationship with Sony. A few days before he unveiled the No Man's Sky trailer, in 2013, he had distributed versions of it to people in the industry, and Sony had been immediately interested. "I sent Sean a barrage of texts," Shahid Ahmad, a director of strategic content at Sony PlayStation, told me. "I said, 'We need to get this on PlayStation. Tell me what you need.' "

Two weeks later, on Christmas Eve, a tributary of the Thames overflowed in Guildford, flooding the Hello Games studio. Murray rushed over and found laptops floating in waist-deep water; tens of thousands of dollars' worth of equipment was destroyed. Sony's offer of assistance remained, but Murray told me that he did not ask for funding. Unlike Hollywood, the video-game industry is marked by a vast chasm between big-budget productions and independent ones, and he had learned with Joe Danger that a small studio could easily become beholden to a distributor. Instead, he requested Sony's help in securing a place for No Man's Sky at the Electronic Entertainment Expo, or E3, the

largest gaming trade show in America. No independently produced title had
ever been featured on the main stage, but, as he recalled, "I said—and this was
really cocky—'We want to own E3.' They were, like, 'That's not going to
happen,' but we pushed for it. We traded working for them for being onstage."
(Ahmad told me that the hesitation was largely logistical: "E3 takes time to
plan.")

Sony agreed, and also decided to throw its resources into promoting No Man's
Sky as a top title—an unprecedented gesture for an unfinished product by a tiny
studio. The video-game industry now rivals Hollywood; by one estimate, it
generated more than eighty billion dollars in revenue last year, and marketing
budgets for triple-A games have become comparable to those of blockbuster
films. Sony's marketing strategy for No Man's Sky suggests that it expects the
game to make hundreds of millions of dollars; this year, Sony will promote it
alongside half a dozen mega-titles, including the latest installment of the
Batman franchise. Adam Boyes, a vice-president at Sony PlayStation, described
it to me as "potentially one of the biggest games in the history of our industry."

All Murray has to do now is deliver. Last year, when an interviewer asked him
when the universe would be ready, he said, "We are this super-small team, and
we are making this ridiculously ambitious game, and all we are going to do in
telling people when it is going to come out, probably, is disappoint them."
Sony's participation meant that timing for the game's launch had to be firmly
decided, but No Man's Sky is not an easy project to rush. Because of its
algorithmic structure, nearly everything in it is interconnected: changes to the
handling of a ship can affect the way insects fly. The universe must be
developed holistically; sometimes it must be deconstructed entirely, then
reassembled. Before I arrived, Murray warned me, "The game is on the
operating table, so you will see it in parts. Other games will have the benefit of

having a level that plays really well, while the studio works on other levels. We don't have that." The previous "builds" of No Man's Sky that he had publicly shown—the ones that had generated so much excitement—contained choreographed elements. Features that might have been light-years apart were pressed closer together; animals were invisibly corralled so that they could be reliably encountered. Shifts in the weather that would normally follow the rhythm of atmospheric change were cued to insure that they happened during a demo. Imagine trying to convey life on Earth in minutes: shortcuts would have to be taken.

We were in a lounge on the second floor of the renovated studio; concept art hung beside a whiteboard covered with Post-its. The furniture was bright, simple, ikea. Sitting in front of a flat-screen TV the size of a Hummer windshield, Murray loaded up a demo of the game that he had created for E3: a solar system of six planets. Hoping to preserve a sense of discovery in the game, he has been elusive about how it will play, but he has shared some details. Every player will begin on a randomly chosen planet at the outer perimeter of a galaxy. The goal is to head toward the center, to uncover a fundamental mystery, but how players do that, or even whether they choose to do so, is open to them. People can mine, trade, fight, or merely explore. As planets are discovered, information about them (including the names of their discoverers) is loaded onto a galactic map that is updated through the Internet. But, because of the game's near-limitless proportions, players will rarely encounter one another by chance. As they move toward the center, the game will get harder, and the worlds—the terrain, the fauna and flora—will become more alien, more surreal.

