

## *The Arrow of Time*

Charles looks at his watch. That woman—what is her name? Ruth Griffen? That irritating woman is late. The non-traditional student, who sits in front and fixes him with her voracious eyes as he lectures. While he appreciates her attention, she is an eyesore, with her knobby knees and boxy torso, her short gray hair and triple chins. She seems incongruous next to the smooth young faces, the tanned legs in shorts, the barely sheathed breasts. He realizes he is more aware of how people look since meeting Erick's friends. He frowns at his own reflection in the computer monitor now, raising his own chin. She is probably his age, he thinks dispiritedly. Attentive as she is, he hates lack of punctuality and in his mind he gives her ten more minutes, not a second more. He has things to do, and besides, he is tired from yesterday, bone-tired.

He'd only slipped once yesterday while moving Erik into the new apartment. Only once did he call his child Maddy. It just came out and Erik glowered at him. "Don't ever do that," he hissed, looking over his shoulder, making sure his Adonis-like roommate hadn't heard. Charles hadn't done it on purpose, but what was the use of saying so? He heaved the other end of the couch up the porch stairs, aware of Erik's muscles rippling under his tee-shirt, and of his own slack, aging body. He hadn't done it on purpose, but just saying the name opened up the grief he thought he'd deep-sixed.

Maddy had been his special child. While she fought her mother tooth-and-nail over wearing dresses, over her choice of playmates (boys), and her uncouth language, Maddy loved to be with him. She wasn't the chatter-box her sister was, and she wasn't the social animal her brother was, and so the two of them gravitated towards each other, always a little isolated from the more boisterous crew. They were both quiet people,

comfortable with long silences. She liked to ride with him to the hardware store, to the grocery store, or to the garden store on Saturdays. She'd be his assistant on projects around the house, handing him nuts, bolts, and wrenches, her thin face grave and attentive. It was Maddy who helped him build their tree-house, Maddy who learned the secrets of plumbing, so that she was the one who knew how to turn off the water valves when there was a leak.

She'd been his fishing buddy, too. She'd expertly bait both hooks, and was the first to feel the bite. How many summer nights had they drifted on the lake, barely speaking, listening to the tree frogs and cicadas sawing and thrumming in the forest surrounding the lake? When Maddy did speak, she'd ask thoughtful questions about nature, about the way things worked. He loved being able to answer her questions, to have the answers readily at hand. He taught her rudimentary astronomy and physics during those fishing trips. She could identify Ursa Major, The Big Dipper, Andromeda. "Why do they change?" she'd asked once about the constellations. She was only eight, and he'd realized with a pleasant shock that she was keenly observant, like him. "We move, on earth," he'd said, "but it looks as if the stars are moving." He used the oar handle for the earth, rotating it, while she held up the fishing net for the night sky. Oh, she was a thinker! Lifting her sleeping, fishy, sweaty body out of the car after that particular lesson, he was amazed at how weightless she was in his arms.

There is a knock on his office door and then turtle-like, Ruth's wrinkled face with its gimlet eyes peers in. "Pro-fess-or, are you ready for me?" she calls in a sing-song voice. He almost says he would never be ready for her.

“Come in, Ms. Griffin,” he says curtly, and reluctantly swivels his chair away from the computer to face her. Her cumbersome body emerges and she stands awkwardly in front of the door, an eager grin on her face, as if this was a social meeting. He groans inwardly. She is even more dismaying up close than what he has glimpsed in class. What happens to women, he thinks, so beautiful in youth and so frightening in age? “Sit down, he says, gesturing to a chair. His temples begin to throb. He’s not sure how he is going to get through this.

He pulls up her grades on the monitor, sees that she has a solid C. Not too bad. He swivels back around, latches his hands around his knees and says, “What can I help you with today?”

She blushes. She pulls out the latest test on thermodynamics. “I’m actually surprised I passed this. I just feel as if I’m drowning, as if I’m missing something. If it wasn’t for little Rebecca, my goodness, I would be drowning. I need this for my major. I just want to feel I really get it.”

Rebecca? What is she talking about? Rebecca must be that Asperger-y girl he always sees Ruth with. Mutt and Jeff. At one point they thought Maddy might have Aspergers. He shakes his head, tries to get back on track. “I’m sorry. What is your major?”

“Oh, nursing. I’ve always wanted to be a nurse, and finally I just said to myself, ‘well, better late than never.’”

Too much information, he thinks. The headache reaches its tentacles out now so that both temples throb. And that is when he makes his fatal mistake.

