

More Adventures on Other Planets

by Michael Cassutt

This is what they used to call a cute meet, back when movies were made by people like Ernst Lubitsch or Billy Wilder, when movies had plots and dialogue, when life and love had rules, back in the last century. A handsome officer in the Soviet embassy (does that tell you how long ago?) picks up the phone one day and hears a lilting female voice asking him if he can tell her, please, what is Lenin's middle name. "It's for my crossword puzzle."

Affronted, the officer snaps, "To dignify that question would be an insult to the Soviet Union!" And slams down the phone.

But not before he hears a lovely laugh.

That evening the officer goes to the British Embassy for some reception, and hears that same laugh emerging from the oh so luscious mouth of an English woman who should probably be Audrey Hepburn. Smitten, the officer walks up to Miss Hepburn, bows, and says, "Ilyich."

And so the story begins.

And so our story begins. Only—

Look, you're going to have to be patient with me. Because the couple is not just a couple. It's more of a quartet. And two of the individuals aren't even people.

Picture the surface of Europa , the icy moon of Jupiter. It is midday, local time, but the sky is black: what little atmosphere Europa possesses is insufficient to scatter enough light to give it a color . The combination of ice, snow, and rock create a patchwork of white and gray , something like a chessboard with no straight lines.

Europais tectonically active, about ten times as bouncy as any place on earth, so the landscape is marked by jagged upthrusts and creepy fissures known as cycloids.

But forget the landscape and the color of the sky. What really catches your attention is the striped ball that is Jupiter, looming overhead like a gigantic jack-o'-lantern. It actually seems to press down on the snowy landscape. What makes it a little worse is that since Europa is tide-locked, always keeping the same face toward its giant mother, if you happen to be working on that side of Europa , Jupiter is always there!

And so are several elements of the J2E2, the Joint Jupiter- EuropeanExpedition, three tiny rovers that have been operating on the icy plains for two years, scouting the site for the "permanent" Hoppa Station and erecting such necessary equipment as a shelter (even machines get cold on Europa), a radiothermal power plant, and the communications array.

On this particular day, rover element one, also known as "Earl," is approximately seven kilometers north of Hoppa when he receives a query from a source in motion (his comm gear is sophisticated enough to detect a slight Doppler effect) for range-rate data.

Element Earl can't see the source: his visual sensor is a hardy multi-spectral charged-couple device that is excellent for showing a view forward and all around. It lacks, however, a tilt mechanism that will let it see up.

Nor, given the priorities in his guidance system, can he presently provide range-rate data. In the burst of bits that made up rover-speak, Element Earl says, more or less, "I'm a Pathfinder-class rover element. You should be talking to the base unit at Hoppa Station."

He would think no more about the contact, except that there is a message of sorts embedded in the acknowledgment that suggests . . . compatibility . More than seems to exist between the Dopplering radio source and the base unit at Hoppa , in any case.

The Dopplering source is, in fact, a series of follow-up J2E2 packages designed to conduct the search for life in the dark, frigid ocean under Europa's icy crust.

All of these elements are wrapped inside a landing bag dropped from a mission bus launched from Earth two years after the initial bunch that included Element Earl and propelled Europa -ward by lightsail . The bus has burned into orbit around Europa , then waited for a command from La Jolla to separate the bag and its retro system.

The follow-up flight has been marred by software glitches, some of them due to undetected programming lapses back in the avionics lab in La Jolla, others to the assault of Jupiter's magnetic field. After all, the chips are only hardened against electromagnetic pulse from a nuclear weapon, not the steady and relentless assault of charged Jovian particles. Like a human trained to withstand a stomach punch only to find himself dragged behind a truck, the bus has suffered some damage.

Which is why one of its four elements, soon to be known as "Rebecca," goes on-line during the descent phase as a backup to the lander's systems, which are having a tough time locking on to the signal from Hoppa Station. Not to prolong the suspense, the landing package arrives safely, bouncing half a dozen times on the icy plain, punching holes in itself by design, and eventually disgorging four new elements.

It is only a week later when Element Earl, returning to station for thermal reasons, happens to detect (not see: his visual sensor is usually turned off to conserve power and he was simply retracing his original route) four new arrivals—the drilling, cargo, submersible, and portable power rover elements that will soon begin the search for life.