Sitting in the lounge, we began on a Pez-colored planet called Oria V. Murray is known for nervously hovering during demos. "I'll walk around a little, then I'll

let you have the controller for a bit," he said. I watched as he traversed a field of orange grass, passing cyan ferns and indigo shrubs, down to a lagoon inhabited by dinosaurs and antelope. After three planets and five minutes, he handed me the controller, leaving me in a brilliantly colored dreamscape, with crystal formations, viridescent and sapphire, scattered in clusters on arid earth. Single-leaf flora the height of redwoods swayed like seaweed. I wandered over hills and came to a sea the color of lava and waded in. The sea was devoid of life. With the press of a button, I activated a jet pack and popped into the air. Fog hung across the sea, and Murray pointed to the hazy outline of distant cliffs. "There are some sort of caves over there," he said, and I headed for them. The No Man's Sky cosmos was shaped by an ideal form of wildness—mathematical noise—and the caves were as uncharted as any material caves. I climbed into one of them. "Let's see how big it is," Murray said.

The cave's interior was rendered in blues, greens, purples, and browns, and the light filled it with warmth. Luminescent bits of matter, like inanimate fireflies, filled the air. Triple-A games are often self-serious, dominated by hues so dark they nearly seem black, but Murray favors vivid, polychromatic graphics. "I think that one of the reasons No Man's Sky resonates is that, at a very reductive level, it's bright—it's colorful, vibrant," he told me.

The game is an homage to the science fiction that Murray loved when he was growing up—Asimov, Clarke, Heinlein—and to the illustrations that often accompanied the stories. In the nineteen-seventies and eighties, sci-fi book covers often bore little relation to the stories within; sometimes they were commissioned independently, and in bulk, and for an imaginative teen-ager it was a special pleasure to imbue the imagery with its own history and drama. Space was presented as a romantic frontier, sublime in its vastness, where ships and futuristic architecture scaled to monumental proportions could appear

simultaneously awesome and diminutive. Danger was a by-product of exploration: rockets that crashed on barren asteroids; plots by haywire computers; ominous riddles left behind by lost civilizations. "But inherently what is going on is optimistic," Murray said. "You would read it and go, Wow, I would love to be this person—this is so exciting. Whereas at the moment a lot of sci-fi is dystopian, and you go, I would hate to be this person. How would I deal with it?"

No Man's Sky's references may be dime-store fiction, but the game reimagines the work with a sense of nostalgia and a knowing style that is often more sophisticated than the original. "One thing a lot of video games are missing is a very confident sense of style," Frank Lantz, the director of New York University's Game Center, told me. "No Man's Sky has a *personality*."

I approached a cave that looked out on the sea, and Murray gestured toward a portion of the digital geology. "I haven't seen that before," he said, and took the controller to get a better look. Murray's primary coding contribution is to planetary terrain, and he had developed a special appreciation for such formations. After exploring for a bit, he said, "Sorry. You can have the controller back."

From inside the cave, I turned and approached an opening that looked out upon a ridge high above the shore. "What happens if I jump off?" I asked.

"You'll be fine," he said. "We didn't want you to break your legs and get hurt. It is about exploring. We didn't want people feeling nervous."

Each planet had a distinct biome. On one, we encountered a friendly-looking piscine-cetacean hybrid with a bulbous head. (Even aggressive creatures in the game do not look grotesque.) In another, granular soil the color of baked salt

was embedded with red coral; a planet hung in the sky, and a hovering robot traversed the horizon. "Those are drones," Murray said. "They will attack you if they find you killing animals or illegally mining resources." On a grassy planet, doe-eyed antelope with zebra legs grazed around us. Mist rose off the grass as I headed down a ravine shaded by trees. "This is a place where no one has been before," Murray said. The biome was Earth-like in light and in color, naturalistic. As I descended, the ravine deepened until rock façades took shape on either side. In spite of the work's semi-finished state, the world was absorbing. "I'm sorry there's no game-play element on this planet yet," Murray said. His mind turned from the screen in front of us—the six planets, tidily assembled for the demo—to the full version of No Man's Sky on the operating table on the studio's first floor, below us. Until many improvements were fully realized, the whole of it would inevitably look worse than what we were seeing. "You can lose sight that it once looked like this," he said.

This version of the game—a frequent reference point for the studio—was a reminder of a public promise: the presentation that Murray had given at E3, where he stood on a huge stage with images of No Man's Sky projected onto ninety-foot screens. "There were five thousand people in the audience, and at least five million watching at home," he told me. "I sat backstage, and, before walking out, I had a feeling that I could go to sleep—just turn around and go." One of the studio's programmers who was with Murray backstage recalled, "Sean got whiter and whiter—he was just catatonic." To overcome his nerves, Murray focussed his mind on the story of the game, beginning with the studio's origins. He told me, "By the time I walked out, I could have burst into tears, because what I was going to say was that this is basically the game I've always wanted to make."

