

EVERY HOLE IS OUTLINED

John Barnes

John Barnes is one of the most prolific and popular of all the writers who entered SF in the eighties. His many books include the novels *A Million Open Doors*, *Mother of Storms*, *Orbital Resonance*, *Kaleidoscope Century*, *Candle*, *Earth Made of Glass*, *The Merchants of Souls*, *Sin of Origin*, *One for the Morning Glory*, *The Sky So Big and Black*, *The Duke of Uranium*, *A Princess of the Aerie*, *In the Hall of the Martian King*, *Gaudeamus*, *Finity*, *Patton's Spaceship*, *Washington's Dirigible*, *Caesar's Bicycle*, *The Man Who Pulled Down the Sky*, and others, as well as two novels written with astronaut Buzz Aldrin, *The Return* and *Encounter with Tiber*. Long a mainstay of *Analog*, and now a regular at *Jim Baen's Universe*, his short work has been collected in...*And Orion* and *Apostrophes & Apocalypses*. His most recent book is the novel *The Armies of Memory*. Barnes lives in Colorado and works in the field of semiotics.

In the complex and resonant story that follows, he takes us to a far-future universe where a new recruit to the crew of a starship soon discovers the strange, and profoundly moving, rituals that are part of life on board...

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THE SHIP WAS AT LEAST fourteen thousand years old in slowtime and more than two thousand in eintime, but there were holes in its records and the oldest ones were in no-longer-accessible formats, so the ship estimated that it was more like eighteen thousand slowtime, three and a half thousand eintime. It had borne many names. Currently it was 9743, a name that translated easily for Approach Control no matter where the ship went in human space.

In the last two centuries of eintime, the ship's conversation with most ports had been wholly mathematical. Synminds chattered about physics

and astronomy to get the ship into a berth, and about prices and quantities and addresses afterward, and the human crew had not learned a word of the local language, despite their efforts, except such guesses as that the first things people said probably were something like “hello,” and the last things something like “good-bye,” and in between, perhaps, they might pick up equivalents of “may I?” and “thank you.”

This had little immediate impact on the ship’s operation except that mathematical worlds had no entertainment, or at least none they would sell to the ship’s library; the long-run concern was that the mathematical worlds tended to begin waving off all ships and not communicating at all, after a time, though strangely some of those dark worlds would sometimes begin to talk and call for ships again, after an interval of a few centuries slowtime.

But the problem for this evening meal was both shorter-run than procuring entertainment for the ship’s library, and much longer-run than the gradual darkening of the worlds. They needed a new crew member, and they were having a real supper tonight, with cooked food, wine, and gravity, to discuss how to get one.

9743 needed a crew of four to work it, when it needed working, which was only for system entries and system departures because the law of space required it, and for PPDs (the business and navigation sessions held whenever predicted prices at destination shifted enough to require considering a course change) because the crew were the stockholders and synminds were required to consult them. Normally they would work the ship for half a shift for PPDs, but sometimes traffic density close to a star was high enough to engage gammor restrictions for as much as a light-day out from the port, and then 9743 had to have crew in the opshall for more than one shift.

Therefore, for the very rare case of needing more than one shift, the ship usually carried eight people: Arthur and Phlox, who were married and were the captain and first mate; Debi and Yoko, the two physicist’s mates, who shared a large compartment with Squire, who was the physicist; Peter, the astronomer, who was too autistic to sleep with anyone or even to talk much, but a good astronomer and good at sitting beside people and keeping them company; and Mtepic, the mathematician, whose wife Sudden Crow, the mathematician’s mate, had died two years ago in eintime.

In slowtime it had been ten and a half years ago, but ship people have a saying that no one lives in slowtime. By “no one,” they mean almost everyone.

Arthur and Phlox had thought that Mtepic might be too old for another wife, but he surprised them by saying he thought he might have another twenty years of eintime left and he didn't want to spend it alone.

There was actually only one possible conclusion. They would have to buy someone from a slave world. That was a bad thing, but not hopelessly bad—rather common in fact. Debi, Peter, Sudden Crow, and Arthur had all been slaves, and at least Debi and Arthur felt strongly that buying a slave into a free life, though morally questionable, was usually good for the slave.

The others had been adopted as infants, raised to age four or five on 9743, and then sent through slowtime on a training ship to rejoin the crew when they were adults. All seven of them, whether born slave or free, agreed that it was better to be raised as ship people right from the start.

But they had had no plans for coping when Sudden Crow had died at fifty-one, without warning, from weightless calcium heart atrophy and overweight. 9743 was at least two years eintime from anywhere with freeborn babies available. They would have had to acquire the baby, tend it till it was four or five years old—a long time for a cargo ship to put up with a child, for ship people don't like to be around other people very much, and children must have attention all the time.

It would constrain them for several voyages—first to a world with adoptable freeborns, then to a shorthaul pair (two inhabited star systems within six or seven light-years of each other) with a training ship orbiting one of them. That shorthaul pair would need to be four to five years eintime away, between twenty-one and twenty-seven light-years distance at the 98.2%*c* that 9743 usually traveled.

At the shorthaul pair 9743 would then have to hand the child over to the training ship, work a shorthaul shuttle back and forth, then return, rendezvous with the training ship, and pick up the former four-year-old as a trained teenage crew member. It would add up to decades of running badly off the isoprofit geodesic.

They could have afforded that, but the nearest shorthaul pair was Sol/Alfsentary, which was nearly five years eintime away from the nearest system that sold babies. This could all add up to as much as seventeen years eintime before the teenaged crew member came back aboard to keep Mtepic company.

Mtepic was eighty-one and if he died anytime soon, they would not have a mathematician at all. Phlox and Debi, both of whom had math as a secondary, would have to cover, and the whole ship would have to assume the risk of having rusty, less-capable mathematicians filling in.

Besides, the best isoprofit geodesic available for adopting and training a freeborn baby had miserable numbers—long hauls and low profits throughout. A slave would be better, surely. And it was not so bad for the slave, they all assured each other.

The slave market at Thogmarch, the main inhabited world in the Beytydry system, was only six light-years away, and their cargo would take only a small loss there, one that 9743 Corporation could easily absorb and infinitely cheaper than the costs of dealing with a depressed mathematician. The medical synmind was confident at 94.4 percent that Mtepic was depressed. Besides, Mtepic said he was, and thought it was because of the loneliness. The synmind concurred with 78.5 percent confidence that a new mathematician's apprentice would help lift Mtepic out of it, but the crew were all sure that estimate was low—medics hate to make predictions of any kind about enfleshed intelligences.

9743 had some spare mass to feed to the shielder, and they could safely boost up to 98.65%*c* and reach Thogmarch in a little less than an einyear. If they radioed now, the message would arrive at Thogmarch almost seven weeks before the ship itself did, so that they could have buyers and sellers ready for cargo switch on arrival, and have dealers lined up to sell them an apprentice mathematician with the sort of personality that could learn to like ship life.

"And 9743 has never bought a slave who wasn't grateful for a chance to stay on after manumission," Arthur said, finishing his long, slow reprise, which had begun with the appetizers and was now finishing in the wine after dessert. "Life here compared to what they have dirtside is a lot better."

Arthur was fond of explaining things that everyone already knew, which was utterly typical. Captains are notorious for spending much time explaining unnecessarily.

Even ship people say so, and for them to say that is saying something, for ship people are all that way. They like to let the talk be slow and affectionate and thorough. They acquire a habit of listening to things they have heard many times before, and already know by heart, just to indulge the person who needs to speak; and, so that the ears of the others stay friendly, most of them learn not to talk very much except at formal

occasions.