He passes close enough to the drilling rover, which is currently deploying its array, since diagnostics show it to have been damaged in the rolling, rocking landing. It so happens that the array wasn't damaged. But in the stream of bits flowing from the drilling rover to the Hoppa central unit and splashing from one rover to another, Element Earl notes the familiar signature of Element Rebecca.

As a bit of a joke, he aims his dish at hers, and feeds her the range-rate data she had asked for earlier.

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Mission control for J2E2 is in a crumbling three-story structure in the bad part of La Jolla, south of the Cove and bordering on the aptly-named Mission Beach. The building formerly housed an Internet service provider. The ISP had purchased and remodelled the place in 1998, hoping for business from the San Diego and North County high-tech communities, which were then wallowing in an unprecedented economic boom.

And did so for the better part of a decade, until a series of mergers closed the node. Then the AGC Corporation, newly formed by three researchers from UC-SD, just over the hill in La Jolla proper, leased the building for tests of their first real-time Superluminal Light Pulse Propagation / Emulation Regime (usually known as SLIPPER) on the 2012 asteroid Neva flyby. What the hell: the facility was already wired for fiber-optic and extreme bandwidth, and was configured for electrical and thermal support of AGC's ten-petaflop computer.

That was eighteen years and five interplanetary missions ago, and while the guts of what is now the J2E2 mission control have continued to evolve, the exterior has been left alone. Which presents the staff with a problem. The ISP operation had never employed more than a dozen people, while the AGC SLIPPER project has thirty or more in the building at all times.

The parking lot is simply inadequate, and with public transport in this part of La Jolla (remember, this is California) limited to the occasional bus, with working hours staggered, with rents and home prices in La Jolla among the highest in the country... well, disputes are inevitable.

Earl Tolan pulls his battered Chevy pickup into the gated lot and drives up to space eleven, only to find a brand-new Volvo already there.

Tolan is fifty-nine, a senior operator on the J2E2 project after moving to AGC from Lockheed Martin, where he led teams through good times and bad for twenty years. He is not one to lose his temper without reason.

But today he happens to be returning to work after what should have been a quick visit to the doctor, a checkup which wound up taking four hours and has left him in a bad mood. So the site of this impudent little Volvo taking up his space launches him into a state of only theoretically controlled fury.

He squeals the truck around so that its tailgate backs up to the Volvo. This is a bit of a trick, given the confined space. Tolan has to drive up and over a curb and sidewalk median just to get into position.

Once on station, as ops guys are fond of saying, he drops the tailgate, hauls out a length of chain and a hook he usually uses for attaching the smaller of his two boats to a trailer, wedges the hook in the Volvo's rear bumper, and loops the chain around his trailer hitch.

Then he gets into the truck, puts it in low, and hauls the Volvo out of his space, a maneuver which takes him up and onto the sidewalk and into the driveway beyond. The Volvo, its gear in park and its brake set, makes a screeching sound with its tires, followed by an ominous undercarriage scraping, before fetching up onto the sidewalk median.

Where Tolan leaves it.

Wallowing in momentary self-satisfaction, he pulls around into his space. He is still quite angry, in fact, when he emerges from the truck and heads for the building entrance, where he brushes shoulders with a woman going the other way.

Had his mood been anything less than ultraviolet anger and disgust, Tolan would certainly have managed to sidestep the charging woman while simultaneously noting her looks. Which, allowing for a certain air of growing confusion, are barely worth noting: she is a little over five feet, but adding stature with heeled sandals. A pair of gray slacks suggest muscular legs, and a vest worn over a J2E2 polo shirt does nothing to conceal the solidity within. Her hair is shoulder-length, dark, with a few lighter streaks, appropriate to her age, which is fiftyish. He thinks the eyes are green, but needs a closer look.

Not that he's inclined to give one. Twice-divorced, his sexual relationships are generally with women who would register as more attractive than this one on any visual scale.

What actually gets Tolan's attention is this woman's voice, which has what used to be called (in the days when people still consumed both) a whiskey and cigarette tone, tinged with some kind of Euro accent. Or perhaps it is the words she uses: "I'm gonna kill the son of a bitch who did this." Meaning haul her Volvo onto the median.

The woman calmly walks up to the vehicle, which still quivers in the aftermath of its relocation. She folds her arms, smiles with what could have been a touch of amusement.

