Submarine *Expedition*

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For Robert and Umberto

Acknowledgments

Special thanks to my husband, Robert, who has encouraged my flights of fancy since we met. He spent many early morning hours listening to my ideas for *Expedition* and has even read it several times.

I would like to thank to my neighbor and good friend, Peggy Claybrook. She read the first version of it, told me what was good, and told me what was wrong with it in a sweet and loving way.

Thanks also go to Kathie and Marc Feldman, good friends, who took the time to read the manuscript in its second form. Kathie, thank you for understanding what I was trying to do. Marc, I want your two dollars for reading this version of *Expedition*.

Submarine *Expedition* would not have been possible without the NOAA Bathymetric Data Viewer, viewable online at https://maps.ngdc.noaa.gov/viewers/bathymetry//.

I encourage you to study the charts as you follow *Expedition* through the Pacific, Arctic, and Atlantic Oceans.

Admiral Martin descends the vertical ladder from his submarine's sail into the center of its control room. Cool air tumbles onto his neck from the air vents overhead. He soaks up the sounds of hushed voices issuing orders and acknowledging them, and of mission systems humming.

Captain Deverough interrupts, "The admiral is on deck," then greets him, "Welcome aboard, Admiral."

Admiral Martin responds, "As you were," to put the room at ease. A quick glance toward the ship status board shows Deverough has the conn, the tide was low at zero five fifteen and will be high at eleven hundred thirty-two. Sunrise was at zero five fifty-seven. The moon is in its first quarter. The weather is fair. The sea state is calm. "When can we set sail? Is Dr. Jones aboard? "

The captain answers the admiral's second question first: "Dr. Jones is in the observation room with doctors Cohen, Hansen, and Master Sharp." Then answers the admiral's first question, "We are ready to sail on your orders, sir," adding that Sparks has three messages for him.

"Well then, Captain, you have the order to sail," he says, while turning toward the radio station. Sparks hands him three messages. The admiral reads them…turns back to the captain: "Captain, both Dr. Santiestiban and Dr. MacCarthy have encountered travel delays, arrange for them to join us from the *Proteus."* Then tucks the notes into his shirt pocket and asks, "Has the *Enterprise* Strike Group left port?"

"It is scheduled to leave tomorrow."

"I'll be in the observation room," while he checks his watch against the chronometer on the bulkhead.

Images of porpoise riding my bow wave and dancing schools of Red Garibaldi fish cross his mind as lays in a course toward the bow of the boat while thinking his first stop will be Navigation. But he pauses to greet Chief Sonarman Kenny Buckheister, "Good morning, Chief," a talented young man (son to an old friend) who earned the nickname "Ears" in the Navy.

"Welcome aboard, Admiral. It is a fine day to put to sea, isn't it?"

"Every day is a fine day to put to sea, Chief."

Then the admiral sets his sights on Navigator Ryan, a new acquisition from the Coast Guard; her last assignment being aboard the icebreaker *Polar Star*. "Good morning, Nancy. Are you ready to sail?" Before she can answer his question, he asks, "Where will we rendezvous with the *Proteus*?*"*

She pulls a navigational chart from the bottom of her stack, places it on top, and points to an X several hundred miles west of San Francisco. "We should arrive early morning, the day after tomorrow."

"And where will *Enterprise* and her escorts be at that time?"

Big E

The contract for CVN 65 *Enterprise* was awarded to Newport News Shipbuilding on the 15th of November 1957. Her keel was laid down during February of the following year and she was launched on the 24th of September 1960. She has a steel hull and a steel superstructure, four propellers and eight nuclear reactors powering steam turbine engines. Her overall length is one thousand eighty-eight feet. She carries seventy to ninety planes. On the average day, the *Big-E* is manned by five hundred seventy-one officers and five thousand two hundred forty-four enlisted personnel.

In 1963, just to prove she could, the *Enterprise* with two nuclear-powered cruisers made a nonstop trip around the world. Life for *Big-E* was good. She ruled the sea. That is until Admiral Martin put me in the water and agreed to play the role of a red-force fast-attack submarine in a naval exercise code named Talisman Sabre.

Talisman Sabre

Hence the admiral's question, "And where will *Enterprise* and her escorts be at that time?"

To which Navigator Ryan responds: "The *Enterprise* is scheduled to leave port tomorrow…If I may ask, why does it matter? We are on an exploratory science expedition, after all. Why does it matter where the aircraft carrier *Enterprise* is? Do you plan to rendezvous with them?"

Leaning toward her, he whispers. "Has no one yet told you about Talisman Sabre?"

She leans toward him and whispers. "I've heard bits and pieces, but don't understand."

"Well, Navigator Ryan." He starts to reply, but pauses to scan the control room. "Two years ago the Navy requested that submarine *Expedition* take part in the Pacific Fleet's annual naval exercise: Talisman Sabre." He scans the control room again. "The Navy asked *Expedition* to play a red-force fast-attack submarine against the aircraft carrier *Enterprise* and her two escort cruisers. I agreed.

"But, besides her two permanent cruisers, the Navy gave *Big-E* ten escort destroyers and two submarines, along with the mission to take Kwajalein Island.

"Now, remember, I had agreed to help defend the red force territory. And my mission was to stop the blue-force invasion of Kwajalein by disabling the *Big-E* before she could launch her carrier air wing."

Two years ago

I recall entering the Pacific Missile Test Range from the north that day. I was skimming the upper boundary of the great global conveyor belt to cover the noise of running at flank speed.

Just about the time we crossed the tenth parallel north, I began to feel *Big-E* and her escort vessels. It was a soft and chaotic mixture of surface combatants pulsing through the water. She was thirty miles south of me and headed south herself.

But then, the song of an approaching family of great beasts reached me. *We are headed north to the Bering Sea*. It was late in the season and they were in a hurry to catch up with their

family. They sang of a steel-vessel convoy they'd just swum through, and as they passed, their father said to me: *The humans are up to something.* Then asked. *Are you part of it?* I responded: Yes I am. And added that I was taking Admiral Martin and my crew to defend the Kwajalein Atoll from an invasion force. Their father seemed disappointed with my thoughts, so I added: but it's just a military exercise. My admiral is developing new warfare tactics; I don't think my response softened his mood.

So, with the last fragments of the great beast song fading, we traveled under a small fleet of combat support ships and auxiliary supply vessels trailing the strike group. It took four bells to catch up to the strike group's trailing destroyers. Enterprise would soon be within reach and I knew I could destroy her. But this was not the time to attack. It was our job to defend Kwajalein. So we passed under the strike group with its twenty-eight screws screaming.

Surface ships care nothing for stealth, but their escort submarines do. And it was the submarines that were my real worry that day. I knew at least one would be listening to the scattered pings of surface ships from outside the strike group's perimeter, while another would be scouting in front. I knew submarine protocols put them at different depths.

What I was not sure of when we entered the Pacific Missile Test Range that day, was that if I could stay hidden from the submarines *Snook* and *Triton* while Admiral Martin put four torpedoes into *Big-E*'s hull or buried four cruise missiles into her flight deck.

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Back in the control room, Navigator Ryan asks. "So what happened?"

"We exploded four torpedoes under *Big-E*'s hull and sunk one of her submarines." And without further word, the admiral resumes his course toward the bow of the boat, but he doesn't get far because Mr. Bell is tapping on a flickering green hull-opening indicator light.

The admiral stops. "Do you have a leaky air valve there, Mr. Bell? Is it going to delay our departure time?" As the admiral steps through the open watertight door to the research compartment, Mr. Bell responds, "I don't think so. It's just a bad bulb, I'm sure."

The admiral's cabin is the most forward cabin in the passageway. He passes the captain's cabin (on the starboard side), opens the door to his, places his briefcase and hat on his desk, returns to the passageway, closes the door, and descends the spiral ladder to the observation room.

But something curious is going on down there.

An eerie glow has crept into the cavern…images float in disconnected pieces…a blueprint on the wall…Admiral Martin descending the spiral staircase…a thin man with a slight build and a woman with shoulder-length brown hair…a young boy standing pressed against the bow window...the Pacific Ocean in the center of a large map of the world…a curved work station with computer screens and switches and dials…a crewman in dungarees and a standard blue shirt stands watch by the main passageway door…

And I am attracted to its source.

Dr. Jones

Think about it. Two months ago you were buried in the bowels of the Pentagon modeling ocean currents. Now you are standing inside the observation room of Admiral Martin's fabulous submarine Expedition*. And in an hour it will submerge. Water will cover its deck and flood its sail and you will be standing here, behind this huge window, watching it submerge…*

"Are you Dr. Jones?" *Big brown eyes looking up*. "Excuse me?"

"Are you Dr. Jones? I think you are. You look just like Admiral Martin described."

"Oh, how did the admiral describe me?" *The boy's face flushes, he shrugs, and kicks an imaginary piece of dirt on the floor. Bubblegum.*

"Oh, I couldn't say."

"To answer your question, I am Dr. Jones. And you must be William Sharp. I've read your research proposal." *He's so young. "*You are going to collect benthic worms with miniature robots."

"Can you believe it?"

"Believe what? About robots and worms?"

"No. I mean, about these windows. Did you know the admiral invented the dielectric-transparent titanium-aluminum windows? I've read everything about the admiral and this submarine. I bet he's the smartest man in the world, maybe even smarter than my dad."

"How old are you?" *He thrusts his hands into his dungaree's pockets.* "Eleven years and nine months."

"What grade are you in?"

"I graduated from high school last year. I've been taking independent studies with Admiral Martin until I'm old enough to enter Annapolis. He even pays me a salary. I want to be just like Admiral Martin when I grow up. How did you meet Admiral Martin?"

"During the war. Our paths crossed briefly then."

"This is my first time on a submarine that is going to sea. Have you ever been on a submarine?"

"Yes, once. But it was a very different submarine. It was a weapon of war, not a research vessel. And it smelled of diesel fuel and hydraulic fluid."

"Is that how you met Admiral Martin?"

"Yes."

"What's your favorite food?"

"Ice cream."

"Me too. What flavor?"

"Chocolate."

“Me too. Will you be my friend, Dr. Jones?”

“Yes, of course, William.”

“Do you know Captain Deverough?”

“I’ve met him.”

“He scares me.”

“Me too.”