“Mostly,” Peter said, startling them all because he spoke so infrequently, “we allow them some dignity and privacy.” He meant the slaves, of course, though he might have meant anyone on the ship. “And by the time the first voyage is up they don’t miss home, which anyway gets far enough into the past that it becomes hard to return to.” He drank off a glass of the chilled white wine; they had turned on the gammors for an extra hour this week, to enjoy a sit-down meal in the conference room, because this was a matter that needed some serious attention. At 98.1 %c, with a course change imminent, a quarter g of acceleration for a few hours of sitting and talking would have little effect on anything. “I’m for,” Peter said.

“We’re not *at* voting yet,” Debi corrected him, a little fussily, which was how she did everything.

Squire rubbed her shoulders; it never made her less fussy but they both enjoyed it. “We know what he means, though. This is something that has always worked so far. We find a teenager with very high math aptitude and very low interpersonal attachment. Slavers are cruel; we are merely indifferent. If she doesn’t have too much need for interpersonal attachment, she may even think we are kind—you do want a girl, right, Mtepic?”

“Yes, a girl.”

Squire gestured like a man who would have liked to have a blackboard. “Well, then, life on the ship is better than being beaten and used and ordered about; a bit of respect and dignity often works wonders.”

Phlox was nodding, and when she did, people usually felt that the vote had already been taken, and the thing approved. Everyone, even Arthur, said she would be a better captain, once he died. She rested her hands together in a little tent in front of her, nodded again, and said, “When we manumit her, she will want to stay with us. They always do. So this plan will get us a new mathematician’s mate who can eventually become our mathematician. It is not as kind as adopting a freeborn baby and having a training ship raise the baby as a free member of the ship’s company, and it is not as easy as working an exchange with another ship would be if there were another ship to do it with. But it is kind enough, and easy enough. So we are going to settle on doing it. Now let us enjoy talking about it for some more hours.”

Everyone nodded; ship people are direct, even about delaying getting to the point, and they like to know how new things will come out, before they

start them, because they so rarely do.

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In the young woman's file, Mtepic had read that Xhrina had been born a shareworker's daughter on Thogmarch, and her sale forced, when she was two, by her parents' bankruptcy. Her records showed that because she had intellectual talent but great difficulty learning social skills, she had been little valued on Thogmarch. The slaver who owned her had slated her for some post where her ability to endure humiliation over the long haul would be an asset; he had in mind either an aristocrat with a taste for brutalizing women, or a household that wanted to boast of its wealth by using human beings instead of robots to scrub floors and clean toilets.

Mtepic, as not only the person who would be working and living with her, but also the most empathetic person on board 9743 (according to the medic-synmind's most recent testing), had been sent dirtside to decide whether to buy Xhrina, and as he sat in the clean-air support tank his major thought was that he would take her if at all possible, rather than endure planetary gravity for much longer.

His bones were old and space-rotten. Though he was strapped up against the interior supports of the tank, and a small man, there was still far too much weight.

Xhrina spoke a language with a distributed grammar and numerous Altaic and Semitic roots, so the translator box worked tolerably well, and with her aptitude, she was unlikely to have any trouble learning Navish, once she was aboard. Mtepic thought her voice was surprisingly musical for someone so discouraged and unhappy. After he outlined what would happen if 9743 bought her, and made sure the translator had made it clear to her, he asked, "Do you want us to buy you, then?"

She trilled a soft trickle of sweet soprano sibilance. The translator box said, "This property had not yet realized there was any choice with respect to the subject at hand, my-sir."

"Officially there is not. Unofficially, we don't like slaving; 9743 has never carried slaves and never will. As you may know, slaving planets all enforce the Karkh Code on ships carrying slaves, so we cannot manumit you until you have performed satisfactory service for thirty years. But the Karkh Code operates in slowtime; in eintime, time as we experience it, you will be a slave for less than seven years, perhaps much less. And as much as we can manage it, within the limits of the Karkh Code, you will be a slave

in the eyes of the law only. We won't ever treat you as a slave." He had to put that through the translator to her a few times, and they went back and forth again until he was sure she understood the deal.

"And my-sir still makes it have a sounding, correction, gives it an aura of, as if it were this property's choice, my-sir, and this property is trained not to make choices where my-sir has the right to choose."

He went at it a sentence at a time, forcing himself to be patient with the translator, which had the uncaring stupidity one would expect of a synmind.

The first critical sentence Mtepic communicated was, "If you ask that we not buy you, we will buy someone else."

Next, because it might matter to her, whether or not she was allowed to think it did, he spent a while explaining that, "Once you are on board, you will be expected to share a bed with me—my demands are minor, at my age, mostly that you keep away loneliness. Other crew will probably not want sex from you, being happy as they are, but if they do you will comply; our computer must show that for the Karkh Code manumission."

She seemed to accept that too easily and he didn't want her to think that was the main issue, so then he worked on getting her to understand that "you will not be coming aboard as a bedmate. Your main job will be to learn enough mathematics so that you are qualified as a mathematician's mate by the time we reach a port where we are legally allowed to free you with a universal manumission so that you will not be in danger if you change ships, or disembark and then travel again. At that port, you can leave our company if you like, or stay in the crew as a shareholder." That was actually easier to say, because the synmind was designed to understand contracts.

Then he got back to the main point, again, and this time it seemed to go faster. "If you ask that we not buy you, we will buy someone else. We do not want you to be unwilling."

"It is forbidden for this property to consider whether this property is willing for anything my-sir wills, my-sir, and I cannot know how this property will feel if this property is ever permitted to consider it, my-sir." She smiled when she said that; perhaps to let him know that she could only speak the formulas, or that the translator would only translate into the formulas, but that she accepted what he was saying, was that it? Or perhaps something in all this appealed to her sense of humor? In either case, he liked her for that smile.

Mtepic breathed deeply and let the thousands of mechanical fingers lift him straight, and the neurostimulators sharpen his perception and ease his discomfort.

Xhrina's skin was brown; the slavers had genetically modified her for almost pure-white hair; her nose was long and slim and her jaw and teeth perfectly formed. Her eyes were dark and almond-shaped. He thought that as little as twenty years ago, he would have felt physically attracted. Now, just turned eighty-three, he was attracted by what he could get through the censoring translator: that she didn't seem to want to exaggerate or overpromise, and clearly *had* an opinion she was trying to express.

He gave her another angle on it, just to make sure. "We think, based on your psychological evaluation, that you are suited to shipboard life, and you will be living like a free crewmember as soon as we leave the dock here." That seemed to go right through.

"If this property may ask, is crew life like freeborn life, my-sir?"

"You can always accept a payout and leave at the next port. Of course you have to be on the ship until we reach a port, and if you did decide to leave the ship after your first couple of voyages, you would have to move into a hospital for rehabilitation if you wanted to move permanently to a planetary surface." That thought reminded Mtepic of how painful the high gravity was, and so he decided to press the offer a little more. He just hoped he correctly understood her quirky smile still struggling through her slavery-deadened face. "I would like you to come with us," he said. "I am asking you. I could buy you and *make* you. I prefer that you say yes." And trying to think of what else he had to offer, he said, "My first order to you, as soon as you are on the ship, will be that you address no one as 'my-sir,' but speak to us all as equals."

She grinned at him as if on the brink of outright laughter. "Then if it pleases my-sir, this property wants to be bought by my-sir, my-sir."

He was fairly sure that was not what she had said, but surely it had been some form of yes. He didn't trouble to conceal his sigh of relief.