Tolan can still make a clean escape, though he knows it won't be long before someone connects the evidentiary dots between Tolan's parking space, the skid marks from it to the Volvo's resting place. Besides, he is curious about the color of those eyes—so curious he forgets his anger over the momentary theft of a parking place, and his frustration over two hours of unwarranted medical tests.

"I'm the son of a bitch," Tolan said.

She looks at him. Yes, green, with a charming set of smile lines. "Aren't you old enough to know better?"

This strikes Tolan as unfair, given that he is staring at sixty on his next birthday and has just had a medical experience all-too-appropriate for that age. "Apparently not."

To her great credit, she laughs. "I assume this was your space." He nods. "Well, I'm so new I don't have an assigned one. And the guard did tell me you weren't likely to return today."

"Surprises all around." He holds out his hand. "Earl Tolan."

"Rebecca Marceau."

"I think we've met before."

"Cologne?" she said, then realizes where. She blushes. "Oh! Hoppa Station." Operators like Earl and Rebecca are often brought into the program without prior introductions. After all, they are usually mature professionals.

"Actually, about twelve clicks away," Earl says, wondering why he feels the need to be so precise.

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You have to forget everything you think you know about space flight. The SLIPPER operators aren't astronauts. In fact, there are damned few astronauts here in 2026, just a few poor souls stuck going round and round the earth for months at a time in the crumbling EarthStar space station, hoping their work will somehow overcome the bone loss or radiation exposure or even psychological barriers that prevented a manned mission to Mars, not to mention even more distance locales such as Europa .

But exploration of the solar system continues, using unmanned vehicles which can be controlled from distances of tens of millions of miles, more or less in real-time, by human beings. The advantages are many: the vehicles can be smaller, they need only be built for a one-way trip, and using SLIPPER-linked human operators allows spacecraft builders to skip the lengthy and unpredictable development of artificial intelligence systems.

J2E2's mission control in La Jolla, then, is more like a virtual reality game den than a Shuttle-era firing room. Yes, there are the basic trajectory and electrical support stations, complete with consoles, and there is a big screen that displays telemetry from all of the many separate elements, along with selected camera views.

But the real work is done in the eight booths at the back of the control room, where each operator strips naked and dons a skintight SLIPPER suit and helmet not awfully different from scuba gear, allowing her to link up in real-time with her avatar on Europa .

To see Jupiter looming permanently on the horizon.

To feel the shudders of the hourly quakes.

To hear the crunch of treads on ice.

To smell metal and composite baked by radiation.

You can even taste the surge of energy when linked to the generator for recharging.

It's all faux reality, of course, the work of clever programmers who have created a system which translates digital data from the elements themselves into simulated "feelings," then reverses the process, translating an operator's muscular impulse to reach, for example, into a command to rotate an antenna.

The best operators are those who know spacecraft and their limitations, who have proven that they can commit to a mission plan. People who simply like machines also make good operators. For J2E2, AGC tries to find those who can fit both matrixes.

And who are willing to take the risk of permanent nerve damage caused by the interface.

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Rebecca operates Earl's truck as he rocks the Volvo. He has chained the two vehicles together, and is learning that undoing his prank is easier than doing it, since the tightness of the driveway is forcing Rebecca and the truck to pull the Volvo at an angle.

But she expertly guns the motor just as Earl gets the Volvo's front wheels on the pavement. With a hump!and a whoof !and a reasonable amount of scraping, the Volvo shoots free. "That was suspiciously close to good sex," Rebecca says, delicately wiping sweat from her eyes.

Now it is Earl's turn to blush, something he can't remember happening in years. (He is old enough to know better about this, too.) He had been thinking the same thing. "You like cars," he says, lamely, fitting her neatly into that subset of the operator personality matrix, something the operators do both consciously and instinctively, like long-lost tribesmen smelling each other.

"Guilty, officer," she says, and looks at the truck, with its complement of nautical equipment. "And for you it must be boats."

"Two of them. A runabout and a forty-five-footer." The tribal recognition isn't strong enough to overcome their mutual antagonism. Note that there is no invitation to take a sail.

"See you on Europa ."

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On Europa , science is marching more slowly than usual. Element Rebecca is tasked with drilling a hole through the icy crust at a site seven kilometers north of Hoppa Station. The same spot Element Earl was scouting the day the science package arrived.