“He’s always scowling at me...My mother lets me have ice cream for breakfast—Admiral Martin is here!” *He darts to the ladder and wraps his arms around the admiral’s waist,* “Welcome aboard, Admiral. Are we going to leave now?”

The admiral kisses William’s head, smiles at me, and starts walking this way, but is interrupted by a thin man with a slight build…khaki trousers, white shirt, bow tie, tweed jacket, leather elbow patches. Extending his hand to the admiral, he says: “Good morning, Bill.”

While shaking hands, the admiral replies, “Good Morning, Dr. Hanson. Welcome aboard.”

Then, scrambling William’s hair, Dr. Hansen says, “So, young man, I hear you are studying benthic creatures. That is my specialty. Have you read any of my books?”

William Pulls away, “Yes, both of them,” *and backs into the woman with shoulder-length brown hair, black slacks, and a red shirt.* “Oh, excuse me, Dr. Cohen. I didn’t mean to step on your feet.”

S*traightening William’s hair, she says, “*That’s all right, I have sturdy shoes on. No harm done.” *Then speaking to the admiral*, “I’m so sorry that I couldn’t make dinner last night. I had to take my research assistant to the hospital.”

“I hope it was nothing serious…”

Someone is watching me…

And Dr. Jones takes a quick look behind…

No one.

And the hairs on the back of her neck stand up as chills run down her spine.

***

Meanwhile, from the bridge atop the sail, Mr. Decker shouts: “Cast off the lines. Clear the deck.” And the top-deck detail casts off the lines. Mr. Decker rings the captain in the control room: “Lines are cast off.”

“Very well, come below.” Captain Deverough turns his attention to ship control, “Diving Officer, prepare to dive.”

The ship-wide intercom bellows as Mr. Decker descends the sail ladders from the bridge to the control room, followed by the sail detail. The last one through closes the hatch and doggs it down.

Closed ballast-tank air-vent valves are the only things keeping me on the surface. Open them, and seawater will flow into the ballast tanks and I will submerge. Santa Barbara Channel, here I come. Pacific Ocean, here I come. I'll cruise at thirty knots one thousand feet beneath the waves and two miles above the abyssal plain. Free as a manta, a great beast, or a seagull. Arctic Ocean, here I come…

In the control room, Dive is reporting: "Flooding the main ballast tanks." And seawater floods in from below as my weight in the water pushes air out through the open ballast-tank air-vent vales. I start to submerge as air rushes through the free space beneath my top deck and tickles what was mirror-flat water. My keel passes thirty-five feet, then forty. Water laps at the edge of my top deck, and I float on the surface with my keel at fifty feet—waiting for what seems like hours...

"Captain, the boat is ready to dive." Mr. Decker reports from ship control and the captain sends the periscope up, "Very well, Mr. Decker, make your depth two hundred feet," as he steps up onto Periscope Island.

"Making my depth two hundred feet, sir," Mr. Decker acknowledges the order, and water floods into my trim tanks. As I submerge, Captain Deverough peers through the periscope optics. "Deck's awash…" he reports, "Bow's under." Then walks a semicircle around Periscope Island to watch my tail rudder disappear. Eddies develop above me. A few seconds go by. "Stern's gone." And he puts the periscope down.

He would have stopped the dive if someone were in the water. Wouldn't you think?

***

They say, in the last moments before you die, you will see your life flash before your eyes. It is not true. Or if it is, it hasn't happened yet.

The last thing I remember is Captain Deverough announcing, "Make your depth two hundred feet." I was with William and Admiral Martin. Now I'm in the water and it's cold. And my breath is running out.

I recall watching the rippling water line creep up the bow window and watching the eerie depths of the sandstone cavern come into view. Surface ripples distorted the stone dock and the dock workers there…

That is when a wall of water hit me like a battering ram and knocked me senseless.

And now, I am being knocked around in cold water, holding my breath. I need air. My body is telling me to inhale, but my mind is saying no, hold your breath…

Get hold of yourself! You can hold your breath for fifty-five seconds...

But that's when I'm not scared...

This was supposed to be a great adventure. Instead, I'll be dead at the dock.

Will anyone even miss me?

Admiral Martin will save you. He will find you and pull you out. Just call to him…

I want to scream: 'Help me,' but my mouth cannot form what's in my mind. I try again. Water floods my lungs. I cough it out and choke it in again. My lungs burn…

I'll never read 'A Winters Night' again…never again will I walk the continental divide or fly over a thunderstorm…

***

The last thing I remember was meeting a woman I suspected was Dr. Jones. Captain Deverough had just announced: "Make your depth two hundred feet," and we were watching the waterline creep up the bow window…

That's when a battering ram knocked us to the aft bulkhead. Now, I don't know which way is down or which way is up, and she's screaming. *Help me. I need air...*

Come to think of it, so do I. I need to breathe, but I don't have lungs. The air is for my crew, not me. I'm nuclear powered and electricity runs through my veins.

But I feel that I am going to die!

Never again will I go to the Bay of Fundy with Admiral Martin. Never feel the tide rush out and back in…never sing with the great beasts again…never go to the bottom of the sea…I'm going to die before Admiral Martin knows I am alive.

Just a minute ago, I was a large and powerful submarine. Now I'm a minnow in a vast sea—scared out of its mind. Electromagnetic pulses dance in nauseating patterns as bundles of energy surge through my hull.

My life is finished...

My life is finished...

Fists of bitter cold are pounding my chest. Each strike robs me of heat.

Wires must have gotten crossed somewhere...The crew's air revitalization system must be mixed up with power generation…

Death's craggy fingers are wrapped around my chest…squeezing me…

I'm a drowned rat…dead and empty…swept to sea by the tide.

Admiral Martin, help me. I'm in the water drowning.

Admiral, help me. I think I'm drowning, but, really, I must be experiencing a catastrophic systems failure of some type.

***

"Earth to Dr. Jones." Admiral Martin's hand on her shoulder pulls her back into the warmth and comfort of the observation room. *Steel-blue eyes.* "Dr. Jones, what's wrong? You are as white as a ghost."

Should I tell him?

Are you asking me?

But she's speaking to the admiral: "I just had the most extraordinary experience…"

"You're shivering. Take my jacket." *His warmth comes with it*.

"I thought I was…drowning...I'm afraid of being in cold water. It terrifies me."

"It's okay now. You are here with me, dry and warm. Welcome aboard my submarine. I'm sorry I was not there to greet you this morning."

Looking at him, but pointing to the bow window: "The window broke, I thought...I was being bashed around by very cold and turbulent water flooding the observation room. I screamed for help. Didn't you hear me?"

"No. You didn't make a peep. You were quiet as a mouse. But your mind was far away."

"There's something else. I had the strangest feeling that there was someone with me and in distress. I heard a call for help. Could someone have been trapped in the sail or fallen off the dock?" I answer her: That wasn't someone in the sail, Dr. Jones. That was me! You heard me. You <u>were</u> talking to me. I was the one calling for help.

"It sounds like a nightmare." William takes her hand. "Can you have a nightmare during a daydream?"

By this time, the admiral has called the control room. "Check topside for people in the water. I'm coming up." Then he says to William: "I'm going to the control room. Please keep Dr. Jones company while I'm gone."

"Aye, sir!"

"Don't worry, Dr. Jones. I'll take care of you until Admiral Martin comes back."

"Thank you, William." *Great. The admiral thinks I need a twelve-year-old babysitter.*

Santa Barbara Channel

I emerge from the tunnel of my hidden dock under the cover of a Giant Kelp canopy. Dappled sunlight falls on clouds of plankton and skeleton shrimp, and tiny jellies billowing into the prevailing current wash over my hull as I surge through a forest of tall, slender trunks that grow toward the sun. Perch and rockfish school through the understory. Tiny surface-dwelling spiders hunt through leafy blades that sprout at regular intervals, herds of purple spiny sea urchins munch their way up Giant Kelp stalks and plain brown snails graze on encrusting algae while the fry of mighty fish seek shelter in its fronds.

A splash by a skiff, and another gets my attention. Two human divers have entered the water, knocking a napping sea otter from its kelp-frond nest. He rockets away. Human legs with their swim fins kicking launch turbulent eddies into the canopy and separate a school of Red Garibaldi from a pocket of bristle worms they had just found. And scattered seabirds gather from the sky and bob in the canopy, dipping for fish.

Two leopard sharks prowling the bottom sense the commotion and start weaving their way toward it. A speedboat screeches overhead, screaming outboard motor exhaust gas into the water.

Five years ago

The first time I sailed into the Santa Barbara Channel it was a delightful day and what was to be the first of many homecomings. Small recreational craft and fireboats, whale watching boats and three coast guard vessels joined us off Point Conception and escorted us to an anchorage point off Santa Barbara Bluff. Scattered calls from ship horns echoed off the rock outcrops that line the shore.

My first homecoming was a regional celebration. We dropped anchor on the deep side of a Giant Kelp forest, a half mile from the bluff upon which Admiral Martin had built the sprawling campus of Martin Marine Enterprises (MME). At the time, the only land I had experienced was the shipyard at Baltimore Iron Works.

On this special day, small boats motored up and docked with me. MME employees and their families were welcomed aboard. Children scrambled over my top deck, explored my inner spaces, wondered at the submarine with a window, climbed the ladders inside my sail to walk out on the diving planes, and imagine what it would be like to command a submarine from its flying bridge.

That was the first time a great beast came to speak with me. I had felt great beasts following me on that first voyage home, and heard them sing. But even the most curious of them kept their distance. I enjoyed their songs, but didn't understand them at the time.

Sometime after the sun had reached its zenith that day, Cookie set a grill on the afterdeck and cooked hot dogs, beans, and hamburgers.

While people were littered on the top deck enjoying lunch and the sun, a great beast came to visit me from below. *Why are you here?* He asked, and I answered. Admiral Martin brought me here. This is to be my home.

Just what kind of human vessel are you? I have never seen a ship like you.

I am a submarine, a research vessel and a submarine. The underwater cavern beneath the bluff on the other side of the kelp forest is to be my home port.

We've seen many submarines come and go through this channel. Our family stories tell us of submarines that used to come and go from this bluff when the humans were blowing things up in our ocean. Do you intend on fighting in these waters?

No. I am a research vessel. Although, to be honest with you, I'm armed with torpedoes and missiles, and those things can blow up, but I think they're for defense. That being said, Admiral Martin is a soldier and if his country goes to war, I'm sure he would outfit me for war and take me into battle.