A few hours later, at her welcome-aboard dinner on *9743*, once she had been assured that now she would never be returned to Thogmarch, she used an uncontrolled translator to explain, "I was always going to say yes, but the translator didn't want me to know I was being asked to say it because I wasn't supposed to have any choices or respond to them if

anyone offered me any. Once I figured out what it wasn't translating, of course I said yes—it was such a pleasure to be asked. And I beg Mtepic's forgiveness, for having kept you upright for too long in that uncomfortable tank." And she favored him again with that extraordinary smile.

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Two years eintime, eleven slowtime, on their way to the Sol system; the earlier PPDs had flipped because at Thogmarch they had acquired cargo P-Hy-9743-R56, which was forecast to be at peak value at Sol almost exactly at arrival time. Xhrina's Navish was fluent and she was already well into group and ring theory, and apter than her test scores showed. Mtepic had turned eight-five the day before, and Xhrina had been disappointed that no one wanted to have a party for him this year (she'd only been able to get two of them to participate the year before), so she'd held one for just the two of them. She had learned to find it comforting when his fragile body pressed against her in the sleepsack, his skin so soft and dry that he felt like a paper bag of old chicken bones, and she was pleased to indulge his liking for going to bed at the same time; when he died, she would miss his company, but he would probably live for many more years; many ship people lived to be 110.

On the rare occasions when he still wanted any sort of sex, he would gently wake her and ask very politely. She understood that he was determined that she should forget that she was a slave, but Xhrina believed in rules, and would not stop being a slave till she was manumitted, though she was delighted to be ordered to behave like a free person, because the pure autophagy of it made her laugh. They often argued about that in a good-natured way, as he insisted on knowing what she thought and she attempted to tell him only what he wanted to hear, and they enjoyed their mutual failure.

She doubted whether she would ever love anyone, but if she did, it would have been very convenient and not at all a bother or a danger to have loved Mtepic.

When his age-knobbed knuckles brushed down her naked back she turned to let him touch her where he liked, but he placed a finger on her mouth and breathed, "Come with me" in her ear.

He slipped from the sleepsack and swam to his clothes. It was dim in the compartment with only the convenience lights on. As she popped from the sleepsack, he smiled at the sight of her, as he always did, and pushed her coverall bag toward her. She caught it and dressed as she had learned

to do, in one movement, like his but swifter because she was young.

He beckoned her to follow him, and opened the hatch into the main crewpipe. They swam in silence up the center of the crewpipe to the opsball. She had only been there the four times that 9743 had needed working: first while they were kerring up the gravity well of Thogmarch, second as they kerred three light-weeks up the gravity well of Beytydry, once before they picked their next destination and turned the main gammors loose to leave Beytydry orbit, and then just two weeks ago for the PPD as budgets, prices, positions, relative velocities, and predictions changed.

That last time, just two weeks ago, Xhrina had been able to follow the discussions, though not really participate in them. Still, she appreciated that Mtepic was a very good ship's mathematician. It had made her bend harder to her studies, for to be an excellent ship's mathematician seemed a very grand thing to her, partly because it was clear that all the other ship people respected it, and mostly because it was what Mtepic was.

But this fifth time in the opsball, they were the only ones. He did not turn on the lights; they sneaked in as if to steal something.

She didn't ask.

She had come, in two years eintime with him, to trust Mtepic. Sometimes she asked herself if she wasn't just being a very faithful slave, but generally she felt that she was trusting like a free person, that Mtepic and she were friends like free people, and Xhrina was secretly very proud of that.

So she didn't ask. She just floated beside Mtepic on one side of the opsball. Since he seemed to be very quiet, she tried to stay even quieter.

Presently the surfaces all around them began to glow, and then the image of the stars shone round the opsball, just as if the human crew were about to commence operation, but perhaps a tenth as brightly. For a moment the display was Dopplered, and there was a blue pole that contained a crunched-down vivid blue Cassipy with Sol and Alfsentary in it, and a red smeared-out Leyo and Viryo, but in less than a second the display corrected.

Mtepic and Xhrina floated in what looked exactly like the dark between the stars, warm and comfortable in their crew coveralls. It was so beautiful with no working screens pulled up that she wondered why the crew did not

do this all the time. Perhaps she could get permission to float here among the pictures of the stars, now and then, on her off-awake shift?

She had lost count of the breaths she had slowly drawn and released as she watched the projected stars creep along the surface of the opsball when from one side of the opsball, where Leyo was crawling slowly across, a pale white glow like a broken-off bit of the Milky Way burgeoned from a blurry dot to a coin of fog and thence into a lumpy fist of thin white swirl. The swirl swelled into a cloud of particles, then of objects, which surged to swallow the ship and closed around them like a hand grasping a baby bird.

The particles were now as large as people—they were people—translucent and glowing, many of them gesturing as if talking, but not to each other, more as if they had all been abstracted from some larger conversation. The vast crowd converged around the ship, and then all of them were gone except for the dozen who passed right through the wall and into the opsball.

How was that possible? Xhrina wondered. The opsball was buried deep in the center of the ship, 750 meters of holds, lifemachines, quarters, and engines in all directions around it, but the translucent figures, glowing perhaps half as bright as the brightest stars, seemed to merge directly from space outside the ship into space inside the ship.

The pallid figures, mere surfaces and outlines of people, filled the dark sphere. They all took up crew stations as if they were where they belonged, reaching for the opsball surface and calling up workscreens before them, drawing them with their fingers or spreading them with their hands just as regular crew did. The one nearest her was a woman whose strangely patterned coverall had sleeves for both legs and arms, slippers for the feet, and gloves on the hands; Xhrina wondered what sort of ship it was that necessitated so much clothing. That woman seemed to be an astronomer, by what Xhrina could see over her shoulder to her screen, but the graphics were labeled in a language that was not written like Navish.

Directly in front of her, a man who wore coat, shirt, and pants like people in prestellar Earth stories tumbled slowly, pointing and gesturing as if he were the captain. Through his dim translucent sheen, Xhrina could see a nude young woman whose head was half-missing, simply gone behind the ears with brains spilling down her back. Despite that, the young woman was working at a very large screen, apparently trying to estimate a vast matrix and not liking what she saw, redoing and redoing; the screen looked like the math software that Xhrina herself used. As she watched, the naked woman beat on the screen with her fists; Xhrina wondered if the problem

was what was on the screen, or the lost parts of her brain.

All round the mathematician and his apprentice, the ghosts worked their ghostly screens, seeming as unaware of each other as of the living beings. They went on working—laughing, cursing, pounding, all without a sound—until the gentle, sweet whistle of Second Shift sounded through the ship. Then they faded through the walls of the opsball, dimming to darkness, and the stars dimmed to nothing after them. Mtepic brought the running lights up. “Breakfast?”

“Surely,” she said. “Perhaps we should nap again after?”

“We’re bound to be tired,” he agreed. If he was disappointed that she asked no questions, he did not indicate it.

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Xhrina had twice celebrated Mtepic’s birthday—the first time with Peter and Yoko who were good-natured but baffled about it, the second time just the two of them the night before they had seen the ghosts. From this, Mtepic deduced that she would like such a thing herself, and checked her bill of sale to find when her birthday was (she had never been told, and Mtepic did not think she should have to see her bill of sale unless she asked).

At one shift close, he surprised her with the news that she had just turned twenty-four, and also with the sort of gifts ship people give: her favorite meal, a small keepsake produced in the ship’s fabricator, and time set aside to sit with her and watch a story he knew she’d like.

