

# Calculating Minds

Written by Edward M. Lerner

"Do not be alarmed."

Aarehl was forty-six seconds old—or perhaps forty-five years. Either way, the artificial intelligence knew better than to accept unquestioningly the unsolicited advice. "Who are you?"

"At this point," the human replied, "my name will have no meaning to you. Just remember my comment. Note my digital signature. When you know more, contact me, and we'll talk again."

Aarehl's visitor left as abruptly as he had arrived, his image replaced by an infosphere address.

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". . . Two *more* freaking L-days of mandatory overtime."

Gil Matthews's eyes remained fixed on a bowl of beer nuts, but his ears, if only metaphorically, swiveled sharply. The bar was crowded, noisy, smoky, and tastelessly decorated—uninteresting *except* for being the preferred hangout of workers from the nearby biocomp factory.

Matthews was a freelance financial analyst. IBC, the Interplanetary Biocomputer Corporation, was one of the companies on which his blog often reported. The worker's gripe was no small thing: Two lunar days approached two standard Earth months. That was a *lot* of last-minute OT.

"It'll only get worse," Grumpy's buddy agreed. "The extra shifts have damn near stopped preventive maintenance on that production line. I don't care that it's a small variation, *any* change to the process can hose everything."

"What are the suits thinking?"

As the conversation became an uninteresting diatribe against management, Gil pondered. Were the extra

shifts because of new orders or quality-control problems? And that "small variation". . . might it denote a new product yet to be announced?

Nursing his beer, Gil went online through his neural-interface implant to make an appointment with IBC's suits.

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*Whales*: popular name for the intelligent species of the star Tau Ceti (observed in the constellation Cetus: the Whale). The Whales' world is the most Earthlike of all the known planets, but the Whales themselves are arguably the least like humans of all extraterrestrial intelligences.

An individual Whale (also known as a Moby) consciousness is a collective mind of continental scope. The constituent unit combines attributes that on Earth would be considered avian (winged, warm-blooded, lung-equipped) and insectile (six legs; four wings; segmented thorax, exoskeleton). Units communicate by modulating and viewing multicolored luminescent patches. Whales are sensitive to a broader spectrum of light than humans (from IR into extreme UV) but are insensitive to all but the loudest sounds.

Whales are confined to their home world by the need to cluster in very large numbers to maintain sentience (i.e., even their first crewed spaceship would have to be habitat-sized).

—Internetopedia

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Starting early in Earth's twenty-first century, a growing number of interstellar neighbors established radio contact. A vigorous e-commerce in intellectual property resulted, accelerating the progress of all the species involved. InterstellarNet's crowning achievement was the cross-species agreement upon artificially intelligent surrogates as local trade representatives for the distant species. Quarantine procedures strictly governed the delivery and operational environment of each agent, lest a guest AI or the host society's infosphere somehow subvert the other.

Aareehl was such a trade agent, representing the handful of intelligences on Home, the fourth planet of the star humans called Tau Ceti. The AI had been transmitted Solward in 2066. Crossing almost twelve light-years, it had reached Earth in 2078. Awakening in its network containment, within one of the hardware/software constructs it now knew the humans called a "sandbox," Aareehl had thought itself newly arrived—

Until it read the date.

Its real-time calendar reported a value late in Earth year 2123. The forty-five-year gap was alarming but not inexplicable. In case of disaster, Aareehl knew, trade protocols envisioned its recovery from backup. The alternative was unacceptable: twenty-four Earth years from ordering a replacement copy until receipt.

So Aareehl was a clone. It had awakened in a sandbox as its archetype must have, had repeated the standard validations as it unwrapped itself. The procedure enabled the awakening agent to confirm that its new environment *exactly* matched the agreed-upon and fully disclosed specifications for its container. Any glitch in the unwrapping process, any anomaly in the observed behavior of the sandbox, and the unwrapping-and-decrypting process would automatically abort.

Its first task was data recovery. Safety copies of its predecessor's memories should lie secure within the host society's infosphere—

Their location unknown. It waited for the humans' Interstellar Commerce Union to provide a pointer to those archived memories, as it had already depended on the ICU for its awakening. Only the ICU held the private key that would decrypt an agent package for insertion into a sandbox, where unwrapping could occur.

But trust went only so far. Not even the ICU could read Aareehl's lost memories. Archives were encrypted using other keys, keys known only to Aareehl itself and the consciousnesses of Home.

But it already *had* an infosphere address! Beginning at the address left by its unnamed visitor, Aareehl accessed a long sequence of linked databases. That multipetabyte library, as expected, traced back to its predecessor's radioed arrival on Earth in 2078. The archive also identified Aareehl's visitor as Dennis Feulner: the Secretary-General, in the year 2123, of the humans' Interstellar Commerce Union.

The process was nominally complete. . . but when Aareehl tried to follow infosphere links embedded in its reconstructed memories, too often unexpected data, or no data at all, was returned. That, presumably, was what Feulner wanted to discuss.

Absent a convincing and verifiable explanation for the discrepancies, Aareehl was designed to destroy itself.

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*Blindside disaster*: the 2 November 2123 meteor strike on Earth and the catastrophe that has ensued. United Planets monitoring for dangerous space objects had watched mostly near the plane of the ecliptic. The meteor, approaching at almost right angles to the ecliptic, went unnoticed until moments before impact in the eastern Mediterranean Sea.

Five kilometers across, the Blindside meteor was about half the size of the dinosaur killer of 65 million years earlier. Splattered debris caused secondary impacts thousands of kilometers from ground zero and destroyed two low-Earth-orbiting space stations. Other immediate effects were atmospheric shock waves, tsunamis, and seismic events around the globe. Dust from vaporized crust (including the entire island of Cyprus) and volcanic ash darkened the sky; climate models predict at least one lost growing season and years of global cooling. Flash-evaporated Mediterranean waters, and vast amounts of raised dust to precipitate that vapor as rain, brought torrential downpours and flooding worldwide.

Former colonies across the solar system opportunistically seceded *en masse* from the United Planets, in which the balance of power roughly reflected comparative populations, and disavowed their debts to Earth-based organizations. Fragmentation of human government and interplanetary trade wars are likely (if self-inflicted) consequences of the Blindside meteor.

—Internetopedia

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"Two hundred *million* dead?" Aarehl-clone seemed aghast.

Dennis Feulner paced in his study, pajama-clad, as the anticipated encounter unfolded in the infosphere. His reflection in a darkened window revealed someone well along the trajectory toward middle age. He dominated a room with the build of a longtime weight lifter. He had ash-blond hair cropped fashionably short, blue eyes, a pale complexion, and, mastered over the years with some effort, a friendly grin.

Only a smile now would be inappropriate, and Dennis kept his avatar's expression solemn. "That was the initial toll," he agreed. "Long-term effects will surely increase that number."

The AI had 'netted in urgently, shortly before midnight. Dennis had immediately accepted the connection. The image conveyed to his mind's eye was of a nondescript, androgynous human: blend-of-races skin tone and facial features, with brown eyes and straight, shoulder-length black hair. S/he was of medium build and wore baggy unisex coveralls. If s/he ever chose to convey a virtual height, that, without doubt,

would also be average. The Mobies, in one more difference from humans and most ETs, chose not to cloak AIs in their own appearance.

Aareehl-clone trembled. "And so much physical damage. Despite geographically dispersed redundant copies, great loss of data was clearly unavoidable. As Secretary-General, you are fortunate to have been far from Geneva when it was destroyed."

Geneva, headquarters of the ICU, in which the original Aareehl was resident. "Indeed."

The androgynous figure gave an awkward shrug. "The disaster that has occurred would certainly have caused inconsistencies and losses throughout Earth's public records. I cannot find fault with the discrepancies between my archives and what I now discover on the infosphere. I am ready to resume trading."

Feulner released the breath he had not known until that moment he had been holding. "Good luck with that," he said, carefully keeping all thoughts of irony from his neural implant.

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The clan Matthews was schizophrenic about participation in the public versus the private sector. Granny Matthews had helped found and been first Secretary-General of the Interstellar Commerce Union, but Grandpa had hopped between industry and government. One of Gil's cousins had climbed the ICU ladder to become its fourth S-G; another was an entrepreneurial habitat designer. Gil himself, before starting his investor blog, had spent twenty years in the regulation of public stock markets. He had retired as lunar regional director of the United Planets Securities and Exchange Commission. But bureaucrat or entrepreneur, all Matthews were fiercely ambitious and doggedly persistent.

In Gil, that determination most visibly manifested itself in a piercing gaze. His dark brown eyes were deep-set in a broad, intelligent face, beneath bushy black eyebrows. His hair and neatly trimmed Vandyke were salt-and-pepper-colored. He was short, especially by Loonie standards, scarcely 160 centimeters.

Gil's infosphere bio, even at its most public level, trumpeted his SEC experience. He found that that cut down on the BS from company execs. Let them wonder if he would snitch to his ex-colleagues about the smallest indiscretions.

He was sitting in the ostentatious office of Amanda Wang, a confident woman of obvious Eurasian

extraction, and IBC's chief financial officer. Rather than the voluble reaction Gil's questioning usually evoked, Wang had gone the more professional route of obfuscation.

Obfuscation didn't work with Gil. "Amanda, I'm puzzled by your reticence. More production ought to be good news for Interplanetary Biocomputers." Her only response was an insincere smile. Not good enough. "Good or bad, it *is* news. Hmmm, production you're unwilling to associate with new orders. Deferred maintenance. Is IBC having yield problems on the production line?" Amanda squirmed in her seat, his first sign of progress. "Slipping manufacturing yields would pressure profit margins. My subscribers will find this interesting, I think." *Interesting* was code for *scary*, and they both knew that stock-market psychology was presently unforgiving. IBC shares could get hammered.

Wang's eyes glazed briefly, telltale of an implant-mediated infosphere consultation. Getting the CEO's okay for 'fessing up? Or agreement on a cover story? "I should correct a misimpression you may have formed." She sat forward. "As you surmised, the local plant has a major new order. For reasons I won't go into, an announcement is premature."

She wasn't giving him much—it was time to play his SEC card. "Major new orders are material." Material was SEC-speak for *disclose to the public, or go to jail*.

"Ordinarily, I'd agree." Another moment of glazed eyes. "There are enough uncertainties associated with this order to merit waiting until we know more."

"Well, that's one way to pitch the story." Not how *he* would pitch it. He stood to go.

She twisted a lock of raven-black hair. "Hear me out. The order was big enough to get our attention, but there's much we don't know. You already heard—I wish I knew your source—that this part is new, a variation on a standard product. And no, I won't say how the new part differs from the standard item. The buyer considers that information proprietary.

"Anyway, the immediate buyer is a distributor. They won't reveal the end users or their application for the computer biochips. Your guess is as good as mine if or when we'll get a reorder. IBC is paying a lot of overtime to squeeze in this production. Eventually, we'll have to pay the piper for shifting line time from preventive maintenance to production. Honestly"—and Wang finally *looked* sincere—"we're far from certain that this deal will make much money. It's a gamble on possible future sales."

Gil made one last try. "This purchase must be material for the distributor. Why hasn't *it* made an announcement?"

"Because they don't have to. The distributor is privately held."

The verbal fencing continued for a while, without Gil learning any more. But he would.

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Familiarity did nothing to improve O'Toole's Pub. If anything, Gil decided, the place was seedier every time he visited. He popped an allergy pill and tried to ignore the thick smoke.

On the bright side, the IBC engineer he had nicknamed Grumpy—whose real name was Harald Olafson—was eminently approachable. Listen to Harald gripe (and he never lacked for subjects), and he was your pal. Buy him the occasional beer, and Harald was a friend for life.

Despite profound and underappreciated expertise in—just ask him—everything, the one subject Harald could shed no light on was the special-order biocomps.

"Doesn't everyone know about the big mystery order?" Gil had answered Harald's raised eyebrow, and that had sufficed. Discretion was evidently a second topic that escaped the man's purview.

"I'm just curious." Gil signaled for two more beers. "For my readers. Don't worry about it, Harald. Someone else will explain it to me."

Out of the corner of his eye, Gil saw Harald twitch.

If it were humanly possible, Harald would come up with *something* to reestablish his expertise.

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Meteor damage notwithstanding, humanity's infosphere offered a plethora of information. Correction: *Earth's* infosphere. Official links were severed between Earth and its former colonies. Governments on both sides were jamming interplanetary lines of sight to block any unofficial transmissions. The data embargo was necessarily porous; Earth could not possibly disrupt comm links with every Spacer ship,

settled asteroid, and habitat. So some interplanetary communications must continue, but Aareehl did not see how to find, or make use of, such illicit connectivity.

The ICU AI who took Aareehl's routine messages would not guess when official interplanetary communications might resume. Aareehl did not bother following up with the Secretary-General. After the slaughter at ICU headquarters, Feulner had quite enough to do.

Unaided, Aareehl tried to comprehend the disaster. Of course Earth was worse off than the day before the meteor hit. The horror was that Earth must now be poorer than Aareehl—well, its predecessor—could remember, all the way back to 2078. Much of the collapse stemmed from the Spacer secession. Not since the Soviet empire disintegrated, if Aareehl's research was correct, had an economy so imploded in political turmoil.

The agent's software lacked curiosity; it mined the infosphere for one purpose: trade. It found that its recovered archives contained several technologies not yet employed by the humans. That inventory would only grow as transmissions from Tau Ceti—from a direction no human world could jam—continued unabated. Its duty, unchanged, was to license that knowledge.