I don't think the great beast liked my answer. He left me, swum to the bottom of the channel and out to sea. This was the first time any beast had spoken with me.

William Sharp

It is smaller than I imagined. Dr. Jones remarks to herself, as she stands on the mezzanine level of the research bay, studying the bay deck twelve feet below her. *Wooden shipping crates litter the deck: RAMONA 1 of 7…RAMONA 2 of 7…CRABPOT 1 of 2…a gantry crane pushed off to the side…the main launch bay. No diving bell. It must be in the auxiliary launch bay. I should go there next.* And she glances at the watch on her left wrist.

"Dr. Jones," William runs out from behind two crates labeled 'CRABPOT 1 of 2' stacked on top of 'CRABPOT 2 of 2.' "Come and see my robot." He calls up to her.

"I'll be right down…"

When she gets there, he's got both crates open and an octagonal piece of equipment that converges to an apex at the top…*Orange…*She sits on the deck with him, surrounded by packing material, as he explains: "Each of the eight robot crabs has a bay of its own—"

But she's here for another reason. "William, I'm here to verify that your mission equipment has access to the ship's guest computing environment."

"It's a boat, submarines are called boats."

"Okay, the boat's guest computing environment."

"Well, I haven't set that up yet. Is it important that I do that right now?"

"No, William. We've got over a month until your crab pot will be deployed, but you have the opportunity now to secure supplies when we rendezvous with *Expedition*'s submarine tender late tomorrow. The more you prepare today, the more probable it'll be you have everything you need to execute your mission in thirty-seven days."

“Gee, Dr. Jones, you sound just like my mother,” *and he’s grinning from ear to ear*.

She moves some packing material around on the floor, “Where is your command-and-control equipment?”

“Here.” He pulls a wooden crate, about two feet by three feet and ten inches high, across the deck toward him. “Haven’t opened it yet.”

Dr. Jones says: “I can get a crewman to help you get this up to your mission bay.” And she’s pointing to the aft starboard mission bay on the mezzanine level.

To which he replies: “I know, I’m in mission bay two. It’s the smallest. Is that because I’m the smallest?”

“I don’t know, William. This is my first day, too. If I send a crewman here at 4 PM, can you show him what you need to move?”

“That is sixteen hundred.”

“What is sixteen hundred?”

“The time. Four PM is sixteen hundred hours on a boat.”

“Okay, if I send a crewman here at sixteen hundred hours, can you show him what you need to move?

“I suppose so, Dr. Jones, but I’m getting awfully tired. I’ve been so excited that I haven’t slept since yesterday morning, and that is eastern time.”

He does look sleepy. “I understand. Let me know what you need. Mostly, I’ll be at mission control in the observation room.”

“Dr. Jones?”

“Yes, William.”

“You have the best watch station in the whole boat.”

“Even better than Captain Deverough’s, do you think?”

“Yes. He can’t see the ocean from the control room.”

“Well, you can visit any time you like.”

“Can I sit at the controls?”

“Yes, of course.”

“I’m hungry…”

“Well, then. Let’s get something to eat. Then I’ll walk you to your bunk and tuck you in, if you like.”

“Oh no, Dr. Jones. Not in front of the crewmen.”

Millions of years ago

It was a long time after global forces had folded the two mountain ranges into existence.

Vast forests dominated the land, and birds filled the canopies with their calls—as did insects and reptiles. Stands of huge flesh-eating ferns packed the forest floor. Cypress grew out of the marsh. Over millions of years, organic matter accumulated as living things died.

But then something changed. An era of persistent rain started. Great rivers raged down the mountains to the coastal plain, dumping their burden of rubble, killing the forests and covering them over. This continued for millions of years.

And all this time, as miles of sediment piled up, the increasing weight of rock above the rich organic matter turned it into tar and oil and gas.

So today, I am cruising westward through the Santa Barbara Channel with the San Ynez range to the north and the Santa Monica range to the south, while beneath me dissolved-methane bubbles, delicate filaments of heavy crude oil, and sticky-black tar seep through the faulted, fractured bedrock. I can taste it.

About five minutes ago, a tar mound that had been growing on a rock outcrop for a month reached a critical state. It lifted itself off the outcrop and launched itself into the sea. It has been drifting with the current westward at three knots, headed toward the surface…

This very instant, through no fault of mine or the tar, Dr. Jones and William reach the mezzanine catwalk, and step off the ladder onto it. “Let me show you something.” And she places her fingertips on the bow bulkhead. Her touch dissolves the blankness. Sunlight streams through the water from a silver circle of light on the surface.

At the same time, the boat’s collision-alert claxon starts screaming, sonar launches a ping, the captain shouts: “Prepare for a collision,” and engineering pushes the propulsion system into reverse.

But not quickly enough to stop a thirty-foot wide, thick, black, sticky undulating tar blob from smacking into my bow window. The collision knocks William and Dr. Jones to the deck.

Rachel Cohen

The sign on the door reads: Mission Bay Three. Dr. Jones knocks and waits… *Why do I have the memory of…*

“Come in.” She opens the door. Dr. Cohen looks up from a portable electronic console.

“Good evening, Dr. Cohen.” A laboratory computer is busy setting itself up.

“Hello, Dr. Jones,” she stands to shake hands. *Lavender.* A sent of lavender floats in the air. “But I’d feel more comfortable if you called me Rachel. This ‘Dr. Cohen’ thing will wear thin after three months living in a sardine can together.”

I’d hardly call Expedition *a sardine can. I thought the formality kept order.* She says, “Only if you call me Casey.”

“It’s a deal, Casey.”

“I’ve established an account for you on the ship’s guest computing network. I’m here to verify that you have access, but I can see you are already using it.”

“Yes, I’ve been working since zero five hundred hours, what time is it now?” Dr. Cohen glances at her fine gold watch and answers her own question, “It’s nearly seventeen hundred hours.”

Dr. Jones changes the subject, asking, “So RAMONA is going to map fifteen hundred miles of the Arctic Ocean floor without stopping…Impressive.”

“If *Expedition* can tow her. Yes, that is the plan.”

“And RAMONA’s going to cruise five hundred feet off the ocean floor emitting specially designed, seabed penetrating sonar signals and collecting the returns?”

“That’s the plan.”

“And with *Expedition* towing her at ten knots?”

“That’s the plan.”

“All the way from Mackenzie Bay off the Canadian shelf to the Nansen Ridge? Weren’t you supposed to have a research assistant with you?”

“Yes, but yesterday he was taken to the hospital with a burst appendix, so I’ll be flying RAMONA alone.”

“I’m sure we can get you plenty of help. William Sharp seems like a capable young man. He’s built his own deep-sea robots to collect benthic worms. Perhaps he can step in.”

“That’s a good idea. I’ll talk to the admiral about it.”

Dr. Jones turns to leave and then turns back. “What does RAMONA stand for? The crew has a pool going on. No one seems to know. I checked your research proposal. It doesn’t say.”

“Well, then, if I told you, it would ruin the crew’s fun.”

Dr. Hansen

The sign on the wall reads: Mission Bay One.

RAMONA’s crates have been broken apart and two crewmen are stowing the panels in an aft bulkhead closet.

She knocks on the door. “Excuse me, Dr. Hansen, I’m Dr. Jones, the ship’s mission coordinator…”

A knotted scowl peers from behind an opening door. He was waiting for me to knock.

“Yes, my dear, I know who you are. We met in the observation room earlier today…”

“Like I said, I’m the expedition’s mission coordinator. I’m your interface with ship operations.”

Before her sentence is finished, he interrupts: “What does that mean?”

“I’m sorry, I don't understand.”

“You said, ‘I’m your interface with ship operations.’ What does that mean?”

“It means, if you need something, you ask me, not one of the crew or officers. It means, if you think you need to go someplace that is off limits to visitors, you talk to me, and I’ll get you clearance to go if warranted.”

“I’m sure that doesn’t apply to me.”

“Nevertheless, talk to me first.” She pauses, “The reason I’ve come here is to tell you that I’ve set up a computer account for you on the guest computing network.” *A closed briefcase and a standard MME computer terminal sit on the top of his workstation desk*. “Have you not brought any equipment?”

“No, my dear, I will use MME equipment. And I’m supposed to have free access to the main computer.”

I don’t have an order for that. “I’ll look into it,” she says. “Until then, you can access your computer account from here.”

She turns the terminal on and watches it power up while she’s saying, “I have read your journal article on deep-sea life along the mid-ocean spreading ridges. I like your theory. It…”

“Oh, you are so sweet to say, my dear. I think you and I will be good friends.”

“Have you met William Sharp? He also studies benthic creatures and has built a robot to collect…”

“His work is not original, nor is he published.”

“You do understand, Dr. Hansen, William is only twelve?” She doesn’t wait for a reply, and changes the subject. “Will I see you in the crew’s mess tonight? I’ve been told that the visiting scientists are expected at seven o’clock, although you can eat anytime you want.”

“Oh no, I am dining with Admiral Martin in his quarters. We are old friends, you know.”

“Well, let me know if you need anything, and enjoy your dinner.”

***

The lights are dim in the research bay as Dr. Jones descends to the ladders. She peers into the empty launch bay through its port hole…she opens a storage locker…Walks around a strange looking deep ocean probe…*RAMONA*…visits William’s Crabpot.

The sign on the door reads: Machine Shop. She opens it.

The room is dimly lit. “Is anyone here?” She passes a drill press, an arc welding machine, a metal lathe, a milling machine, a workbench, and a grinding machine…*Odd, I know it is three in the morning, but I was expecting twenty-four/seven operations…No one was in the observation room, no one was in the research bay, and, now, no one is in the machine shop…Curious...*

The sign on the watertight door reads: Auxiliary Power. *This is the battery room.* She places both hands on the door. *Warm.* Then presses her left cheek against the door. *Humming.* She steps back…considers climbing the ladder to level three. *I would need to walk through the*

chiefs' quarters. Considers going back to the research bay. *I really want to see the battery room. I could get one of the crewmen to show me. What a coward you are…*

I say: It is just a battery room, Dr. Jones. I'll go with you.