She had already known that Mtepic thought that she had a great deal of mathematical talent and believed she would one day be a fine ship’s mathematician, and she knew too that he liked to have her around him. But still it was a surprise to Xhrina to realize that he also just wanted to do things that would make her happy. No one had ever appeared to care about that before, at all. It took her by surprise, put her a little off balance, but she considered the possibility that she might like it.

By her twenty-sixth birthday, after their five months of slowtime in the port orbiting Old Mars, 9743 was bound for Sigdracone, where she was to be manumitted. By now she was quite sure that she liked Mtepic’s kindness and concern for her happiness, and as his health began to fail little by little, she realized that she was glad to be taking care of him, which he only needed occasionally so far, and to be there when he was afraid, which was rare but sometimes severe.

After much thought she concluded that she had been very damaged by the things the slavers had done to her, and guessed that this taking care of Mtepic might be as close to love as she would ever feel. Though she did not miss sex much, she wished he were still well enough to enjoy it; though he was sometimes crabby, and nowadays he slept a great deal, she liked to sit or float where she could have a hand on him, or an arm around him, constantly, as if he were her blanket and she were two years old.

His mind, when he was awake and not in pain, seemed as fine as ever, and she was grateful for that. She was glad she had said she wanted to come along, and everyone knew without saying that she would be staying on the ship, and would probably qualify to be ship's mathematician as soon as Mtepic died or became senile, though no one mentioned the inevitability of either of those to her. Ship people are indifferent, usually knowing nothing of each other's feelings, and not caring even when they must know, but even they could tell that she would miss Mtepic terribly and that the title of ship's mathematician would mean little to her compared to the loss of the only friend she had ever had.

Friend, she thought. That's what Mtepic is to me. I thought he might be, and how nice to know it now, while I can appreciate it.

They were about halfway there; it would be about two years or so eintime until they would lock themselves into the support field caskets so that every cell wall in their body could be held up against the hundred and fifty g acceleration of the gammors running flat out; three days later they would stagger out hungry and tired. Xhrina had been through all that now three times, and had no dread of it; as far as she was concerned, going from gammors down to Kerr motors meant minor discomfort followed by the most enjoyable meal and nap she was ever likely to have.

But for the moment that was still two years eintime, more than a decade slowtime, in the future. They had little to do but think and learn. Learning was fun: Xhrina had already passed her mathematician's mate's exam with highest distinction, and was well on her way to qualifying as a ship's mathematician.

As for thinking, Xhrina often thought about recursion. She thought it was interesting that she didn't always know what she liked, and she thought that everyone must have the same problem, for the only people she knew well were her shipmates, and they were impossible to know well, perhaps because they did not know what they liked, either.

She particularly liked the way that thinking about how it was possible not to know what she herself liked made her thoughts turn into circles and whorls and braids, spiraling down into the first questions about how she knew that she knew anything, as if descending into dark empty singularities; as her thoughts would vanish at the edge of those absent unthinkable thoughts, they marked the boundary as surely as the glimmers of vanishing dust and atoms at the Schwarzschild radius of a black hole.

Sometimes for a whole day she would keep track of which thought led to which thought and count how often, and by what diversity of paths, thoughts returned to the surfaces and boundaries of the unknowable. She could have flicked her fingers across any flat surface to make a workscreen, recited her data into the air, and played to her heart's content with the *grafsentatz*. But when she was working on the recursivity of her thoughts, she preferred to hang in the dark in the opsball, and bring up stars for their current position/time (she could have brought them up for anywhere/anywhen, but she always chose current position and time). She always brought them up to just bright enough to see once her eyes adjusted.

Then she would slow her breathing and heartbeat, and wait for the perfect calm when her chi settled into tan tien, and see only in her mind's eye the screens, matrices, graphs, and equations, and endlessly devise graphs to portray, and statistics to measure, the recursion and circularity of her own thoughts, and consider whether thoughts about recursion should be intrinsically, or just accidentally, more or less recursive than other thoughts, and watch as all those thoughts drifted down onto the unknown, unknowing surfaces of those first known-to-be-unanswerable questions.

When she was finally cool and beautiful inside, she would softly ask the opsball to let the stars dim out, watch them till the last star was gone from the blackness, then swim back to Mtepic's quarters, where she would often find him sleeping fitfully and uneasily, drifting all over the compartment because he had fallen asleep outside the sleepsack. Then she would bathe him and rub him till he fell asleep smiling, and curl up against him for lovely, deep, dreamless sleep. The nightmares of her childhood were mostly gone now, and no more than pale shadows when they returned.

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In the Sigdracone system, she still had enough of her gravity-bone to stand up and raise her hand, down on the surface of Aloysio, and receive her freedom under the open air. She wasn't quite sure why she chose to do

that. It all seemed so harsh and uncomfortable and when she returned to the ship, it felt as if she *really* received her freedom at the dinner they had for her. Though they treated her just as they always had, as an equal, it mattered to her that now they were supposed to.

She affirmed and they voiceprinted it, making Xhrina a shareholder in 9743, backvested with all the equity that she had built up in the trust fund they had kept for her, while she had not been allowed to own property in case the ship had to touch base, and face a books inspection, on a Karkh-Convention world. They drank a toast.

The slowtime people at Aloysio wanted a total cargo changeover, something that only happened once in a century or so of eintime. An organization that the translators called the “Aloysio Museum of Spiritual Anger Corporation” bought the whole cargo, and sold 9743 an entirely new cargo: 1,024 cubes, sixty meters on a side, with identifier strips on every face.

None of 9743’s ship people had known in a long time what ships carried, except that they never carried slaves, because they refused to, or any living thing that needed tending, because none of them wanted to learn how. So they knew the containers in the hold had nothing alive, or at least nothing actively alive, in them.

Other than that they knew nothing; over the slow correspondence of decades between ship people on other ships, there was an eternal argument about why no crew knew what was in the cargo. Some said it was because in the wars of fifteen thousand years ago, a tradition had been established that no ship people were ever to be responsible for anything they carried. Others said it was simply that the hundreds of thousands of cultures in slowtime changed so much and so fast compared with ship people that no one could have understood what the cargo was anyway. And still others said that the people on the worlds did not trust ship people not to steal it if they knew what it was, but most people said that was the silliest of all ideas, since anyone knew that the most valuable thing on a ship was hold space, and who would want to keep cargo and never be able to use the hold space again? Or who would buy or sell something when all contracts were broadcast openly, and it would be obvious to anyone that it was stolen?

Actually even if she had known, she would not have cared what was in the cargo. She did know where the cargo was going—that was what a mathematician did, after all—and she liked that very much. The ship would

be making a very long haul, out into the north polar section of the Third Pulse worlds, where the inhabited stars were too distant to have ancient names because they had not been naked-eye visible from Earth, and so had been named for abstract qualities by the Second Pulse surveyors; she loved the idea that the suns all had names like Perspicacity, Charity, and Preternaturalness. And it would be six years eintime before their next system entry, perhaps more if the PPDs broke right.

On her twenty-ninth birthday, they were outbound and life had settled into the most comfortable of routines; after the small gifts and the warm feeling of attention, she rubbed Mtepic to sleep—he was just a soft, thin cover of lumpy bones, anymore, she thought—and drifted off herself, glad Mtepic had been there for her first birthday as a free person, hoping she could complete her mathematics preps and qualify for ship's mathematician while he could congratulate her for it.

* * * *

Mtepic's soft palms and fingers pressed for one light instant on her shoulder blades. "It's strange how it happens on birthdays."

