REEF

Paul J. McAuley

Born in Oxford, England, in 1955, Paul J. McAuley now makes his home in London. A professional biologist for many years, he sold his first story in 1984, and has gone on to be a frequent contributor to *Interzone,* as well as to markets such as *Amazing, The Magazine of Fantasy & Science Fiction, Asimov's Science Fiction, When the Music's Over,* and elsewhere.

McAuley is considered to be one of the best of the new breed of British writers (although a few Australian writers could be fit in under this heading as well) who are producing that brand of rigorous hard science fiction with updated modem and stylistic sensibilities that is sometimes referred to as "radical hard science fiction", but he also writes Dystopian sociological speculations about the very near future, and he also is one of the major young writers who are producing that revamped and retooled wide-screen Space Opera that has sometimes been called the New Baroque Space Opera, reminiscent of the Superscience stories of the thirties taken to an even higher level of intensity and scale. His first novel, *Four Hundred Billion Stars,* won the Philip K. Dick Award, and his acclaimed novel *Fairyland* won both the Arthur C. Clarke Award and the John W. Campbell Award in 1996. His other books include the novels *Of the Fall, Eternal Light,* and *Pasquale's Angel,* two collections of his short work, *The King of the Hill and Other Stories* and *The Invisible Country,* and an original anthology coedited with Kim Newman, *In Dreams.* His most recent books are *Child of the River, Ancient of Days,* and *Shrine of Stars,* which comprise a major new trilogy of ambitious scope and scale, *Confluence,* set ten million years in the future. Currently he is working on a new novel, *Life on Mars.*

In the suspenseful and inventive story that follows, he suggests that it's not necessarily enough to find life in the outer reaches of the Solar System—you also need someone who'll be willing to fight to preserve it…

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MARGARET HENDERSON Wu was riding a proxy by telepresence deep inside Tigris Rift when Dzu Sho summoned her. The others in her crew had given up one by one and only she was left, descending slowly between rosy, smoothly rippled cliffs scarcely a hundred metres apart. These were pavements of the commonest vacuum organism, mosaics made of hundreds of different strains of the same species. Here and there bright red whips stuck out from the pavement; a commensal species that deposited iron sulphate crystals within its integument. The pavement seemed to stretch endlessly below her. No probe or proxy had yet reached the bottom of Tigris Rift, still more than thirty kilometres away. Microscopic flecks of sulfur-iron complexes, sloughed cells and excreted globules of carbon compounds and other

volatiles formed a kind of smog or snow, and the vacuum organisms deposited nodes and intricate lattices of reduced metals that, by some trick of superconductivity, produced a broad band electromagnetic resonance that pulsed like a giant's slow heartbeat.

All this futzed the telepresence link between operators and their proxies. One moment Margaret was experiencing the three-hundred-and twenty-degree panorama of the little proxy's microwave radar, the perpetual tug of vacuum on its mantle, the tang of extreme cold, a mere thirty degrees above absolute zero, the complex taste of the vacuum smog (burnt sugar, hot rubber, tar), the minute squirts of hydrogen from the folds of the proxy's puckered nozzle as it maintained its orientation relative to the cliff face during its descent, with its tentacles retracted in a tight ball around the relay piton. The next, she was back in her cradled body in warm blackness, phosphenes floating in her vision and white noise in her ears while the transmitter searched for a viable waveband, locked on and—*pow*—she was back, falling past rippled pink pavement.

The alarm went off, flashing an array of white stars over the panorama. Her number two, Srin Kerenyi, said in her ear, "You're wanted, boss."

Margaret killed the alarm and the audio feed. She was already a kilometre below the previous bench mark and she wanted to get as deep as possible before she implanted the telemetry relay. She swivelled the proxy on its long axis, increased the amplitude of the microwave radar. Far below were intimations of swells and bumps jutting from the plane of the cliff face, textured mounds like brain coral, randomly orientated chimneys. And something else, clouds of organic matter perhaps.

The alarm again. Srin had overridden the cut-out.

Margaret swore and dove at the cliff, unfurling the proxy's tentacles and jamming the piton into pinkness rough with black papillae, like a giant's tongue quick frozen against the ice. The piton's spikes fired automatically. Recoil sent the little proxy tumbling over its long axis until it reflexively stabilized itself with judicious squirts of gas. The link rastered, came back, cut out completely. Margaret hit the switch that turned the tank into a chair; the mask lifted away from her face.

Srin Kerenyi was standing in front of her. "Dzu Sho wants to talk with you, boss. Right now."

The job had been offered as a sealed contract. Science crews had been informed of the precise nature of their tasks only when the habitat was under way. But it was good basic pay with the promise of fat bonuses on completion: when she had won the survey contract Margaret Henderson Wu had brought with her most of the crew from her previous job, and had nursed a small hope that this would be a change in her family's luck.

The *Ganapati* was a new habitat founded by an alliance of two of the Commonwealth's oldest patrician families. It was of standard construction, a basaltic

asteroid cored by a gigawatt X-ray laser and spun up by vented rock vapour to give 0.2 gee on the inner surface of its hollowed interior, factories and big reaction motors dug into the stern. With its AIs rented out for information crunching and its refineries synthesizing exotic plastics from cane sugar biomass and gengeneered oilseed rape precursors, the new habitat had enough income to maintain the interest on its construction loan from the Commonwealth Bourse, but not enough to attract new citizens and workers. It was still not completely fitted out, had less than a third of its optimal population.

Its Star Chamber, young and cocky and eager to win independence from their families, had taken a big gamble. They were chasing a legend.

Eighty years ago, an experiment in accelerated evolution of chemoautotrophic vacuum organisms had been set up on a planetoid in the outer edge of the Kuiper Belt. The experiment had been run by a shell company registered on Ganymede but covertly owned by the Democratic Union of China. In those days, companies and governments of Earth had not been allowed to operate in the Kuiper Belt, which had been claimed and ferociously defended by outer system cartels. That hegemony had ended in the Quiet War, but the Quiet War had also destroyed all records of the experiment; even the Democratic Union of China had disappeared, absorbed into the Pacific Community.

There were over fifty thousand objects with diameters greater than a hundred kilometres in the Kuiper Belt, and a billion more much smaller, the plane of their orbits stretching beyond those of Neptune and Pluto. The experimental planetoid, Enki, named for one of the Babylonian gods of creation, had been lost among them. It had become a legend, like the Children's Habitat, or the ghost comet, or the pirate ship crewed by the reanimated dead, or the worker's paradise of Fiddler's Green.

And then, forty-five years after the end of the Quiet War, a data miner recovered enough information to reconstruct Enki's eccentric orbit. She sold it to the *Ganapati.* The habitat bought time on the Uranus deep space telescopic array and confirmed that the planetoid was where it was supposed to be, currently more than seven thousand million kilometres from the Sun.

Nothing more was known. The experiment might have failed almost as soon as it begun, but potentially it might win the *Ganapati* platinum-rated credit on the Bourse. Margaret and the rest of the science crews would, of course, receive only their fees and bonuses, less deductions for air and food and water taxes, and anything they bought with scrip in the habitat's stores; the indentured workers would not even get that. Like every habitat in the Commonwealth, the *Ganapati* was structured like an ancient Greek Republic, ruled by share-holding citizens who lived in the landscaped parklands of the inner surface, and run by indentured and contract workers who were housed in the undercroft of malls and barracks tunnelled into the *Ganapatis* rocky skin.