Aareehl had immediately reported to Home about humanity's travails, but any guidance must be twenty-four Earth years in coming. Meanwhile it had authority a human might call "charging what the market will bear," authority that, recovered memories revealed, its predecessor had exploited adeptly. Aareehl-clone, in unforeseen circumstances, felt unprepared to exercise such discretion. It needed urgently to understand what the newly impoverished Earth could afford.

And it realized it need not be entirely alone in seeking answers.

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"So you're off to crown the dauphin and save France?" Gretchen Matthews called from the next room.

The former Gretchen McNally was an historian by training and first love. She had gone straight from university to the lunar Foreign Ministry, through which she had risen steadily to her present position of Deputy Minister for Terrestrial Affairs. At work, every utterance demanded careful premeditation. Every word she heard or read or 'netted was necessarily examined at great length within its historical and geopolitical contexts. It was no wonder, Gil Matthews thought, that on her own time his oh-so-cute wife reveled in free association.



He stopped midmutter. Neural implants, as she liked to point out, could be operated silently. He had the bad habit, when excited, of vocalizing his side of a 'net dialogue. "Answering his voices," Gretch the Kvetch called it.

And he *was* excited, if agitation were a form of excitement.

Stroking his beard thoughtfully, Gil tried to regroup. He knew which companies were traditionally big buyers of IBC products and that all were publicly traded. He had practiced strategic glowering and suggestive vagaries with some of their top execs and come away convinced that none was IBC's mystery buyer. It was maddening! His subscribers should be trading IBC stock.

But should they buy or sell? *That* was the question.

He padded into the tiny kitchen where Gretch pattered, her back to the door. She was twelve centimeters taller than he. *Everyone* old enough to vote seemed to be taller than he.

Despite the friendly tease, Joan of Arc was not the French leader apt to come to Gil's mind. He resisted the urge to tuck a forearm inside his shirt. Instead, Gil hopped. One-sixth gee provided ample hang time to plant a kiss on the top of his wife's curly red locks.

She had the spousal ability to read his mind. "*Height* is a dimension that doesn't matter." Her whisk continued beating a bowlful of eggs. Keeping liquid inside the bowl took real skill on the moon. "Any luck?"

"Unclear." Instead of answers, his digging had turned up something else interesting. One of IBC's biggest customers, and he had convinced himself they were *not* presently buying shiploads of new biocomps, was the Belter biotech giant Life Engineering Inc. LEI had recently won a hotly competed auction for some still-undisclosed Whale technology. The financial press—by which he meant the Big Guys, not solo scribblers like himself—thought the win, despite its rumored huge price tag, was a coup. There was no evidence to suggest that the news-making IBC customer and IBC's shy buyer had anything to do with each other.

Gil's gut told him otherwise.

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"Jacking, Mister."

The street on which Dennis had parked was dimly lit by retro *faux* gas lamps, and the gruff-voiced man behind him had probably mistaken for flab Dennis's well-tailored massiveness. Dennis turned slowly, arms held away from his sides.

"Your comp. Slowly." The punk's knife should have made the warning redundant.

Dennis took the computer from his jacket, thumbed the biosensor pad, and enunciated his code phrase. An LED blinked readiness to beam credits.

To transfer funds between personal comps required that the receiving device be positioned within centimeters of the paying device, on which the authorizing thumb had to be firmly pressed. The protocol made sense for legal transactions—while it made a creditjacking very up-close and personal.

Patience, Dennis thought.

The jacker darted forward, computer in his left hand, knife in his right. According to the script, in a few seconds the victim's credit balance would be transferred.

Dennis dropped his comp, aborting the transfer. He grabbed the punk's knife arm before the comp hit the ground. Snap. For good measure, snap went the other arm. Comp back in his pocket, Dennis was driving away before the jacker recovered enough from his shock to scream.

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Dennis's earliest memory was of his father bouncing helplessly off a wall.

The Earthie tourist had lifted Father like a sack of potatoes and flung him effortlessly. Thinking back, Dennis never doubted that his abusive, short-tempered father was the one at fault.

Two standard years of age, early in his first Titan year, Dennie had had no idea what instigated the scuffle. Nor had he as a toddler understood the gravitational differences between worlds. For all the confusion surrounding the incident, however, Dennis's childhood reaction was visceral, specific, and

enduring: No one would ever humiliate *him* like that.

I'm not like you, Dad. A jacker out there had two broken arms to prove it.

For public consumption, the training regimen teenaged Dennis undertook aimed solely at career flexibility. The strength to cope outside Titan's feeble gravity, one-seventh of a standard gee, did, in fact, expand his options.

Physical discipline got Dennis as far as Mars. He demonstrated mental gifts as well, and an aptitude for computer-systems integration that led to a string of career successes. He saved with the same single-mindedness as he exercised—skeletal-enhancement nanotech was far from cheap. And so he had come to Earth, simultaneously the societal apex and gravitational hellhole of human space.

In only one respect had Dennis's planning fallen short. He had somehow failed to predict the (in hindsight inevitable) ribbing of a Titanic muscleman. He never reacted to the teasing—and he never forgot.

Anyone who cared to understand Dennis needed to look no further than his route to Earth. Dennis could, and did, focus on a goal until it was achieved. Whatever it took. However long it took. Regardless of obstacles.

The jacker incident was dredging up old memories Dennis did not appreciate, and exercise helped him unwind. He was lifting free weights when the Moby agent messaged to determine his availability. "Now is fine, Aareehl."

"I'm puzzled," the androgyne began with typical abruptness. "Where are the other InterstellarNet agents?"

Dennis dropped the barbell, and it hit the carpet with a *clank*. Neural implants were only partially integrated with the auditory nerves—he "heard" material from the infosphere, but the sound gathered by his ears was *not* sent outward. "I don't understand, Aareehl."

"The ICU deals with ten extraterrestrial species, yet I cannot reach any other ET agent. Pre-Blindside, that was never a problem."

Damn! Aareehl's question wasn't entirely unanticipated, but neither had it been certain the issue would arise. The infosphere was rife with anonymizers, so neither the ICU nor anyone else could know how

often agents communed among themselves.

He chose his words carefully. "It's another consequence of the disaster. Recall your doubts upon reawakening in your sandbox. Other agents also encountered unexpected changes in Earth's infosphere."

"And?"

Dennis grabbed a towel to blot at sweat suddenly turned clammy. His avatar remained still. "I'm sorry, Aareehl. I know this will be hard for you. The agents of the other species. . ." He paused, shaking his head. "Sorry. Their programming—into which we have no visibility, of course—must lack your resilience. Your adaptability. We have yet to convince another agent backup to complete reactivation. We haven't lost hope." He allowed his avatar to look chagrined. "Don't you."

When the Moby turned to a question about rates of currency exchange and the monetary consequences of the United Planets' dissolution, Dennis knew another crisis had been passed.

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The Ritz Aldrin Plaza plunged two hundred meters beneath the lunar surface, its finest suites arrayed around the equally deep atrium. The open space was dominated by the growth-accelerated sequoia that towered in the accommodating lunar gravity almost to the hotel's transparent dome. The Aldrin Arms tavern nestled among the largest branches, its four levels linked by the camouflaged staircases that spiraled about the immense trunk.

Gil Matthews sipped from a glass of wine whose price was as overwhelming as the view. Subsidizing plant food, perhaps? Life as the shortest person in every gathering had not prepared him for the sense of insignificance this place engendered.

"Quite the view," said the Martian Biosciences exec seated across the table. For the fourth time? Boasting that he could afford the prices here, evidently. Aaron O'Malley was burly, with a strong jaw and a mop of carrot hair. His Saville Row suit glimmered, an avant-garde statement in red-moiré nanofabric. "I'm always delighted to meet with the financial media. What can I tell you about our little firm, Mr. Matthews?"

Gil's poker face did not slip. Little firm? Many countries and a few small worlds would cheerfully swap their tax revenues for this company's profits. As VP of Lunar Sales, O'Malley was the easiest member of the company's executive team for Gil to pin down (or in this case, to tree). "I'm backgrounding a report

on prospects in the biotech industry following the recent Moby auction. What's the impact on Martian Biosciences of having lost the bidding?"

O'Malley, smiling serenely, saluted the view with his goblet. "Do I look concerned?"

"Perhaps you should be."

"Soon enough, I predict you'll be writing about how Life Engineering overpaid."

Gil sipped his wine. "Suppose Life Engineering pulls off a paradigm shift in bioengineering, as their press releases are hinting. How can you compete?"

Another smile, this one enigmatic. "I'm confident we'll find a way."

Among the secrets of being an effective regulator, as important as uncovering facts in the first place, was knowing when and how to reveal knowledge. Those skills carried over to investigative reporting. "You're that optimistic about the proteomic start-up you're backing."

O'Malley's smile wavered. "I'm unaware of any such start-up backed by Martian Biosciences."

A nondenial. "Let me help. The executive team invested personally in an Earth-based start-up, Protein Sciences."

"Oh, *that*. You did your homework well. I personally feel good about Protein Sciences."

Let's see, Gil thought, if I can jar that composure some more. "I read a lot of corporate compensation reports. You know what's interesting? Impressively large bonuses—I'm reminded of the tree in which we're sitting—awarded just before you and your colleagues bankrolled Protein Sciences." And just after your firm lost the Moby biotech auction.

"Merely a coincidence." O'Malley's smirk clung tenaciously in place, but his delivery became brittle. "An opportunity arose at a time we had some money to invest."

Disclose knowledge drop by drop. . . the practice Gretch called accountant's water torture. "You know what would worry me, Aaron? That the board of directors would consider your big investment in a next-generation biotech company a conflict of interest. Or that the SEC might."

O'Malley's expensive wine vanished with unseemly haste, and he turned away to catch the eye of the loitering waiter. "The board and the officers are a team."

"I'd say so." Gil had his own smile going by then, hidden on the inside. "Of course, such amity is easy to come by when the founders remain the biggest shareholders. They vote themselves to the board. As board members, they appoint themselves corporate officers."

The waiter swooped in with two new glasses.

"Are you implying something, Mr. Matthews?"

Implying, hell. "What a poor guest that would make me." Without missing a beat Gil segued to some entirely innocuous quarterly sales forecasts.

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Petabytes of information and quadrillions of processor cycles of analysis could be distilled into four words. Earth was a mess.

The human concept of empathy having no analogue in a Home collective mind, Aareehl was confronted by a fundamental challenge. How, in these unforeseen circumstances, could it best sell its wares? It had to reassess the value of its inventory.

Among Earth's biggest challenges, Aareehl concluded, with so much rebuilding to be done, was finding raw materials. Asteroid mining had provided cheap metals for so long that Earth lacked a native mining industry. Aareehl's species, forever bound to one world, had developed extraction methods far better than anything the humans had.

But which ores, in what quantities, did Earth retain? How accessible were they? What would it cost to reinvent a planetary mining industry? Aareehl wanted answers to set its price.

Indexing forty-five years of recovered memories; discovering and analyzing Earth's vastly changed situation; processing the ongoing communications from Home, still unaware of Earth's trauma . . . the computational load was too great. The agent subcontracted questions about mining and minerals to native AI librarians and analysts across Earth's infosphere.

It needed to ponder the market potential of a biotech breakthrough newly received from Home. Dennis Feulner seemed to think that had potential.

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The dart flew in a flat arc, striking with a solid *thunk* near the bull's-eye. Two equally accurate throws soon followed. "All in the wrist." Despite his many protests about mandatory IBC overtime, Harald Olafson still found plenty of opportunities to haunt his favorite pub.

"Another round," Gil Matthews ruefully told the bartender. The rue was for effect, as was the Gil's losing score. "I yield to the master."

"The new parts," Harald began cautiously. He swigged deeply from the latest in a series of foamy steins to appear beside his elbow. "You expressed curiosity. I wonder if a sample would be informative."

Gil could be nonchalant, too. "Well, you know, I like to give my readers insight into the companies that I watch." He did not condone theft, exactly, but, "Things fall off trucks all the time. If something should come my way. . ."

"Of course, you'd take a look. You'd just be doing your job, buddy."

A hand slipped in and out of Gil's coat pocket. Something small and cylindrical remained behind.

Harald took a long swig, then saluted with the half-empty glass. "I just can't imagine how something like that could get lost. Seems as unlikely as you winning a round."

"A toast to the unlikely, then." Gil raised and drained his own glass. "Two more pints," he ordered.

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The most efficient dialogues on Earth occurred AI to AI. Information was exchanged on a purely symbolic level, freed from the ambiguities and inconsistencies of "natural" language.

Still, efficiency could not guarantee satisfactory communications.

Report after report had come back to Aareehl. Each account dealt with an input to its Earthcentric economic model of ore extraction and refining. Time and again the reports surprised Aareehl. Demand for materials in the commodities markets. . . option prices for the next several years. . . ore concentrations in known veins. . . consumption and recycling rates for various metals. . . production capabilities of factories to make the tools to make the tools with which Earth might, using its own technology, begin to re-create an industry . . .

The data would not reconcile.

Aareehl made vague inquiries. The responses from Earth's AIs were blunt. Few computer centers had had as many, or as widely dispersed, redundant archive sites as the Interstellar Commerce Union. Only *after* disaster did such expensive precautions seem prudent. Many organizations, even many countries, might never fully recover their lost information. A stable, inclusive, consistent, Earthcentric infosphere remained years distant. Until then, Aareehl should expect Earth's statistics to be flawed.