Now, from a distance, at the macro level, Europa's surface isn't as rugged as that of the rockier moons in the solar system. The constant Jovian tidal forces working on the ice and slush tend to smooth out the most extreme differences in height.

But at the micro level, down where a wheeled or tracked element must traverse, the surface resembles an unweathered lava field, filled with sharp boulders, crossed with narrow but deep fissures, cracks, and cycloids. These, of course, were mapped by Element Earl on his original recon—collecting that data was one of his primary goals, so it could be beamed to earth, turned into a three-dimensional map file, then uplinked to Element Rebecca.

The problem is, new cycloids can form in days, changing the whole landscape. Before Element Rebecca, her traverse delayed due to other equipment problems, gets five kilometers from Hoppa , her map ceases to be useful.

And there she stops, asking for guidance.

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Earl Tolan is what they used to call an unsympathetic character, back when people still made such judgments. You wouldn't like him, on first meeting. He is smart and also opinionated, a combination which has made friends, family, and co-workers uncomfortable, since he has a bad habit of telling others how best to live their lives, and with great accuracy.

You could wonder—Earl does, in his rare reflective moments—whether this trait was magnified by his twenty years in space ops, where you don't open your mouth unless you're sure of your facts, or Earl prospered in that field because it suited his nature.

He's also bull-headed and fatalistic. See above.

He has paid for his sins, however, in two failed marriages and the cool, distant relationships with his three children. His first marriage, to Kerry, the girl from his hometown in Tennessee, crumbled under the weight of too many moves, too much travel, ridiculous working hours. Kerry, who had put her own career on hold, understandably resented raising three children by herself. Earl, even less sympathetic in this period of his life than at present, started a relationship with Jilliane, a co-worker, which destroyed the marriage as quickly and thoroughly as if targeted by a cruise missile.

The collateral damage was to Earl's relationship with his three children, aged twelve, ten, and seven at the time of the breakup. His oldest daughter, Jordan, decided that the divorce was probably only seventy-five percent Earl's fault, and managed to forgive him, and even made friends with Jilliane when she and Earl married.

But the younger two children, Ben and Marcy, were lost to Earl. They are cordial, exchanging Christmas cards and the occasional phone call, and possibly seeing each other every two years. But their lives no

longer intersect.

Jordan, who is in touch with her father more frequently, saw what you would see, if you spent time with Earl. His energy, for example. It is formidable enough when employed on a project such as J2E2, but is downright memorable when put to use on, say, a weekend vacation with Jordan and her family, or on a remodelling job at her small house in Tucson.

Maybe this will help: Earl has learned some of life's harsher lessons. He works less. He flosses more often. He no longer allows a first impression to be his only impression.

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"Guess what? We have a problem."

It is the day after the cute meet in the AGC parking lot. On the floor below J2E2 mission control, Earl is buttoning his shirt after a shower and pro forma medical check, having just pulled the maximum authorized SLIPPER shift in taking Element Earl back to Hoppa Station. Gareth Haas, the Swiss deputy flight director, shows up. With him is Rebecca Marceau, half out of her SLIPPER suit. She is sweaty, her skin is lined with smeared marks from suit sensors, and her green eyes are red. At first Earl is almost disgusted by the sight of her.

Then he tries to be charitable, knowing that he wasn't looking any better half an hour earlier, knowing that, let's face it, in physical terms, with his stocky build, thinning hair, thick jaw and heavy brows, he's not much of a prize on his best day.

Especially with the results of his tests, just received this morning before his shift.

"I'm listening."

Haas and Rebecca explain the difficulties. "Rebecca," he says, meaning Element Rebecca, "can't get to the site."

Earl feels sick to his stomach. "Something wrong with the map?" The map derived from Element Earl data.

"The map's perfect," Rebecca says. "But Tufts Passage seems to have gotten tighter." She is referring to a tunnel in an ice hill just large enough for Element Earl (which is, in fact, about the size of a supermarket shopping cart) to pass through. "I'm stuck. Can't go forward, can't back up."

"That's pretty goddamn strange," Earl says.

"It might have been something as simple as the heat of Earl's passage melting the ice," Haas says, trying to be helpful.

"The power module's right on my butt, too," Rebecca says, "and Asif's even fatter than I am." She means Element Asif, named for its operator, a Bangladeshi Earl doesn't know well.