On the long voyage out, the science crews had been on minimal pay, far lower than

that of the unskilled techs who worked the farms and refineries, and the servants who maintained the citizens' households. There were food shortages because so much biomass was being used to make exportable biochemicals; any foodstuffs other than basic rations were expensive, and prices were carefully manipulated by the habitat's Star Chamber. When the *Ganapati* reached Enki and the contracts of the science crews were activated, food prices had increased accordingly. Techs and household servants suddenly found themselves unable to afford anything other than dole yeast. Resentment bubbled over into skirmishes and knife-fights, and a small riot the White Mice, the undercroft's police, subdued with gas. Margaret had to take time off to bail out several of her crew, had given them an angry lecture about threatening everyone's bonuses.

"We got to defend our honour," one of the men said.

"Don't be a fool," Margaret told him. "The citizens play workers against science crews to keep both sides in their places, and still turn a good profit from increases in food prices. Just be glad you can afford the good stuff now, and keep out of trouble."

"They were calling you names, boss," the man said. "On account you're—"

Margaret stared him down. She was standing on a chair, but even so she was a good head shorter than the gangling outers. She said, "I'll fight my own fights. I always have. Just think of your bonuses and keep quiet. It will be worth it. I promise you."

And it was worth it, because of the discovery of the reef.

At sometime in the deep past, Enki had suffered an impact that had remelted it and split it into two big pieces and thousands of fragments. One lone fragment still orbited Enki, a tiny moonlet where the AI that had controlled the experiment had been installed; the others had been drawn together again by their feeble gravity fields, but had cooled before coalescence had been completed, leaving a vast deep chasm, Tigris Rift, at the lumpy equator.

Margaret's crew had discovered that the vacuum organisms had proliferated wildly in the deepest part of the Rift, deriving energy by oxidation of elemental sulphur and ferrous iron, converting carbona-ceous material into useful organic chemicals. There were crusts and sheets, things like thin scarves folded into fragile vases and chimneys, organ pipe clusters, whips, delicate fretted laces. Some fed on others, one crust slowly overgrowing and devouring another. Others appeared to be parasites, sending complex veins ramifying through the thalli of their victims. Water-mining organisms recruited sulphur oxidizers, trading precious water for energy and forming warty outgrowths like stromatolites. Some were more than a hundred metres across, surely the largest prokaryotic colonies in the known Solar System.

All this variety, and after only eighty years of accelerated evolution! Wild beauty won from the cold and the dark. The potential to feed billions. The science crews would get their bonuses, all right; the citizens would become billionaires.

Margaret spent all her spare time investigating the reef by proxy, pushed her crew

hard to overcome the problems of penetrating the depths of the Rift. Although she would not admit it even to herself, she had fallen in love with the reef. She would gladly have explored it in person, but as in most habitats the *Ganapatis* citizens did not like their workers going where they themselves would not.

Clearly, the experiment had far exceeded its parameters, but no one knew why. The AI that had overseen the experiment had shut down thirty years ago. There was still heat in its crude proton beam fission pile, but it had been overgrown by the very organisms it had manipulated.

Its task had been simple. Colonies of a dozen species of slow-growing chemoautotrophs had been introduced into a part of the Rift rich with sulphur and ferrous iron. Thousands of random mutations had been induced. Most colonies had died, and those few which had thrived had been sampled, mutated and reintroduced in a cycle repeated every hundred days.

But the AI had selected only for fast growth, not for adaptive radiation, and the science crews held heated seminars about the possible cause of the unexpected richness of the reef's biota. Very few believed that it was simply a result of accelerated evolution. Many terrestrial bacteria divided every twenty minutes in favourable conditions, and certain species were known to have evolved from being resistant to an antibiotic to becoming obligately dependent upon it as a food source in less than five days, or only three hundred and sixty generations, but that was merely a biochemical adaptation. The fastest division rate of the vacuum organisms in the Rift was less than once a day, and while that still meant more than thirty thousand generations had passed since the reef had been seeded, half a million years in human terms, the evolu-tionary radiation in the reef was the equivalent of Neanderthal Man evolving to fill every mammalian niche from bats to whales.

Margaret's survey crew had explored and sampled the reef for more than thirty days. Cluster analysis suggested that they had identified less than ten per cent of the species that had formed from the original seed population. And now deep radar suggested that there were changes in the unexplored regions in the deepest part of Tigris Rift, which the proxies had not yet been able to reach.

Margaret had pointed this out at the last seminar. "We're making hypotheses on incomplete information. We don't know everything that's out there. Sampling suggests that complexity increases away from the surface. There could be thousands more species in the deep part of the Rift."

At the back of the room, Opie Kindred, the head of the genetics crew, said languidly, "We don't need to know everything. That's not what we're paid for. We've already found several species that perform better than present commercial cultures. The *Ganapati* can make money from them and we'll get full bonuses. Who cares how they got there?"

Arn Nivedta, the chief of the biochemist crew, said, "We're all scientists here. We prove our worth by finding out how things work. Are your mysterious experiments no

more than growth tests, Opie? If so, I'm disappointed."

The genetics crew had set up an experimental station on the surface of the *Ganapati,* off limits to everyone else.

Opie smiled. "I'm not answerable to you."

This was greeted with shouts and jeers. The science crews were tired and on edge, and the room was hot and poorly ventilated.

"Information should be free," Margaret said. "We all work towards the same end. Or are you hoping for extra bonuses, Opie?"

There was a murmur in the room. It was a tradition that all bonuses were pooled and shared out between the various science crews at the end of a mission.

Opie Kindred was a clever, successful man, yet somehow soured, as if the world was a continual disappointment. He rode his team hard, was quick to find failure in others. Margaret was a natural target for his scorn, a squat muscle-bound unedited dwarf from Earth who had to take drugs to survive in micro-gravity, who grew hair in all sorts of unlikely places. He stared at her with disdain and said, "I'm surprised at the tone of this briefing, Dr Wu. Wild speculations built on nothing at all. I have sat here for an hour and heard nothing useful. We are paid to get results, not generate hypotheses. All we hear from your crew are excuses when what we want are samples. It seems simple enough to me. If something is upsetting your proxies, then you should use robots. Or send people in and handpick samples. I've worked my way through almost all you've obtained. I need more material, especially in light of my latest findings."

"Robots need transmission relays too," Srin Kerenyi pointed out.

Orly Higgins said, "If you ride them, to be sure. But I don't see the need for human control. It is a simple enough task to programme them go down, pick up samples, return." She was the leader of the crew that had unpicked the AI's corrupted code, and was an acolyte of Opie Kindred.

"The proxies failed whether or not they were remotely controlled," Margaret said, "and on their own they are as smart as any robot. I'd love to go down there myself, but the Star Chamber has forbidden it for the usual reasons. They're scared we'll get up to something if we go where they can't watch us."

"Careful, boss," Srin Kerenyi whispered. "The White Mice are bound to be monitoring this."

"I don't care," Margaret said. "I'm through with trying polite requests. We need to get down there, Srin."