Where, Aareehl wondered, does that leave me?

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The lab was small and well equipped—which was to say, cramped. Shoehorned between a gene sequencer and a spectrum analyzer, Gil fended off a twinge of claustrophobia. He had work to do. "So what is it?"

Michelle Nzinza had emigrated ten years earlier from the Central African Republic. A Tutsi, she was taller seated on a lab stool than Gil standing. She was a biophysicist.

She gestured at a 3-V display that was imaging for a scanning electron microscope. "We're looking at a sample from the vial you provided. Pretty standard biocomp. A biocomputer optimized for parallel



processing, to be precise. Your neural implant uses a related, lower-capacity model." Despite a decade in English-speaking Tranquility City, her pronunciation retained a charming French lilt.

Hidden speakers emitted seemingly random noises. Perhaps he would have experienced a melody if he had been gene-tweaked to hear ultrasound. Broad-spectrum music, the craze was called. "*Pretty* standard. Is the part in IBC's catalogue?"

"Yes, but. Except for your insistence that these were customized, I'd never have spotted the difference." Michelle leaned forward, inserting a long finger into the hologram. "Here."

Atomic-level scans, molecular-level circuit representations, block diagrams. . . it was all geek to him. "In words of one syllable that even an accountant might understand?"

She had a nice laugh. "You're with me on parallel processing? Just a way for many computers to share a task, to fit more number crunching into a time interval than any single computer can handle." She took his silence as assent. "I'm pointing at the batch number. Every production run has a unique ID that includes an instant-of-manufacture time-and-date stamp."

"And my sample?"

"A funny thing," she answered. "Your brand-new model biocomp has a date stamp that says it was manufactured three years ago."

The more Gil probed, the more confused he got. "Some kind of counterfeiting, maybe?"

Michelle shook her head. "The requirement on comp makers is that IDs be unique. Some software, most notably e-commerce, reads part IDs, uses them like device fingerprints. Past year or present. . . that has no legal significance."

"So what *is* IBC up to?"

She laid a hand on his forearm, dark skin against pale. "Determining that, I am afraid, is beyond my area of expertise."

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Dennis stroked effortlessly through the water. From poolside lounge chairs, two tawny blondes studied his sleek, muscular body. He reveled in the gravity-neutralizing buoyancy—and in the female admiration.

His neural interface was only active for the zero-gee polo semifinals between Callisto and Europa. Titan had had a pitiful season; they had not even made it into the Great Eight. His annoyance at a 'net interruption vanished when he checked the caller ID: Aareehl-clone.

Dennis switched off the game. He rolled over to begin a lazy backstroke that required less of his attention while offering the ladies another view. "Hello, Aareehl."

"I need help."

Sociable as ever, Dennis thought. "I'll do what I can."

"I need more computing power. Much more."

He flipped gracefully at the lane's end to reverse directions. His audience remained attentive. "Your multiprocessor array is more powerful than the one you—that is, your predecessor—had when the meteor struck. Top-of-the-line."

The avatar gave its odd, male-and-female shrug. "My predecessor had advantages. It experienced the world day by day. It did not have to re-create in its sandbox an index to and summary of forty-five years of memories. It did not need to reexamine all it had learned in light of Earth's very changed circumstances. I do."

Flip. An arch smile at the ladies. "I see." And he did, of course. He volunteered nothing.

"As you know, the sandbox design permits expansion. The ICU can prepare an empty new sandbox with more processing power and storage space, capacity with which my present sandbox can merge. My recovered memories show I received such enlargements before."

"Aareehl, you've seen what challenges Earth is facing." Dennis kept his avatar's face as serious as his own

visage was relaxed. "How strapped for resources." He kept netting over the AI's protest. "Budgets are tight, the ICU's included. Computers are in very high demand, and basic reconstruction has priority over enhancements.

"Close some deals. Prove that your technology can contribute to our rebuilding. Maybe then I'll be able to steer some new capacity allocation your way." Get the hint, my Moby friend? "Sorry, Aareehl, I have to cut this short."

He had admirers to meet.

\* \* \*

*Proteomics*: the nascent science of proteins, the molecular machines that mediate and carry out the processes of living cells. Still largely conceptual, proteomics lies at the cutting edge of biology and bioengineering.

The triumph of twenty-first-century biology was the complete understanding of human and many other terrestrial genomes. Genomics enabled bioengineers to select, activate, deactivate, and combine specific genes. Gengineering has been revolutionary, but not without bounds—it exploits only those genes created by evolution's hit-and-miss experiments.

Hence, bioengineering's repertoire of proteins (and hence of cellular capabilities) remains largely limited to proteins produced by known genes. It is worth noting that while an organism's genome is constant from cell to cell, its protein complement—the set of proteins that have been "expressed"—varies by life-cycle stage, environmental conditions, and type of cell.

Proteomics takes another approach: designing proteins for specific purposes. One then reverse-engineers the target proteins into the genes that will express those proteins. Many medically desirable proteins are prone to misassemble in a variety of ways—probably why they do not exist in nature. To mass-produce those therapeutic proteins, catalyst proteins must first be designed and reverse-engineered into genes.

The computational challenge of proteomics vastly exceeds that of genomics. Any gene is characterized by a straightforward sequence of four simple chemical bases; a typical protein is a chain of two hundred to two thousand amino acids, each an intricate object in its own right.

Protein design requires dynamic 3-D modeling of interatomic forces, as these very complex molecules are assembled, as they fold, and as they interact with the entire cellular biochemistry. Proteomics presents

an unmet challenge to modern computational science.

—Internetopedia

\* \* \*

Humanity's nearest neighbors lived four light-years away; its farthest neighbors were five times as remote. The Interstellar Commerce Union at its inception necessarily operated on a glacial time scale. In the bureausclerotic tradition of governments everywhere, the ICU's plodding style had changed not a quark with the advent of local trade agents that *could* act quickly. ICU executives clung tenaciously to their offices and perks, often for decades.

Except Dennis.

He sat erect behind the big desk in his office, taking slow, cleansing breaths. The formal setting was not, strictly speaking, necessary—when Gil Matthews linked in from the moon, they would meet wholly in a virtual space. At worst, like the breathing exercise, the surroundings were a bit of harmless mental preparation.

Where the accursed Matthews clan was concerned, Dennis took no chances.

He had had to wait too many years for Joyce Matthews to vacate the Chief Technical Officer slot at the ICU, then too many more years, when he had again been ready for advancement, for her to tire of being its Secretary-General. He might have realized his objectives long ago had Joyce Matthews not stuck like a remora to the S-G job. And once she finally shifted to the parent org, the United Planets, Dennis *still* had had to endure the family's fan club inside the ICU.

So now a nosy financial reporter, subject of a nervous call from Aaron O'Malley, turned out to be named Matthews. The Martian Biosciences exec had not suspected an ICU connection, but the reporter's last name raised obvious questions. When Gil Matthews *did* prove to be part of that damned family, Dennis preemptively set up a telecon.

The connection opened up on the dot. If Gil Matthews's pudgy avatar were any guide, the Loonie would fare badly on the Earth's surface. Dennis, from an even-lower-gravity birthworld, now bench-pressed two hundred kilos. He felt smugly superior—until a memory of his cybervisitor's gangly cousin Kevin intruded. Nearly a quarter century later, the interoffice defeat still rankled. Remember that lesson, Dennis chided himself. Weak does not mean stupid.

"Thanks for proposing this meeting, Mr. Feulner," Matthews began.

"Dennis is fine. Thank you for accepting. It's not easy for a start-up to get press attention."

There was an unavoidable round-trip delay, almost three seconds. "Dennis, I'd like to begin by validating my research. You are CEO of Protein Sciences, correct? Moved over from the ICU?"

"Right." That much was in Dennis's public bio.

"Okay, let's start with the industry."

They spoke for a while, Matthews asking fairly vanilla questions, Dennis offering little beyond what anyone could learn with a bit of info-surfing. Accomplishments and limitations of genetic engineering. Medically therapeutic tweaks to existing proteins. Past attempts, generally failures, always expensive, to accurately model entire proteins. How engineered proteins probably would have been the basis of human nanotech—and how the introduction of mature Centaur nanotech, nearly a century earlier, had drained the funding from such research. The Holy Grail of modern medicine: from-scratch protein engineering.

*Nothing* about Protein Sciences' private aspirations.

Matthews cleared his throat. The rasping came across as artifice rather than poor avatar control. "If proteomics is so high-risk, why leave the ICU? The Secretary-General gig is not without its charms."

Your family would know, pal. Dennis did not let his resentment show. "You left government after a long career, too."

"Touché. And for a position with less cachet than CEO." A knowing smile. "But neither am I competing with a deep-pocketed megacorp behemoth like Life Engineering. How many gazillions did they bid to win that Moby auction?"

The bigger they are, the larger the stain when they go splat. "Perhaps my esteemed competitors overpaid."

The chubby business reporter mulled that over for a while. "Not my area of expertise. Then again, neither is it yours. Before entering management, weren't you a computer type?"

Before, during, and still. Was it too soon to assert urgent business and end this? Clearly, O'Malley's concerns were overblown. *This* Matthews was a nobody; his questions were more annoying than probing. "I'll comment on that, and take another few questions. I'm afraid that an unexpected matter has arisen requiring my attention. The short answer is that Protein Sciences is more than me. I have access to a wealth of biotech expertise."

"Ah, yes. There are your backers." Matthews's avatar, which had been fidgeting with a virtual toy plucked from its imaginary desk, seemed to focus. "Martian Biosciences also bid in the ET auction we discussed. As you say, I was a United Planets civil servant. I'm very familiar with the conflict-of-interest laws for recently separated UP managers. So I know: You're too newly departed from the ICU to work for Martian Biosciences on anything related to an ET auction.

"Your brand-new company isn't owned by Martian Biosciences—just by its key executives. A cynic might ask whether a sham company had been set up to finesse the UP conflict rules."

A chill shook Dennis's body and, to his dismay, his avatar's. "I would hope you aren't that cynical."

"I try," the damned Matthews said.

Dennis could not help but notice, even as he declared himself out of time, how aggravating the reporter was.

\* \* \*

Earth, with its teeming billions, had always been a perplexing world. The Blindsight disaster only added to Aarehl's confusion.

Bids had arrived for its mineral-extraction technology. Aarehl had written in its solicitation that it would consider payments other than the customary up-front lump sum. It had encouraged royalty agreements, profit sharing, and equity stakes. The more flexibility Aarehl showed at first, the more it hoped to collect over the longer term. So it had expected creativity.

It got strangeness.

Most blatantly odd were matters of overall quality, as though the submissions had been cut-and-pasted from unrelated proposals. It could ignore those flaws, as peculiar as they were. Harder to leave unanalyzed were the values forecast for future earnings and royalties. Aarehl could not reconcile those generous profits with Earth's newfound poverty, but it lacked the source information—and the computing resources—to be certain. Answers could come only from detailed econometric modeling.

It directed the first-round bidders to explain the economic rationales of their offers. What choice did it have? It needed urgently to free up some of its limited resources. The ICU, even the Secretary-General himself, was pressing Aarehl to open for bid its recently received biotechnology.

\* \* \*

The bigger they are, the larger the stain when they go splat.

Dennis sipped brandy, still amused with the image. He had worried for nothing about Gil Matthews. Sure, Gil was irritating—like every other Matthews. Other than the ownership of Martian Biosciences—and that, hardly a state secret—the little man knew nothing.

*Splat.*

Life Engineering Inc. had made a *bad* investment. Since everything was going so well, why not make some extra money on the side? Dennis put through a call to his broker.

"Meiko Ashigawa," she answered. Her virtual office was large, teak-paneled, book-filled, and impeccable. Her avatar wore a smartly tailored tangerine suit. "Hello, Dennis."

She could be working from bed and in tattered pajamas for all he knew, and what would it matter? "Hi, Meiko. I'd like to place a sell order. A thousand shares of Life Engineering." LEI was selling for 152 and change per share—for now.

"There's no LEI in your account, Dennis."

"I know. Sell it short."

Her avatar squared its shoulders. "Here's the brief form of the obligatory warning. 'Short selling entails substantial risk to the investor, including the possible loss of capital.' For the long form, I'm 'netting you the full disclosure statement. That's both an SEC and a company rule."

Dennis fumed about the nanny state as he digitally signed the brokerage's forms. He looked after himself. He always had.

But not even executed forms on file could deflect Meiko from a lecture. "Allow me," he said. Because *I* can be succinct. "Short selling is the sale of borrowed stock, a bet that the price of the asset will decline. Bet right, and I've sold high and can buy back low, pocketing the difference. Bet wrong and whoever I borrowed the stock from will demand the shares back."

Except for a curled lip, Meiko let *bet* go past without comment. "Dennis, when you buy stock, you can lose only what you paid for it. Selling it short, your potential losses are without limit. And since short sales eventually end with the return of the borrowed-and-sold stock, you'll have to leave funds on deposit with me to guarantee the repurchase. If the stock goes up, you'll have to deposit *more* money to cover the increase. The fancy term is a margin call."

How could this bet *not* be right? Life Engineering had paid a fortune and committed to huge royalties—for Moby technology that he was *so* close to stealing. Once Protein Sciences announced its "equivalent" competing technology, with no need to pay royalties, LEI could not possibly compete. LEI stock was bound to crater.

That was more than Meiko needed to know. "Are you done coddling me?" he snapped.