She glanced at the clock; she and Mtepic had been asleep for five hours since they had celebrated her birthday. Xhrina turned and held him in a light embrace; he sometimes woke up, now, talking to people he had been talking to in dreams, and she didn't like to startle him.

He embraced her in return, firmly and strongly, and now she knew he was awake, just starting in the middle as he tended to do. She waited to see what he would do or say. After a sigh—he liked holding her and she knew he might have been glad to do it much longer—Mtepic said, "There will be ghosts in the opsball tonight. I am going to watch them again. Would you like to come with me?"

"Of course," she said. "Does it happen on everyone's birthday?"

"Just mine, I thought. But now yours. Dress quickly. There's never much warning. We must be there and silent before the ghost-power lights up the opsball."

They dressed, swam through the main crewpipe, and entered the opsball.

Everything that evening was as before, except that the ghosts were different. First the Dopplered stars, and then the corrected stars, dimmer

even than when Xhrina came in here to meditate. The fast-moving cloud made of ghosts zoomed silently up out of the Southern Cross to surround them in less than a minute. The ghosts in their thousands swarmed around the outside of (the ship? the opsball? But the opsball was 750 meters inside the ship, and yet the twenty or so ghosts who came inside seemed to merge directly from the projected stars to their positions in the opsball).

This time Xhrina mostly watched two young men, apparently twins, trying to solve what she thought must be an equation, though on each side of the equals sign there was only a rotating projection of a lumpy ellipsoid in several colors.

Or perhaps it was a game. They were both laughing very hard about it, whatever it was, and Xhrina liked the way they threw arms around each other and rested their heads on each other's shoulders, then went back to their game or problem or whatever it was, sitting left shoulder to right shoulder, making little blobs of multicolor swim off one blob and across the equals sign to stick to the blob on the other side. Whenever they did that, both blobs would reorganize into different colors and shapes, and the two of them would clap, together, rhythmically, silently, as if to an unheard song.

A teenaged girl that Xhrina thought might have been a daughter or some other relative to the smashed-headed woman from last time—or was it the same woman at an earlier stage of life?—was working her screen, whose language looked like some late Konglish derivative, with a gymnast's concentration.

Another woman, old and stout with jowls, thin short gray hair like velvet, and something rough and wrong with the skin of her neck, wore a military uniform that could have been Late Brazilian Empire, Old Lunar Mexico, or Old Taucetian Guinea; somewhere in the First Interpulse, anyway, around the time of the Trade and Momentum Wars, because she looked just like the characters in a story, with bank codes on her sleeves, Mahmud boots, and a vibratana in a back scabbard.

Xhrina looked more closely, flapping her hands very gently to move herself toward the older woman in the military uniform. Bank trademarks on the shoulders; an admiral, then. Skull-jewels, gold with ruby eyes, in her pierced lower lip; four of them, four battle victories. The bank's symbol had the ancient dollar and yen signs, crossed, in two pairs, on either side of a balance, which could be any of the dozens of military-and-financial-services companies in any of the three millennia of that era.

The admiral was worried, her fingers gliding over a screen that kept

changing its display but always showed a cluster of white points surrounded by a swarm of red points, sometimes labeled in the blocky letters of ancient Romantisco, sometimes connected by varicolored lines, sometimes with little translucent spheres around them and clocks ticking beneath them, sometimes in a view that tumbled and rotated to show the shape that the whole formation made in space.

She kept touching the white dots like a mother cat checking her kittens. Abruptly Xhrina understood; the squadron was bunching together to try to make a run through the closing bag, and the admiral didn't want to lose any of them. It was a classic situation, so common during those wars; the red dots were ringoes, robot ships that came in at a single target at 100 g, expending their entire magazines at the target and fuel supplies in acceleration, trying to ram just as they ran empty.

Once a ringo locked on and cranked its gammor to full power, they just kept coming, everything about them bent toward pure raw violence, game pieces intended to sacrifice at one to one, but they knew that they were too valuable to throw away on a bad risk, so they would not lock on until they decided they were close enough for a high probability of a kill. The admiral was trying to get her squadron out of a bag of ringoes, losing as few as she could manage. It did not look like that number would be zero, and it would be many hours before the brief burst of their violent escape, so she could choose to save any ship, but not all of them.

A very overweight, brown-skinned older woman dressed in a sleeveless coverall like Xhrina's own opened an application that Xhrina knew well. Xhrina gently paddled through the air to see better what the woman was doing and found that she was bumping up against Mtepic, paddling over from the other side.

He floated, reflecting the glow of the ghost in front of them. His rounded, reflecting surfaces—forehead, nose, knuckles, knees—glowed gray in the dim light; these seemed to shrink back, as if he were falling back away from the ghosts and the stars beyond them, into utterly lightless dark.

Across Mtepic's face, shoulders, and chest, a tangle of bright-glowing filaments emerged as if rising through his skin, like noodles in a colander slowly surfacing from boiling water.

The filaments broadened, stuck to each other, filled in gaps between. The dense, glowing web merged into the pale white shape of a newborn baby, like a bas relief just a centimeter or so above Mtepic's ghost-lit wrinkled old skin. The baby stretched and yawned. Its light washed over

Mtepic's gray, still form and seemed to suck the color out of even his red coverall, leaving his lips blue-gray as dried mold.

The baby's tiny feet on apostrophes of legs barely reached the bottom of Mtepic's ribcage, but its head was almost as big as his. The arms, ending in hands too small to fully wrap Xhrina's thumb, reached out to fathom space around the baby but did not extend as far as Mtepic's slumped-in shoulders on either side. But the puckered face opened in a toothless, radiant smile of pure *What? How? What's all this?* Then the vast, deep eyes, clear and wide, focused on Xhrina, and the tiny soft mouth twisted and folded in the expression with which Mtepic always favored her best jokes. She could not help smiling back.

Not knowing why, she placed the palm of her right hand on the baby's chest, ever so gently, as if sure it would sink through to the sleeping Mtepic. She was surprised that the baby's chest was warm, damp, and firm under her hand for that instant.

Then she realized the baby was male, for a stream of phosphorescence poured wet and warm onto her sternum, making a glowing patch on her coverall, and she glanced down to see that the ghost baby, if that was what it was, had no more bladder control than a real one.

It was so unexpected that she giggled, carefully not making a sound but letting her chest convulse, and under her palm she felt the baby's chest pulse with the baby's giggle, sharing her delight. Her hand sank a tiny fraction forward, and the baby was gone. Her palm lightly pressed Mtepic's chest, where his heart thundered and his breath surged in and out as if he had worked too long and hard in the gym again, as he did so often despite her gentle scolding. His bony old hands closed around her strong young fingers, and he smiled at her, squeezing her hand.

For the rest of the night they held hands as they watched the laughing twins, the motherly admiral, the fat mathematician, and the rest of the ghostly crew. At last the shift chimes sounded, and the ghosts faded away, and then the stars. "Lights up slow," she said, and the opsball appeared around them, its surfaces matte gray, shut-down and inert, the same old opsball it was for months and years at a time.

"Breakfast in our quarters and a long talk?" she asked.

"Surely! And I am so pleased."

"At what?"

“You said ‘our quarters,’ not ‘your quarters.’ That is the first time in six years.”

“It was important to you? I would have said it much sooner if I had known it mattered.”

“It was important to me that you say it without my asking. And it was not important at all, at first, but it is now.” They swam through the iris door of the opsball. “And when it became important, I began to count. You wouldn’t laugh at my silly senility?”

“You are not senile and I would not laugh at you.”