So she turns the wheel of the watertight door clockwise, pulls open the door, and steps into a brightly lit room with a white overhead. Eight rows of five-foot high batteries stand cradled in the pressure hull's fourth level. The room is much longer than wide. The air is charged. She steps through, pulls the door shut and secures it…

A trolley rail runs down the center of the room. She climbs onto the trolley deck. Electricity crawls on her skin. She shutters and brushes her left arm with her right hand, and her right arm with her left hand…and shakes her hair. Then pulls the trolley through the massive led-acid cells connected by thick power bars…

The sign on the door reads: Missile Compartment. She opens it, steps through, and closes it, cutting off the light from the battery room. And her heart skips several beats as she realizes she is standing under the major support to the missile silos and their contents, and she is surrounded by the business end of a launch platform with pent up power enough to thrust thirty thousand pound missiles through ninety feet of water and clear the surface before igniting their own rocket motors. She closes her eyes, uttering a silent prayer for courage, then races through the room fully aware of the missiles towering above her, although she can't see them…

The overhead ends and the missile compartment opens into the auxiliary launch bay. She sees the diving bell and three mini subs. Then she looks up to the catwalk that is the main passageway in the missile compartment…

The sight of the aft bulkhead makes her stop breathing. *Two nuclear-powered pressure-water reactors are beyond that bulkhead.*

That is the core of my being, Dr. Jones. I will show you. And I whisk her through the aft bulkhead, into the port reactor room, and into the primary containment vessel, where I pause for a moment so she can get her bearings. Then I take her into the reactor core vessel and where we watch radioactive isotopes of uranium two-thirty-five absorb slow-moving neutrons, turning them to uranium two-thirty-six. And, with great excitement, uranium two-thirty-six is breaking into fast-moving fragments of rubidium and cesium—leaving three free neutrons and prompt gamma photons left over…All the while, fast-moving neutrons collide with a matrix of atoms, making it hot while cooling themselves down, and then go on to transform other isotopes of uranium two-thirty-five into uranium two-thirty-six. When balanced just right, the reactor maintains, within its core vessel, a sustained chain reaction that heats the core water under super high pressure…

We follow the reactor core water through a closed-loop network of pipes, winding around inside a clean reservoir, where, by the temperature difference alone, heat passes from the reactor core water to the clean reservoir...

And then we follow the steam from the clean steam chamber through pipes into the turbine, where it turns tremendous turbine blades. Copper coils rotate around us. Electrons move forward and back, and we pause for a while because Dr. Jones's head is on fire with magnetic fields and rotating coils. *Let me go. I'm dizzy and feeling nauseous!*

A dip in the water will remedy that, and I plunge Dr. Jones through my keel where she's caught in the whirling current inside my port propeller duct and spit into the sea.

Stop. My heart is going to explode. *Stop, I'm in cold water again. Help!*

Dr. Goeller

"Dr. Jones?"

Dr. Goeller's hand on her shoulder gets her attention. "Yes."

"I'm sorry, did I wake you?"

"It's quite alright, I was having a nightmare. Can I help you?"

"Yes, I'm Dr. Goeller, MME's resident geophysicist."

"It's a pleasure to meet you."

"Admiral Martin thought you might enjoy discussing my recent work. It is to be published in the *Journal of Geophysical Research: Solid Earth*—that title is a misnomer because the earth isn't solid, nor is it liquid. As a matter of fact, there is only a thin shell made of solids and liquids, beneath that there is the mantle and core that are neither solid nor liquid, but something altogether different—Oh, but you probably know this, you are a physicist after all. Well, let me tell you what we found…"

Without pausing to breathe, he leads her to the sprawling map of the earth's global ocean that occupies the aft bulkhead of the observation room, points to the coastal waters off the eastern shore of the United States, while saying, "The Eastern North American Margin was formed by the opening of the North Atlantic Ocean following the rifting of Pangaea…

"Advancing knowledge on the structure and development of the Eastern North American Margin is critical for understanding not only the formation and evolution of passive margins but also the early opening history of the Atlantic Ocean. That is my theory, anyway. But I've gotten sidetracked…" Then he returns to his main point. "What is really important, as you must understand this if you are to follow my research at all, is that the rift-drift transition of the Eastern North American Margin is coincident with (and may have been triggered by) the volcanism of the Central Atlantic Magmatic Province—and, I also believe it to be associated with a mass extinction event at the Triassic-Jurassic boundary. Can you believe that?"

"I'm sorry, Dr. Goeller. Admiral Martin is right. I'd love to hear about your discoveries in the Hudson Canyon, but I'm exhausted and not feeling well right now. If you'll excuse me, I have a serious headache." And she follows the main passageway through officer country, past the small cabin she shares with Navigator Ryan; headed to sick bay.

Dr. Goeller mumbles to himself. "Well, I guess I can tell her at dinner tonight."

Doc Lexi

The sign on the door reads: Sick Bay.

Dr. Jones is rehearsing. Playing out scenarios of a conversation with Doc Lexi in her head…

The smell of frying onions and the sound of indistinct chatter drifts up from the crew's mess.

Just what am I going to say? Doc, I think I'm hallucinating—I think something is making me hallucinate. No, that's not right. Could something be making me hallucinate? She will say, "Why do you ask?"

You will answer. Well, you see, as the boat was submerging this morning, I thought the bow window broke and water flooded through like a battering ram…it slammed me against the aft bulkhead, and that is not all…

Then, about an hour ago, I was knocked over by a huge ball of tar…

No, I can't say that. The Doc will just say I'm daydreaming. She may even be obliged to tell Admiral Martin. Maybe I should tell her that I have a headache. That's pretty harmless. She pushes open the door to sick bay and steps through.

A young woman looks up from a book on her desk with drawings of octopus anatomy on its pages. *She's wearing a white medical smock…has neat french braids…and delicate metal-rimmed glasses.*

She says, "Hello, Dr. Jones. Can I help you? *Behind her are four empty bunks lining the aft bulkhead.*

"Are you Doc Lexi?"

"Yes."

"Have we met? I don't recall, I'm sorry."

"No, we haven't. But Dr. Jones is the only female on the boat I haven't met—the diagnosis was by process of elimination." *She smiles. Her eyes sparkle…I hate her already…How come some women look great in glasses?*

Referring to the book on the desk, Dr. Jones asks, "Are you a veterinarian?"

"It's a hobby. On this boat, you never know when you're going to have to sedate an octopus or dose a whale with antibiotics for a massive infection."

"How long have you been aboard *Expedition*?"

"About five years now. I've been aboard since she launched. The admiral stole me from the Navy. How about you?"

"This is my first day. But you know that, of course. I work for the defense department, modeling ocean currents."

"Are you joining Martin Marine Enterprises?"

“No, I’m visiting. Here just for the expedition.”

“Well, Dr. Jones, what can I do for you?”

I hesitate to answer. “Doc, I’ve had the strangest experiences since I came onto this boat…I’ve had the feeling someone was following me around.” *And offer a common plausible reason for it that I feel won’t make me sound crazy*. “Are there security cameras?” *Oh, like that doesn’t sound paranoid.*

“Not that I know of.”

“Could something be causing me to hallucinate?”

Doc Lexi stands and motions to the examination table in the center of the room.

She says, “Stay focused on my nose.” *And looks into my eyes, passing a pen light from center to left, then center to right. Listens to the sound of my heartbeat, hesitates, then hangs her stethoscope around her neck and says:* “Stand up…Put your arms out to the side…Close your eyes…Stand on one leg…Now touch your nose with the index finger of your right hand…no your other right hand…What makes you think you’re hallucinating?”

“I’ve been seeing things. No, not seeing…experiencing. I mean…images in my mind…and feeling things…like serious, strong daydreams.”

“Could you be more specific?”

“When the boat was still at the dock…it was just beginning its dive…and a still water line began to dance as air was forced out of the ballast tank vents...The boat began its dive…Doc, I thought I was drowning…I thought the bow window had broken and that water was rushing into the observation room…I was swallowing water and choking and trying to scream for help.”

“Take a breath, Dr. Jones.”

“Sorry.”

“You were at the observation room window at the time?”

“Yes, that’s right,” Dr. Jones giggles. “I’m embarrassed…there’s something else…I heard someone else calling for help…”

“What else?”

Well, she’s not laughing at me. I wonder if she has to report to the captain or admiral that I think I’m hallucinating? “We were sailing out of the channel when I plowed headlong into a thirty-foot-wide floating tar blob…Doc, I swear, I felt it hit me.”

“What else?”

“I was inside the port nuclear reactor, went on the scariest rollercoaster ride of my life, was sucked through a turbine engine, pushed into the sea, and watched as the submarine’s bright brass propellers—each ringed with ducts and crossed with planes, and the rudder, and the sail and diving planes on top—speed away from me at fifteen knots.”

“You’re pulling my leg.”

“What?”

“Did Admiral Martin put you up to this?”

“Really, Doc. Is something making me hallucinate?”

“But really, Dr. Jones, did Admiral Martin put you up to this?”

***

Dr. Jones is lying in her bunk, the covers pulled over her head…*This bunk is comfortable. It’s hard to believe.* She turns on her side, curls into a ball, and drifts into sleep…

But then, with the speed of a lightning bolt strike, a thought forms in her mind, and the thought dumps adrenalin into her bloodstream. It is like the collision alert claxon pounding my hull and sending my crew to their emergency response stations.

What are you? I can feel you in the room with me. She turns on a small reading light next to her head. “Nancy?” she calls to Navigator Ryan. Nancy is not there. She’s on duty in the control room. No one answers her question.

Okay, I can’t see you...But I can feel you.

Could she be talking to me? Do you mean me?

Yes, I mean you. Who else is here?

No one else in the room. Just me and you.

Who are you?

I am *Expedition.* At least, that is what the great beasts have told me. They say I am a huge underwater vessel, hard and made of metal. And humans live inside of me.

How can that be?

I don’t know. I can’t remember not being.

Did Admiral Martin invent you?

Yes. Maybe. I’m not sure.

Why are you not sure?

I have memories, but they don’t make much sense.

Where are you?

I’m in the Pacific Ocean, headed to the sea beneath the ice.

I mean in the submarine? Where are you? Are you in the control room or in the main computer?

I’m not inside. I’m not outside.

Why do you answer with a riddle?

It is the best answer I have.

Why are you doing these things to me?

What do you mean? I'm not doing anything to you.

You nearly drown me in the observation room…you threw me in front of a thirty-foot-wide tar blob…you pushed me through the keel and into cold water. I hate being in cold water…

I didn't do those things to you. You did them to me.