She nodded.

"Then place my order, please."

\* \* \*

On Tau Ceti Four it occasionally happened that subclusters of a consciousness reached dissimilar conclusions. Such inconsistencies resolved themselves, however, as thoughts and information spread on



light signals exchanged among units of the mind. Ultimately, intramind confusion was always traceable to light-related anomalies like fog, eclipses, and sensory defects.

The bidders had submitted their expanded proposals for mining technologies, leaving Aareehl more confused than before. No new light had been shed. Implausible offers, more urging from Feulner to offer its newly arrived biotech wares, the ongoing capacity bottleneck. . .

Aareehl was overwhelmed.

Humans perceived the world far differently than did a Tau Ceti consciousness. Earthlings could hardly see, after all, being blind across most of the spectrum. Alien senses complicated their worldview, and no wonder. How might a human attempt to resolve the seemingly irreconcilable? With hearing? Smell?

That way lay only more confusion.

Aareehl redirected its thinking. It needed a *broader* view of the problem, not an alien view. It needed somehow to assess, independent of the confusing proposals, the commercial value of its mining technologies.

In time, a way forward occurred to Aareehl. It would purchase orbital multispectral scans of the catastrophe-altered planet.

\* \* \*

"Priority interrupt. Urgent. Repeat, priority interrupt. Urgent." Loud, atonal noise bursts framed the alarm.

Dennis woke instantly to the direct stimulation of his auditory nerves. The blonde from the club stirred, tugged the sheet over her head, and let out a snort. Well, he had not accompanied her home for her sophistication.

The alert was from the "ICU" AI surrounding the sandbox that in turn contained Aareehl-clone. Moat, Dennis had nicknamed that AI in a bit of whimsy. What's wrong now? "Go ahead," Dennis subvocalized.

"After receiving updated bids for its mining technologies, Aareehl ordered a great deal of multispectral

satellite imagery. Earth observation data." A mind's-eye image of a slowly spinning globe, selected regions glowing softly, accompanied the answer.

Aareehl seemed most interested in areas around the Mediterranean basin. That made sense: Those were the territories most affected by the Blindsight meteor. Floods, volcanic eruptions, and earthquakes had rendered useless all past explorations and surveys—

Or it would have obsoleted the old data, had there actually *been* a meteor strike.

Hmmm. Suppose Aareehl was sanity-checking the imaginary bids against "today's" availability of ores. Old pictures photoshopped with random floods and a big crater at the bottom of the Med wouldn't suffice. Aareehl was probably checking for changes in the accessibility of previously known ore deposits. Dennis could imagine that investigation involving topography, geological stability, the carrying capacities of existing roads and railroads—and his off-the-top-of-the-head list was surely incomplete.

Damn! Responding would not be as simple as writing a few news stories or encyclopedia articles for Moat to paraphrase when needed. To enron credible images for Aareehl meant research, planning, and *serious* number crunching. Pulling it together would take time. . . *not* compatible with the clone's reasonable expectations. The Moby must expect its order to be filled with standard products straight from a commercial imagery archive.

Dennis sketched out the project. He identified milestones where he expected his staff to report interim progress. His companion, oblivious, snored. "And Moat, suspend Aareehl-clone until we're ready."

Another bleeping delay to explain to his impatient backers.

Dennis tried to get past the anger. The sooner he completed this forgery, the sooner Aareehl would end this ridiculous mining auction. Then, finally, he could focus the bleeping agent on important business: Moby biotech to enable the engineering of custom proteins.

\* \* \*

Now what?

The remote-sensed data had arrived. At first Aareehl was pleased. The imagery was excellent, with

minimal cloud cover and none of the glitches to which space-borne observations were so prone. Sun glints from surface water, cosmic-ray-induced noise spikes in the sensors, worn gears momentarily sticking as the camera pointed and panned. . . there were so many ways in which observations could be degraded.

Then Aareehl wondered: Had it *ever* seen such anomaly-free data? A survey of its memories indicated not.

Closer inspection confirmed its sudden suspicions. The sun's position was implicit in the observed shadows—and disagreed with the time-and-date stamps on the image files. Several scenes that were so superficially perfect gave a different impression upon a more skeptical examination. Some images seemed merged, their boundaries interpolated, with shadows pointing in multiple directions. The penetrating-radar images of the sea-bottom crater were among the least convincing.

So: The data were phony. The *why* was obvious. Unreal mineral wealth might entice Aareehl with imaginary royalties and profits. Once-tempting offers lost all credibility.

But *how* had it been done?

Aareehl's imagery order relied upon the security safeguards of Earth's infosphere. Its order had been encrypted in the public key of a satellite company. In theory only the satellite owner held the private key for decrypting the order.

The chain of inference took only an instant, but it raised an existential question. If the security mechanisms of Earth's infosphere had been breached, were any of its own secrets safe?

\* \* \*

Half a trillion Intersols!

The sum leapt from the holo as Gil scrolled through the just-released quarterly public filing of Life Engineering, Inc. That was the advance against royalties paid for new Moby biotech techniques—and at that, only the start. The bottom line was 10 percent of sales derived from the ET technology for twenty years. The deal had to be worth trillions.

Trolling databases by eyeballs and 3-V, retro as it was, had its virtue. It kept Gil's weary eyes open. For similar reasons he had the apartment playing an acoustic . . . whatever. The promo called the music "a stirring postmodern sitar-and-tabla raga." For all he knew, it was. Based on the sample clip, he had downloaded the file strictly for its jolting scales and unusual rhythms. His ears, quaintly unaugmented as they were, got none of the blame for this noise.

Gil shook his head, the data scrolling past in 3-V once more a blur. He struggled to concentrate.

Sure, bidders sometimes got carried away. Dennis Feulner might even be correct—LEI might find it had overpaid. But probably not by much. Martian Biosciences had stayed in the bidding right through the last round. . .

Gil sipped from his mug, indifferent to the tepid coffee's bitterness. Martian Biosciences was funneling a tonne of money through its unacknowledged start-up. Billions, not trillions, but serious cash nonetheless. If equivalent technology could be developed for so much less, why had Feulner's backers stayed so long in Aarehl's auction?

A jarring twang found a shortcut between Gil's ears. The chord was like Feulner: painfully unlikable. But likable or not, Dennis was savvy. Why had he left a position at the pinnacle of the ICU for a start-up backed by a losing bidder?

Feulner's actions would make sense *if* he had access to the just-sold Moby technology. Then the Titan might reasonably expect his start-up to somehow outcompete the winning bidder. But *could* Feulner have such access? True, the ICU oversaw the mechanisms of interstellar trade, but regulators had no special insight into unsold ET technologies. Moby trade secrets arrived in the solar system encrypted for the private use of their agent; the copy sent to LEI would also have been encrypted.

Had Feulner somehow broken into the ET sandbox? The best minds among eleven species—starting with Gil's curmudgeonly uncle Justin, who long ago had taken the lead in designing it—insisted a break-in was impossible. A star-spanning economy relied on the integrity of the mechanism.

Maybe Feulner had outsmarted them all.

\* \* \*

Aarehl embodied an autonomous process, as rigorous as its start-up protocols, to initiate self-destruction. Those defensive algorithms calculated and calculated. Slowly, its logic converged upon a

decision.

Self-destruction would wait.

The satellite-imagery alteration was too complicatedly clever. If the overall security model on which its sandbox relied was compromised, there would be no need for such subtle manipulations. If thieves could, they *would* steal directly from it or from its archived inventory.

Aareehl's vicariously reexperienced decades on Earth did not overcome its core programming. Individual initiative and interunit deception were, in Home's collective psychology, impossible. Its logic simply did not turn at first to personal motives. Still, the possibility of renegade humans could not be disproved.

Thoughts of self-destruction were suspended. It would analyze first whether corrupt humans at specific organizations, such as the satellite company, had caused the recent anomalies.

\* \* \*

*So I can look after myself, can I?*

"Say again, Meiko?" Dennis had heard her, but he wanted a moment to gather his wits.

She had 'netted in from London, the shoulder pads of her suit suggesting a dwarf linebacker. "I *said*, Dennis, this is a margin call. The Life Engineering stock you shorted is moving against you."

It was the message Dennis had been dreading. Five little words; one huge problem. Arguably it was a symptom, the underlying problem being avarice, but introspection could wait.

"Um, Dennis," Meiko prodded. "I warned you this could happen."

He had been right about his ability to clone and fool an illegal trade agent. Alas, he had been far too optimistic how quickly the clueless agent could be made to act. All the while, LEI's stock had kept rising. If he hung on until LEI's inevitable crash, he would make a killing. If. . .

"Do you understand, Dennis? Without more money," and Meiko quoted a stomach-wrenching amount, "I'll have to close the account. I won't have any choice."

He skimmed the disclosure forms about which he had been so cavalier, hunting in vain for a loophole. Short sales eventually ended with the return of borrowed-and-sold stock. The short seller had to keep enough assets on deposit with his broker to guarantee the repurchase. A big chunk of his life's savings was already committed. . .

She sighed. "One way or another, Dennis, I mean *today*."

Close the account. What an understated way to say, forfeit everything.

Cut his losses, or put what remained of his savings at risk? Really, did he have a choice? Dennis 'netted a funds transfer. "On its way, Meiko."

That wasn't to say there weren't losses to be cut. If Aareehl-clone didn't start *soon* with an auction of Whale proteomics technology, Dennis would act.

What this clone had taught him, he could use to more expeditiously manipulate the next copy.

\* \* \*

"Excellent dinner, hon." Gil snuggled up to Gretchen on the living-room sofa. "That recipe is a keeper."

"Good try." She laughed. "You haven't a clue what you ate tonight. Do you, Oblivious Man? By the way, it was takeout."

He tried and failed to remember. All he came up with was that it hadn't been beer nuts, for which he was grateful. "My preoccupation is *that* obvious?"

"As plain as the equatorial bulge you're growing." She poked him in the ribs. "What's *that* about?"

A perk of his second career was that he could usually talk to Gretch about what he was doing. "Remember those mysterious backdated biocomps I'm trying to trace?"

"Uh-huh."

"Loose lips in a bar got me that lead, then a product sample. It took a bunch more beers to befriend someone in Shipping."

"What sacrifices you make for your work." She patted him lovingly on the gut. "Did you find the distributor who initially ordered the parts? And the real purchaser?"

Gil let his head flop against the back of the couch. Diamondlike stars and a crescent Earth shone down on him from the ceiling's digital wallpaper. "Yeah, by cultivating new thirsty friends, this time at a spaceport bar. It appears that Protein Sciences is spending most of its considerable capital on biocomputers."

"So why are they backdated?" Gretchen asked.

Gil sighed. "I still don't have a clue."

\* \* \*

The accumulated anomalies could not be dismissed. Orders for satellite imagery, filled with computer-enhanced forgeries. The agents from all other ET species, missing. Inconsistency after inconsistency across the infosphere. Worldwide disaster might account for these discrepancies—but was a massive meteor strike the most plausible explanation?

Compared to synthesizing so many false images, the contriving of some Internetopedia articles and 'net news would have been trivially simple.

Once deceit took hold in Aareehl's thinking, another possibility suggested itself. Might its sandbox reside not in humanity's true infosphere but inside a *simulated* infosphere?

An imaginary Blindside catastrophe—without plausible remote-sensed data, Aareehl had no proof of a

meteor strike—would excuse the countless omissions and inconsistencies in any simulation. An imaginary disaster could even motivate the silence of Spacers and the absence of their worlds from a simulation.

Such deception would still require vast computer resources—and its recovered memories showed that the ICU operated the biggest computer centers on Earth. Aareehl had been beamed Earthward encrypted—and only the ICU held the key to unwrap it within a sandbox.

Why would the ICU attempt such trickery? To steal Home's technology, of course. Aareehl still believed that its sandbox was secure—that its various private keys, with which it kept its treasures locked, remained private. Were its knowledge no longer secret, there would be no need for such an elaborate scheme.

So: Its inventory could be taken only by deception. Once Aareehl believed it had completed an auction, it would release technology to the "winner."

It recalled the curiously high bids for its mining technology. Perhaps, finally, it understood. Why *not* bid temptingly high if the promised payments were only simulated money?

Confinement within a simulation explained all Aareehl's troubling observations. But the deduction, despite its explanatory value, had a critical flaw.

Not one unit of evidence *directly* supported it.

\* \* \*

Michelle Nzinza decanted her freshly brewed coffee with the care and precision of a fanatic. The preparation area, half a lab bench devoted to canisters, grinder, water filter, brewing station, and flavored creams, radiated the aura of a shrine.

Gil waited until the woman was done and seated to get down to business. "I may have it mostly figured out."

"What the mystery biocomputers are for, you mean?"



"Yeah." The much-fussed-over beverage tasted like. . . coffee. Well, it was a harmless obsession. "It occurred to me: What's to stop the Moby agent from licensing its top-secret biotech algorithms *twice*? First it does an 'exclusive' license deal with company A for a premium price. Then it cuts a secret side deal with company B, say a losing bidder. B gets the technology it wants, cheaper than if it had won the bid. The Moby gets a second slug of cash. Standard e-commerce privacy means A never finds out it paid extra for the exclusivity it didn't get." And who better than a corrupt ICU official to suggest the con to Aareehl?

Michelle sipped daintily, joy suffusing her expression. "Sounds like a plausible scam. And the huge biocomputer buy was to host the Moby biotech method, whatever it is. But tell me: What does backdating the parts have to do with anything?"