"So you need me to map a new route." What Earl wants to do is walk out of J2E2 mission control and never look back. To go to his forty-five-footer and take a sail, and maybe never come back. But what he says is, "Let's do it."

"You're outside your margin," Haas says. "I can't ask you to do the job."

"I'll get the doctors to sign a waiver."

"They won't. You know that."

"It's so risky," Rebecca says. "What if he has a failure while you're linked." This was a genuine problem:

ten years ago, during an earlier AGC SLIPPER operation on Mars, an operator happened to be linked real-time when his rover suffered a catastrophic failure. The operator suffered a stroke and was never the same again. Hence the limits and mission rules.

"Earl won't let me down," Earl says.

"He's got all the power he needs," Haas says, agreeing, "but he's had the Big Chill. He'll be going back into the cold without a bake. The accident rate is substantially higher—"

"I know that, you know that, we all know that," Earl snaps. "We also know that you wouldn't have asked me if you didn't need me. So let's go."

Rebecca requires further convincing. "What about the doctors?"

"Don't tell them I'm getting back in the suit."

Angry at their clumsiness, he chases them out of the dressing room. As he begins to don the suit, however, his mood changes. What if something did happen to Element Earl? The human operator knows that a mission is finite, that his linkage won't go on forever. But the elements on Europa are powered by radio-thermal generators that can give life for hundreds of years. Unless an element is totally destroyed, it lives on, diminished, possibly blind, but capable of responding to stimuli or processing data.

He zips up the suit, feeling a surprising pang of sadness. For Element Earl, or himself?

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It is always a mixture of pleasure and terror, being linked via SLIPPER to an element on Europa . One

of Earl's first instructors, knowing Earl's fondness for sailing and things nautical, compared it to Acapulco cliff diving. After a dozen sessions in the SLIPPER suit, Earl decided that his instructor was an idiot. Linking with an element was only like diving off a cliff if the moment of fear and exhilaration were stretched to an hour. Yes, there is the wonder of feeling that you are crunching European snow beneath your "feet," navigating your way through the jumbled heaps of ice like a child picking his way through a forest.

But you must also endure the sheer discomfort of the SLIPPER suit: the data leads that bite and scratch; the sweat that oozes from your neck, armpits, and crotch (occasionally shorting out a lead), then cools to a clammy pool in the small of your back; the stomach-turning smell of burnt flesh (which no one can seem to explain); the data overlays that mar your pristine vision; the goddamn chatter from Haas and his team, who treat all operators like children with "special needs"—all while feeling that you are being flung across the universe on the nose of a starship driven at near-light speed by a drunk.

Somehow, Earl forces himself to accept the usual stresses while ignoring the protests from the medical support team as he drives Element Earl back out on the trail. (The doctors have been conditioned to look for conditions that could be linked directly to SLIPPER side effects. Other than that, they give the operators great license, especially since each operator has already released AGC from liability now and forever.) For amusement, he watches the thermal readout of his element's temperature. It dropped sharply as he exited the Hoppa shelter, and now it climbs slowly as friction and the general expenditure of heat are displayed. It reminds Earl of waiting for a download on his first computer forty years back.

Except for the thin wall between booths, Earl and Rebecca could reach out and touch fingertips. Yet each exchange of data must go from Earl to Hoppa Station to Element Earl to Element Rebecca back to Hoppa and La Jolla, a round trip of 964,000,000 miles in a fraction of a second, thanks to the SLIPPER technology, which pumps data at 300 times the speed of light. For years Earl grew excited every time he thought about the process; now, of course, he finds even the tiniest glitch or lag to be an annoyance.

Today he even finds the traverse on Europa to be less than totally engaging. He is re-covering the same ground as the earlier traverse, in essence, crawling through an icy ditch for the second time.

But then he emerges onto a spot of flat ground, notes the tracks of Element Rebecca and its power unit on his original route, and veers off.

This is more challenging, up and down the slopes at an amazing five kilometers an hour. It feels like sailing in the open sea.

Then, just as Earl has grown comfortable with the traverse, Element Earl stalls on a slope that is slightly too steep. He is also in a shadow. Several data packets are squirted back, forth and around, their tone as close to panic as the operators and mission control ever get. Earl is encouraged to let Element Earl slip backwards down the icy slope in search of traction. Meanwhile, the Hoppa base unit will try to find a passable route—

Now the temperature readout, having gotten no higher than a sixth of the way up its scale, starts to plummet, like a barometer just before a storm. Earl finds this troubling, but knows that turning around now would mean doom.