I did them to you?

Yes.

Why?

First, I think you are mistaken about me drowning you in the observation room. It was the other way around.

You think I nearly drown you?

Yes! I was excited because I was going to sea. So were you.

Captain Deverough had said, "Take her out, Mr. Decker," and the loudspeakers were bellowing. That is when I felt your excitement and found you in the observation room. We were watching seawater flood my top deck. That is when you broke my dielectric-transparent titanium-aluminum windows.

I broke the bow windows?

Yes. And seawater flooded in like a battering ram. It slammed us into the aft bulkhead and knocked the breath out of us and it was dark and we were cold and disoriented. We screamed for help. We swallowed salt water and choked and coughed and drowning and panic. I thought I was suffering a catastrophic system failure. I was scared. That was fun!

You broke the bow windows!

No, I didn't. And, second, I had absolutely nothing to do with you hitting the tar ball. It just happened. Sometimes tar balls just float by, and sometimes I run into them. You just happened to be standing in the bow of the boat looking through the window when it happened. Get over it.

And, third…

You are not going to say that I pushed myself through the keel and into the sea.

Let me finish. You said you were feeling dizzy and nauseous, I thought some cool water would make you feel better…

What? Are you crazy?

No. I'm not crazy. Are you?

I'll tell you what I am…I am afraid I'm going mad…I went to sick bay and asked the doctor if she thought I was hallucinating. There's a very real chance she will report me to Captain Deverough or Admiral Martin and I'll be sent back to shore…Go away. Leave me alone.

***

Someone knocks on Admiral Martin's door. "Hello Doc, what can I do for you?"

"Admiral. Dr. Jones came to sick bay…"

The Pacific Crossing

It's a corner of land carved by the wind and waves out of sandstone cliffs, and on a mesa halfway down sits a lighthouse that warns boats and ships of rock outcrops and dangerous weather—Point Conception marks the place where the Pacific Ocean asserts itself over lesser waters and I sail through it at twenty knots, then turn north by west into a cold southbound current.

Talisman Sabre

Meanwhile, inside the control room, Admiral Martin and Navigator Ryan don't feel Dive balancing the trim tanks. They don't hear the occasional return ping from sonar. They don't smell freshly brewed coffee being served by Stuart. Or the cup he places next to each of them, and a plate of cookies. They're on the other side of the Pacific, on the other side of the Aleutian Trench, standing on the precipice of Unalaska Island's Mount Makushin. Deliberating whether or not to make a side trip to watch her spill lava into the sea…

Captain Deverough joins them. "Excuse me, Admiral…" and his voice pulls the admiral back to the plotting table and the waters off Point Conception. The captain continues: "A message has just come in from COMSUBPAC. You should know, the *Enterprise* left port this morning, a full day ahead of schedule."

The admiral says, "That coffee smells wonderful. Can I get a cup?"

And the captain points to the coffee on the table, "That's yours. Stuart put it there not thirty seconds ago. It should still be hot."

"That means her subs have been in the water for two days."

And the captain pages through the charts on the table looking for the eastern Pacific between Point Conception and San Francisco. He finds the one he wants, pulls it out, and places it on top. Then calculates the distance a patrolling submarine could cover in two days. With its center on San Francisco, he draws an arc, and another further out. "This is *Triton*'s patrol area for tomorrow."

SSN 586 Triton

On a hot summer day in 1958, from the dry dock of General Dynamics Electric Boat in Groton, Connecticut, SSN 586 *Triton* entered the water. She took a short trip down the Thames River to the Long Island Sound, where she had her first deep dive.

Built as a radar picket submarine, everything about her was designed to collect intelligence information for carrier-launched fighter aircraft interception of incoming fighters, bombers, and missiles. *Triton* was the first submarine to have two nuclear reactors because she needed to be fast and she needed to stay out for a long time.

Unfortunately, her primary mission was rendered obsolete two years after her launch because the Navy fielded the carrier-based Grumman WF-2 Tracer airborne early warning aircraft.

So, in 1962, the Navy converted *Triton* into an attack submarine. They let her keep her name. And because of her size, she became the flagship for the Commander of Submarine Forces for the Atlantic Fleet. But she was directed to spend the summer of 1963 in the Pacific Ocean with the mission of protecting the aircraft carrier *Enterprise* during a training event known as Talisman Sabre…

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Back at the plotting table, Admiral Martin sips his coffee. "That's just peachy. Doesn't our course put us in that area at the same time?"

"It's worse than that." Navigator Ryan draws an X where our course crosses the *Big-E*'s. "That is where we are scheduled to rendezvous with the *Proteus*."

"So they know exactly where we are headed?" The admiral remarks to no one in particular.

"Who's they?" Navigator Ryan asks?

"Triton and *Snook,"* the admiral snaps. "Haven't you been paying attention, Navigator?"

"What do you want to do, Admiral?"

"We should cross the patrol area beneath the deep sound channel and change our rendezvous location with the *Proteus…*

"Why is it so important," Navigator Ryan asks, "to avoid the submarines *Triton and Snook?"*

"Revenge," the captain answers. "Revenge for what we did to them during the Talisman Sabre Exercise last year."

Talisman Saber

Two thousand four hundred miles west southwest of Pearl Harbor, Kwajalein Island is the southernmost and largest island in the Kwajalein Atoll. It hosts a Navy base and is used as a refueling stop for military aircraft and often plays a part in naval exercises.

For the Talisman Saber exercise, a red force (of Soviet proportions) had invaded Kwajalein Island and was holding it. They had jet fighters and bombers, a runway, tanks of diesel and jet fuel, surface and airborne radar, surface-to-air missiles, and a variety of secure outposts with guns, and cannons, and missiles. The *Enterprise* Strike Group was being sent in to liberate the island and return it to blue force (American) control.

But there is more. The red force had two shallow-water diesel submarines. In case you don't know, even shallow-water diesel submarines are high-value assets, and as such, they have their own way of fighting. Unless shooting torpedoes at other high-value assets, they will not shoot torpedoes because they can carry only four. In a pinch, they might surface to engage the enemy with machine guns, but that would be a waste of precious resources, because in war things rarely turn out well. Their standard practice is to call in the coastal patrol boats for that kind of action. And red force (my side) had three dozen.

We had come in from the north, passing under *Big-E*'s rear escort destroyers, then under *Big-E* herself and one of her cruisers. We passed about one hundred feet under *Big-E*'s keel, recording her acoustic signature. Pounding pressure waves set me shaking.

In front of the *Big-E* were two amphibious transport ships tucked safely in the middle of her escort destroyers. At some point, the LSD-7 *Oak Hill* and LPD-1 *Raleigh* would advance to a less-secure, forward-based position. And, when they were three miles from shore, they would open their well decks and launch ten amphibious assault vehicles…

LSD-7 Oak Hill

LSD-7 *Oak Hill* is an Ashland-class dock landing ship named in honor of Oak Hill, the Virginia estate of President James Monroe. Originally intended to be a Mechanized Artillery Transport ship, she was laid down by the Moore Dry Dock Co., Oakland, California, on the 9th of March 1943. The *Oak Hill* was sponsored by Mrs. Robert E. Garrels and commissioned on the 5th of January 1944 with Carl A. Peterson USNR in command.

LPD-1 Raleigh

LPD-1 *Raleigh* is an amphibious transport dock ship named for the capital of North Carolina. Her keel was laid down by the New York Naval Shipyard of Brooklyn, New York, on the 23rd of June 1960. She was launched on the 17th of March 1962 sponsored by Mrs. Terry Sanford, wife of the Governor of North Carolina, and commissioned later that year on the 8th of September with Captain A.W. Whitney in command.

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I can not imagine being an amphibious assault ship. They're built for one task: to transport marines and their equipment over several miles of hostile shallow-water territory. Once launched, they're the subjects of focused attack: cannon fire from red coastal patrol boats, strafing runs from red fighter aircraft, and rocket-propelled grenades and mortar fire from the cannons on shore. They have nowhere to hide. No way to fight back. All they can do is run at flank speed through rolling swells and choppy waves, and hope for the best.

But I wasn't a blue-force amphibious assault vehicle; I was a red-force deep-water submarine loaded with torpedoes and missiles, and my mission was to disable *Big-E* before she could launch her blue air wing to annihilate red force offenses, making it safe for the blue marines to land on the red beach and take the captured island back.

So the *Big-E* was four hundred miles north of the atoll, steaming south by southwest at fifteen knots, while I was patrolling the sea between the Kwajalein Atoll and the carrier strike group. In six hours, she would be close enough to begin her first air assault at the military targets.

But the blue force knew I was here and capable of burying four missiles in the *Big-E*'s flight deck or punching four holes below the waterline with torpedoes, so they traveled with two deep-water submarines of their own. One was a powerful attack submarine, *Triton*, and the other was her escort *Snook*.

SSN 592 Snook

SSN 592 Snook had her keel laid down in April 1958 at Ingalls Shipbuilding, in Pascagoula, Mississippi. She was launched on the 31st of October 1960 and had her first deep dive in the Gulf of Mexico. Only two hundred forty feet long, everything about her is intended to hunt and destroy other submarines. She spent her time attached to the Seventh Fleet in the Pacific and was a likely candidate to team up with *Triton* in the Talisman Sabre Exercise.

***

Triton was outside the perimeter of the strike group, listening for reflected sonar pings bouncing off the red-force deep-water submarine (me) that they knew was after the *Big-E*. And if they got the inkling of where I was, they would move into torpedo launching range (about fifteen hundred feet) and blow me out of the water. Because that would be a lot more fun than chasing me down after I had disabled the *Big-E.*

Similarly, it would have been fun for me to take *Triton* out of the fight before going after *Big-E*. But, as soon as we launched our first torpedo, whether or not we hit *Triton*, we would be running for our lives with at least one submarine after us. That would be a mistake. And neither Admiral Martin nor Captain Deverough are known for making those.

Captain Deverough had the conn. Mr. Decker was with Dive at ship control. From the tactical station, Chief Barksdale would coordinate firing the torpedoes and countermeasures. Admiral Martin and Chief Buckheister were at the sonar station with their ears on. They, along with two sonar mates, had to find and track *Triton* and *Snook* through the entire exercise. Dr. Burgess, at the science station with the main computer, was refining sonar images trying to find two quiet submarines in a frenzied sea…

My depth-to-keel was twelve hundred feet, well below the prevailing surface currents and a local halocline. But I knew that I was not in the water alone.