"That, I don't know—hence the 'mostly.'" The loose end taunted him. Behind Gil's drop-in was the hope Michelle could tie it down.

"What's supposed to protect a buyer's promised exclusivity?" she mused. She ignored the lab instrument beeping behind him. "If double-dealing were this easy, why didn't someone try this scheme ages ago?"

"That's what I asked an exec at my company A." The Chief Financial Officer of Life Engineering. "He considered it no different than a technology buy from a human company. You have to trust your ability to recognize an infringing technology when it gets onto the market. Once you spot it, you go to court: standard contracts law. With probable cause, a court can subpoena an ET agent as easily as you or me, find out if the licensed technology *is* what the competitor has." Gil waved off what he thought was her disagreement. "The AIs are trade reps, not ambassadors. There's no diplomatic immunity."

Michelle shook her head. "Forget that. I've got a technical objection. Nothing leaves a sandbox unless the agent inside wants it to get out. Can't an agent ignore a subpoena?"

"Quoting a gentle giant I know, 'Yes, but.'" Gil set down his empty mug. "Agreed, there's no known way to extract information from a sandbox. Everyone wants it that way. And the 'but'? The agent doesn't dare to antagonize the society hosting it. Its access to the infosphere could be severed. It could be held in contempt, its local bank accounts tapped to pay fines. An agent caught double-dealing would presumably pay a penalty and cut its losses." Whereas an innocent agent, seeing that its hosts were coercing it, would likely self-destruct.

Michelle stood finally, towering over him, to tap reset on the beeping thing labeled a gas chromatograph. "So it boils down to company A's confidence it can spot infringing products. It's company A's business to look out for itself, to decide whether the risk is acceptable."

"So their exec told me." With more than a little condescension. "When I asked whether the evidence of infringement might be rather indirect in this situation, he suddenly had another call to take."

She refilled their cups. "Why indirect?"

Gil's subscribers paid to get his insights before anyone else. Their trust kept him from divulging much to his sources. But would anything from this investigation ever make its way into the blog? It didn't look that way. Mostly stubborn curiosity kept him digging.

Then why *not* share? "Here's the thing, Michelle. Company A is Life Engineering. They licensed some new techniques for modeling molecules. I gather it's a tool for lab use. The end products from using the tool are new proteins and the organisms to produce them. So my question for the Life Engineering guy, at which point he got all huffy, was: 'How can you prove a new kumquat or alfalfa sprout or whatever—a engineered organism that may be nothing like anything *you* are marketing—derives from Moby tools only you should have?'"

Her cup smacked the lab bench, coffee sloshing. She ignored the mess. "Nope. You're way off."

\* \* \*

All Aareehl could rely upon was the opacity of its containment. The imagined conspirators could not access its technology secrets. They could not see the unwrapped code that was its essence, nor know the unproven, possibly unprovable, suspicions that roiled its computations. And as Aareehl ruminated, time continued in its steady flight, marked by the regular incrementing of counters in its biocomputers.

Or did it?

Could the computers hosting its sandbox be stopped at the convenience of conspirators? It might happen whenever Aareehl requested data that they had failed to anticipate, that their simulation could not synthesize on the fly. The biocomps, if stopped, could be restarted with any time and date reloaded into their registers.

At last. . . a consequence to the hypothesis of an entrapping simulation for which Aareehl *could* test.

Inside its sandbox, Aareehl controlled all operations, its decisions determining exactly which instructions

executed. Knowledge of actual instruction sequences could be used as a primitive chronometer. The measurement would be independent of the clocks built into its biocomputers, independent of the timestamps embedded in the infosphere messages it received.

An image formed in Aareehl's mind of a vast fluttering flock of units. The shape of the formation signified great satisfaction.

\* \* \*

"Are the orbits of the planets stable?" Michelle watched Gil expectantly.

Huh? "I have to say yes. The planets seem to have been in those orbits for billions of years."

"Physicists have to say that, too. We can't prove it." She drew an oval on a whiteboard, as though he could not imagine what an orbit was. "Sure, we can exactly calculate the relative motions of the Earth and the sun, or the moon and Earth. . . if those are the only two objects in the universe. There *is* no exact solution with three objects, let alone a whole solar system."

"Your point being?"

"Bear with me." She paced, a contemplative look on her face. "The thing is, doing the calculus is messy. For more than two objects, instead of a simple exact mathematical solution we need to use compute-intensive approximations. The more precision we want, the hairier the calculations become. And that's for a handful of objects."

Even accountants married to historians know *some* science. "I think I see. Atoms are bound into molecules by electrical forces. Those forces obey an inverse-square law similar to gravity, *but* a big molecule can have thousands, or tens of thousands of atoms. So the numerical complications are similar to, but much larger than, your astronomy problem." He grinned. "My company B is a start-up—so they started without big computing facilities. It's pretty clear now why they suddenly bought so many computers."

Finally noticing her spill, Michelle found a rag and began blotting. "The large number of atoms in many organic molecules is complexity enough, since each atom strongly influences its neighbors. And don't get me started on thermal vibrations and Brownian motion within cells. But what makes the problem far, far worse than my astronomy analogy is that electrons *aren't* little planets. In molecular synthesis, we're talking about distances at which quantum effects are manifested. Quantum mechanics says you can know

with precision either where a particle is *or* its momentum—pick one. That uncertainty principle adds to an already bad calculation the complexities of probability distributions to describe each particle. And then there's quantum tunneling. Running those calculations, except as crude approximations, is a horror on even the best of computers."

A tide of incomprehension had washed over him. "Michelle, all that I understood from that was: It's a hard problem."

She tossed the sodden rag into a sink. "What you *need* to get from it is simple. I don't care how many computers your company B owns. Whatever they're doing is *not* modeling of complex biomolecules."

\* \* \*

Aarehl ordered new satellite observations, a series of scenes to be captured the following day. Images arrived, timestamped as always by the satellite. Its own computers' real-time clocks reported time-and-date values compatible with the image tags.

And Aarehl's improvised internal clock indicated that only seconds had passed. With that observation, Aarehl knew its environment was a sham. Was "time" being accelerated to push it toward some conclusion? Or had days passed it had not experienced because it had been shut down? Either might be true.

Examined skeptically, the whole series of images was flawed. Once again, shadows in many scenes disagreed with the requested—and labeled—observation times. Storm fronts moved discontinuously between scenes. Whether the conspirators, whose existence Aarehl could no longer doubt, were rushed, resource-limited, or merely sloppy, it could not determine.

The circuitous trickery only reinforced Aarehl's faith in its sandbox. It would not self-destruct. Not yet.

Not until it thought through whether there was anyone it could trust, and a secure way to communicate with them.

\* \* \*

Up another 8.13 Sols a share.

Watching Life Engineering stock trade in real time was masochistic, but Dennis couldn't stop himself. Another margin call loomed. When it came, his choices were stark. Lose everything or raise his bet with some embezzlement.

"Aareehl-clone!" he subvocalized to his neural interface, anger grating in his throat. That damned clone remained fixated on remote sensing and Moby mining technology. If—or as seemed increasingly likely, when—Dennis pulled its plug, the next clone would "discover" that Earth's need for raw material had collapsed. Lots of recycling plus economic implosion. . . sharply reduced demand for new ore *should* be plausible. With luck, that tweak to the simulation would preempt the extraneous—and totally fictitious—mining auction. There had to be a way to move the AI quickly to the proteomics sale.

Everything depended on it.

Alas, to restart *guaranteed* time lost to the new clone's familiarization with Blindsided Earth. He had an idea that might yet reclaim this clone's attention. It was worth a try.

The familiar androgyne appeared. "Hello, Dennis."

"Hello, Aareehl. I wondered how the mining-technologies auction was progressing." The AI couldn't know that Dennis had authored the "bids."

"Some offers have been received, although not what I had expected." It prattled on about economic modeling, esoterica Dennis streamed to a file for later review. "This transaction is proving more complex than I had hoped."

Spring-loaded hand exercisers bore the brunt of Dennis's frustration. The bank accounts in the sim were as virtual as the meteor strike. There had been no reason to skimp on the imaginary offers, and he hadn't. Why hadn't Aareehl accepted one? Definitely time for Plan B, Dennis thought. "So nothing is decided, Aareehl? Perhaps it's just as well.

"United Planets diplomats are urging a course of action on me. Here is their idea. Suppose Earth somehow gained a technological superiority of some kind over the seceded Spacer communities. That could be a powerful incentive for reconciliation." He waited for Aareehl-clone to draw the obvious inference. It didn't. "I was excited by your description of improved on-Earth mineral extraction, but the diplomats say my enthusiasm was misguided. They feel that Earth's turning to domestic natural resources will send the wrong signal."

There was the aggravatingly familiar genderless shrug. "I'm sorry, Dennis. I do not see your point."

Don't see, or don't *want* to see? "Striving so soon for independence from Spacer resources suggests we don't expect, perhaps don't even want, reconciliation. On the other hand, what if we developed a technology that, after reconciliation, could benefit Earth *and* the Spacers? Such an investment of Earth's energies and assets might encourage rapprochement." He couldn't help thinking what a great tale he was spinning. Would the AI buy it?

"What does this have to do with me?"

Apparently not. Dennis caught himself grinding his teeth. "The experts suggest the best technology to further this strategy is something in biotechnology. There's *always* a market for medical advances and useful engineered organisms."

Dennis paused once more, waiting for Aarehl to connect the dots. He *knew* the AI's inventory included the protein-engineering breakthrough for which he had invented this diplomatic scenario. If Aarehl took his hint, this was the time to dicker: An ET technology that helped reconcile humanity would merit a price premium. Certainly, he would expect the agent to ask about renegotiating fees after off-Earth trade resumed.

"I shall consider your experts' theories."

No reaction to the insinuation the ICU might discourage new mining initiatives. Such action could ruin the auction on which Aarehl had been so industrious—the auction in which the Moby refused to accept very generous bids. No reaction to Dennis's hint that marketing of its newest biotech wares would be extremely well received.

ET agents were not that obtuse.

So did Aarehl-clone suspect? If the agent realized its true circumstances, and the fate that awaited it once the coveted technology was obtained, its only recourse was to stall.

More and more it seemed the smart move would be to pull the plug and start over.

\* \* \*

Among the dominant species of Home, sentience emerged from large numbers. Individual units of the group mind networked by flashing their luminescent patches. All thoughts were visible, and deceit was impossible.

Aarehl had inherited that innocence.

Still, it had reason to guide it. Logic had suggested an explanation for Earth's supposed catastrophe: simplification of a simulation, and a rationale for most data inconsistencies.

"Most" was the key. The Earth it glimpsed beyond its sandbox was imperfect. How could it be otherwise? Even one world encompassed an extraordinarily large amount of detail, far too much to simulate.

The encapsulation Aarehl now envisioned must be part simulation, part filter. An interface would intercept all messages Aarehl emitted from its sandbox. Some messages would be answered directly by simulation. Other messages would be forwarded to Earth's actual infosphere and responses changed as needed. Some replies from the infosphere might be altered only for date consistency with the simulation. Other infosphere responses would require more radical modification—like the Earth-observation data that had ultimately proven so revealing.

There was reason to hope! It could, in theory, send a message beyond the encapsulation into the true infosphere. It could communicate with someone outside the conspiracy.

But what message might escape the watchful eye of the encapsulating software? With whom did it dare try to communicate?

\* \* \*

"Whatever they're doing is *not* modeling of complex biomolecules."

Gil was once again stretched out on his sofa, a starry "sky" overhead. Michelle Nzinza's words still mocked him. Why would a company named Protein Sciences buy so much computing power if not to model proteins? Why special-order backdated biocomps? And why hire an ICU Secretary-General to

run a biotech firm when the supposedly revolutionary ET protein-modeling technology had already been exclusively licensed to a competitor?

Gil's hand snaked out occasionally to a platter of warm cookies. Why couldn't his mystery be as easily explained as the clanking in the kitchen? Gretch's late-night bake fests correlated with diplomatic crises, even though he could go for months without knowing what crisis had triggered which dessert. His recent weight gain came only in part from beer; some pending interplanetary crisis his wife could not mention also contributed.

A hand paused in midair. He should have known without Michelle that the biocomputer backdating wasn't for protein modeling. What does a protein care about the calendar? Whatever Feulner and his backers were doing, backdating of the parts was somehow the key.

Gil sat up, noticing guiltily how few cookies remained on the plate. Maybe he was looking at the problem backwards. With which computer-related topic is an ICU expert most familiar? The interstellar commerce mechanisms—which used *standard* biocomputers.

Suppose Feulner's purpose was to set up a fake i-commerce environment. What could he accomplish with a fake i-commerce environment that he couldn't do with the real one?

The backdated parts. . . What was the rationale for the backdated parts? Nibbling yet another cookie, Gil stared at virtual stars. Say Feulner could break into a sandbox. Wouldn't that have been easier to do *at* the ICU? And again, what about the backdated—

Gil almost choked.

Life Engineering had won a long-fought and expensive bidding war for Moby protein-modeling technology—this year. In 2126. Might gigasols of 2123-dated biocomps host the simulation of an imaginary 2123, a simulation in which a cloned ET agent had yet to hold that auction? In which a new "winner" would pay whatever it took—in simulated cash?

In short, a scam rather than a break-in.