"Sure, boss. But getting arrested for sedition isn't the way."

"There's some interesting stuff in the upper levels," Arn Nivedta said. "Stuff with huge commercial potential, as you pointed out, Opie."

Murmurs of agreement throughout the crowded room. The Reef could make the *Ganapati* the richest habitat in the Outer System, where expansion was limited by the availability of fixed carbon. Even a modest-sized comet nucleus, ten kilometres in diameter, say, and salted with only one hundredth of one per cent carbonaceous material, contained fifty million tons of carbon, mostly as methane and carbon monoxide ice, with a surface dusting of tarry long chain hydrocarbons. The problem was that most vacuum organisms converted simple carbon compounds into organic matter using the energy of sunlight captured by a variety of photosynthetic pigments, and so could only grow on the surfaces of planetoids. No one had yet developed vacuum organisms that, using other sources of energy, could efficiently mine planetoids interiors, but that was what accelerated evolution appeared to have produced in the reef. It could enable exploitation of the entire volume of objects in the Kuiper Belt, and beyond, in the distant Oort Cloud. It was a discovery of incalculable worth.

Arn Nivedta waited for silence, and added, "Of course, we can't know what the commercial potential is until the reef species have been fully tested. What about it, Opie?"

"We have our own ideas about commercial potential," Opie Kindred said. "I think you'll find that we hold the key to success here."

Boos and catcalls at this from both the biochemists and the survey crew. The room was polarizing. Margaret saw one of her crew unsheathe a sharpened screwdriver, and she caught the man's hand and squeezed it until he cried out. "Let it ride," she told him. "Remember that we're scientists."

"We hear of indications of more diversity in the depths, but we can't seem to get there. One might suspect," Opie said, his thin upper lip lifting in a supercilious curl, "sabotage."

"The proxies are working well in the upper part of the Rift," Margaret said, "and we are doing all we can to get them operative further down."

"Let's hope so," Opie Kindred said. He stood, and around him his crew stood too. "I'm going back to work, and so should all of you. Especially you, Dr Wu. Perhaps you should be attending to your proxies instead of planning useless expeditions."

And so the seminar broke up in uproar, with nothing productive coming from it and lines of enmity drawn through the community of scientists.

"Opie is scheming to come out of this on top," Arn Nivedta said to Margaret afterwards. He was a friendly, enthusiastic man, tall even for an outer, and as skinny as a rail. He stooped in Margaret's presence, trying to reduce the extraordinary difference between their heights. He said, "He wants desperately to become a citizen, and so he thinks like one."

"Well, my god, we all want to be citizens," Margaret said. "Who wants to live like this?"

She gestured, meaning the crowded bar, its rock walls and low ceiling, harsh lights and the stink of spilled beer and too many people in close proximity. Her parents had been citizens, once upon a time. Before their run of bad luck. It was not that she wanted those palmy days back—she could scarcely remember them—but she wanted more than this.

She said, "The citizens sleep between silk sheets and eat real meat and play their stupid games, and we have to do their work on restricted budgets. The reef is the discovery of the century, Arn, but God forbid that the citizens should begin to exert themselves. We do the work, they fuck in rose petals and get the glory."

Arn laughed at this.

"Well, it's true!"

"It's true we have not been as successful as we might like," Arn said mournfully.

Margaret said reflectively, "Opie's a bastard, but he's smart, too. He picked just the right moment to point the finger at me."

Loss of proxies was soaring exponentially, and the proxy farms of the *Ganapati* were reaching a critical point. Once losses exceeded reproduction, the scale of exploration would have to be drastically curtailed, or the seed stock would have to be pressed into service, a gamble the *Ganapati* could not afford to take.

And then, the day after the disastrous seminar, Margaret was pulled back from her latest survey to account for herself in front of the chairman of the Ganapatis Star Chamber.

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"We are not happy with the progress of your survey, Dr Wu," Dzu Sho said. "You promise much, but deliver little."

Margaret shot a glance at Opie Kindred, and he smiled at her. He was immaculately dressed in gold-trimmed white tunic and white leggings. His scalp was oiled and his manicured fingernails were painted with something that split light into rainbows. Margaret, fresh from the tank, wore loose, grubby work greys. There was sticky electrolyte paste on her arms and legs and shaven scalp, the reek of sour sweat under her breasts and in her armpits.

She contained her anger and said, "I have submitted daily reports on the problems we encountered. Progress is slow but sure. I have just established a relay point a full kilometre below the previous datum point."

Dzu Sho waved this away. He lounged in a blue gel chair, quite naked, as smoothly fat as a seal. He had a round, hairless head and pinched features, like a thumbprint on an egg. The habitat's lawyer sat behind him, a young woman neat and anonymous in a grey tunic suit. Margaret, Opie Kindred and Arn Nivedta sat on low stools, supplicants to Dzu Sho's authority. Behind them, half a dozen servants stood at the edge of the grassy space.

This was in an arbor of figs, ivy, bamboo and fast-growing banyan at the edge of Sho's estate. Residential parkland curved above, a patchwork of spindly, newly planted woods and meadows and gardens. Flyers were out, triangular rigs in primary colours pirouetting around the weightless axis. Directly above, mammoths the size of large dogs grazed an upside-down emerald green field. The parkland stretched away to the ring lake and its slosh barrier, three kilometres in diameter, and the huge farms that dominated the inner surface of the habitat. Fields of lentils, wheat, cane fruits, tomatoes, rice and exotic vegetables for the tables of the citizens, and fields and fields and fields of sugar cane and oilseed rape for the biochemical industry and the yeast tanks.

Dzu Sho said, "Despite the poor progress of the survey crew, we have what we need, thanks to the work of Dr Kindred. This is what we will discuss."

Margaret glanced at Arn, who shrugged. Opie Kindred's smile deepened. He said, "My crew has established why there is so much diversity here. The vacuum organisms have invented sex."

"We know they have sex," Arn said. "How else could they evolve?"

His own crew had shown that the vacuum organisms could exchange genetic material through pili, microscopic hollow tubes grown between cells or hyphal strands. It was analogous to the way in which genes for antibiotic resistance spread through populations of terrestrial bacteria.

"I do not mean genetic exchange, but genetic recombination," Opie Kindred said. "I will explain."

The glade filled with flat plates of colour as the geneticist conjured charts and diagrams and pictures from his slate. Despite her anger, Margaret quickly immersed herself in the flows of data, racing ahead of Opie Kindred's clipped explanations.

It was not normal sexual reproduction. There was no differentiation into male or female, or even into complementary mating strains. Instead, it was mediated by a species that aggressively colonized the thalli of others. Margaret had already seen it many times, but until now she had thought that it was merely a parasite. Instead, as Opie Kindred put it, it was more like a vampire.

A shuffle of pictures, movies patched from hundreds of hours of material collected by roving proxies. Here was a colony of the black crustose species found all through the explored regions of the Rift. Time speeded up. The crustose colony elongated its ragged perimeter in pulsing spurts. As it grew, it exfoliated microscopic particles. Margaret's viewpoint spiralled into a close-up of one of the exfoliations, a few cells wrapped in nutrient storing strands.