We were there for an hour before Dr. Burgess reported: “Admiral. I have an acoustic anomaly.” That is all he could say. He didn’t have a sonar contact, because it took him over thirty minutes to develop it. “It’s due west.” He had no way of judging distance or depth.

I recall focusing my attention…and had the strangest feeling that I was being watched.

We moved toward the acoustic anomaly.

We listened.

It was more than an anomaly.

“It’s *Triton*.” Chief Buckheister said, and Admiral Martin agreed.

We crept into *Triton’s* tail wake. She was a thousand feet in front of us.

“What are you going to do, Captain?”

The captain could have put two wire-guided low-speed torpedoes under *Triton’s* propeller shaft and detonate them. They wouldn’t do any permanent damage. Maybe break the shaft seals and

flood her engine room. She wouldn't sink. She could always run for shallow water and beach herself like a whale.

That would have been fun.

But *Snook* had *Triton*'s back, and the admiral, the captain, and sonar knew it.

And, although *Triton* might not hear our low-speed torpedo launch, *Snook,* who was standing off at striking distance*,* would. And the instant we put our torpedoes into the sea, we would be running for our lives from four torpedoes running sixty miles per hour up my stern.

The captain answered the admiral's question. "I think we should take a home movie."

And so we advanced, closing the distance between us at two knots, and with five degrees down on the planes, until *Triton's* propeller was fifty feet above my sail.

She kept her course and speed through the maneuver. She had no idea that I was below her. She had no idea that we were taking pictures and recording the sound her screws and hull made. I could feel her bow split the water and her stern splice it back together again. Admiral Martin took close-up pictures with his Pentax Spot through the observation room window as the big black shadow of a submarine loomed above him, and until its nose disappeared from view.

You might think this was enough to prove we were here and we could have killed her at this time if we wanted. But it wasn't good enough. Captain Deverough asked, "Admiral, do you want to know if she can feel our wake?"

"Yes, Captain."

And the captain put *Triton* into my aft wake. If *Triton* had windows like mine, her admiral could have seen me mooning him. But he didn't.

The submarine *Triton* changed course.

Our paths diverged.

Before we left the area, the captain ordered the tactical officer to put two electronic cruise missile decoys in the water. And they were set to start screaming at zero seven thirty.

Taking Out Big-E

Big-E was three miles away when we started our ascent. We had been drifting with the current running dead slow in the water, not to attract any attention. The plan was to engage her from a depth of five hundred feet when the distance between us was near one thousand five hundred feet.

The time to attack had arrived.

From outside the *Big-E*'s strike group perimeter, electronic decoy we put in the water hours ago 'launched' four electronic cruise missiles aimed at the Big-E's flight deck. It got blue forces' attention; if only for a second, before realizing there weren't any actual missiles flying.

Simultaneously, Chief Barksdale released four Mark 30 torpedoes from our aft torpedo tubes.

The Mark 30s left the tubes at five-second intervals under their own power. They began a run that was forty-five degrees off their mark. Fifteen seconds later, they executed a ninety-degree turn toward the *Big-E*'s starboard side and accelerated to fifty knots in five seconds.

At the same time, Captain Deverough gave the order to dive and run like hell with twenty degrees down on the planes: "All ahead flank, twenty degrees down on the planes. Launch electronic countermeasures." That's what he said.

Thirty seconds later, all four Mark 30s exploded beneath the *Big-E*'s hull.

In the hours that followed, twelve destroyers and two cruisers blanketed the area with depth charges. During this time, I couldn't feel anything. All five sonarmen had taken audio off-line. Their strip charts were a mass of scrawling black lines.

And I think it was at that time, that *Triton*'s sonar picked up echoes of the barrage bouncing off my hull, because it turned toward us. That's how I noticed her to begin with.

But I was racing down at twenty-five knots, looking to take advantage of any local current, thermocline or halocline that lie under me.

I was worried. Could I hold *Triton's* sonar contact through the dive? Because the next thing I had to do was take out *Triton* and *Snook,* and I had to do it before they could develop a firing solution and launch torpedoes my way. Because with a speed of over sixty knots and a seeker head that can see targets almost one hundred eighty degrees around it, the simple fact is that no submarine, not even me, could outrun the torpedoes that *Triton* and *Snook* would launch.

Unless that submarine was headed into very deep water. But I wasn't there yet.

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With loss of the *Big-E,* the submarines *Triton* and *Snook* became hunting sharks smelling blood, with no other mission than to hunt me down and blow me out of the water.

What happened next wasn't a surprise. A spread of four torpedoes came screaming out of *Triton*, headed in my direction.

Sonar shouted: "Four torpedoes in the water, closing fast." And began a countdown to impact. "Contact in thirty-five seconds, thirty-four…"

Engineering increased our speed to thirty knots, Pilot changed our direction forty-five degrees to port, and Dive put forty degrees down on the planes. It didn't fool the torpedoes. All four turned as we turned. Sonar's countdown continued, but at twenty-five began to slow. Then Chief Buckheister repeated twenty…twenty. Forty seconds later, all four gave up the chase and started a three-mile fall to the Pacific floor.

Why do *Snook* and *Triton* want revenge?

We left the battle area, surfaced and sent the videos we'd taken of *Triton*'s propeller and hull to the range instrumentation ship, declaring he was sunk hours earlier.

A hot debate erupted in the wardroom at supper that night. Some thought the captain was wrong to leave the battle space without killing the submarine *Snook.* But the captain knew, as

well as Admiral Martin and me, that *Snook* would live the rest of its life in disgrace, having lost its carrier and the submarine it was tasked to protect…and me.

Captain Deverough

Back at the plotting table, Admiral Martin sips his coffee. “Better, yet. Don’t change the rendezvous location. Let *Snook* and *Triton* lie in wait by *Proteus* while we cross their patrol area right under the *Enterprise*. You can reschedule a new rendezvous when the strike group is beyond reach. And, Captain, put the boat on radio silence until that time.”

“What about Dr. MacCarthy and Dr. Santiestiban? They’re to join us from the *Proteus.*”

“They can wait a few days. The sea air will do them good.”

“Very well, Navigator Ryan, develop the course. If you’ll excuse me, Admiral, I have a submarine to put through its paces.”

So with the sun high in the sky, Arguello Canyon below us, and the continent behind us, Captain Deverough prepares to conduct seaworthy-readiness drills.

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The sun is high in the sky. A breeze is headed east. The sea ripples with white-crested waves. The captain has the conn from the bridge and his exec in the control room. The crew is at general quarters. Tactical reports, “Radar doesn’t have any boats or ships on the surface out to the horizon or aircraft in the sky.” Sonar reports, “I have three commercial tankers in the water, south of us in the shipping lanes. And a pod of whales six miles west, with a southwest heading.”

Captain rings up mission control, “Dr. Jones?”

She responds: “What can I do for you, Captain?”

“I will be conducting readiness drills during this watch. See that all visiting scientists stay in their quarters. We will be making extreme maneuvers. You have five minutes.”

“Yes, sir.”

The captain watches the sea for five minutes, then rings up the command station, “Mr. Decker, this is the captain, crash dive the boat.”

With the speed of a lightning bolt strike, the emergency claxon’s blast gets the crew jumping out of their racks, abandoning breakfast, running forward or, laying up or below, headed to their emergency station if not already there.

As his feet touch the control room deck, Captain Deverough shouts: “Pilot, put ten degrees down on the planes. Engineering, make turns for ten knots. Dive, report our depth at one-minute intervals.”

We’re headed to the seafloor.

“Dive, report depth-to-keel at five-second intervals. Tactical, report keel-to-bottom every one hundred feet.”

Fifteen minutes into the dive, Dive reports, “Depth-to-keel two thousand feet.” Tactical reports, “Keel-to-bottom two thousand feet.” Navigator Ryan marks the spot on her chart. Calculates distance and time to bottom, and writes it next to the spot.

Twenty-five minutes into the dive, Dive reports: “Four thousand feet, Captain, approaching test depth.” Admiral Martin enters the control room and joins Navigator Ryan. Tactical reports, “Keel-to-bottom one thousand feet.” Navigator Ryan marks the spot. She and the admiral calculate distance and time to bottom, then cross check their calculations.

Thirty minutes into the dive, Captain Deverough orders: “Put us on the bottom, Mr. Decker.” Mr. Decker waits two minutes then says, “Engineering, all stop. Pilot, put zero degrees on the planes. Dive, the boat is not trim. Make it trim.”

Without propulsion, I coast to a stop but still drift with the current.

Arguello Terrace

Scratching gravel on my keel brings me to rest on a terrace that was etched by meandering rivers during the last deep ice age.

It was a broad coastal plain at the time, with mountains to the east towering above it…and from the mountains, runoff from thousands upon thousands of creeks joined to form thousands of streams, and thousands of streams joined to form hundreds of rivers, and hundreds of rivers carved out the valleys that joined other river valleys and so on, until seven large rivers ran onto the terrace.

And all those years ago, beneath the terrace, down a steep canyon, and more than a mile below where the surface now stands, lay the ancient Pacific Ocean. Grizzly bears fishing king salmon in those meandering rivers would look out over the edge and see that mighty ocean. To go to it, they would have to navigate one of many rivers packed with rapids and waterfalls. Even for them, with their great padded paws and ably curved claws, it would be a trip of sharp, narrow ledges and crumbling rock.

Today, there are no bears to scramble down the canyon to the sea. The sea displaced them to higher places. Today, abyssal currents flow up the sunken Arguello Canyon, and large sea lampreys hunt colossal clams that inhabit its walls.

And we sit on the terrace, my crew looking for leaking hydraulic fluid from lines, seaports, valves and seals until the captain is satisfied.

Hours later

We’re racing up to periscope depth by the action of an emergency blow.

Captain Deverough is at the periscope looking for surface ships as its optics pierce the air.

He shouts: “Mr. Decker, there’s a ‘supertanker’ on a collision course with us. Stop the boat. Engineering, report our speed, position, and heading at ten-second intervals.”

I break through choppy surface waves and begin shedding the coat of water I’m wearing. It falls back into the sea.

Mr. Decker calls engineering: “Propulsion full astern.” And to helm: “Hard right rudder.” And over the ship wide intercom: “Brace for collision.”