Murray's earliest memories are of life on a cane farm in Brisbane, Australia. He

was born in Ireland, but his parents migrated to Australia when he was two years old. "We basically lived in a glorified shed," he told me. "It was up on stilts, and it had a corrugated-iron roof." Two years later, Murray's parents moved again, to work on a remote million-acre ranch in Queensland. The settlement resembled an alien outpost, with its own power-generation system and its water pumped on-site. Visitors who wanted to avoid a four-hundred-mile drive on a rutted track had to fly in. (The ranch had seven airstrips and an abandoned gold mine.) Dust storms swept across the desiccated soil. Merely crossing the property was like an expedition. "You would go out to check that the windmill, or whatever, was working," he said. "And you always had to go out in twos. As a kid, you were told that, if something happened to the person you were with, then find some shade, and if there is no shade don't go looking for it. You will survive for three days without water and without food, and so you have only one job: gather kindling to light a fire. You stay exactly in the same place, and you light a fire at set times, and that's it. There is a plan: we can fly over, and in three days we can cover the whole grid." Murray often accompanied his father on multi-day treks. At night, they camped under pristine night sky, with all of space arcing above them.

In the outback, Murray became fascinated with sci-fi. When he first encountered "Dune," he said, "I can remember being hungry reading it, forgetting to eat." Years later, when he formed Hello Games, he told his co-founders—two coders named Ryan Doyle and David Ream and an artist named Grant Duncan—to consider their childhoods as source material for games. "I said, 'Think back to when you were a kid. What did you want to be? A cowboy, an astronaut, a stuntman, a fireman, a policeman, whatever.' " Working in Murray's living room, the four men at first devoted their attention to fundamentals, writing software to determine how objects would behave in a

theoretical game space. "We mentioned Pixar a lot, because their work is colorful but not childish," Duncan told me. The inspiration for Joe Danger came from a stuntman figure that Duncan found in a box of old toys.

The partners worked for a year, and went nearly broke. "I had sold off my PS3," Murray told me, referring to his PlayStation. "We were down to the bare essentials." For the release, in June, 2010, Murray bought some cheap cider. "We decided, we are going to drink cider, and it will come out and do what it will do," Murray said. The game did not appear online in the United Kingdom until after midnight. When it first loaded, the screen was black, causing momentary panic. But within an hour the partners had made back their money.

Murray started No Man's Sky one morning two years later, during a difficult negotiation with Microsoft over the marketing for Joe Danger's sequel. "Everyone else was at home," he recalled. "I was in the studio on my own, and I just started programming. I was furious, and I kept working until three in the morning. Looking back, I think I had the equivalent of a midlife career crisis. What is the point of these games? Like, Joe Danger—how impactful is it?" Murray and his co-founders had joked that they would one day make an ambitious game, which they called Project Skyscraper. The following day, he told Duncan and Ream, "We're doing it." He had created only a small patch of sample terrain, without a clear sense of what it would be, and Ream told me, "The thing was quite abstract, and we were like, What are you *doing*?" Duncan was skeptical. Artists he knew were dismissive of the technique that Murray was using; one had warned him that the results "look like shit."

Duncan and Ream began to design a relatively conventional game, in the mold of Joe Danger—another humorous take on a childhood dream profession. Their working title was Space Cadets. But Murray urged them to consider the project

in more open-ended terms. "I had this feeling: I want to start a new company, like almost an alternate path for Hello Games," he told me. He split his company into two, and for months the three men, along with a coder named Hazel McKendrick, worked on No Man's Sky in secrecy, in a locked room.

To build a triple-A game, hundreds of artists and programmers collaborate in tight coördination: nearly every pixel in Grand Theft Auto's game space has been attentively worked out by hand. Murray realized early that the only way a small team could build a title of comparable impact was by using procedural generation, in which digital environments are created by equations that process strings of random numbers. The approach had been used in 1984, for a space game called Elite, which Murray played as a child. Mark Riedl, the director of Georgia Tech's Entertainment Intelligence Lab, told me, "Back in those days, games had a lot of procedural generation, because memory on computers was very small; it was largely forgotten, but now it is being rediscovered." (Minecraft, an expansive world that was designed by only one person, also uses the technique.) Games based on procedural generation often suffer from unrelenting sameness, marked by easily detectable algorithmic patterns (imagine a row of more or less identical trees, stretching to infinity), or from visual turmoil. But Murray hoped that if a middle ground could be achieved he could create graphically rich environments worthy of discovery—a fictional version of exploration that had a grain of reality to it.