Millions of these little packages floated through the vacuum. If one landed on a host thallus, it injected its genetic payload into the host cells. The view dropped inside one such cell. A complex of carbohydrate and protein strands webbed the interior like intricately packed spider webs. Part of the striated cell wall drew apart and a packet of

DNA coated in hydrated globulins and enzymes burst inward. The packet contained the genomes of both the parasite and its previous victim. It latched onto protein strands and crept along on ratchetting microtubule claws until it fused with the cell's own circlet of DNA.

The parasite possessed an enzyme that snipped strands of genetic material at random lengths. These recombined, forming chimeric cells that contained genetic information from both sets of victims, with the predator species' genome embedded among the native genes like an interpenetrating text.

The process repeated itself in flurries of coiling and uncoiling DNA strands as the chimeric cells replicated. It was a crude, random process. Most contained incomplete or noncomplementary copies of the genomes and were unable to function, or contained so many copies that transcription was halting and imperfect. But a few out of every thousand were viable, and a small percentage of those were more vigorous than either of their parents. They grew from a few cells to a patch, and finally overgrew the parental matrix in which they were embedded. There were pictures that showed every stage of this transformation in a laboratory experiment.

"This is why I have not shared the information until now," Opie Kindred said, as the pictures faded around him. "I had to ensure by experimental testing that my theory was correct. Because the procedure is so inefficient we had to screen thousands of chimeras until we obtained a strain that overgrew its parent."

"A very odd and extreme form of reproduction," Arn said. "The parent dies so that the child might live."

Opie Kindred smiled. "It is more interesting than you might suppose."

The next sequence showed the same colony, now clearly infected by the parasitic species—leprous black spots mottled its pinkish surface. Again time speeded up. The spots grew larger, merged, shed a cloud of exfoliations.

"Once the chimera overgrows its parent," Opie Kindred said, "the genes of the parasite, which have been reproduced in every cell of the thallus, are activated. The host cells are transformed. It is rather like an RNA virus, except that the virus does not merely subvert the protein and RNA making machinery of its host cell. It takes over the cell itself. Now the cycle is completed, and the parasite sheds exfoliations that will in turn infect new hosts.

"Here is the motor of evolution. In some of the infected hosts, the parasitic genome is prevented from expression, and the host becomes resistant to infection. It is a variation of the Red Queen's race. There is an evolutionary pressure upon the parasite to evolve new infective forms, and then for the hosts to resist them, and so on. Meanwhile, the host species benefit from new genetic combinations that by selection incrementally improve growth. The process is random but continuous, and takes place on a vast scale. I estimate that millions of recombinant cells are produced each hour, although perhaps only one in ten million are viable, and of those only one in a million

are significantly more efficient at growth than their parents. But this is more than sufficient to explain the diversity we have mapped in the reef."

Arn said, "How long have you known this, Opie?"

"I communicated my findings to the Star Chamber just this morning," Opie Kindred said. "The work has been very difficult. My crew has to work under very tight restraints, using Class Four containment techniques, as with the old immunodeficiency plagues."

"Yah, of course," Arn said. "We don't know how the exfoliations might contaminate the ship."

"Exactly," Opie Kindred said. "That is why the reef is dangerous."

Margaret bridled at this. She said sharply, "Have you tested how long the exfoliations survive?"

"There is a large amount of data about bacterial spore survival. Many survive thousands of years in vacuum close to absolute zero. It hardly seems necessary—"

"You didn't bother," Margaret said. "My God, you want to destroy the reef and you have no *evidence.* You didn't *think."*

It was the worst of insults in the scientific community. Opie Kindred coloured, but before he could reply Dzu Sho held up a hand, and his employees obediently fell silent.

"The Star Chamber has voted," Dzu Sho said. "It is clear that we have all we need. The reef is dangerous, and must be destroyed. Dr Kindred has suggested a course of action that seems appropriate. We will poison the sulphur-oxidizing cycle and kill the reef."

"But we don't know—"

"We haven't found—"

Margaret and Arn had spoken at once. Both fell silent when Dzu Sho held up a hand again. He said, "We have isolated commercially useful strains. Obviously, we can't use the organisms we have isolated because they contain the parasite within every cell. But we can synthesize useful gene sequences and splice them into current commercial strains of vacuum organism to improve quality."

"I must object," Margaret said. "This is a unique construct. The chances of it evolving again are minimal. We must study it further. We might be able to discover a cure for the parasite."

"It is unlikely," Opie Kindred said. "There is no way to eliminate the parasite from the host cells by gene therapy because they are hidden within the host chromosome, shuffled in a different pattern in every cell of the trillions of cells that make up the reef. However, it is quite easy to produce a poison that will shut down the sulphur-oxidizing metabolism common to the different kinds of reef organism."

"Production has been authorized," Sho said. "It will take, what did you tell me, Dr

Kindred?"

"We require a large quantity, given the large biomass of the reef. Ten days at least. No more than fifteen."

"We have not studied it properly," Arn said. "So we cannot yet say what and what is not possible."

Margaret agreed, but before she could add her objection, her earpiece trilled, and Srin Kerenyi's voice said apologetically, "Trouble, boss. You better come at once."

* * * *

The survey suite was in chaos, and there was worse chaos in the Rift. Margaret had to switch proxies three times before she found one she could operate. All around her, proxies were fluttering and jinking, as if caught in strong currents instead of floating in vacuum in virtual free fall.

This was at the four-thousand-metre level,where the nitrogen ice walls of the Rift were sparsely patched with yellow and pink marblings that followed veins of sulphur and organic contaminants. The taste of the vacuum smog here was strong, like burnt rubber coating Margaret's lips and tongue.

As she looked around, a proxy jetted towards her. It overshot and rebounded from a gable of frozen nitrogen, its nozzle jinking back and forth as it tried to stabilize its position.

"Fuck," its operator, Kim Nieye, said in Margaret's ear. "Sorry, boss. I've been through five of these, and now I'm losing this one."

On the other side of the cleft, a hundred metres away, two specks tumbled end for end, descending at a fair clip towards the depths. Margaret's vision colour-reversed, went black, came back to normal. She said, "How many?"

"Just about all of them. We're using proxies that were up in the tablelands, but as soon as we bring them down they start going screwy too."

"Herd some up and get them to the sample pickup point. We'll need to do dissections."

"No problem, boss. Are you OK?"

Margaret's proxy had suddenly upended. She couldn't get its trim back. "I don't think so," she said, and then the proxy's nozzle flared and with a pulse of gas the proxy shot away into the depths.

It was a wild ride. The proxy expelled all its gas reserves, accelerating as straight as an arrow. Coralline formations blurred past, and then long stretches of sulphur-eating pavement. The proxy caromed off the narrowing walls and began to tumble madly.

Margaret had no control. She was a helpless but exhilarated passenger. She passed the place where she had set the relay and continued to fall. The link started to break up. She lost all sense of proprioception, although given the tumbling fall of the proxy

that was a blessing. Then the microwave radar started to go, with swathes of raster washing across the false colour view. Somehow the proxy managed to stabilize itself, so it was falling headfirst towards the unknown regions at the bottom of the Rift. Margaret glimpsed structures swelling from the walls. And then everything went away and she was back, sweating and nauseous in the couch.