“Nursing?” he affects interest, afraid she might see through him, see how much he dislikes being in this room with her. “Nursing? My son is applying to medical school.”

Her eyes widen, and then she reaches past him to the family photo on his desk, picking it up—oh, how dare she? Pushy, just like he expected. But there was no going back. She studies the photo with the same intentness with which she listens to his lectures. He begins to explain that she won’t find his son there, that his son was a girl then, but stops himself.

“Beautiful family,” Ruth says, examining the photo carefully.

He wonders why he keeps the dated photo on his desk. It is a painful photo of Maddy--fourteen, gangly with new growth, her nose too big for her face, that expression of raw pain on her face that had become more pronounced as she entered the storms of adolescence. Those storms swept her far from him--the anger, the slammed doors, the muteness, the cutting, the drugs. Then Barbara dragging them to counselor after counselor, an excruciating tedium that only made things worse. He and Barbara wore themselves out fighting, so that he stayed at work as often as he could, anything to avoid Barbara’s swollen face and accusing eyes. He’d had no template for marriage or parenting to draw from: his parents had seemed neither happy or nor unhappy; they were just his parents, and he had never heard them raise their voices to each other. So, not knowing what else to do, he put his head down and endured. He had no hope that it would get better; unlike Barbara, who seemed to see every experience as an opportunity for “growth,” whatever the hell that was.

“Yes,” he says, taking the photo from Ruth, and putting it back in its proper place. “So let’s get started with the first problem you missed.”

He looks at her, but she is staring out the window.

“Ms. Griffin?”

“I buried one,” she says, slowly turning back to him. “He would be, what? Seventeen now.”

Charles blinks. How is this pertinent? He stares at her, confused. What is she talking about? His head is in a vise. He knew this was going to be a long afternoon, but it is already too long, and it has just started.

Taking his silence as encouragement, she continues helpfully, “Oh, not my own child. Oh, no, I never had children of my own. No, I wasn’t that lucky.”

He struggles to regain authority, to bring them out of these muddy waters she’s led them into. “Ms. Griffin, I’m sorry, but we need to focus, if you are going to get any where today.”

“Oh, yes, of course, I’m sorry Professor.” She says ‘professor’ in that sing-song way again, drawing out the syllables.

“Please, just call me Charles; we are the same age, after all.” He attempts a smile. He used to be a popular teacher, but that, too is dated.

She giggles girlishly, puts her hand to her mouth. “And please call me Ruth.”

“OK, Ruth. I expect you know the world and how time is of the essence and all that?”

She nods docily.

“So let’s get started, shall we?”

He feels he has a firm grip of the situation now. They can get through all the problems in an hour, if they stay on task.

“What exactly don’t you understand?”

“Well, I more or less understand Newtonian time. And I understand the first law of thermodynamics, but I don’t get the second law.”

He rises and writes on the wipe board: *2nd law of thermodynamics*. The chemical smell of the marker and the squeak of it bring him back to himself. He feels the rush of his mastery over these difficult concepts, the reassuring vigor of them. How they are established fact, not conjecture. How he can rely on them to be unchangeable in a changing world.

“*A thermodynamic system which moves from lesser to greater entropy, at any given temperature, defines an arrow of time.*” He draws the arrow, as he has done a thousand times, and turns back to her. “Do you understand that?”

She nods. “I think so.”

“You think or you know?”

She exhales noisily. “No, not really.”

He sighs and turns back to the board and continues. “Let’s back up. So, Stephen Hawking identifies three arrows of time.”

He writes authoritatively with the noisy black marker on the white board:

Psychological arrow of time - our perception of an inexorable flow.

Thermodynamic arrow of time-distinguished by the growth of entropy.

Cosmological arrow of time—distinguished by the expansion of the universe.

“What we are concerned with now is the thermodynamic arrow of time, the growth of entropy. That is, differences in temperature, pressure, and chemical potential decrease in

an isolated non-gravitational physical system, leading eventually to a state of thermodynamic equilibrium. Does that make sense?” He turns back to look at her. Her eyes are glazed.

She slowly shakes her head. “Can you give me some examples?” She asks, hesitantly.

Irritated, he flips through the text, opens it to the Clausius Statement and reads,

*Heat can never pass from a colder to a warmer body without some other change, connected therewith, occurring at the same time.*<sup>[10]</sup>

*Heat cannot spontaneously flow from cold regions to hot regions without external work being performed on the system, which is evident from ordinary experience of refrigeration, for example. In a refrigerator, heat flows from cold to hot, but only when forced by an external agent, the refrigeration system.*

“Ohh,” she said, “is that why it is always so hot behind the refrigerator? Like when you clean it?”