Once Murray decided on the basic mathematical architecture of the game, he needed random numbers to feed into it. No computer can generate true randomness, but programmers use a variety of algorithms, and sometimes the physical limitations of the machine, to create approximations. "Computers can understand numbers only of a set size," Murray told me. "When you are building a computer, you are literally saying, This is where a number gets

stored, and this is how many digits can fit in that space." For a game console, that space is sixty-four bits. When a player first turns on No Man's Sky, a "seed" number—currently, the phone number of a programmer at Hello Games—is plugged into an equation, to generate long strings of numbers, and when the computer tries to store them in that sixty-four-bit space they become arbitrarily truncated. "What you are left with is a random number," Murray said. The seed defines the over-all structure of the galaxy, and the random numbers spawned from it serve as digital markers for stars. The process is then repeated: each star's number becomes a seed that defines its orbiting planets, and the planetary numbers are used as seeds to define the qualities of planetary terrain, atmosphere, and ecology. In this way, the system combines entropy and structure: if two players begin with the same seed and the same formulas, they will experience identical environments.

The design allows for extraordinary economy in computer processing: the terrain for eighteen quintillion unique planets flows out of only fourteen hundred lines of code. Because all the necessary visual information in the game is described by formulas, nothing needs to be rendered graphically until a player encounters it. Murray compared the process to a sine curve: one simple equation can define a limitless contour of hills and valleys—with every point on that contour generated independently of every other. "This is a lovely thing," he said. "It means I don't need to calculate anything before or after that point." In the same way, the game continuously identifies a player's location, and then renders only what is visible. Turn away from a mountain, an antelope, a star system, and it will vanish just as quickly as it appeared. "You can get philosophical about it," Murray once said. "Does that planet exist before you visit it? Sort of not—until the maths create it."

Initially, the system proved fantastically difficult to control. It was generating

planetary terrain that was wild, alien-seeming, and also impossible to traverse. If Murray pushed the system in the other direction, the terrain became dull and repetitive. There were also specific natural features, such as rivers, that did not lend themselves easily to equations. To make a river in a conventional game, an artist creates a mountain, places a digital drop of water on it, and maps the water's trajectory downward. "That is the correct way," Murray told me. But the process involves laborious computation, and requires that the topography be known in advance. Because of No Man's Sky's algorithmic structure—with every pixel rendered on the fly—the topography would not be known until the moment of encounter. Theoretically, the game could quickly render a sample of the terrain before deciding that a particular pixel belonged to a river, but then it would also have to render a sample of the terrain surrounding that sample, and so on. "What would end up happening is what we call an intractable problem to which there is only a brute-force solution," Murray said. "There's no way to know without calculating everything." After much trial and error, he devised a mathematical sleight of hand to resolve the problem. Otherwise, the computer would have become mired in building an entire world merely to determine the existence of a drop of water.

Every morning, at a little past ten, Murray leads a brief meeting with his team. A dozen coders and artists stand among the rows of computers, or swivel their chairs around. In a quick rundown, problems are identified, goals set; in the evening, work is checked into a master build. Murray delegates readily but watchfully.

During my visit, four artists outlined their plans, and then sat down to work. The artists devise archetypes for the coders' algorithms to mutate. One spent a day making insects: looking up images on Pinterest, designing features for an insect archetype, studying how the algorithms deformed the archetype in

hundreds of permutations, then making corrections. "It's a constant slog of iterating and polishing," the art director, Grant Duncan, told me. He was working that day on architectural modules that could be combined in myriad ways. Because small changes can have unpredictable effects—the color of a single plant infecting every tree, rock, and animal on a planet—his team uses an algorithmic "drone" that navigates the universe, taking snapshots to measure the repercussions of decisions. Occasionally, Duncan stopped his work to offer suggestions. Reviewing some insects, he said, "Except for the colors, these shapes are kind of working—but the others are bonkers."