“Well, then, as it became important, I calculated backward to your arrival, and then began to count, and so I know that it has been 2,222 days eintime since you came aboard, and this is the first time you have said ‘our quarters.’ “

“Other people might find something odd in that number,” she said, “all those twos.”

They swam into their quarters. Mtepic flipped over like a seal resting at sea, hands on his belly. “Other people might find something odd in that number, but you and I know about numbers, eh?”

“Exactly so,” she said. “In octal it is merely 4,256, and in duodecimal an even less meaningful 1,352. 32,342 in quintal is about as close as you can get to meaningful expression in any other base, and that’s not *very* meaningful. And I would say that if meaning is not invariant we can ignore it.”

“Except when we can’t, of course?”

That struck them both as funny, for reasons that they knew no one else would understand, and they laughed as they filled out their breakfast order, and filed their official intention to serve their shifts on call in their quarters that day.

Mtepic’s sweet tooth had grown ever stronger as he aged. His favorite breakfast was now a fluffy, sweet pancake spread with blueberry jam and wrapped around vanilla ice cream, and as he slowly ate that this morning, he seemed to relish it more than ever. “Well,” he asked, “what would you like to know?”

“Was it real?”

He pointed to her chest; the damp spot still glowed.

She ran a finger over it; the very tip of the finger glowed for an instant, and then faded.

“How does it work?” she asked.

“I don’t know,” he admitted. “I don’t even know why I wake up knowing there will be ghosts. Or why it was so important to show them to you, or why I want to see them, myself.” He took another bite of his pancake and caressed it in his mouth until it dissolved; she waited until at last he said, “I would have gone, you know. That ghost was Sudden Crow, my wife before you—not that you are my wife, though the offer is open if you want it, it meant a great deal to her, but you’ve never seemed to care.”

“I don’t. ‘Not slave’ is all the title I ever wanted, and you gave me that, and you know I’ll be with you as long as you live—maybe I should say as long as you want to stay. But you almost... left? Do you miss Sudden Crow?”

“Not very much, to tell the truth. She was bad-tempered and sometimes rough with me. I wouldn’t mind saying hello again but I hope I wouldn’t have to spend any time with her as a ghost. Thirty years of combined time on this side was enough.”

“Do you say ‘this side’ because it feels spatial?”

Frowning, he thought, and then at last shook his head. “More like the sides of a game or a question than the sides of a segment or a surface.” He pondered more, then took another delighted bite of his breakfast. “Really, your friendship is one good reason to stay on this side, more than enough reason all by itself, but this breakfast could be another, and when I think of all the other things I still enjoy, I can understand why so few people want to go before they have to. It was just that seeing her there, somehow I knew *how* I could go, if I wanted to go. And the old body is such a nuisance, you know, sometimes, it gets so sore and itchy and hurty. So I did want to, just for that moment, but now I’m glad I didn’t.”

“Do the ghosts come aboard often?”

“You’ve been with me the last two times. Out of six in all. Five on my

birthdays, now one on yours. And I've never told anyone else, but I knew you were the right one to see it. I've searched through all twenty-seven thousand years of star trader history, and records from more than a million ships—traders but also slavers, military, scout, and colony—and though there are many accounts of ghosts, most are just fiction, labeled as such, and many of the rest seem to be merely some bit of culture that came loose from its old moorings in some folktale and washed up in the star trader culture. And 9743 itself records the ghosts but doesn't perceive them; they are there on camera recordings but if you ask 9743 to look for the ghosts in all its thousands of years of recordings of the opsball, it won't see any ghosts, and it can look right at a camrec full of ghosts and does not perceive them, it only sees an empty, dark opsball."

"So they are aphysical. But they record physically. What do you suppose they are?"

"A very expressive hole in spacetime?" Mtepic shrugged. "Most star traders commit bodies to space at peak velocity. Most of us run at 98%*c* or higher. Once the body is outside the protection of the forward shield, the atoms and dust in interstellar space erode it, and it loses velocity, though not quickly. And of course it is far above galactic escape-velocity. Except for the very few that run into stars or black holes or comets, all the bodies committed to space must still be out there, some as much as thirty thousand light-years away if you allow for burials during the First Pulse when there was little or no trade.

"You could picture each corpse as a long pathway, sweeping atoms and ions and molecules and dust out of interstellar space, shaped very much like the dead person at this end in time and space, and as the interstellar medium punches them full of holes and breaks them down, trailing off into just a cloud of nucleons at a far end somewhere way outside the galaxy and some millions of years in the future. Perhaps something aphysical flows back along the path they make, and—'crystallizes'? 'condenses'? maybe just 'organizes' is the word for what it does, around any passing seed or nucleus or whatever you would call a thing a ghost organizes around. Maybe where a large number of pathways run close together, they entangle like spaghetti, and express as a ghost swarm when something that can appreciate their meaning comes along. That would explain the association with birthdays. Birthdays are meaningful even though they're so drastically different in slowtime and eintime and depend completely on when you got on the ship, and where it goes, and how long an Old Earth year was at the moment they standardized it. So maybe ghosts annucleate around meaningful things like ships and birthdays. It makes a certain kind of sense. Meaning is aphysical, and ghosts are

aphysical. Then again, what do physical beings like us know of aphysics?”

“But none of that would explain the baby coming out of your chest, or that the baby was you, or that we both remember it, let alone that I’ve got a patch of spiritual pee right over my heart.”

“Was I a baby? I wondered why I felt so strangely proportioned, and so small, and had no teeth. Well, that is certainly data to add to the puzzle.”

“Why should there be ghosts or spirits on a starship?”

“Why not here as much as anywhere? And for that matter, why should there be ships? Robot-only starships are just slightly less likely to reach their destinations, but it would be so easy to factor that into the price, and it would be more profitable to send containers one way and just accept some losses at the other end. As it is 9743 pays for an immense amount of space and mass to keep us alive. So why are we here? Why is there even an economy? We make everything on the ship by transmutation and molecular assembly—we never ‘pick up supplies’ though we sometimes buy new goods to record them for later manufacture—and we know the people in slowtime are centuries or millennia ahead of us—so why is there cargo for us to carry?”

“You think that has something to do with the ghosts,” Xhrina said, not a question, just trying to stay with him; clearly he had been thinking about this for a long time, had worked out the perfect presentation in his mind, wanted to have it produce perfect understanding—it was the way he had taught her mathematics. She knew he liked it when she understood at once, and she knew this might be her only chance to understand.

“I think it’s another void in spacetime. Once pretty much everyone human traded, going way back to Old Earth. For some reason it paid to trade between the stars. The ships began to move. Now they just move, bodies in motion remaining in motion, and the trading just happens. Maybe. Maybe we’re *all* just the ghosts of what humans used to do. Three-quarters of the star systems we traded in at one time or another now just wave us off, new ones come on line, and old ones reactivate after centuries of slowtime. Who can say what goes on out there?”

“Is it possible that the slowtime people on the planets are all just crazy, or perhaps playing at things because there’s nothing real left?”

“The slowtime people might ask the same things about us. We could just liquidate, and move into a nice orbital resort where they’d pamper us

silly for the rest of our lives.”

“I would hate that.”

“So would I.” Mtepic smiled shyly. “Do you think it would be all right for me to have another pancake like that last one?”

“You’ve been losing weight,” she said, “and I worry about your appetite. You can have ten as far as I’m concerned. And actually, being very concerned, I wish you would.”

“Let’s start with one, but I’ll keep the offer in mind. And you’re right, I haven’t been taking very good care of myself, and for some reason, now I feel like I want to, at least for a while.”