It was bad. More than ninety-five per cent of the proxies had been lost. Most, like Margaret's had been lost in the depths. A few, badly damaged by collision, had been stranded among the reef colonies, but proxies sent to retrieve them went out of control too. It was clear that some kind of infective process had affected them. Margaret had several dead proxies collected by a maintenance robot and ordered that the survivors should be regrouped and kept above the deep part of the Rift where the vacuum organisms proliferated. And then she went to her suite in the undercroft and waited for the Star Chamber to call her before them.

* * * *

The Star Chamber took away Margaret's contract, citing failure to perform and possible sedition (that remark in the seminar had been recorded). She was moved from her suite to a utility room in the lower level of the undercroft and put to work in the farms.

She thought of her parents.

She had been here before.

She thought of the reef.

She couldn't let it go.

She would save it if she could.

Srin Kerenyi kept her up to date. The survey crew and its proxies were restricted to the upper level of the reef. Manned teams under Opie Kindred's control were exploring the depths—*he* was trusted where Margaret was not—but if they discovered anything it wasn't communicated to the other science crews.

Margaret was working in the melon fields when Arn Nivedta found her. The plants sprawled from hydroponic tubes laid across gravel beds, beneath blazing lamps hung in the axis of the farmlands. It was very hot, and there was a stink of dilute sewage. Little yellow ants swarmed everywhere. Margaret had tucked the ends of her pants into the rolled tops of her shoesocks, and wore a green eyeshade. She was using a fine paint-brush to transfer pollen to the stigma of the melon flowers.

Arn came bouncing along between the long rows of plants like a pale scarecrow intent on escape. He wore only tight black shorts and a web belt hung with pens, little silvery tools and a notepad.

He said, "They must hate you, putting you in a shit hole like this."

"I have to work, Arn. Work or starve. I don't mind it. I grew up working the fields."

Not strictly true: her parents had been ecosystem designers. But it was how it had ended.

Arn said cheerfully, “I’m here to rescue you. I can prove it wasn’t your fault.”

Margaret straightened, one hand on the small of her back where a permanent ache had lodged itself. She said, “Of course it wasn’t my fault. Are you all right?”

Arn had started to hop about, brushing at one bare long-toed foot and then the other. The ants had found him. His toes curled like fingers. The big toes were opposed. Monkey feet.

“Ants are having something of a population explosion,” she said. “We’re in the stage between introduction and stabilization here. The cycles will smooth out as the ecosystem matures.”

Arn brushed at his legs again. His prehensile big toe flicked an ant from the sole of his foot. “They want to incorporate me into the cycle, I think.”

“We’re all in the cycle, Arn. The plants grow in sewage; we eat the plants.” Margaret saw her supervisor coming towards them through the next field. She said, “We can’t talk here. Meet me in my room after work.”

* * * *

Margaret’s new room was barely big enough for a hammock, a locker, and a tiny shower with a toilet pedestal. Its rock walls were unevenly coated with dull green fibre spray. There was a constant noise of pedestrians beyond the oval hatch; the air conditioning allowed in a smell of frying oil and ketones despite the filter trap Margaret had set up. She had stuck an aerial photograph of New York, where she had been born, above the head stay of her hammock, and dozens of glossy printouts of the reef scaled the walls. Apart from the pictures, a few clothes in the closet and the spider plant under the purple grolite, the room was quite anonymous.

She had spent most of her life in rooms like this. She could pack in five minutes, ready to move onto the next job.

“This place is probably bugged,” Arn said. He sat with his back to the door, sipping schnapps from a silvery flask and looking at the overlapping panoramas of the reef.

Margaret sat on the edge of her hammock. She was nervous and excited. She said, “Everywhere is bugged. I want them to hear that I’m not guilty. Tell me what you know.”

Arn looked at her. “I examined the proxies you sent back. I wasn’t quite sure what I was looking for, but it was surprisingly easy to spot.”

“An infection,” Margaret said.

“Yah, a very specific infection. We concentrated on the nervous system, given the etiology. In the brain we found lesions, always in the same area.”

Margaret examined the three-dimensional colour-enhanced tomographic scan Arn

had brought. The lesions were little black bubbles in the underside of the unfolded cerebellum, just in front of the optic node.

"The same in all of them," Arn said. "We took samples, extracted DNA, and sequenced it." A grid of thousands of coloured dots, then another superimposed over it. All the dots lined up.

"A match to Opie's parasite," Margaret guessed.

Arn grinned. He had a nice smile. It made him look like an enthusiastic boy. "We tried that first of course. Got a match, then went through the library of reef organisms, and got partial matches. Opie's parasite has its fingerprints in the DNA of everything in the reef, but this—" he jabbed a long finger through the projection "—is the pure quill. Just an unlucky accident that it lodges in the brain at this particular place and produces the behaviour you saw."

"Perhaps it isn't a random change," Margaret said. "Perhaps the reef has a use for the proxies."

"Teleology," Arn said. "Don't let Opie hear that thought. He'd use it against you. This is evolution. It isn't directed by anything other than natural selection. There is no designer, no watchmaker. Not after the AI crashed, anyway, and it only pushed the ecosystem towards more efficient sulphur oxidation. There's more, Margaret. I've been doing some experiments on the side. Exposing aluminum foil sheets in orbit around Enki. There are exfoliations everywhere."

"Then Opie is right."

"No, no. All the exfoliations I found were nonviable. I did more experiments. The exfoliations are metabolically active when released, unlike bacterial spores. And they have no protective wall. No reason for them to have one, yah? They live only for a few minutes. Either they land on a new host or they don't. Solar radiation easily tears them apart. You can kill them with a picowatt ultraviolet laser. Contamination isn't a problem."

"And it can't infect us," Margaret said. "Vacuum organisms and proxies have the same DNA code as us, the same as everything from Earth, for that matter, but it's written in artificial nucleotide bases. The reef isn't dangerous at all, Arn."

"Yah, but in theory it could infect every vacuum organism ever designed. The only way around it would be to change the base structure of vacuum organism DNA—how much would that cost?"

"I know about contamination, Arn. The mould that wrecked the biome designed by my parents came in with someone or something. Maybe on clothing, or skin, or in the gut, or in some trade goods. It grew on anything with a cellulose cell wall. Every plant was infected. The fields were covered by huge sheets of grey mould; the air was full of spores. It didn't infect people, but more than a hundred died from massive allergic reactions and respiratory failure. They had to vent the atmosphere in the end. And my parents couldn't find work after that."

Arn said gently, “That is the way. We live by our reputations. It’s hard when something goes wrong.”

Margaret ignored this. She said, “The reef is a resource, not a danger. You’re looking at it the wrong way, like Opie Kindred. We need diversity. Our biospheres have to be complicated because simple systems are prone to invasion and disruption, but they aren’t one hundredth as complicated as those on Earth. If my parents’ biome had been more diverse, the mould couldn’t have found a foothold.”

“There are some things I could do without.” Arn scratched his left ankle with the toes of his right foot. “Like those ants.”