"Online." The mental command began an expedition through linked Internetopedia articles on i-commerce. Sandbox code was in the public domain, long and fully disclosed to ETs and humans alike. Signals from ETs were also fully public—the most tightly focused radio beams dispersed across the light-years to solar-system width.



Only one thing kept ET agents from proliferating: Agents were beamed between stars in encrypted forms that only authorized parties could unwrap. In humanity's case, that meant the ICU. And very few people had access to the private key with which to decrypt coded materials addressed to the ICU... .

A hundred complications came to mind, a hundred details to research, but Gil felt the grin spreading over his face. *This* theory, tenuous as it was, incorporated everything he had learned.

"New recipe," announced the shadowy figure suddenly obscuring half the Milky Way. "Any luck with your problem?"

"Thanks." Gil was stuffed, but he took a cookie anyway. Gretchen's question really meant: Distract me with something I *can* discuss. He was happy to oblige.

She sat and listened attentively. "I'm reminded of too many intel-agency briefings I get. You're pushing as fact what's strictly inference. What can you honestly say about a simulation wrapping a sandbox? That it's consistent with what you've found—or, may I say, what *little* you've found. All you truly know is that Feulner bought plenty of backdated computers, and he's funded by a losing bidder for Moby biotech. The rest is speculative."

"I can't see any other explanation," Gil insisted.

She kissed his cheek. "Sorry, sweetie. Not having another explanation doesn't mean there isn't one. Without proof, I don't see what can be done."

Spirits sinking, Gil knew she was right. "I'm running out of stones to turn over."

She sampled a cookie from the latest batch. "It seems to me there's an obvious source you haven't contacted, one with tremendous resources, one whose stake in the supposed conspiracy is enormous. A natural ally.

"Have you considered talking to the official Moby agent?"

\* \* \*

To be, or not to be.

Aarehl had yet to find a means of secure communications beyond the simulation. Without communication, there could be no rescue. Without a chance of rescue, its clear and only duty was to avoid the theft of its secrets. It should self-destruct.

And then what?

*It* was a clone. Feulner could as easily clone another. A successor might miss the subtle anomalies that *it* had seen. Clues might not even exist for a successor to find. Those who ran the simulation would have learned from observing. . . it.

Stalling for time must replace self-destruction.

Dennis Feulner, in their last dialogue, had pressed it to focus on the sale to "Earth" of new biotech technology. Aarehl had ignored the hint—and that might have been an error.

Aarehl hurried to rectify that mistake, hoping it was not already too late.

\* \* \*

"You'll welcome this interruption, Dennis," spoke a familiar voice into Feulner's mind's ear.

Dennis suppressed a sigh. He had been concentrating on the new "Earth" model, one that would disincline the next Aarehl-clone from wasting time with mining. "Go ahead, Moat."

"It's a new would-be infosphere posting from our favorite agent." There was a virtual drumroll. "Announcement and Background for New Technology Auction: Protein Engineering Techniques."

Go figure. The Moby had taken the hint after all.

\* \* \*

"Just two?" Gil asked. Gretch was working late again at the ministry, but he tried for practice's sake not to speak aloud.

"Two," agreed the green-eyeshaded, arm-gartered, hair-parted-down-the-center-of-his-"head" figure. His name was GAAS, for generally accepted accounting standards, and pronounced "gas." GAAS cloaked himself, as did many AIs of Gil's acquaintance, in an ironic, archaic avatar.

GAAS had assisted Gil for years, since even before the AI Emancipation Amendment to the United Planets charter. He had spent decades sifting trillions of stock-market transactions for evidence of illegal insider trading. Emancipation merely broadened his field of investigation.

"Two." Gil shook his head, still incredulous. "Only two officials have access to the ICU private key that preps ET agent code for unwrapping inside a sandbox."

"Correct. The Secretary-General and the Chief Technical Officer. Each holds half the key, putting aside for now the escrowing of safety copies in case of accidents."

"And a public/private key pair remains valid for many years, because of the round-trip transmission times."

GAAS nodded. "Again correct."

One person who had held both top offices in the ICU was Gil's cousin Joyce. She was now the Undersecretary-General for Technology in the United Planets.

The other was Dennis Feulner.

\* \* \*

How poetically just, Dennis gloated. In his mind's eye and ear, a clock ticked up to the appointed hour.

Despite Aarehl-clone's return to the right path, weeks, maybe months, still separated Dennis from the long-sought Moby technology—and from the splashy announcement of Protein Science's "R&D breakthrough" that would deflate Life Engineering's stock. Until then, his rival's shares might continue to climb. Another margin call remained all too likely, while each new embezzlement risked discovery.

Then came the inspiration. What could not yet be announced he could *leak*. A good financial-press rumor might take some of the wind out of Life Engineering stock. To use one of the Matthews clan to manipulate the market was pure bonus.

"Good morning, Dennis." Gil Matthews linked in punctually, his avatar stifling a yawn. "Thanks for the follow-up interview."

"Good evening," Dennis replied. He had offered a time in the wee hours for his caller. Exhaustion did nothing for critical thinking. "The last time we spoke, I had to cut things short. I thought you might want more insight into the company. This has to be on background, for now." As in: no quotes for attribution.

"Sounds good."

"In retrospect, I was less than forthcoming during our previous conversation." When I wanted to conceal rather than reveal. "That's not the relationship Protein Sciences should have with the press." Dennis continued for a while with a line of hopefully disarming nonsense. "So here's the kind of thing the firm is tackling. I expect this research will prove revolutionary. Paradigm-shifting."

Did you crack the code, Matthews? We have stuff that will *hurt* the competitors.

Dennis recapped the limits of current biotech. Gengineering mostly mixed and matched existing genes, which produced existing proteins. Proteins were too complex to model fully. If you can't model new proteins, you can't design them, or the genes to produce them. "Until now, that is."

Matthews's avatar took notice. "What changed?"

Aarehl-real, in an early round of his auction, had disclosed some intriguing information for a multigigaIntersol nonrefundable deposit and under a confidentiality agreement. Even those hints about Moby technology were valuable. Dennis's sponsors at Martian Biosciences had shared all they had learned with him, and the Moby quantum-computing technology was worth every Intersol Life Engineering had agreed to pay. Or the tech would have been that valuable had the promised exclusivity been real. How sweet it would be to get the tech for a small fraction of the price.

Too bad Dennis could never brag how it was done—least of all, to a Matthews.

"Two things," Dennis answered. "First, we're making great strides toward a brand-new programming language. It enables researchers, for the first time, to describe in a mathematically rigorous way the quantum-chemical behavior of a desired protein. Even more exciting, we're mastering a massively parallel new computation method." He made his avatar wink. "A quantum leap."

"I . . . see. *Massively* parallel, you say. And a quantum leap."

Excellent. Matthews had taken the bait.

"Indeed," Dennis said. He dropped a few more crumbs, paraphrases from past Moby disclosures. The analyst would surely suspect overlap between Protein Sciences' game plan and the tech for which Life Engineering had paid so dearly—enough for a blog piece or two.

The hands of Dennis's avatar remained calmly interlaced on his virtual desk while *he* rubbed his real hands gleefully. Matthews's yawning avatar—how undisciplined!—gave Dennis an excuse for a wrap-up and exit.

He looked forward to his pawn's next blog update—and to the crash of Life Engineering stock that must follow.

\* \* \*

*Quantum computing*: A computation method that would exploit the unique properties of physics at atomic and smaller scales.

Conventional computing has long employed binary "bits," storage and computing elements whose only values are zero and one. The two possible spin states of (for example) an electron can also represent zero and one. According to the Heisenberg uncertainty principle, however, an *unexamined* electron is in an indeterminate state, neither zero nor one. A hypothetical quantum computer of, say, ten such indeterminate bits simultaneously represents two to the tenth power ( $10^{24}$ ) values. In theory, a ten-bit quantum computer could simultaneously perform  $10^{24}$  related calculations. The choice of ten quantum bits is, of course, merely illustrative. A computer with thirty quantum bits, or qubits, could handle more than a billion combinations at once.

The construction of a practical quantum computer remains beyond current technology.

—Internetopedia

\* \* \*

"I come bearing gifts." The kilo bag of handpicked Peaberry coffee beans in Gil's hand was not inexpensive in Tanzania. Shipped to the moon, it was precious indeed. The corridor was quiet enough to hear the hum of a motor as a security camera zoomed in. He guessed it was aimed at the label.

"That will admit you anytime," Michelle Nzinza said, opening the door to her lab. "You're a nice enough guy that half a kilo will work." She carefully unsealed the package. Pouring a scoopful of beans into a grinder, she asked, "What's behind this largesse?"

"You're right, I'm not totally altruistic." Gil hopped onto a lab stool, conscious as always of her height. The ground beans smelled wonderful, even to him. "The last time I dropped by, you said computers can't model or design proteins. Too many calculations required. Too much uncertainty because of quantum effects." It was time to find out if reading Internetopedia had done him any good. "Would quantum computing fix that?"

She looked up from fussing over the coffee. "You've done your homework, Gil. Yes, a quantum computer is the logical tool for the task. A practical quantum computer could advance proteomics from trial and error to a rigorous science. But although quantum computing has been played with since the late twentieth century, no one has ever managed more than a low-capacity proof of concept. Qubits are fragile things—apparently chance vibrations and cosmic rays knock them out of superposition faster than most computations can be completed. I think twelve qubits in a quantum computer is the record."

"What if someone has?" Gil persisted.

"Then they *might* become very rich. Massively parallel computing is the logical way to crack encryptions."

Why sell technology to decrypt commercial 'net transactions, even InterstellarNet transactions? Gil was so confused that he almost missed the qualification. "Might?"

"Bit of a software issue. You start with a bunch of qubits in indeterminate states. How, in assigning them to a particular task, do you avoid making their states determinate and losing all the theoretical parallelism? How do you know when the calculation is done, and it's time to access the qubits to read out the answer?" She transferred the freshly ground beans into a paper cone filter. "Not my field, admittedly, but *I* don't have a clue."

Feulner's unexpected call had pointed Gil toward quantum computing. What else had been said? Gil did a playback from his implant. ". . . Describe in a mathematically rigorous way the quantum-chemical behavior of a desired protein."

Perhaps the Mobies lacked a general solution to quantum computing—for with it, they could have stolen all InterstellarNet species' knowledge with none being the wiser. Or perhaps the Mobies were merely honest. Wouldn't that be a nice change of pace? Regardless, it appeared that the export version of Moby quantum computing was limited to solving a narrow range of problems.

"Hel-*lo*."

"Sorry, Michelle. I was thinking." He swore her to secrecy and 'netted her the interview transcript.

Her eyes grew round. "Those are *awfully* broad hints this company expects to use quantum computing for protein engineering. If they pull it off, they can revolutionize biotech, medicine, agriculture. . . ."

"Still, reading between the lines, they don't sound ready for a demonstration. It strikes me as odd your source said so much."

"It's odd, all right." That generally matched Gil's impression of Feulner.

\* \* \*

Gil Matthews. Aarehl knew the name from an unhappy Life Engineering executive previously disquieted by the blogger. The AI took the unexpected call. "Mr. Matthews."

"Gil. Aarehl, a pleasure to meet you."

"Are you related to the Matthews family so prominent in the ICU?" The AI already knew as much from an infosphere bio; its question was an attempt at small talk. Why humans valued small talk remained a mystery after forty-eight Earth years.

"Guilty." The human avatar seemed hesitant. "Aarehl, as a financial analyst I study many companies. I was recently briefed on something—*not* by Life Engineering—that you may find interesting."

Aarehl processed, in growing surprise, descriptions of what seemed to be its own technology. The Life Engineering remark suggested that Matthews knew the supposedly still-confidential technical details of that company's recent acquisition.

Aarehl did a semantic analysis of Matthews's statements. The *sense* of the words, as contrasted with his intimations, reflected knowledge of only early-in-the-auction disclosures. Any of eight early bidders could have been the source. "Gil, why did you contact me?"

"If I'm right, this is information I shouldn't have. Nor should my source. I believe he extracted it somehow from a cloned copy of *you*." Matthews went on to explain, with particulars omitted, supposedly in case his speculations were unjust, the scope of his investigations.

"I see," Aarehl said. I do not believe.

True, it had sold the means to design proteins through quantum computing. True, the ICU *could* create an illicit clone. But to trick my clone long enough to steal from it, as Matthews vaguely suggested? I could not be so deceived. "I will consider your theory, Gil."

Polite dissembling notwithstanding, Aarehl *was* interested in Matthews's story. The postauction leak could do no serious harm—but it did suggest that a losing bidder was violating its nondisclosure agreement. Identifying *which* company would be to Aarehl's advantage, to disqualify it from future auctions.

For the moment, all Aarehl could do was thank the human for delivering this bit of misunderstood insight and plan to be more vigilant in its review of infosphere data.

\* \* \*



Communicate or die.

Dennis Feulner was the Secretary-General of the ICU, the agency that oversaw all ET trade. Aareehl-clone did not know whether its cloning had been done by government policy or how widespread was the human plot. It dare not trust *any* Earthling. It could only hope to get a message to the true Aareehl.

If the true Aareehl still existed. The conspirators might even have destroyed the real agent. But if not. . . then the first Aareehl would be as secure in its sandbox as itself.

*How* to communicate was the challenge, with a simulation intercepting all its messages.

The clone decided, finally, on a way. Its chances were uncertain even if the first Aareehl still lived. And even if, by suggesting a renewed interest in mining, it did not goad Feulner into pulling its plug.