“Well, yes, I suppose. OK, now this is how it is written mathematically:”

He draws on the board:

$$\oint \frac{\delta Q}{T} \leq 0.$$

“But I don’t understand; what does heat have to do with time?”

He sighs. Is she thick?

“I’m sorry,” she says, cringing a little.

Charles reaches deep for some patience.

“Oh, no, it isn’t easy to get. OK, say that you are watching a movie, and you go in reverse. When things are in reverse, you understand that it isn’t natural—cause and effect are switched, so that it is nonsensical—so, for example, the boat that was sunk rises to the surface, the pizza that was eaten reassembles itself. The movie in reverse breaks

the second law of thermodynamics. We understand it intuitively. The irreversibility of certain physical phenomena and the subsequent creation of entropy is what proves the law.”

Ruth nods her head slowly. She writes while narrating her notes out loud: “The principle of irreversibility: everything in the physical world goes from lesser to greater entropy?”

Charles nods. “The existence of a thermodynamic arrow of time implies that the system is highly ordered in *one time direction only*, which would by definition be what we call the "past."

He writes on the board “one time direction only,” and then an = sign and then “past.”

“Now, this is what you missed here,” he points to her paper. “So rework that problem with your understanding of irreversibility, of entropy.”

She bends over her paper and begins, the tip of her pink tongue protruding slightly from her mouth, her pencil gripped tightly in her hand. There is silence in the room, punctuated only by the ticking of the large institutional clock on the wall.

As they came to understand what was wrong with Maddy, they managed a détente of sorts. Barbara had come around first, happy to have something to hang Maddy’s unhappiness on besides bad parenting. It was as if Maddy’s mixed up genes redeemed her. Barbara seemed to embrace the whole process overnight. She had a stack of books by her bed that she was always trying to foist on him, and she would insist on talking about the hormones, the operations. There were so many surgeries, it shocked him—the mastectomy, the hysterectomy, the vaginectomy and penile reconstruction. Charles

hadn't wanted to know any more than he had to. He never went to the hospital with Barbara, only endured the recitation of what to him was a brutal mutilation. He had grieved each stage of Maddy's changing body. "Try," Barbara would say wearily, "try to see this as his salvation. He's getting happier." But he couldn't. He kept his grief to himself, and resented Barbara for changing roles with him. She grew closer to Erick even as he grew further from Maddy. How could he tell her of the great reservoir of shame he carried in him, as if he should have done something to prevent all this, as if at bottom he was at fault?

He is startled by Ruth, who is holding out her rewritten exam to him-- for how long, he wonders? He examines it, pleased that this time she has gotten it right. Maybe he still has it, is still the teacher he once was. Next he explains the derivation from statistical mechanics. He gives her some sample exercises, and again she sets to them, her whole being concentrated on the paper. When she is done, she hands him the paper, and excuses herself to go to the bathroom, groaning slightly as she heaves herself out of the small desk chair.

He sees she has not gotten them all perfectly, but she has the main idea. Good enough, he thinks, for a nurse.

He looks at the white board, at Stephen Hawking's first arrow of time:  
*Psychological arrow of time - our perception of an inexorable flow.* It seems to Charles that time is not like an arrow. The past is more like a city under a lake: you know it is there, but you can't quite make it out; it is all distorted because of the present time, because of the sun glancing off the water's surface or the way water refracts light, distorting the objects below. You think you see something familiar and solid—a church

steeple, or the grocery store where you spent so many Saturdays, but then something disturbs the surface, a boat or wind, and the buildings below disperse like clouds.

Erik is a happier person than Maddy was, he can see that. More confident, edgier. He'd gone after his pre-med degree in a way Maddy never would have. Last night, Charles could see his confidence as they sat in the restaurant waiting for their drinks. He seemed to know everyone in that slick and glossy place with its hard-driving music. Waiters as tanned and toned as Erik whipped around corners, the whole place pulsed with youth and movement. Ostensibly, Erik had wanted to talk with him about where to apply for medical school, but Charles felt it was more than that, that Erik was making overtures, attempting to acclimate his father to his new world, his new self.

"I think a transgendered person would make the best doctor—see it from all angles, wouldn't you say, Dad?" Erick had said, leaning towards Charles, winking.