“Well, we don’t know if we need the ants specifically, but we need variety, and they contribute to it. They help aerate the soil, to begin with, which encourages stratification and diversity of soil organisms. There are a million different kinds of microbe in a gram of soil from a forest on Earth; we have to make do with less than a thousand. We don’t have one tenth that number of useful vacuum organisms and most are grown in monoculture, which is the most vulnerable ecosystem of all. That was the cause of the crash of the green revolution on Earth in the twenty-first century. But there are hundreds of different species in the reef. Wild species, Arn. You could seed a planetoid with them and go harvest it a year later. The citizens don’t go outside because they have their parklands, their palaces, their virtualities. They’ve forgotten that the outer system isn’t just the habitats. There are millions of small planetoids in the Kuiper Belt. Anyone with a dome and the reef vacuum organisms could homestead one.”

She had been thinking about this while working out in the fields. The Star Chamber had given her plenty of time to think.

Arn shook his head. “They all have the parasite lurking in them. Any species from the reef can turn into it. Perhaps even the proxies.”

“We don’t know enough,” Margaret said. “I saw things in the bottom of the Rift, before I lost contact with the proxy. Big structures. And there’s the anomalous temperature gradients, too. The seat of change must be down there, Arn. The parasite could be useful, if we can master it. The viruses that caused the immunodeficiency plagues are used for gene therapy now. Opie Kindred has been down there. He’s suppressing what he has found.”

“Yah, well, it does not much matter. They have completed synthesis of the metabolic inhibitor. I’m friendly with the organics chief. They diverted most of the refinery to it.” Arn took out his slate. “He showed me how they have set it up. That is what they have been doing down in the Rift. Not exploring.”

“Then we have to do something now.”

“It is too late, Margaret.”

“I want to call a meeting, Arn. I have a proposal.”

* * * *

Most of the science crews came. Opie Kindred's crew was a notable exception; Arn said that it gave him a bad feeling.

"They could be setting us up," he told Margaret.

"I know they're listening. That's good. I want it in the open. If you're worried about getting hurt you can always leave."

"I came because I wanted to. Like everyone else here. We're all scientists. We all want the truth known." Arn looked at her. He smiled. "You want more than that, I think."

"I fight my own fights." All around people were watching. Margaret added, "Let's get this thing started."

Arn called the meeting to order and gave a brief presentation about his research into survival of the exfoliations before throwing the matter open to the meeting. Nearly everyone had an opinion. Microphones hovered in the room, and at times three or four people were shouting at each other. Margaret let them work off their frustration. Some simply wanted to register a protest; a small but significant minority were worried about losing their bonuses or even all of their pay.

"Better that than our credibility," one of Orly Higgins's techs said. "That's what we live by. None of us will work again if we allow the *Ganapati* to become a plague ship."

Yells of approval, whistles.

Margaret waited until the noise had died down, then got to her feet. She was in the centre of the horseshoe of seats, and everyone turned to watch, more than a hundred people. Their gaze fell upon her like sunlight; it strengthened her. A microphone floated down in front of her face.

"Arn has shown that Contamination isn't an issue," Margaret said. "The issue is that the Star Chamber wants to destroy the reef because they want to exploit what they've found and stop anyone else using it. I'm against that, all the way. I'm not gengeneered. Micro-gravity is not my natural habitat. I have to take a dozen different drugs to prevent reabsorption of calcium from my bone, collapse of my circulatory system, fluid retention, all the bad stuff micro-gravity does to unedited Earth stock. I'm not allowed to have children here, because they would be as crippled as me. Despite that, my home is here. Like all of you, I would like to have the benefits of being a citizen, to live in the parklands and eat real food. But there aren't enough parklands for everyone because the citizens who own the habitats control production of fixed carbon. The vacuum organisms we have found could change that. The reef may be a source of plague, or it may be a source of unlimited organics. We don't know. What we do know is that the reef is unique and we haven't finished exploring it. If the Star Chamber destroys it, we may never know what's out there."

Cheers at this. Several people rose to make points, but Margaret wouldn't give way.

She wanted to finish.

"Opie Kindred has been running missions to the bottom of the Rift, but he hasn't been sharing what he's found there. Perhaps he no longer thinks that he's one of us. He'll trade his scientific reputation for citizenship," Margaret said, "but that isn't our way, is it?"

"*NO*!" the crowd roared.

And the White Mice invaded the room.

Sharp cracks, white smoke, screams. The White Mice had long flexible sticks weighted at one end. They went at the crowd like farmers threshing corn. Margaret was separated from Arn by a wedge of panicking people. Two techs got hold of her and steered her out of the room, down a corridor filling with smoke. Arn loomed out of it, clutching his slate to his chest.

"They're getting ready to set off the poison," he said as they ran in long loping strides.

"Then I'm going now," Margaret said.

Down a drop pole onto a corridor lined with shops. People were smashing windows. No one looked at them as they ran through the riot. They turned a corner, the sounds of shouts and breaking glass fading. Margaret was breathing hard. Her eyes were smarting, her nose running.

"They might kill you," Arn said. He grasped her arm. "I can't let you go, Margaret."

She shook herself free. Arn tried to grab her again. He was taller, but she was stronger. She stepped inside his reach and jumped up and popped him on the nose with the flat of her hand.

He sat down, blowing bubbles of blood from his nostrils, blinking up at her with surprised, tear-filled eyes.

She snatched up his slate. "I'm sorry, Arn," she said. "This is my only chance. I might not find anything, but I couldn't live with myself if I didn't try."

* * * *

Margaret was five hundred kilometres out from the habitat when the radio beeped. "Ignore it," she told her pressure suit. She was sure that she knew who was trying to contact her, and she had nothing to say to him.

This far out, the Sun was merely the brightest star in the sky. Behind and above Margaret, the dim elongated crescent of the *Ganapati* hung before the sweep of the Milky Way. Ahead, below the little transit platform's motor, Enki was growing against a glittering starscape, a lumpy potato with a big notch at its widest point.

The little moonlet was rising over the notch, a swiftly moving fleck of light. For a moment, Margaret had the irrational fear that she would collide with it, but the transit platform's navigational display showed her that she would fall above and

behind it. Falling past a moon! She couldn't help smiling at the thought.

"Priority override," her pressure suit said. Its voice was a reassuring contralto Margaret knew as well as her mother's.

"Ignore it," Margaret said again.

"Sorry, Maggie. You know I can't do that."

"Quite correct," another voice said.

Margaret identified him a moment before the suit helpfully printed his name across the helmet's visor. Dzu Sho.

"Turn back right now," Sho said. "We can take you out with the spectrographic laser if we have to."

"You wouldn't dare," she said.

"I do not believe anyone would mourn you," Sho said unctuously. "Leaving the *Ganapati* was an act of sedition, and we're entitled to defend ourselves."

Margaret laughed. It was just the kind of silly, sententious, self-important nonsense that Sho was fond of spouting.

"I am entirely serious," Sho said.

Enki had rotated to show that the notch was the beginning of a groove. The groove elongated as the worldlet rotated further. Tigris Rift. Its edges ramified in complex fractal branchings.

"I'm going where the proxies fell," Margaret said. "I'm still working for you."

"You sabotaged the proxies. That's why they couldn't fully penetrate the Rift."

"That's why I'm going—"

"Excuse me," the suit said, "but I register a small energy flux."

"Just a tickle from the ranging sight," Sho said. "Turn back now, Dr Wu."

"I intend to come back."