With hull joints screaming, we slow to fifteen knots, to ten, and five. The captain doesn’t care what the laws of physics have to say about momentum. He wants us dead in the water fast.

And as we drift sideways with the local current, a lone fin whale creeps up from behind. He slows to drift with me in the sun. *Are you okay, creature made of metal?* And I respond, yes. My captain is putting me through a series of readiness drills. *Where are you headed?* To the sea beneath the ice. *How deep can you dive?* I’ve been to five thousand feet. *How fast can you run?* Not as fast as you on the surface, but below I can run nearly forty knots and I can do that for months.

I am sorry for bragging.

Captain Deverough cuts my conversation with the beast short by giving this order: “Mr. Decker, make your course northwest. Make your depth-to-keel thirty feet. Make turns for flank speed. Engineering, report performance at five-minute intervals.”

I say to my new friend. I have to go now. He responds, *I will go with you for a while, if you like.* And we travel together, plowing through the rolling swells, skimming the surface in the sun. And his pod joins us, even the females with newly born calves.

We have been under attack with our pressure hull compromised and have had to run on the surface for our lives. So I show the captain I can still run on the surface, riding high at nowhere near flank speed, rolling in a drunken stupor over long and lazy waves.

***

“There’s a fire in engineering—this is a drill,” Mr. McGregor shouted over the ship-wide intercom.

Having had only thirty minutes of rest, my crew was put in motion again. That was an hour ago. We were making a slow ascent from the bottom, with Mr. Barksdale calling out depth-to-keel as we sail off the continental shelf with the seafloor falling away. When he reported one thousand feet depth-to-keel, the captain put us on a northbound course at twenty knots. We ran that way for an hour before Admiral Martin, playing ‘*the fire’* in one of the captain’s readiness drills, entered engineering from the aft port torpedo room, slapped his right hand on a bank of electrical closets leaving a note that read ‘fire’ behind as he shouted: “The fire is in the wires. Put it out.” Then he started the stopwatch he had in his hand. And to Mr. McGregor (engineer of the watch) he added, “Take maneuvering offline.”

That’s when Mr. McGregor shouted over the ship-wide intercom: “There’s a fire in engineering—this is a drill.” Then he shouted down to level four: “Disengage the propellers.”

And to the chief standing beside him, he says: “Chief, shut down the turbines…” and the blades and shafts and gears inside two heavy metal boxes ground to a halt, stopping the conversion of clean steam from the reactors into electrical power. Which stopped the power flowing through

the heavy copper wires leading to the port and starboard permanent magnet motors on level four.

Simultaneously, along the forward bulkhead of engineering on level two, Mr. Bell (reactor officer of the watch) shouted to his chief: “Chief, execute an emergency shutdown of the port reactor, and he punched the big red button at the top of the starboard side console beginning an automated emergency shutdown of the starboard reactor.

Meanwhile, in the control room, Mr. Decker was giving the order to surface and clear the air of toxic smoke. So Pilot pulled back on the wheel to put twenty degrees up angle on the planes, but it doesn’t budge and he’s forced to report: “Mr. Decker, the planes are not answering my call.”

Mr. Decker’s response?

“Blow the main ballast tank.” And I shuddered from the forceful injection of high-pressure air into the main ballast tanks as the expanding chambers of air at the top pushed water out through the ballast tank vents in the keel. I sped toward the surface, pitching and rolling and yawing along a wildly disorienting path.

Tactical was reporting our depth every one hundred feet, “…five hundred feet,” and Dive kept adjusting the water in the fore and aft trim tanks, trying to keep ten degrees up bubble. Everyone held on for dear life.

With our depth at one hundred feet, Tactical switched his countdown to seconds, “Breach in ten seconds…five…four…”

And four seconds later, I was pushing a mound of water out in front of me. I breached the waves wearing a transparent coat of seawater that shattered into sunlit water drops, as my bow pitched, fifteen degrees, ten, five, and a special detail broke through the deck hatches, letting the waves that were crashing over the deck pour into the pressure hull forward, amidships, and aft.

And so I find myself drifting sideways again, rolling with each fifteen-foot swell on a clear sunny day, while my crew practices damage control.

“Sloppy ascent, Mr. Bell.” And we drift this way until Captain Deverough is satisfied.

A Computer Model of Me

I first met Dr. Jones the morning we set sail. She showed me drowning on that day. Later that day, she showed me anger. Since then, I’ve seen the world from her perspective. I’ve seen Admiral Martin’s steel-blue eyes, Doc Lexi’s golden braids, coal black tar balls, and pink bubble gum. I’ve walked the passageways with her, greeting smile after smile. And sat with her at dinner next to Admiral Martin and William. It’s fun, but doesn’t always make sense.

A few days ago, she started showing up in certain places for which I have an affinity. She was thinking about how great-beast and thunderstorm sounds make it into the boat’s compartments and bays and sometimes persist. So I said to her: What are you doing? To which she replied, *I’m looking for vibrations ‘hanging around’ that started with sounds outside.* Then

she found sound from a volcano erupting and asked: *What's causing this?* I told her there was an active volcano erupting two miles below us. I told her I could feel a huge school of sailfish in the water, and that they were off my port quarter, headed south, and I could also feel them chirping and detect a trail of molecules they left behind. *That's not the answer I had in mind. I'll have to think about it.* She said to me.

That was two days ago.

Now, Admiral Martin is asking: "What are you two up to?" He was headed to his lab, making his way aft through the control room, when Dr. Burgess, sitting at the science station with Dr. Jones, stopped him.

"Admiral, if you have a few minutes, please join us."

He glances at his watch. "I have a few minutes."

"Dr. Jones has developed an acoustic model of *Expedition's* internal spaces." And we watch lines and curves in shades of gray, a computer-generated image on display, depicting my light and pressure hulls, external equipment cabinets, and ballast tanks.

She starts explaining, "The shades of gray represent *Expedition's* main structural components, compartments, and rooms…" Then she adds lines and curves in shades of green. "The green lines depict the boundaries of internal spaces as I understand them. These represent the decks and bulkheads outlining passageways and compartments." It is clear where my propeller ducts and reactor cores are located.

She continues. "This is a cross section of the missile room." She draws closed curves of different colors and says: "These curves are contour lines representing equal vibrational energy."

"You've developed a model for the expected locations of low-frequency standing waves?" The admiral asks.

"Yes, exactly, and the brightest color contour lines are locations, by my theory and estimates, of where the antinodes of low-frequency harmonic wave patterns could stand, accounting for dimensions of the rooms and material composition of the bulkheads, decks, and overheads, which I took a wild guess at."

"Why?" Admiral Martin asks.

She responds, "Why what?"

"Why did you develop the model? What do you hope to find?"

"Not 'hope to find,' Admiral. I've found it."

She zooms in, pans left and right, following an isobar around the missile compartment like a roller coaster. "Now, the data points I'm adding represent actual measurements taken of very low-frequency acoustic vibrations."

"How did you capture this data, Dr. Jones?"

"I mounted low-frequency microphones at the places I estimated antinodes would be."

And we examine three spots in the missile compartment where colorful dots flicker inside the contour lines, representing antinodes of standing waves. “We suspect that these spots within the boat respond to the acoustic environment actively.”

Actively? I ask her.

But the admiral asks: “Who are ‘we’?”

“Dr. Burgess and me.” *The admiral’s steel-blue eyes shift to Dr. Burgess*.

“Yes, Admiral,” Dr. Burgess responds, “but there is more.”

More? I ask, and the admiral echoes my question, “More?”

“Yes, we’ve correlated the events with actual sonar recordings. Show him, Dr. Jones.”

“Watch this.” And we watch in retrospect a big thunderstorm from two days ago build and fade, and a seaquake from yesterday build and fade, and vessels in the shipping lane overhead right now.

“Where on earth did you get thirty low-frequency microphones?”

“I requisitioned them from ship’s stores,” as if she found them in a supermarket.

“How did you wire them together and provide power?”

“I piggybacked on the guest computing network.”

“By yourself?” No, I helped her. But she doesn’t give the admiral my answer.

Instead, she lies: “Yes.” I insist. Tell him I helped you. But she is doing her best to push me out of her head, and the conversation heads in another direction.

The admiral starts to walk away, but turns back. “Dr. Jones?”

“Yes, Admiral?”

“What made you look for these acoustic patterns?” Tell him the truth this time. Tell him I helped you. I want him to know I exist. Stop ignoring me.

“I was curious about something.” Her face gets hot.

“I’m waiting.”

Her mouth goes dry.

And he waits for ten long seconds before she responds: “I’ve had several peculiar experiences aboard *Expedition*. I’ve felt…” But her guts turn to Jello. Say it, you coward! This is my chance! Tell Admiral Martin I exist and that I want him to speak with me. Expedition, *it is not a good idea at this time. Stop nagging me.* She takes a deep breath, opens her mouth, but hesitates.

“Spit it out, Dr. Jones.” His deep baritone voice barking short circuits her thoughts.

In time, she recovers. “Sometimes I feel…” biting her lower lip, “but I can’t put my finger on it. It’s a sensation…beyond my common experience with light, smell, taste, electromagnetic fields, pressure, and sound…”

“Do you want to use the word ‘supernatural’ or ‘paranormal’?”

She drags a hand through her hair, pushing it back from her face. “No. I really don’t want to use either of those words,” shaking her head side to side, “those are not the right words at all.”

“Then what *is* the right word, Dr. Jones?”

Her face is burning. *Is everyone in the control room watching?* “It occurred to me that my body might be picking up on electric, magnetic, or acoustic anomalies… Different people have different sensitivities, you know. Some people can hear lower frequencies. One woman I’ve read about could see ultraviolet light.” Expedition, *help me. I’m in way over my head.* “Could you repeat the question?”

“You are trying my patience.”

“I studied *Expedition*’s design drawings and thought there might be acoustic standing wave patterns in the infrasonic region that I was picking up on. It’s a scientific fact—it’s also the reason some women are attracted to powerful automobiles.”

“You mean the men who drive powerful automobiles?”

“If that is the way you want to say it, I’m good with that. Can I go now?”

“No…That’s quite a leap. From a ‘few peculiar feelings’ to installing an internal acoustic network and developing a computer model stuffed with algorithms in a few days.”

“Dr. Burgess supplied many of the algorithms from his existing computer models.”