She prepared it for him, not because he couldn’t do it himself, and not because she had to. She pointed that out as she served it to him, and he said, “You see? Part of what makes it good is all the things it’s not.”

She thought about that for a while and she said, “So the ghosts are not hallucinations. And they’re not physical as we understand it or the machines would be able to see them, rather than just record them. And you think maybe they’re where the bodies—well, the traces of the bodies—are not.”

“Except that Sudden Crow destroyed that theory,” he said. “She always was good at destroying theory. Part of why she was a good shipmate.”

“She hurt you,” Xhrina said, surprised at her own vehemence. “You said she was rough with you.”

“True. But I was not as fragile then as I’ve become, and besides she was a valuable member of the crew. And of course so are you, and getting more valuable all the time, and you are very good to me. You fill up a space different from the one she vacated.”

“I’d better,” she said. “I wouldn’t want to fill her place, at all.” And because she had said it a bit too vehemently, and the two of them were looking at each other awkwardly, she hurried on with the first question she could think of. “Why did you say Sudden Crow destroyed your theory about the traces of the bodies in spacetime?”

“Because she was buried in space about a year and a half out of

Aydee-to-Ridny, outbound. Her pathway couldn't have come anywhere near here."

"But she was on this ship. Her path before she was dead included it. What if it doesn't matter as long as you can describe the path, or the place where the path was? Suppose that, and maybe—"

"But it might be too hard if we suppose that," Mtepic objected. "It doesn't restrict things enough. Why don't we see everyone's ghost all the time?"

" 'Mathematics is how we find the logical implications of the boundaries of things, and the whole history of mathematics is the story of working with fewer and flimsier boundaries,' " she said. "You said that to me the very first time I sat down to learn algebra. Maybe we don't see them often enough because there aren't enough boundaries to produce them, or because we live inside so many boundaries, or... well, we don't even know what the boundaries are, do we?"

"Hard to evaluate the boundary conditions," Mtepic agreed. "But as far as I can see, it's all holes and voids. There's some odd thing in the slowtime world, some place we fill, though we don't know what it is. Empty spots left in crews and on ships when people die, and the holes in space they make when we throw their bodies away, and the big emptiness of space itself, and every hole is outlined, and every outline means the hole—and, well, you must think I'm senile by now, surely."

"I don't," she said. "Oh, I *don't*. You *know* I don't. Can I make you another pancake?"

* * * *

In Mtepic's last few years, they talked more. She liked that. She had received the last promotion she could get while he was alive, to mathematician's-mate-pending-mathematician. That forced her for the first time to think of the succession. She decided that however she acquired her apprentice (she rather hoped to buy one out of a slave world, she would feel good about freeing someone as she had been freed), she would consider looking for someone who would talk. Many ship people didn't, for weeks or months at a time.

That was another guess of Mtepic's, that ship society was where the surrounding slowtime societies were dumping their autistic people and those whose mathematical gifts were no longer needed because they had

synminds. “Sort of a featherbedding asylum for mathematicians,” he would say, coughing and laughing as she bathed, dried, and rubbed him. She would always laugh too, just because it was Mtepic and she felt how close he was to crossing over to the other side, and she expected to miss him then, and wish she could hear his jokes again.

The night after her thirtieth birthday, she awoke knowing that there would be ghosts in the opsball, and felt Mtepic waking within the circle of her arms. Xhrina dressed them both quickly and gently towed him with her, as she had had to do for the past few months, since his limbs had grown too feeble and shaky to keep him stable as he swam in the air.

It was as before, with a new swarm of ghosts, and in the middle of it, the baby emerged from Mtepic; she held the baby for a long moment, and kissed the tiny mouth tenderly, and then watched it sail off, giggling and tumbling, into the stars, until it was just a star itself, and then gone. She towed Mtepic’s remainder back to their quarters; for reasons she did not understand, she didn’t want to tell her shipmates that he had died in the opsball.

They might have been surprised at how dry her eyes were, and how perfect her composure, when they buried Mtepic’s body in space on the next shift, but ship people are never very surprised at anything human, for they don’t understand it and lose the habit of being curious about it.

* * * *

Treo often floated with her in the dark opsball now. “It’s a big promotion,” he said, “and an honor, and you would make a good captain. I admit I’m delighted with the idea of being ship’s mathematician without having to wait for you to die.” That was the longest speech he had made, and Xhrina found it faintly ironic that he made it as they floated in the opsball, where normally they were most silent.

It was not a normal occasion; Phlox had chosen to die voluntarily after Arthur’s death, and would be doing it after she said her good-byes tonight, so they were replacing a captain and a first mate. The crew had chosen Xhrina as captain, with Officer-Apprentice Chang to be brevet-promoted to first mate, if they wanted the positions.

Xhrina thought Chang would be all right as a first mate; he was young and should ideally have had a few more years as an apprentice, but she reckoned that he would have them by the time she died, and would still be a young, vigorous, apt-to-be-successful captain. It was a good match all

around.

They were far out in the Sixth Pulse systems now, newer worlds with more cargo to send and receive, out in the thinly populated fringes of the human sphere. So there could have been very few of those pathways of the dead that Mtepic imagined, but when they jettisoned Phlox's body, Xhrina felt something; and the next day was her fiftieth birthday, and she felt it more strongly; so that night she was unsurprised to awaken and feel that it was time to see ghosts in the opsball. It had been a long time since she had seen ghosts, only twice since Mtepic's death, and this was the first time since Treo had come aboard. She woke him, told him to dress and be quiet and to hurry.

The blue-to-red Dopplered stars became plain white stars, the swarm of ghosts arrived, and as Xhrina was just beginning to watch with wonder, and celebrate being here for such a thing again, Treo cried out in fear, having seen Phlox swim through the hull and take up her navigation station, and all of it vanished.

That settled Xhrina's mind. She took the captain's cabin, and shared it with Chang, from then on, letting him rub her back because he seemed to like to do it and it did feel good, and occasionally relieving him sexually, though he was much more attracted to the second physicist's mate, Robert, who was unfortunately not interested in sex at all, or at least not any kind that Chang offered.

Xhrina didn't exactly give up on any idea of love, but it was a long time before she trusted Chang as more than a mere colleague and convenient bed companion, so long that she got to know him too well, and settled for trust without love. It was an even longer time before she saw ghosts again.

* * * *

Of the old generation, only she, Peter, and Squire were left on her eighty-fifth birthday, and Squire spent all of his time sleeping in his life support tank now, though when roused he seemed coherent enough in a querulous sort of way. 9743, by vote of the crew (a vote Xhrina had very carefully nurtured into happening) had been renamed *Ulysses*, a name it had last had 290 years eintime before. Xhrina could not have said why she preferred that.

There was a Seventh Pulse underway, carrying the human frontier out past 150 light-years from the home system, and at great distances, now and then, they detected the sonic boom of near-lightspeed bodies of a

kilometer or more across, pressing so fast through the interstellar medium that their bow shock was too much for the thin trace of plasma and shook it hard enough to make microwaves. “The new colony ships move much faster than the old,” Captain Xhrina observed, at the table with everyone. She had insisted on establishing a tradition of birthdays, real birthdays for everyone, even looking up some old traditions so that everyone wore funny hats, and they served fish, and sang a song called “Years and Years” in ancient Konglish.

“I would like to see one more new part of space before I pass on,” she said. “There may just be time for that if we do this, and there is something in it for all of you. It will make our reputation forever as traders; the name of *Ulysses* will be known, and that would please me, and I hope it would please you.