Murray sat down with David Ream, whose focus is coding the game-play systems. Ream had been working to make spaceships handle more realistically in flight, and he wanted Murray to test his work. "I have to give the controller to Sean, because I find that I naturally play the game so that it works, because I know all the numbers," Ream said. "And also because we have our strong bonds, so I can tell Sean to fuck off."

Murray played for a few minutes, dogfighting with enemy ships. "This is so much more enjoyable than it was on Sunday," he said. But he was worried that excessive realism would confuse players who were unaccustomed to the frictionless quality of motion in space. He suggested some tweaks. During the testing, Murray noticed that his ship had exited a planet's atmosphere too rapidly, without the drama it had in the E3 build. "We're missing something that used to be there," he said. "It was a surprise to be suddenly in space."

Hazel McKendrick walked over and said, "The atmosphere isn't as thick." She had adjusted formulas to provide a more natural effect of sunlight passing through it, and a better view of nearby planets. To re-create the old feel, she suggested, the atmosphere's depth could be artificially increased as the ship

passes through.

"So, annoyingly, by doing it wrong you get a nicer effect," Ream said.

Throughout the day, other members of the team worked on shadows, on creature artificial intelligence, on imbuing objects with "collision," or physicality. After a coder gave trees and rocks collision, they became destroyable; he shot at a hillside, causing rocks to tumble down, hitting one another in a cascade. Peculiar problems had emerged from the sphericality of planets; in conventional video games, digital spaces are perfectly flat. Until gravity was precisely calibrated, objects sometimes fell off planets. One of the programmers, Charlie Tangora, described a problem with cowlike creatures that kept walking on cave ceilings; it took some troubleshooting before he realized, "Oh, wow. You're in the Southern Hemisphere. Everything is upside down."

When Murray wasn't being pulled away from his computer, he worked on the terrain. He told me that he was always searching for ideas. Last year, he saw the film "Interstellar," which features scenes of a lifeless snowy planet that "had some very perfect 'mathlike' terrain." The next day, he developed formulas that would create similar crevasses. More recently, he had noticed geological formations that an artist had hand-designed for another video game, and realized that the algorithms of No Man's Sky were not equipped to make them. The problem nagged at him, until he found an equation, published in 2003 by a Belgian plant geneticist named Johan Gielis. The simple equation can describe a large number of natural forms—the contours of diatoms, starfish, spiderwebs, shells, snowflakes, crystals. Even Gielis was amazed at the range when he plugged it into modelling software. "All these beautiful shapes came rolling out," he told *Nature*. "It seemed too good to be true—I spent two years

thinking, What did I do wrong? and How come no one else has discovered it?" Gielis called his equation the Superformula.

*"The hardest part of homework is keeping my parents motivated."*Buy the print »

Murray, sitting before his monitor, typed the Superformula into the terrain of a test planet. He began simply, creating walnut-shaped forms that floated in an infinite grid over a desert. The image resembled a nineteen-eighties album cover, but the over-all look was not the point. Whenever he refreshed the rendering, the floating shapes changed. Many were asymmetrical, marred by depressions and rivulets. Game designers refer to lines of code that require lots of processing time as "costly." The Superformula is cheap.

"One of the hardest things for us to do is to create coherent shapes," he told me as he worked. In order to produce varied landscapes, a formula must be able to cope with a wide range of random information without generating mathematical anomalies that cause glitches. "This sounds ridiculous, but it is

hard to find a formula that you can rely on," he said. The Superformula appeared to be reliable. He pointed to a rocky overhang, which looked like desert geology sculpted by harsh erosion. "This is quite naturalistic," he said. He added more noise to the formula, rotated the shapes it made, played with their scale, buried them beneath the planet surface. "This is effectively more turbulence entering the maths." He envisioned using the Superformula throughout the game, especially at the center of the galaxy, where landscapes would become more surreal. With only small shifts in its parameters, the equation was producing impressive variability. In one rendering, it produced rolling hills. Murray refreshed the screen: a star-shaped rock formation appeared. He seemed pleased. "It's always a good sign when I am clicking the button, and there is that slight amount of excitement," he said.

The allure of taking one more peek at the unknown had a way of distracting even the game's creators. At one point, I sat next to Duncan, who was populating a test planet with alien fungus. "I'm trying to develop some weirder vegetation," he told me. Birds flew high above a towering black obelisk—space architecture inspired by John Harris, a British illustrator. Duncan had activated the bird algorithm, but, oddly, a herbivorous dinosaur had also appeared. "I made this world for this test, and I have never encountered animals on it before," he said. "I don't know what it's going to do." The dinosaur scampered off. After several minutes, I asked what attributes of the fungus he was studying. "I'm just exploring," he said, sheepishly. "Sometimes I'm, like, What am I *doing*? I'm supposed to be working."