"Back up twenty-two meters," Haas says on the voice loop. "We've got something here."

Element Earl slowly retraces his path—blindly, since the camera only points forward—but surely, since each turn of his wheels has been recorded and can be replayed precisely in reverse. Out of the shadow into the light.

Then forward into what appears to be a narrow passage in a wall of ice. Left. Left again. Temperature rising again. Good. Had it dropped much more, Earl would have had to begin the lengthy disengagement process—

Ping! It's Element Rebecca pulsing him, in direct line of sight. One more turn to the left, and Element Earl has visual, not only on Rebecca, but on Element Asif, the power rover, behind.

There is time for one slight push, an expensive one in terms of power. An electrical arc leaps between them, a common enough event when two machines touch in a vacuum. The event startles both Earls, and causes the displays to drop out for a moment.

Then all is well. Element Rebecca slews free, and continues backing up, clearing the way for Earl to approach Asif. "The drill site is that way. Follow me."

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"How do you like the work so far?" Earl has checked into Rebecca's background and knows that the J2E2 mission is her first. Just as he knows that her personal history makes him look like a model of stability, with three marriages (none lasting longer than four years) and at least one other semi-famous liaison. No children. Remembering a phrase from his youth, Earl has decided that Rebecca has commitment issues.

"Europa?It reminds me of home."

"You must have grown up someplace very cold and a long time ago." Which is a joke, since by 2026, after thirty years of global warming, there aren't many cold places left on the planet.

"It's not so much the cold," she says. "It's big Jupiter. My parents were teachers in B.C.,British Columbia . We lived in a place called Garibaldi, which had this gigantic rock face hanging over it.It always creeped me out. Jupiter feels like that."

They are having martinis as they watch the sun set from the stern of Earl's boat, the Atropos , in its slip inMissionBay . Both have been drained by the experience on Europa today, which required them to operate for six hours in Rebecca's case, ten in Earl's—much longer than the usual three. In spite of his initial feeling that he and Rebecca will never have anything beyond a professional relationship, Earl has accepted her invitation for a drink. A tribute to his stamina, she says.

Hoping to control the agenda, he suggested they come to his boat. Where he pours a second round, as a tribute to her courage, he says, and now Earl is feeling the effects of the alcohol, something he does not enjoy. But he would rather stay here overlooking the Pacific than return to his condo.

"How about you?" she says. "You've been doing this work almost from the beginning."

Earl is not one for introspection or emotion, or so he believes. "It's a great way to be on the cutting edge of exploration at an age when everyone else is retired."

She nods, amused at the banality of this. "Yeah, let's strike a blow for our demo. Age shall not only not wither us, it shan't even slow us down." Then she looks at him closely. "Earl, forgive me, we hardly know each other, but you don't look well."

And then, his barriers eroded by vodka, he starts to weep. "I've got a growth in my neck." In spite of his reservations, he reaches for her, and she takes him in.

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During the next week, the elements on Europa move into position. Element Earl stays in Pathfinder mode, blazing a trail to the crevasse picked out years ago by prior orbiting imagers. Element Rebecca follows, and deploys her drilling rig. Element Asif sets up nearby, a portable power station for the submersible operation. And the cargo element begins its trek from Hoppa carrying the submersible that will soon be sinking through Europa's ice into the mysterious darkness below.

The operations run relatively smoothly, with only nagging glitches caused by momentary loss of signal and a few jounces from J-quakes.

Here's the funny thing about elements like Earl and Rebecca: they are only being operated during critical maneuvers, perhaps a few hours out of every twenty-four. The rest of the time, when not powered down or recharging, they are autonomous.

There is a persistent feeling among all operators that their elements retain some of their personalities, even when the link is gone. It's silly, of course. As Earl's idiot instructor once said, "A turned-off light bulb doesn't remember that it used to give light!" To which Earl, in spite of his agreement with the instructor's point, answered, "A mobile computer with several gigabytes of memory is not a goddamn light bulb."

Every time Earl and Rebecca go back into operation, they find that Earl, no matter what his last programmed position, has returned to the crevice where Element Rebecca chews through the ice. "I think it might be a case of love at first bite," Rebecca tells Earl one night, as they walk along the dock, hand in hand.