“Sixty years ago, according to radio, the Sol and Alfsentary systems were known to be open, so we could make one stop on the way. My plan would be that we would take only half a hold of cargo—we probably can’t even get that, nowadays, anyway, there doesn’t seem to be much at any port—and then stuff the empty holds with extra mass, which we could feed into the shielders, and we could run at ninety-nine-four instead of our usual ninety-eight-two. That would mean eintime would be about one ninth of slowtime, instead of one fifth, and we could be back to the center in about seven years eintime. Switch cargos and pick up more mass there, head out again, and run at ninety-nine four for a hundred twenty years of slowtime, so that we get all the way into the Seventh Pulse worlds on the other side. The corporation could afford to do it a hundred times over; I’d just like to take a chance on being there at the end of that voyage, and if we make it there, we will have made a name for ourselves, forever, among star traders. No other reason.”

Treo would vote with her; he always did because he feared that she thought he was a coward, though she had never said so. And his mathematician’s mate Fatima would vote yes along with him. Peter would probably vote yes just because he found all port calls distressful and would like the idea that he would probably die before they made their first stop. With her vote, that was fifty-fifty; she thought Chang had liked the idea when she explained it to him, but with Chang it was hard to tell about things. The other three tended to think that the economic models that slithered and hissed through *Ulysses*’s computers, paralyzing everything with their venom of marginal returns, were gods to be propitiated.

“Call the question?” Sleeth, the second physicist’s mate-pending-first, said. That was conventional because she was juniormost voting member; it

also fit Sleeth, because she was young and bouncing with energy in a crew of old, tired people. Most of the crew muttered that she was annoying except Squire, who said it outright whenever he was out of the tank, and Robert, the first physicist's mate, who said it coldly, as if it were the atomic mass of oxygen or the orbital velocity of a planet.

To compensate, Xhrina made no secret that Sleeth was as much her favorite now as when she had come aboard as a too-noisy-for-ship-people two-year-old. As the captain grew older, she had felt more and more that Sleeth was the only person, besides Xhrina, who liked to get things done. So this calling the question was natural, aside from being a duty.

The vote wasn't even close—only Squire and Robert voted against. Sleeth said apologetically to her cabin mates, "I'd like to be from a famous ship, and these runs around on the surface of the Sixth Pulse are getting dull."

It seemed to Xhrina more likely that Sleeth, who was barely twenty, but had come back from the training ship when only twelve, had been living too long with an angry husk in a tank, and a cold man who never spoke (did Robert use her roughly? Xhrina had asked Sleeth, more than once, and Sleeth had said no in a way that Xhrina thought meant *yes, but please don't do anything*). This looked to be Sleeth's first little step to saying that she would not be pushed around by Robert and Peter, and it made Xhrina glad in a way that she had not felt in a while.

That night, when Chang crawled into the sleepsack beside Xhrina, he said, "When we approach the home system, and you wake knowing that there are ghosts in the opsball, don't wake me. I'm afraid of them and I don't want to know about them."

"All right," she said. "Have you been reading my diary?"

"Yes," he said, "it's my right as first mate to read anything you write, and I don't like to ask. And I asked Treo and he told me how frightened he was, and I went back and looked at all your birthdays, and Mtepic's, and saw the ghosts on the recordings. It made me so afraid I have had a hard time sleeping since. So don't take me with you. I don't want to see ghosts." More gently, he said, "You might talk to Sleeth about it. She's always been your little shadow, and she would face the fear just for love of you."

"Thank you," she said, "I will." And Xhrina turned her back on him, to enjoy his warmth but not to talk anymore. *I suppose I would have faced the*

ghosts for love of Mtepic, she thought, but I wanted to see them anyway, though I didn't know it until he showed them to me. I hope it can be that way with Sleeth.

* * * *

On the night of her ninety-third birthday, Xhrina rolled over and touched Sleeth, who had been her sleepsack partner for some years now. "Ghosts," she said, "finally."

"I'm glad," Sleeth said, awake at once, and they turned up the lights and dressed quickly.

She wasn't sure that she really was glad. Sleeth and the captain had talked of ghosts at least every few shifts for the last five years, and Sleeth had come to realize that her first time seeing ghosts would be the captain's last. She had forced herself to seem happy and cheerful about the impending visit of the ghosts all through the annoying too-long layover around Old Earth's moon, as well, and now that the time was here, she hadn't really had time to think through what she wanted to feel, or ought to feel, and was stuck with just feeling what she felt—which was a mystery.

She had heard so much from the captain about Mtepic, and ghosts, and all the theories about ghosts, because the captain only needed to work an hour a day or so during the layover, while they found whatever cargo they could. The synminds of Old Earth and *Ulysses* at last found a small load, but did not seem to be able to explain what was in the containers, except that it was something that it was not inconceivable that someone in the new Seventh Pulse worlds out toward the Southern Cross and Sentaru might want 120 years from now.

The captain had not cared, so Sleeth had not cared. The scant cargo meant that their holds had had that much more room for a load of U238, depleted uranium, not for atomic power as in ancient times—they might as well have taken hay, oats, and water, and would have if nothing denser had been available—but because it was a conveniently dense supply of mass to be torn to nucleons and shot out the bow by the shielder, to clear a path through the interstellar medium for them. With the extra mass, they were able to run at 99.7%*c*, which meant almost thirteen years of slowtime to one year of eintime. *Ulysses* would be some sort of legend, now, for sure.

But, Sleeth thought sadly, the end of the legend will not be Captain Xhrina bringing Ulysses to the port of Summer, the port that they had been

aiming for since their last PPD and change of course about a year eintime ago.

Xhrina and Sleeth had talked of ghosts, many times, and Sleeth longed to see them, with Xhrina; but she would miss their conversations about them, and it seemed sad that she would have no one to talk about this first time with. But then apparently Mtepic had seen them five times alone, and who knew how many others saw them and never talked about it at all?

Still, Sleeth had always imagined that when at last she saw them, she would be able to talk about them with Captain Xhrina. She had been ship-raised, and because of the way the schedules had worked out, had only been on a training ship for six years, about half what was normal, so that she had spent a great deal of time following Xhrina around when she was younger, and then more time tending her later. Xhrina had always been her one real friend.

Sleeth knew she would miss the captain dreadfully, but she didn't think she should say so, with the captain's eyes alight with joy; once they were in the opsball, it was easier, waiting in the dark, because Sleeth could just let her tears quietly flow.

It was all as Sleeth had heard it told, so many times.

As the ghosts neared, Xhrina bounced and fidgeted as if she had a tenth of her years. When the slender, small ghost that had to be Mtepic—though now strong and young—swam through the wall into the opsball, the glowing baby emerged from her head and chest in just two heartbeats, formed fully in the air, and held its arms to Mtepic, who swooped in and scooped up the newborn Xhrina. *Just a few seconds, the first time I ever saw the ghosts, and it was all over*, Sleeth thought sadly.

As if he had heard her thoughts, Mtepic, still cradling the fiercely glowing ghost-baby, turned back, and smiled a warm knowing smile at Sleeth.

To everyone's surprise—even to the surprise of Mtepic's ghost—ghost-Xhrina, newborn and toothless, huge-eyed face wide with glee, in the ghost-mathematician's now-strong and young arms, waved bye-bye to Sleeth, in a way so like any other baby that Sleeth giggled, aloud, and all the ghosts but Mtepic and Xhrina fled as the stars began to fade.

Grinning, Mtepic raised a finger to his lips—*Shhh!*—and so did Xhrina, and they both waved bye-bye once again before they were gone into the field of stars, which faded after them, leaving Sleeth laughing in darkness.

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