By May, the team was working furiously. Murray's hair and beard were growing wilder. Discussions with Sony became more complicated; the company was banking on No Man's Sky as a genre-defying hit, and, as its marketers began to consider different ways to promote it, the story of the game was slipping from

his full control. Murray told me that he couldn't sleep at night. "The biggest worry for me is that we release the game because of all the momentum behind it before we are happy with it," he said. Because of the game's scope, and because he had decided not to reveal key features, he feared that it had become a Rorschach test of popular expectation, with each potential player looking for something in it that might not be there. "Hype is a difficult taskmaster," David Braben, one of the creators of Elite, told me when I asked him what he thought about the game.

Even a feature as simple as the Superformula—a hundred and twenty lines of code—created complications when it was written into the terrain-generation system. When I asked Murray how it was working, he told me, "It's cool, though it currently plays hell with creature A.I." He was spending as much time as he could coding, but distractions were hard to block.

People at Sony wanted to issue a companion book, and, once he realized that it might be inevitable, he decided to get involved. One afternoon, he met with Dave Gibbons, the co-creator of the "Watchmen" comic series, to discuss his possible role as editor. In the upstairs lounge, they talked excitedly about Philip K. Dick, and about "Terran Trade Authority," an old sci-fi series that Murray had loved. Then Murray turned toward the flat-screen TV and brought Gibbons onto a snowy mountainous planet, from a build that had been created after E3. "A living, breathing universe," he said. "I can walk in any direction for days and days, and I will eventually walk the entire planet and come back to where I started."

"So you could really explore one planet and map it," Gibbons said.

"For some people, that will be all they do, and they'll be able to have quite a nice

game," Murray said. He climbed into a ship, and flew through an asteroid belt. "The thing that we haven't really shown publicly, but I think is really cool, is that if I press a button I can pop out to a galactic map," he said. He pressed a button, and all of space shrank into a pinpoint of light, representing that solar system.

*"Thank you for neglecting your work long enough to listen to my thoughts on efficiency."*Buy the print »

The galactic map—as bright and compelling as an image from a Carl Sagan documentary—gave the ship's location by framing its proximate sun in a white square. A panel of text noted the solar system's computer-generated name, Ethaedair; a diagram of vectors indicated stars that were reachable with the ship's hyperdrive. "This has been in games before, but it has always been a fake," Murray said, gesturing to the map. "Normally, it would be a painting that somebody has made, and there would be two little levels that you can go between, or ten levels, each set on a pretend 'solar system.' " Like a magician

working toward a showstopper, he added, offhandedly, "But it is quite nice to just pull around . . ." He manipulated his controller, and all of space rotated around Ethaedair's sun. Stars and plumes of luminous cosmic matter arced past; what had seemed like a two-dimensional representation suddenly revealed itself to be full of depth. Gibbons gasped, and Murray began to speak more softly: "If I pull back a bit, you start to get a sense of the size of what we are building." Millions of stars drifted by. Gibbons laughed softly. "It's like a huge box of chocolates!" he said.

"Maybe I should just go a little faster," Murray said. Light-years of space unfolded at a terrific rate. It may not have been the universe as it actually was, but there was nonetheless an awesome reality on display: the system's vast mathematics. Murray turned toward a phosphorescent glowing orb. "That's the center," he said. This version of the game allowed Murray to leap to any solar system he wanted, but, drawing out the suspense, he moved deeper into the galactic map's three-dimensional space. "This build was brought together so I could do a demo onstage. I chickened out, because when I press this button, basically, I don't know what we're going to see—and it can be a really weird way to end a demo. Something might go terribly wrong. Or we might find a planet that is quite boring. But I can see now that I should have gone with it, because even when it is boring it still is something new."

"It is a bit like it really does exist, isn't it?" Gibbons said.

Murray stopped at a star cluster and admired its density. Finally, overcoming his hesitancy, he picked a destination. "I can't promise if this is going to be interesting," he said. The map vanished. He was back in his cockpit. His hyperdrive kicked on. Then all of space blurred, and the ship hurtled into the unknown. ♦