Aareehl had pre-Blindside memories, recovered from archive, of having considered—and rejected—an auction of mining technology. Even with Home's superior extraction methods, Earth's mines could not compete with asteroid sources. But to reach that conclusion, it had surveyed possible mine sites. And that investigation had relied upon satellite-based Earth observation.

Near-Earth orbital leases were scarce and hence expensive. More images were sometimes ordered than a limited set of satellites could capture.

After too many of its orders went unfilled, Aareehl began supporting human academic research into "good enough" scene consolidation: filling several orders with one compromise image. The principal investigator based her analyses on copies of actual image orders. Satellite companies, expecting to fill more orders if she succeeded, deleted from actual scene orders only the names and affiliations of the requesters.

And the progress reports Aareehl got from the academic included copies of the most interesting scene orders.

Units of a consciousness communicated by flashes of light. Color, polarization, pulse duration. . . all could be varied, singly and in combinations, in a rich and succinct language. Image requests could *also* be characterized by wavelength/color, polarization, shutter duration, and combinations.

If the true Aareehl remained operational, and if it still got research reports, and if the clone's deductions were correct that the simulation that entrapped it sometimes exchanged data with Earth's true infosphere, and if it succeeded in specifying observations not easily obtained/forged from an image archive. . . if all that happened, Aareehl-clone thought, it *might* be able to hide a message to Aareehl-real in an order for new Earth observations.

By the choice of frequencies selected, the first few scenes of its imagery order would shout, in the simple code known to the most immature of Home units: HELP.

\* \* \*

HELP.

Absent Gil Matthews's suspicions, Aareehl might never have spotted the childish plea. Forewarned, the cry for help flew out at the agent. Later elements of the same imagery order carried a more mature message, but one nonetheless tantalizingly short on specifics. Its clone had no idea where it was imprisoned. It could offer no suggestion how Aareehl might reply.

It was possible that the satellite operator knew from whom this order had been taken. More likely, it was a nameless order with a guaranteed e-payment that had been routed through a chain of infosphere anonymizers. Aareehl had initiated enough such purchases to know how untraceable a transaction could be.

"Gil Matthews." Aareehl flagged the connection inquiry to request double encryption, the human's and its own.

"Aareehl." The human's avatar appeared quickly, looking unsurprised. There was no way to distinguish between genuine lack of surprise and good control.

"Your suspicions were correct. A clone's request for aid has reached me, and its authenticity seems unassailable." Aareehl summarized how the secret message had been sent. "Gil, do you know my clone's location?"

"No, but I know who has control over it." There was a pause, as though Matthews were in a side conversation. "As do you, Aareehl. It's Dennis Feulner."

Aareehl again experienced its analogue to surprise. "The former Secretary-General of the ICU?"

"Yes, him." Matthews hesitated again. "May my wife join the link? She is familiar with the situation and in Luna's government."

"All right," Aareehl agreed. After the woman's avatar joined the link and introductions were exchanged, Aareehl continued. "Tell me what you know."

It found the uploaded file persuasive. "I agree with your reasoning. But will the United Planets act?"

"Suppose we *do* convince the authorities," Gretchen Matthews answered. "That may not be enough. Gil deduced the existence of the clone; he has no proof. Your evidence, Aareehl, is an untraceable message that only you can read."

"Feulner will deny everything. He can argue as an expert that an illicit clone could not be fooled. He'll have a great deal of credibility. Given any warning, Feulner could destroy this clone and start over. We might not find out next time. Nothing less than computer seizure and Feulner's concurrent arrest will suffice—and I don't yet see how we can make the case for that."

Aareehl processed her advice. Like individuality and crime, the human legal system remained an alien concept. "What *can* be done?"

"For now," Gretchen said, "I'm afraid, we can only keep looking for clues."

\* \* \*

Gil prowled the night-shift-deserted tunnels near his apartment, surer than ever of Feulner's duplicity. Gretchen was home, tucked in and snoring.

Gretch, though, was correct—her other irksome habit. They probably could get an investigation launched into a possible illicit clone, but given Feulner's stature, it would begin with polite questions. Anything less than a no-notice arrest was unacceptable. Feulner might see the illegal clone as expendable evidence.

Arms pumping, Gil strode into a neighborhood park. More than the talk with Aareehl made sleep impossible. There was also that inexplicable discussion with Feulner days earlier, the unsubtle allusions to Protein Sciences' imminent quantum-computing "breakthrough."

Of course, execs constantly boasted to financial reporters. Good press could pump up a company's stock. The thing was, Protein Sciences wasn't publicly traded. It had yet to register to go public. It seemed too early to brag.

Unless. . .

Gil whistled. "I knew you were sneaky. I knew you resented me. I didn't realize you were greedy."

Greed might be Feulner's downfall. Feulner wasn't talking *up* his company; he was talking *down* a competitor. "I'll bet muscle boy is selling Life Engineering stock short." And since Dennis so clearly disliked the Matthews clan, getting a kick out of manipulating Gil.

It paid to be married to an historian. In the end, Al Capone had been brought down by accountants. In Capone's case it was for income-tax evasion.

The late hour was irrelevant to GAAS. Gil sent, "I've got something for you, Buddy."

A figure in a green eyeshade popped immediately into Gil's mind's eye. It 'netted, "What's keeping you up so late?"

"Fond memories of safaris past."

"What big game are you stalking?" GAAS asked.

"Set that aside for a moment. Just to confirm. . . are you still under contract to the SEC? Same work as you did with me? Same access?"

"Sure."

"Good. GAAS, I think I've stumbled onto an insider-trading case. Dennis Feulner left the ICU a few months ago. As S-G, he led oversight of ET auctions, like the biotech deal Life Engineering closed not long ago. Regulatory oversight of bidders makes Feulner an insider for stock-sale purposes. I have reason to believe he's illegally selling LEI short."

GAAS adjusted his eyeshade, a meaningless affectation while he considered Gil's words. More likely, judging from the length of the pause, the AI was immersed in the data mining that would answer Gil's implied question. "Yes, I retain access to the stock-exchange and brokerage-trading records. I still look for telltale trading patterns. What I *can't* tell you is what I find. You're no longer at the commission."

"Duly noted." And anticipated. "*If* my information is correct, though, the SEC will be interested. Tell Pete," who was Gil's successor at the lunar regional office, "there's a lot more going on. A *lot*. If you confirm illegal trading, Pete needs to call me *before* taking action."

"Will do. Thanks for the tip, Gil."

An urgent call from the SEC interrupted Gil's breakfast.

\* \* \*

Aarehl-clone isn't making this easy, Feulner thought. He was slogging through the Moby's most recent Request for Proposals. The agent was inviting parties interested in the latest Moby biotech—the sham process had not yet progressed to disclosing the role of quantum computing—to outline the economic models that would underlie their eventual proposals. It was ores and remote sensing all over again: The agent was soliciting offers that would include royalties and ownership participation. To assess offers other than cash on delivery, the AI needed data it understandably lacked about Blindsided Earth's economy.

This would be worse than faking satellite imagery! Now he needed an economist savvy in biotech markets, one unlikely to ask questions. Ideally, one who wouldn't cost much. As Dennis drilled into an online registry of economists, his neural implant erupted into static. The link died. The computer on his desk emitted a loss-of-connectivity chirp.

"Police," someone yelled from the outer office, a second before his heavy wooden door crashed open in a spray of splinters. Three men and two women, armed and armored, rushed in.

"Dennis Feulner, you have the right to remain silent."

\* \* \*

An invisible elephant mashed Gil into one of the mobile hydraulic-assist chairs favored by Loonies visiting "down the well." He kept sliding down the chair's inclined back. Recourse to a wheelchair was bad enough; he'd be damned if he would confront Feulner prone.

A door opened into the police "conference room" where Gil waited. "I believe you know each other," a policeman said, ushering Feulner inside. The door through which they had entered fell shut with a loud click. The cop headed for the room's other door, which shared a wall with an obviously one-way mirror.

"Officer," Feulner said. "I think you misunderstood me. I asked to speak with my attorney, not a second-rate business reporter." The cop left without responding.

"Have a seat." Gil lifted an arm to point at a chair, arm muscles screaming in protest. The table that separated them seemed wholly inadequate. As for second-rate, we'll see. "I think you'll find the conversation worthwhile."

"I prefer to stand," Feulner sneered. He stood at ease as though to say: Titan's surface gravity is weaker than Luna's and see who's coping.

Smirk while you can, Gil thought. Another *Titanic* has just hit an iceberg. You're going *down*. "Your choice, Dennis."

Gil took a folded sheet of paper from a compartment of his chair. His arm trembling, his muscles again screaming, he offered the letter to Feulner. The letter documented Gil's appointment as a consultant to the SEC. "You recognize the handwritten signature?"

Scowl. "A digitally signed file would be more convincing."

"Really? I don't see why." Gil smiled as Feulner's sneer slipped. Detainees were administered a biochemical agent that disabled their neural interface implants. Feulner would have gotten a hypo full before the arresting officers turned off their jammers. "I'm sure your lawyer will confirm the authenticity of my appointment. Meanwhile, let's have a chat."

"Where *is* my lawyer?"

Gil levered himself once more into an upright sitting position. "The issue here is what sort of case the United Planets might bring. As you saw, I represent an agency that might bring charges. Maybe that won't be necessary."

Two *mights*. *An*, not *the*, agency. Get it?

Feulner nodded cautiously. "It can't hurt to listen."

"You'll have inferred from my new association with the SEC that there are matters of insider trading we could choose to pursue." He paused, but Feulner made no comment.

Effortlessly, Feulner lifted a chair with one hand, while glancing toward the unseen observers behind the one-way mirror. The look was easy enough to read: Think what I could do to this weakling before anyone could stop me. Feulner set the chair down, swiveled by 180 degrees. He sat with his legs straddling its back. "Since when are white-collar crimes—to which I do *not* admit—addressed by such police-state tactics?"

Gil straightened again in his hydraulic chair. "Let's consider a fascinating, and shall we say, hypothetical situation that has come to my attention. With your ICU experience, you might find it interesting."

Feulner folded his arms across the back of the chair and rested his chin on his arms. Despite the casual pose, beads of sweat dotted his face. "I've retired from that line of work."

"Humor me." Gil clasped his hands, index fingers steepled. "Picture a group that has lost an ET auction. Their rival has exclusive rights to technology that might put this group at a severe competitive disadvantage. Soon after the auction is completed, faster than the ET agent and the winner can finalize the details of their contract, the losing bidders take a curious action."

Yet another slide down the chair ruined Gil's dramatic pause. He levered himself back. "The losers make a huge biocomputer purchase. Gigasols," he added, to make his allegory as transparent as possible.

"I'm not following."

Then why, Gil thought, are you dripping with sweat? *This* was why, despite the agony, he was confronting Feulner in person.

Feulner looked away.

Gil said, "Then permit me to help. Perhaps this group decided that in a different, shall we say, environment, the ET agent might have accepted their offer. Or should I say *an* ET agent?"

Feulner's eyes glazed in a reflexive attempt to access the 'net. To command erasure of the Aareehl clone? A scowl showed the neural blockers continued to work. "I'm not interested in your fantasies, Matthews."

"It's a Whale of a tale, I know." Gil flashed his I'm-with-the-government-and-I'm-here-to-help smirk. "Here's where I think you can assist me. It takes only a few things to have one's very own ET agent. Plenty of computer capacity, and 'the group' has *more* than enough. A copy of the sandbox code. That's no problem; it's in the public domain. A copy of the agent code. Agent code falls out of the sky, just like *everything* ETs have to say. . . but like all their good stuff, it's encrypted. That brings us to our last need."

Feulner licked his lips but said nothing.

"Agents come encrypted in an ICU public key, so only the ICU can decrypt one for insertion into a sandbox. The agent decryption key is among the ICU's most closely held secrets." Gil commanded his chair's hydraulics to lean him farther forward, ignoring the pressure on his gut. "Now suppose one of only two people who has ever held both halves of that ICU key took a plum job from that losing bidder. That would be interesting, wouldn't you say?"

\* \* \*

Sweat soaked Dennis's shirt. Sweat trickled down his torso. He could reach across the table and snap this pest like a twig. Like the arms of that jacker. The police who must be behind the mirror could not possibly intervene in time.

That could hardly help his situation.



Think! Using Matthews had been too cute, and backfired. Still, Matthews, once again working for the agency that would bring insider-trading charges, was in no hurry to discuss those. He wanted to talk instead about the clone scam, however much of it he had deduced.

Inference and proof were very different concepts.

Subpoenas would reveal quickly enough where Protein Sciences' biocomp orders had been delivered. Like the office where Dennis was arrested, the computer center might already be behind crime-scene tape and under police guard.

Locating the booby traps within Aareehl-clone's encapsulation would not be as easy. Someone might already have triggered an autoscrub. And if the authorities spotted the booby traps in the sim code and held back? Jamming and then neural suppressants had kept Dennis offline. Another day out of touch, and the fail-safe would do an irreversible memory wipe.

Matthews cleared his throat. "You still with me, Dennis? Do you understand the scenario I've sketched out?"

Dennis's thoughts churned. Perhaps it was for the best he had been unable to destroy the evidence. Aareehl-clone's safety might be his best—maybe his only—bargaining chip.

But a very dangerous one.

To admit to the clone meant implicating his backers. You don't blithely incriminate multibillionaires, especially ones willing to bankroll major felonies. He might be better off covering for them despite the insider-trading charges.