It was a struggle to stay calm. Margaret thought that Sho's threat was no more than empty air. The laser's AI would not allow it to be used against human targets, and she was certain that Sho couldn't override it. And even if he could, he wouldn't dare kill her in full view of the science crews. Sho was bluffing. He had to be.

The radio silence stretched. Then Sho said, "You're planning to commit a final act of sabotage. Don't think you can get away with it. I'm sending someone after you."

Margaret was dizzy with relief. Anyone chasing her would be using the same kind of transit platform. She had at least thirty minutes head start.

Another voice said, "Don't think this will make you a hero."

Opie Kindred. Of course. The man never could delegate. He was on the same

trajectory, several hundred kilometres behind but gaining slowly.

"Tell me what you found," she said. "Then we can finish this race before it begins."

Opie Kindred switched off his radio.

"If you had not brought along all this gear," her suit grumbled, "we could outdistance him."

"I think we'll need it soon. We'll just have to be smarter than him."

Margaret studied the schematics of the poison spraying mechanism—it was beautifully simple, but vulnerable—while Tigris Rift swelled beneath her, a jumble of knife-edge chevron ridges. Enki was so small and the Rift so wide that the walls had fallen beneath the horizon. She was steering towards the Rift's centre when the suit apologized and said that there was another priority override.

It was the *Ganapatis* lawyer. She warned Margaret that this was being entered into sealed court records, and then formally revoked her contract and read a complaint about her seditious conduct.

"You're a contracted worker just like me," Margaret said. "We take orders, but we both have codes of professional ethics, too. For the record, that's why I'm here. The reef is a unique organism. I cannot allow it to be destroyed."

Dzu Sho came onto the channel and said, "Off the record, don't think about being picked up."

The lawyer switched channels. "He does not mean it," she said. "He would be in violation of the distress statutes." Pause. "Good luck, Dr Wu."

Then there was only the carrier wave.

Margaret wished that this made her feel better. Plenty of contract workers who went against the direct orders of their employers had disappeared, or been killed in industrial accidents. The fire of the mass meeting had evaporated long before the suit had assembled itself around her, and now she felt colder and lonelier than ever.

She fell, the platform shuddering now and then as it adjusted its trim. Opie Kindred's platform was a bright spark moving sideways across the drifts of stars above. Directly below was a vast flow of nitrogen ice with a black river winding through it. The centre of the Rift, a cleft two kilometres long and fifty kilometres deep. The reef.

She fell towards it.

She had left the radio channel open. Suddenly, Opie Kindred said, "Stop now and it will be over."

"Tell me what you know."

No answer.

She said, "You don't have to follow me, Opie. This is my risk. I don't ask you to share

it."

"You won't take this away from me."

"Is citizenship really worth this, Opie?"

No reply.

The suit's proximity alarms began to ping and beep. She turned them off one by one, and told the suit to be quiet when it complained.

"I am only trying to help," it said. "You should reduce your velocity. The target is very narrow."

"I've been here before," Margaret said.

But only by proxy. The icefield rushed up at her. Its smooth flows humped over one another, pitted everywhere with tiny craters. She glimpsed black splashes where vacuum organisms had colonized a stress ridge. Then an edge flashed past; walls unravelled on either side.

She was in the reef.

The vacuum organisms were everywhere: flat plates jutting from the walls; vases and delicate fans and fretworks; huge blotches smooth as ice or dissected by cracks. In the light cast by the platform's lamps, they did not possess the vibrant primary colours of the proxy link, but were every shade of grey and black, streaked here and there with muddy reds. Complex fans ramified far back inside the milky nitrogen ice, following veins of carbonaceous compounds.

Far above, stars were framed by the edges of the cleft. One star was falling towards her: Opie Kindred. Margaret switched on the suit's radar, and immediately it began to ping. The suit shouted a warning, but before Margaret could look around the pings dopplered together.

Proxies.

They shot up towards her, tentacles writhing from the black, streamlined helmets of their mantles. Most of them missed, jagging erratically as they squirted bursts of hydrogen to kill their velocity. Two collided in a slow flurry of tentacles.

Margaret laughed. None of her crew would fight against her, and Sho was relying upon inexperienced operators.

The biggest proxy, three metres long, swooped past. The crystalline gleam of its sensor array reflected the lights of the platform. It decelerated, spun on its axis, and dove back towards her.

Margaret barely had time to pull out the weapon she had brought with her.

It was a welding pistol, rigged on a long rod with a yoked wire around the trigger. She thrust it up like the torch of the Statue of Liberty just before the proxy struck her.

The suit's gauntlet, elbow joint and shoulder piece stiffened under the heavy

impact, saving Margaret from broken bones, but the collision knocked the transit platform sideways. It plunged through reef growths. Like glass, they had tremendous rigidity but very little lateral strength. Fans and lattices broke away, peppering Margaret and the proxy with shards. It was like falling through a series of chandeliers. Margaret couldn't close her fingers in the stiffened gauntlet. She stood tethered to the platform with her arm and the rod raised straight up and the black proxy wrapped around them. The proxy's tentacles lashed her visor with slow, purposeful slaps.

Margaret knew that it would take only a few moments before the tentacles' carbon-fibre proteins could unlink; then it would be able to reach the life support pack on her back.

She shouted at the suit, ordering it to relax the gauntlet's fingers. The proxy was contracting around her rigid arm as it stretched towards the life support pack. When the gauntlet went limp, pressure snapped her fingers closed. Her forefinger popped free of the knuckle. She yelled with pain. And the wire rigged to the welding pistol's trigger pulled taut.

Inside the proxy's mantle, a focused beam of electrons boiled off the pistol's filament. The pistol, designed to work only in high vacuum, began to arc almost immediately, but the electron beam had already heated the integument and muscle of the proxy to more than 400°C. Vapour expanded explosively. The proxy shot away, propelled by the gases of its own dissolution.

Opie was still gaining on Margaret. Gritting her teeth against the pain of her dislocated finger, she dumped the broken welding gear. It only slowly floated away above her, for it still had the same velocity as she did.

A proxy swirled in beside her with shocking suddenness. For a moment, she gazed into its faceted sensor array, and then dots of luminescence skittered across its smooth black mantle, forming letters.

Much luck, boss. SK.

Srin Kerenyi. Margaret waved with her good hand. The proxy scooted away, rising at a shallow angle towards Opie's descending star.

A few seconds later the cleft filled with the unmistakable flash of laser light.

The radar trace of Srin's proxy disappeared.

Shit. Opie Kindred was armed. If he got close enough he could kill her.

Margaret risked a quick burn of the transit platform's motor to increase her rate of fall. It roared at her back for twenty seconds; when it cut out her pressure suit warned her that she had insufficient fuel for full deceleration.

"I know what I'm doing," Margaret told it.

The complex forms of the reef dwindled past. Then there were only huge patches of black staining the nitrogen ice walls. Margaret passed her previous record depth, and

still she fell. It was like free fall; the negli-gible gravity of Enki did not cause any appreciable acceleration.

Opie Kindred gained on her by increments.