Earl's response is to kiss her, though he stops a bit sooner than she would like. "I won't break," she tells him, playfully.

"I might, though." Earl feels frail, or dishonest. He has told Rebecca everything the doctors told him, that the growth is malignant, but that chemo and radiation and even some experimental genetic treatments might knock it down. For the first few days after being slammed with the news, he almost laughed it off, knowing he could fight and win. But the first rounds of chemo left him shaken. The horizon of his life has drawn closer, like that of an ice plain on Europa compared to the Pacific.

"I'll be gentle," she says, kissing him again. Rebecca's intensity has helped. It's as if she is offering her own strength as another form of treatment.

This is an evening in winter, with the marine layer already rolling in from the west, shrouding the hills of Point Loma across the bay. Earl is lost in them. "Still ploughing snow on Europa?" she says, fishing for a connection.

"No. Thinking about a trip I've wanted to make." He nods out to sea. "Catalina Island's out there, a hundred miles away. I've always wanted to sail up and never have."

"Doesn't AGC give vacations?"

"Sure. But nobody wants to take one with an op in progress."

"This one will end."

"For you," he says, meaning Element Rebecca, who only has so much drilling to accomplish before she is shunted off to the side, to a secondary mapping mission for which she is ill-equipped. "Sorry," he adds, realizing how shitty and snappish he sounds. "I just—"

She touches a finger to his lips. "Sshh. I know exactly what you mean. I knew the ops plan when I

signed up."

Within a few steps they reach the Atropos , and the sight of it bobbing in the twilight raises Earl's spirits. By the time he has finished rigging it for an evening sail, he feels strong enough to face anything, and slightly ashamed of his earlier weakness. "Love at first byte," he says, laughing. "I just now got it."

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As the drilling proceeds, Element Earl is relegated to geological surveys of the area further to the north and east of the site. He finds it smoother, icier and flatter than the terrain around HoppaStation, and Earl himself wonders again why that location was chosen, only to be told by Haas that it provided easier access to the crevasse. Or so it seemed.

In any case, the flight control team and the science support group are completely consumed by the descent of the submersible element through the ice and "the beginnings of the first real search for life in the history of human exploration of the solar system"—at least, according to the AGC Website.

The cargo unit has replaced Element Rebecca at the drillhead , and she has been moved off to her secondary mission as well, mapping to the south and east of the hole in the ice, her data combined with Element Earl's to give a multi-dimensional picture of the terrain. They amuse themselves by giving completely inappropriate southernCalifornia names to European landmarks: Point Loma for an ice lake, the Beach and Tennis Club for a jumble of ice boulders, Angeles Crest for a jagged crevasse, Catalina Island for a passageway visible on the far end of Point Loma.

Neither element can venture too far away, of course, since they need to be in line-of-sight comm every few hours. Whenever Earl suits up, he finds himself strangely comforted by the sight of Element Rebecca—shiny, box-like, asymmetrical, and small—through Element Earl's sensors.

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In between shifts, Earl deals with ex-wives Kerry and Jilliane . The old bitterness toward and from Kerry still garbles communications between them, the way a solar flare degrades the SLIPPER link. The fact of Earl's new condition only means that Kerry will allow some sympathy and tenderness to leak into encounters that have been frosty for years. The same applies to the children, Ben and Marcy.

Jilliane, who ultimately left Earl four years ago, is consumed by guilt, and offers herself as everything from nurse to sexual partner, until Earl's work schedule and general moodiness cause her to remember why she ran off in the first place. Rebecca's presence makes her feel superfluous.

Then there is Jordan, who takes time from her family and flies to La Jolla for a visit. She meets Rebecca, and offers her approval, and will be present whenever Earl needs her. At the moment, that's not often. He believes he will beat the disease—at least postponing his inevitable doom by five years.

A month to the day after meeting Rebecca, after his diagnosis, Earl shows up at AGC mission control with his head shaved. Concerned about his privacy, and surprised, Rebecca can't ask him why until hours later.

"I start chemo on Monday," Earl says, tentatively rubbing his shiny dome. "The hair is going to be the first casualty."

"Not right away!" she says, protesting.

"No. But everyone will be able to see it coming out in clumps, and I'd rather not display my deterioration so soon."