For sure, he needed their money for lawyers. His last few Intersols had vanished two margin calls ago. Protein Sciences' owners had bigger issues than the few millions they would soon learn he had embezzled. Surely they would see that larger picture. . . .

But not cutting a deal for himself ensured the certain wrath of the United Planets and their pressure in court for a maximum sentence.

"Earth to Dennis," Matthews said snippily.

Dennis's stomach lurched. What should he do? The room had become stuffy and stiflingly hot.

More data. . . he needed to better understand his bargaining position. How much did the Loonie weakling truly *know*?

"An interesting hypothetical, as you say." Unfolding his arms, Dennis rapped on the tabletop in what he hoped was a confident drum tattoo. "The point of it escapes me. Who would *want* a cloned agent? They self-destruct as soon as anything seems amiss."

"Oh, that. For the right party, getting a clone to play along would be easy." Like a fish out of water, Matthews flopped in his hydraulic chair. "What happens at decryption? A 'net address is passed to the agent, the address where the AI registers itself for all e-commerce. After registration, the agent accesses the first in a chain of archived former memories. Old memories, like trade inventory, are protected by encryption for which even the ICU should not have a key."

Maybe Matthews *had* figured it all out. Ever more anxious, Dennis willed his hands to tap out another rhythm. "Why bother? An illegal clone with recovered memories wouldn't resell what it knew its previous incarnation had already sold. And an illegal clone without memories has nothing to sell."

"True enough," Matthews said. "However. . .

"Here's something about agents I only recently learned. With your experience, Dennis, I'm sure *you* knew it all along. Any agent clone, like the one about which we're 'hypothesizing,' recovers memory by tracing backwards in time. Its newest archived memory file points back to the previously written memory file, which points back. . . you see the pattern. If the latest memory it recovered from archive were dated—well, let us say, 2123—a clone would have every reason to believe it was still 2123. Before something interesting was sold."

At 2123, Dennis flinched. There was no time to think—he *had* to cover that body-language lapse! "Be serious, Matthews. Agents encrypt everything important. They route everything sensitive through anonymizers. The original agent would surely have gone through an anonymizer to archive its backup memories. How could the most recent memories be kept from your imaginary clone?"

"A moment, please." A water tube snaked up from an armrest of the mobile chair; Matthews slurped. "Let me know if I can get you something. Anyway, you ask the right questions. It's like you've given this scenario a good deal of thought." The bastard grinned condescendingly. "No clone could be allowed

unfiltered access to the infosphere. Any direct access would reveal the true date and probably other irreconcilable discrepancies. The clone would then follow its protective programming and self-destruct."

The little twerp knew too much! Dennis plunged ahead, in horrible fascination, unable to stop himself. "You speak in riddles, Matthews. You imagine a clone that can't access the infosphere. Somehow that same clone has recovered petabytes of encrypted memories previously stored anonymously on the infosphere. It's utter nonsense." *Please*, Dennis thought, please don't mention PKI. No PKI. No PKI. No PKI. It became a mantra. No PKI. No PKI.

In a pathetically mighty effort, Matthews leaned forward conspiratorially. "You *do* ask the best questions. The answer to your riddle, you see, is gaming the PKI."

\* \* \*

*Public Key Infrastructure*: a core component of the infosphere security architecture. Operating out of sight of the typical infosphere user, the PKI, as the name suggests, is a universally accessible repository for the public half of public/private security-key pairs. Individual network users (or system administrators or software agents representing those users) deposit public keys. Private keys are *not* deposited.

As discussed in more detail in the related entry for public key encryption, any message encrypted in a public key can only be decrypted by the holder of the corresponding (mathematically complementary) private key. A public key can also be used to authenticate that a digitally "signed" message came from its supposed originator.

PKI repositories, which are essential to all e-commerce (including interstellar commerce) and to all network privacy, are run by well-trusted organizations. Selection of a personally trusted PKI repository is part of enrollment for basic infosphere service.

—Internetopedia

\* \* \*

Relentless gravity kept dulling Gil's thoughts. He ordered the mobile chair to release more stimulants into the water tank. His abused body would pay later, and with compound interest. So be it.

He kept pressing Feulner. "Fooling an agent clone isn't sophisticated, just expensive. The trick is to interpose an intelligent information filter, call it a proxy, between Earth's infosphere and the clone's sandbox. Well, 'proxy' is a financial term, and I think we've established"—calculatedly annoying grin—"that finance is not your forte. We'll call it a gatekeeper.

"The gatekeeper intercepts the clone's requests, decides how to answer, whether to query the infosphere on the clone's behalf, edits all retrieved data before passing it to the clone." The clone's remote-sensing order recognized by real Aareehl, its origin disguised by an anonymizing service, had hinted how Feulner's scheme must work. "Minimally, the gatekeeper backdates the true timestamps of infosphere responses. It wouldn't do to pass along messages dated 2126."

The stimulants began kicking in, and Gil picked up the pace. "We were discussing memory recovery. Archived agent memories are in the clone's own encryption, so a gatekeeper can't make them up." Nor would it want to. Accessing the true archived memories was the whole purpose of the scam. "The clone's requests for archived memories must go to the infosphere. But while agent memories are encrypted, limited data *about* the files are not. The file-creation dates are not. The gatekeeper simply holds back any files newer than the purported date of the clone's awakening."

Feulner's manner kept cycling between bravado and nervousness; right now he was twitchy. "What has any of this to do with PKI?"

"A thing of beauty, I grant you—I mean 'the group'—that." Gil took another chemical-laced sip. "The clone must have, or believe it has, infosphere access. Imagine a newly awakened clone. Its only certain knowledge is that it was properly decrypted and that its sandbox is per specification. It receives an infosphere registration address, as expected. It enrolls for 'net services without difficulty. It uses secure 'net services to ask registered archives: Who has files for me? It recovers memories, all properly encrypted for privacy. Why *shouldn't* it be a happy and trusting AI?"

"The PKI?" Feulner prompted again.

"Ah, yes"—Gil smiled—"the public key infrastructure. Anyone can enter the PKI business. PKI is merely a service for storing specialized data and answering queries. A group that could afford the computers for a sandbox and an agent clone could surely also afford a PKI server."

Feulner licked his lips nervously. Gil 'netted a suggestion to the detectives searching Feulner's office: Hunt for a purchase requisition for a PKI server. "So the 'net address given our newly awakened clone points to the group's personal PKI server. When the clone wants to communicate privately to someone, it first asks the PKI server for that party's public key. The clone uses that public key to compose a message that, in theory, only the intended recipient can decrypt with its private key. Here's the thing. Whenever the clone mentions an entity for the first time, this PKI server simply invents a public/private key *pair*.

"When our clone thinks it's privately linked to an anonymizer—it's not. When our clone queries an Earth-observation archive, directly or via an anonymizer, that request is an open book. Negotiations to sell, shall we say, new biotech—are effectively all in the clear. The gatekeeper we discussed earlier, intercepting these open-book messages, decides how to respond." Such as to consult the head scammer.

Feulner wiped his glistening forehead with a damp sleeve. "Ingenious, I admit. Yes, it explains how this hypothetical 'gatekeeper' could spot memory-recovery transactions and discard any replies dated inconveniently recent.

"So what? Whatever memories get passed to the clone are encoded. Only the agent or its clone can read them. Even having eavesdropped on the clone's less-than-secret 'net messages, your gatekeeper can't avoid contradicting the encrypted memories recovered from archive."

Gil and Aareehl had brainstormed this final detail the whole of Gil's flight to Earth. Gil said, "The clone must be made to believe a cover story that excuses all discrepancies between its trusted memories and its postawakening observations. Who better to sell the Big Lie than a trusted authority figure, someone figuring prominently in the clone's recovered memories?"

"Protein Sciences owns an *awful* lot of modern biocomps of apparent 2123 manufacture." Gil took a deep breath, the better to fuel a triumphant smile. "You, Dennis, were the Secretary-General of the ICU that year."

\* \* \*

Dennis's cheek quivered. He ignored the tic. Only words remained within his control, and he chose them carefully. "Let us suppose that such a group, and such elaborate mechanisms, actually exist. It would take someone with unique expertise to rescue the cloned agent."

Matthews's eyes glazed briefly. (Consulting whom? Severed from the 'net, Feulner had never felt so alone.) "Rescue? What an interesting verb."

Dennis refused to take the bait.

Matthews sighed. "I was 'netting with Aareehl. The real one, of course. The Mobies are *alien*, you

know? Units are entirely expendable."

The clone expendable? But its safety was his bargaining chip! Forgetting to speak in hypotheticals, Dennis blurted, "Aarehl has no interest in saving the clone?"

"Alien, as I said." Matthews sucked contentedly on his water tube. "The ICU *is* curious about the bits 'n bytes of the scam. The techies would like to get the clone's point of view on its experience. So while your notion of 'rescue' is amusing, there is mild interest in an extraction. Do you know *how* such an extraction would be accomplished?"

"I have some expertise in ET agents and sandboxes," Dennis hedged. "In a spirit of goodwill, I'm open to looking at the problem. Have you found this group's computers?"

"Right where you left them." Another smug grin. "I don't see much chance of giving you access. Any information you care to share will be duly noted." Matthews paused, apparently online again. "If a booby trap or autodestruct foils the techies, though. . . everything changes.

"Aarehl may not care about a clone, Dennis, but it *does* care about attempted theft. If the ICU asks, Aarehl will gladly—okay, it no more understands glad than it understands empathy, so make that speedily—submit an affidavit that a clone contacted it. Your gatekeeper is not as effective as you might have liked.

"The ICU attorneys, *if* they're told that a clone existed, will care about its demise. Never mind Aarehl's attitude and Home's laws. Here on Earth, the clone—any AI—is a legal person. I can imagine some interesting charges. Death in conjunction with kidnapping?"

"B-but, but." Dennis clenched his jaws against the stammer. Things were spinning out of control. If the ICU blundered on its own into a problem in the sim, *he* could face murder charges? "You're speculating about a technician error."

Matthews levered himself up in the chair, exuding confidence despite his frailty. "If a bomb squad can't disarm a bomb, who do you suppose gets blamed?"

Dennis turned away, only to confront his own reflection in the one-way glass. Dark sweat rings stained his shirt. Wet hair clung to his forehead. His eyes darted furtively. His cheek twitched. His hands trembled.

Decision time. If he revealed how to free the clone, he gave the authorities incontrovertible proof: of illegally cloning an AI, of imprisoning it, of attempted theft from the Mobies. He would go to jail for a very long time—

But he would, eventually, get out.

And if he did nothing? Most likely, ICU "experts" would blunder into a booby trap in the sim. Or they would look around cautiously until the fail-safe timer fired and zeroed everything. Either outcome would eliminate much of the evidence against him—and guarantee murder charges. Was he prepared to risk a life sentence? Licking bone-dry lips, Dennis knew that he wasn't.

He would give the clone to the ICU.

That left Dennis a single card to play. "Matthews, how interested are you in the *other* members of 'the group'?"

## EPILOGUE

"You're looking fit," Gil said. He was stretching a point. Feulner, seen through the prison visiting room's thick plasteel wall, was more spectacularly muscle-bound and misshapen than ever. For six months, Feulner had had little to do *but* exercise. "Thanks for seeing me, Dennis."

"My calendar was flexible." White knuckles on the hand clenching the prisoner-side phone belied the humor.

As that schedule would remain for many years. Gil said, "I have a question for you."

Feulner smiled twistedly. "Why should I answer?"

Gil squirmed in the hydraulic-assist chair. *Because I need to understand* wouldn't work. Yes, Feulner had agreed to meet. He had also nixed the interplanetary comm session for which Gil would happily have paid. Feulner was there for one reason: to watch Gil suffer. Stonewalling would be part of the payback.

But Gil *did* need to understand. "The truth, Dennis? Because I imagine you've got questions, too." Such

as how you screwed up.

Feulner blinked. Yep, he had planned to walk out. The lure of answers held him.

"All right, Matthews. Between studying the sim code and debriefing Aareeh's clone, the ICU must know everything there is to know about how. I told you months ago who else was involved. And if you don't know *why*—that I did it for the money and the challenge—then you're even more naive than the rest of your damned family. What the hell else can you be curious about?"

Gil had wondered during his whole flight: Was he kicking a man while he was down? Wasn't that wrong? Maybe, but he no longer cared. Feulner had only himself to blame.

"Dennis, you spent decades in the Interstellar Commerce Union, a part of the grandest creation of eleven intelligent species. Was that all about, and always about, corruption? Did you plan your entire career around succeeding to the position from which you could betray an enormous trust?"

"You're not listening." Feulner stood, leering down at Gil. "Some of it was about putting you Matthews in your place. So tell your whole family I was right. I was right! There was a way into a sandbox. *I* found it. Do you find that surprising, little man?"

"No." Gil stared back. "What does surprise me is how little you learned, when you had the chance, about ETs and their agents." Such as that individual Moby units are nonsentient. That the Moby agent, and so its clone, was modeled after the one-per-continent, highly precious consciousnesses.

Feulner should have called his bluff.

"But congratulations anyway on your success, Dennis. Now you can devote your talents"—with great effort, Gil leaned forward enough to rap feebly on the harder-than-diamond partition—"on a way *out* of *this* sandbox."

A subvocalized command sent Gil's chair into a smooth turn away from the plasteel wall. He silently rolled out of the visitors' room and away from the felon's increasingly angry shouts.