In vacuum, the lights of the transit platform threw abrupt pools of light onto the endlessly unravelling walls. Slowly, the pools of light elongated into glowing tunnels filled with sparkling motes. The exfolia-tions and gases and organic molecules were growing denser. And, impos-sibly, the temperature was rising, one degree with every five hundred metres. Far below, between the narrowing perspective of the walls, struc-tures were beginning to resolve from the blackness.

The suit reminded her that she should begin the platform's deceler-ation burn. Margaret checked Opie's velocity and said she would wait.

"I have no desire to end as a crumpled tube filled with strawberry jam," the suit said. It projected a countdown on her visor and refused to switch it off.

Margaret kept one eye on Opie's velocity, the other on the blur of reducing numbers. The numbers passed zero. The suit screamed obscenities in her ears, but she waited a beat more before firing the platform's motor.

The platform slammed into her boots. Sharp pain in her ankles and knees. The suit stiffened as the harness dug into her shoulders and waist.

Opie Kindred's platform flashed past. He had waited until after she had decelerated before making his move. Margaret slapped the release buckle of the platform's harness and fired the piton gun into the nitrogen ice wall. It was enough to slow her so that she could catch hold of a crevice and swing up into it. Her dislocated finger hurt like hell.

The temperature was a stifling eighty-seven degrees above absolute zero. The atmospheric pressure was just registering—a mix of hydrogen and carbon monoxide and hydrogen sulphide. Barely enough in the whole of the bottom of the cleft to pack into a small box at the pressure of Earth's atmosphere at sea level, but the rate of production must be tremendous to compensate for loss into the colder vacuum above.

Margaret leaned out of the crevice. Below, it widened into a chimney between humped pressure flows of nitrogen ice sloping down to the floor of the cleft. The slopes and the floor were packed with a wild prolifer-ation of growths. Not only the familiar vases and sheets and laces, but great branching structures like crystal trees, lumpy plates raised on stout stalks, tangles of black wire hundreds of metres across, clusters of frothy globes, and much more.

There was no sign of Opie Kindred, but tethered above the growths were the balloons of his spraying mechanism. Each was a dozen metres across, crinkled, flaccid. They were fifty degrees hotter than their surroundings, would have to grow hotter still before the metabolic inhibitor was completely volatilized inside them. When that happened, small explosive devices would puncture them, and the metabolic inhibitor would be sucked into the vacuum of the cleft like smoke up a chimney.

Margaret consulted the schematics and started to climb down the crevice, light as a dream, steering herself with the fingers of her left hand. The switching relays that controlled the balloons' heaters were manually controlled because of telemetry interference from the reef's vacuum smog and the broadband electromagnetic resonance. The crash shelter where they were located was about two kilometres away, a slab of orange foamed plastic in the centre of a desolation of abandoned equipment and broken and half-melted vacuum organism colonies.

The crevice widened. Margaret landed between drifts of what looked like giant soap bubbles that grew at its bottom.

And Opie Kindred's platform rose up between two of the half-inflated balloons.

Margaret dropped onto her belly behind a line of bubbles that grew along a smooth ridge of ice. She opened a radio channel. It was filled with a wash of static and a wailing modulation, but through the noise she heard Opie's voice faintly calling her name.

He was a hundred metres away and more or less at her level, turning in a slow circle. He couldn't locate her amidst the radio noise and the ambient temperature was higher than the skin of her pressure suit, so she had no infrared image.

She began to crawl along the smooth ridge. The walls of the bubbles were whitely opaque, but she should see shapes curled within them. Like embryos inside eggs.

"Everything is ready, Margaret," Opie Kindred's voice said in her helmet. "I'm going to find you, and then I'm going to sterilize this place. There are things here you know nothing about. Horribly dangerous things. Who are you working for? Tell me that and I'll let you live."

A thread of red light waved out from the platform and a chunk of nitrogen ice cracked off explosively. Margaret felt it through the tips of her gloves.

"I can cut my way through to you," Opie Kindred said, "wherever you are hiding."

Margaret watched the platform slowly revolve. Tried to guess if she could reach the shelter while he was looking the other way. All she had to do was bound down the ridge and cross a kilometre of bare, crinkled nitrogen ice without being fried by Opie's laser. Still crouching, she lifted onto the tips of her fingers and toes, like a sprinter on the block. He was turning, turning. She took three deep breaths to clear her head—and something crashed into the ice cliff high above! It spun out in a spray of shards, hit the slope below and spun through toppling clusters of tall black chimneys. For a moment, Margaret was paralyzed with astonishment. Then she remembered the welding gear. It had finally caught up with her.

Opie Kindred's platform slewed around and a red thread waved across the face of the cliff. A slab of ice thundered outward. Margaret bounded away, taking giant leaps and trying to look behind her at the same time.

The slab spun on its axis, shedding huge shards, and smashed into the cluster of the

bubbles where she had been crouching just moments before. The ice shook like a living thing under her feet and threw her head over heels.

She stopped herself by firing the piton gun into the ground. She was on her back, looking up at the top of the ridge, where bubbles vented a dense mix of gas and oily organics before bursting in an irregular cannonade. Hundreds of slim black shapes shot away. Some smashed into the walls of the cleft and stuck there, but many more vanished into its maw.

A chain reaction had started. Bubbles were bursting open up and down the length of the cleft.

A cluster popped under Opie Kindred's platform and he vanished in a roil of vapour. The crevice shook. Nitrogen ice boiled into a dense fog. A wind got up for a few minutes. Margaret clung to the piton until it was over.

Opie Kindred had drifted down less than a hundred metres away. The thing which had smashed the visor of his helmet was still lodged there. It was slim and black, with a hard, shiny exoskeleton. The broken bodies of others settled among smashed vacuum organism colonies, glistening like beetles in the light of Margaret's suit. They were like tiny, tentacle-less proxies, their swollen mantles cased in something like keratin. Some had split open, revealing ridged reaction chambers and complex matrices of black threads.

"Gametes," Margaret said, seized by a sudden wild intuition. "Little rocketships full of DNA."

The suit asked if she was all right.

She giggled. "The parasite turns everything into its own self. Even proxies!"

"I believe that I have located Dr Kindred's platform," the suit said. "I suggest that you refrain from vigorous exercise, Maggie. Your oxygen supply is limited. What are you doing?"

She was heading towards the crash shelter. "I'm going to switch off the balloon heaters. They won't be needed."

After she shut down the heaters, Margaret lashed one of the dead creatures to the transit platform. She shot up between the walls of the cleft, and at last rose into the range of the relay transmitters. Her radio came alive, a dozen channels blinking for attention. Arn was on one, and she told him what had happened.

"Sho wanted to light out of here," Arn said, "but stronger heads prevailed. Come home, Margaret."

"Did you see them? Did you, Arn?"

"Some hit the *Ganapati."* He laughed. "Even the Star Chamber can't deny what happened."

Margaret rose up above the ice fields and continued to rise until the curve of the

worldlet's horizon became visible, and then the walls of Tigris Rift. The *Ganapati* was a faint star bracketed between them. She called up deep radar, and saw, beyond the *Ganapatis* strong signal, thousands of faint traces falling away into deep space.

A random scatter of genetic packages. How many would survive to strike new worldlets and give rise to new reefs?

Enough, she thought. The reef evolved in saltatory jumps. She had just witnessed its next revolution.

Given time, it would fill the Kuiper Belt.

* * * *