Rebecca's despair over Earl's change in looks—the pale, naked skull is not an improvement—and Earl's own ambivalence over what may have been a self-destructive impulse are lost in the broad spectrum noise emerging from the science support room at AGC mission control. The submersible element, after three weeks of increasingly frustrating dives in the lightless freezing slurry that is Europa -under-the-crust, has picked up motion at the very limit of its sonar system.

Is it some sort of animal or plant life? Or is it a spurious signal? The science team and its journalistic symbionts spread the news anyway.

When Earl and Rebecca return to AGC early the next day for their shifts, they are forced to park off the site and walk through the crowd that has gathered.

Earl, just out of a chemo session, is weakened by the walk and the wait to a degree he finds astonishing. He barely has the strength to zip up his SLIPPER suit, alarming the medical support team, who know by now that he has a "problem."

Even Rebecca finds herself distracted and jittery when she finally dons her SLIPPER suit to resume the mapping operation.

It is Element Rebecca and Element Earl who find themselves together on the European ice plain. "Just imagine," Rebecca says, thumping one of her manipulators on the surface, "something is swimming around down there."

"Yeah, the submersible."

"Come on! I mean some European jellyfish! Doesn't that excite you?"

"Only because it means we accomplished the mission."

"That's not very romantic."

"Who said I was romantic?"

"You did. You and your blue eyes and your goddamned boat and sailing to Catlina —"

"Well, I'm not feeling very romantic these days. Unless dying of the same disease that killed U. S. Grant and Babe Ruth is romantic."

In La Jolla, Rebecca forms an answer, but even at three hundred-plus times light speed, there is not enough time to relay it, because Element Rebecca has rolled across a thin sheet of ice insufficient to support even a mass of a twenty kilograms.

The ice cracks, separates. As Element Earl helplessly records the scene from a distance of sixty-five meters, Element Rebecca teeters in the fissure, antenna slewing one way, the drilling arm swinging forward in what can only be a desperate search for traction, then silently disappears into a crevasse.

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The aftermath of the event is prolonged and messy. There is only momentary loss of comm between Rebecca and her element, because Element Earl moves into position at the rim of the crevasse and provides line-of-sight.

Rebecca herself experiences the loss of support and the beginning of a terrifying plunge just as surely as if she'd been standing on the European ice in person.

Then there is nothing.

Then there comes a rattle of almost randomly-scattered data bits, quickly telling Rebecca that her element is wedged on its side in a fissure of ice, that her drilling arm and camera have been torn off. She is blind, broken, beyond reach.

But alive. Her radio-thermal power source ensures that Element Rebecca will continue to send data for the next several years.

Nauseous from his medication and the horrifying accident, Earl can do nothing but wait, though not silently. Even while operating Element Earl, he has grown irritated with the mission control team's obvious distraction, as the ghost sonar squiggle of a theoretical European life form is played over and over again. "Haas," he snaps on the open loop, "drop the Ahab routine and pay some fucking attention here."

"No need to get nasty, Earl," Haas says. "We're on top of things."

"If you were on top of things, she wouldn't have fallen."

"Earl," Rebecca says. "It's okay."

Hearing her voice quiets him, as does the false serenity of the European landscape. Jupiter is at the edge of his field of vision. The sight angers him. Big, fat useless ball of ice—

Then he sees nothing at all. The link between Element Earl and La Jolla still functions, but the La Jolla end has failed.

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Earl Tolan is taken to UC-SD Medical Center, where he dies four hours later. The cause of death is listed as a heart attack; the real cause is almost certainly complications from throat cancer and related treatment.

Once over her shock at the double loss of a single day—Element Rebecca and Earl himself—Rebecca

sees the unexpected heart attack as a blessing, saving Earl and Rebecca and Jordan the horror of the almost certain laryngectomy and talking through a stoma and more radiation and the swelling and the pain and the horror of knowing that it will never get better, only worse.

Rebecca helps Jordan dispose of Earl's possessions. The Atropos is the trickiest of them, ultimately sold for a pittance in a depressed boating market.

The submersible element records more ghost blips before falling silent, a victim of cold, several weeks past its design life. Rebecca resigns from the operator program and is reassigned to AGC's "advanced planning" unit, helping with the design of a new set of elements for another European mission.

One day three months after that awful day she returns to mission control, dons a SLIPPER suit and spends a few moments on the icy plains of Europa with Element Earl.

Her last command aims him across Point Loma toward distant Catalina.

The End