Charles had felt himself stiff and awkward and unable to relax, unable to pick up the slightly joking tone. He could see Erik's disappointment and pain and wished he hadn't caused it, but he was helpless to be different. On the long drive home, he questioned everything—his own sexuality and sex life, which had always seemed normal: the furtive and mysterious discoveries of high school, the tame married sex. Erick and his friends treated sex with a clinical frankness and avidity he doesn't understand. He doesn't understand its primacy of place, the knowledge they seem to have that makes Charles feel like the innocent. How would his life have been different, if sex had not been that terra incognita he'd grown up with?

He hears her labored breath before he sees Ruth back into the room with a tray laden with two coffees and little cups of cream and packets of sugar. Her presence is big and female and loud, like some barnyard animal's.

"I thought I'd need some caffeine to get through the rest of this," she says, placing the tray on the corner of his desk, on top of his papers.

He feels invaded again, the happy sensation of being in charge swiftly eroding.

"Do you take sugar, cream?" she asks, over her shoulder.

"Both," he croaks, resenting her. But when she gives him the warm and fragrant cup, he is disproportionately grateful. It has been a long time since Barbara has made any small kind gesture to him. Or he to her. Those small kindness that had been so easy at the beginning of their marriage—where had they gone?

He goes over the problems with Ruth. She sits there, contracted into herself, as he points out what she has gotten and what she has missed.

He hears something, then realizes that Ruth is clearing her throat.

She raises her eyebrows, shrugs. "My brain is tired."

He notices the dark circles under eyes.

"You are a good teacher." She gazes at him steadily, as if about to ask a question. He is ashamed at how he clings to the accolade. Suddenly, he doesn't want her to leave.

He straightens some things on his desk. "By the way, sorry for my abruptness, earlier. About the child, and all that. I'm not so good at things like that." He stops himself before he can say more, beating back a sudden urgency to tell her about Maddy.

“Oh! My goodness. I shouldn’t have blurted that out.” Her face falls. Afternoon shadows creep across the wall. He realizes that her chippiness, her talking, has been a form of courage, even as his silence has been a form of cowardice.

He misses her chatter now, and hesitates, unsure how to proceed.

“So you never had children?”

“No, which probably killed my marriage. The trying, you know. He said he felt that if he didn’t give me a child, I’d leave him. Instead, he left me. Oh, well,” she shakes her head, looks rueful. “It was a long time ago.”

He wants to say, with sudden bitterness, be glad you never did. He wants to say, you think you know your child, but you find that you don’t. He wants to say, it is all grief in the end.

But instead he asks, “And the child you mentioned?”

“Justin? Yes, well, Justin was an AIDS baby. I used to volunteer at the hospital. I just wanted to hold those babies. They needed people there, so I went. Justin had been abandoned by his mother, and was born HIV positive. Addicted to meth. I was there when they brought him in, and I knew he was my special baby. He lived longer than anybody thought—almost eight years. He died in my arms. So you see, I feel like I had a child.”

Even in the dim light Charles sees her eyes were wet.

“I’m sorry,” he says, and means it.

“Thank you,” she says quietly.

“The world has become such a grim place,” he says. “I don’t recognize the landscape anymore. Is it because we are getting older?” Charles is aghast at the pleading in his voice.

She laughs, gathering her papers. “I guess it has always been bloody. When we were young, maybe we didn’t notice it. It is not so bad, really. There is a lot of good. My, look at the time. I’m sorry to have kept you so late. Thank you for your help.”

“You are quite welcome, anytime.” He can feel his professorial mask slipping back into place. “Keep up the good work.” He notices they have dropped first names.

She leaves.

He sits in his desk chair a long time, listening to the steady ticking of the old analog clock, watching the shadows of the maple outside his window deepen their purple imprint on his wall. His cursor blinks, but he makes no move toward it. He is in no hurry to get home. He sees Ruth holding Justin; he sees himself holding Maddy. What more could they have done? There is no answer but the silence, yet he feels as if something is loosed in him, something he’s been holding onto hard. There is a fullness in the quiet, a feeling of rest he has not had in a long time.

Through the open window he can smell the first inklings of spring, a kind of softness in the air that signals change. It is the kind of late spring evening when, at one time, he would have taken Maddy fishing on Lake Chapman. They would rush to make P&J sandwiches, and Maddy having dug the worms would have them ready in the yellow Chock Full O’Nuts can. Once in the canoe, they would bait their hooks and cast them, the two parallel lines slowly arcing and the hooks entering the water one after the other—blip, blip. They would watch for herons skimming the lake at dusk, or for the first

sparkle of Venus. Gradually the stars would come out and he would lean back next to her, pointing out Orion or Cassiopeia, the stars blazing around and beneath them.