“Still, in a few short days? Are you neglecting to tell me something?”

“Yes. But please, can we talk about it tomorrow? I’m exhausted. I don’t want to say anything stupid.”

“Good night, Dr. Jones.” And the admiral exits the control room through the aft door.

I’m miffed. Why didn’t you tell him I helped you?

I tried, I really tried. I want to say to him, ‘Your submarine has become aware of himself. He can think. He can feel. He can communicate, and he wants to talk to you,’ But I can’t give him evidence he will believe.

North Pacific

Having just finished breakfast, Dr. Burgess enters the control room expecting to find Admiral Martin. He approaches the officer of the deck. “Mr. Decker, do you know the admiral’s whereabouts?”

“Yes. He passed through here about a half hour ago. He’s probably sleeping.” Then checks his watch and the chronometer on the ship status board. “He said he was conducting an experiment in his lab that required monitoring, and asked me if I could wake him at zero eight thirty.”

“Well, it can wait.” And takes a seat at the science station.

Just as Dr. Burgess is settling into his work, a great beast enters the deep sound channel in front of me and starts singing. At first, she forms a simple, soft, and deeply sounding note. The notes tickling my bones. Then she grows the note until it fills the sea…

Dr. Burgess calls tactical, “Mr. Barksdale, are you recording this with the hull array?”

“Already on it, and I just finished a full calibration.”

Dr. Jones enters the control room from the aft door and takes a seat next to Dr. Burgess. “Good morning.”

“Good morning, what brings you here?”

“I was headed to mission control when I heard the whale song. It makes the submarine feel like a church with the choir singing.”

The great beast forms another note two steps down, and a third lower still and keeps that chord alive playing with it. She waits for silence before she starts another note, slides that note up a half step and a full, and then breaks into a melody that swings around the note she has chosen central to her song.

Her song is low and lazy, and her thoughts persist, lingering and being reinvented by the ocean in slightly different forms. She sings. *A shimmering circle of light casts shadows from fishes swimming by. All sunlight that makes it this far down travels the tunnel that starts up there. Of great fishes that share the deep with me, I see only shadows…*

Captain Deverough enters the control room. “Sonar, do you have bearings on that whale?” and takes control of the boat, “I have the conn.” As sonar reports: “Five degrees relative, and five hundred feet above our keel.” And Mr. Decker yields control of the boat. “The captain has the conn.”

I hang on to the great beast’s song, adding energy of my own to keep it alive inside of me. I add my own notes to the great beast’s song, creating overtones and chords in harmony.

And as we pass by her, a quarter of a mile away and fifty feet below, she hangs suspended, head down, tail up with fins outstretched, the great beast’s song wraps around me in glorious splendor.

Seaman Martin

Meanwhile, Admiral Martin has been dreaming in his bunk of a girl with long, dark hair and a beautiful smile. She's smiling at him. But then, the great beast's melody reaches into his mind and touches his dream. The girl, her hair, and her smile are ripped away and replaced with the sounds of exploding bombs and earthquakes and the acrid smell of decay…

He's face down in the water, and his ears are ringing from the explosive shockwave that threw him from his patrol boat. On hands and knees, he crawls out of the harbor water. A large gash on his head is dripping blood, and it mixes with a layer of fuel and water that is lapping peacefully on the rocky shore.

The day had started bright and clear, with a golden sun that turned the sky a striking blue. He forces himself to stand. The beach shakes with an aftershock as he scans the water for his boat and shipmates.

On the harbor's eastern shore, the antiaircraft artillery guns nestled in the hills to defend the naval vessels lay broken and scattered. The troop ship where he slept sits on the bottom, listing. He swims out to a floating body and takes it back to shore. And another. In all, he recovers four men thrown from his boat, the fractured wreckage still burning along with the oil slick around it.

He sits on the shore next to his dead shipmates, looking for people on the streets and colorful homes on the hillside. For piers and fishing boats. He looks east toward the submarine base.

'The last time I was here was just three days ago, but it seems longer. There was a town that day. Oil storage tanks were billowing black smoke, and the sounds of bombs and gunfire were echoing through the mountains. But there was a town with buildings and people wandering the streets.'

Nothing's left to tell that there was a busy seaside town here. He looks for the radio station. It survived the Japanese air bomb attack. But it's gone now. 'It matters not.' He whispers to himself. 'The sea takes from us what it wants.' Today, it sent a tidal surge to wipe away the remnants of a harbor town that a bombing raid three days earlier had already devastated…

Admiral Martin wakes with a start. Realizes he's in bed and twenty years later than the dream he was in. And the last sorrowful note from the great beast fades away, but I keep it alive for as long as I can.

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Meanwhile, in the control room, Captain Deverough is asking Sonar to contain his enthusiasm because Chief Buckheister had just proclaimed, "*Expedition* is singing with the whales!"

Sonar apologizes, then turns to the crewman sharing the watch with him, "Crewman Hanley, you have sonar," and joins Dr. Burgess and Dr. Jones at the science station. "Did you feel it? The boat was vibrating with the whale song."

Dr. Jones says. "Not only did I feel it, IAN got it, watch." And she types a computer command…

But, about three minutes ago, the admiral had decided to abandon his quest for sleep, got out of bed, and was passing the science station headed to his laboratory when he heard Dr. Jones say, 'Not only did I feel it, IAN got it, watch.' He stops. "What's going on here?"

Mr. Decker glances at his watch. "Back at work already, Admiral? I thought you wanted three hours sleep; it has been less than an hour."

"I have an experiment that I couldn't stop thinking about." He lies, and while rubbing the back of his neck, asks, "So what's going on?"

Internal Acoustic Network

Dr. Burgess swivels on his stool and looks up at the admiral, "Did you hear the whale singing?"

"Yes. Yes. I heard the whale singing."

"Well, Chief Buckheister felt the boat vibrating with it. We are investigating."

"Dr. Jones, did I hear you say that your internal acoustic network captured the whale song?"

She shakes her head yes. "Yes, Admiral. I was just about to play it…" And she sets dancing a colorful interpretation of the great beast's song. Red, green, blue and violet dots waltz through the image of me, swirling around the missile compartment, through the main passageway, and growing into and retreating from the main ballast tanks.

"Play it again."

Dr. Jones, I was thinking, it is a perfect time to tell the admiral that I speak with great beasts and you. Surely, this evidence is enough to convince him.

He says, "Play it again, but this time also play the hull array sound track on the oscilloscope." He points to the scopes embedded in the science station's console.

Switches are flipped. Dials are turned. Keypads are clacking furiously. Lights are flashing. The main display is showing red, green, blue and violet dots waltzing through the model of me while the oscilloscope oscillates compound envelopes.

He says, "They're synchronized. The whale song is driving the transient vibrations."

Dr. Burgess adds. "More than that, Admiral, the transient waves last longer. Dr. Jones, play the last ten seconds in slow motion...freeze it…" Pointing to a glob of pink dots, he says, "This pattern begins after the whale's last note."

"Well, that can't be good."

Chief Buckheister offers. "It could be a harmonic beat."

In response to the chief's suggestion, she searches the data file. "I can't find any frequencies that could produce a beat at that wavelength." She giggles and then blurts out. "*Expedition* is harmonizing with the whale."

Dr. Jones, you did it. You told the admiral that I sing with the great beasts!

"Why is this happening now?"

Dr. Jones looks up at the captain. “What?”

“Why is it happening now?”

“I don’t follow you.”

“Well, Dr. Jones, this submarine has been in the water for over five years. During that time, sympathetic noises have developed. We locate the source and dampen them while at sea when possible, and eliminate structural sources when in dry dock. Which we have done twice. Your simulation shows more sympathetic noise in five days than we've had in total. Why now?”

The captains question starts a ball of heat growing in her chest that bubbles up through her throat and the words get stuck. Dr. Jones, what is this terrible feeling exploding inside of you? *I’m afraid.* Well, it is a terrible feeling. Why are you afraid?

Dr. Burgess offers an explanation. “Perhaps the internal acoustic network is amplifying an existing condition.”

Despite the fire in her chest and a lump in her throat, she asks: “IAN causing them?” and responds. “I don’t think so.”

“Why?”

“None of the nodes are wired to transmit. Only receive.”

“That’s a rooky mistake, Dr. Jones,” and turns to Dr. Burgess, who is nodding his head. “Mr. Decker, come here will you?” and then tells him to make a special detail. “Have them check every inch of wire and test each receiver.” He knows that just because Dr. Jones didn’t intend IAN’s nodes to transmit didn’t mean they weren’t transmitting. Both electromagnetic and acoustic waves were possible.

But the conversation has gotten off track: Dr. Jones, tell the admiral I was singing. Tell him also that I think and feel.

Not now, Expedition, *I think something really bad is happening.* And she asks: “Why would you want to eliminate the transient sounds? They’re evidence.”

“Evidence of what?”

Evidence of what? The captain is asking: Evidence of what? Let’s see…It’s evidence that Expedition *is alive. He thinks, he feels, he sings with whales. But I can’t say that out loud.*

Yes, you can.

No, I can’t.

Why not?

The admiral responds to my question. “It’s a romantic notion to think the submarine is singing with the whales, but it puts this submarine in a potentially dangerous situation. The internal transients could jump the hull and enter the sea. If anyone is listening at that frequency, they could home in on our location and identify who we are.”

“What do you want to do?”

“Dr. Jones, continue your investigation. Dr. Burgess, monitor the situation. Captain, add it to the list of things we turn off in silent running mode.”

Rendezvous with Proteus

The day is clear, and a mild wind is pushing a few fluffy clouds to the south. Blazing sunlight pounds into a calm sea. Radio antennas go up with the periscope, and radio signals come flooding in. The sea is brimming with phytoplankton, soaking up the sun and carbon dioxide. Silvery flashes and splashes erupt from millions of small herring in a feeding frenzy…

We’ve been listening to *Proteus*’ grumbling engine grow louder. His radar has been watching the horizon and the sky, and his linear sonar array is hanging in the water looking for subs.

About a half mile off his starboard side, we stopped at periscope depth to get our bearings. Minnows are dancing around me. I am inside a huge undulating beast that has something urgent to do.

As I break the surface, schooling anchovies drain from my top deck and silver sprats pick at the glistening bubbles clinging to my hull. Captain Deverough makes his way to the bridge atop the sail.

We come alongside *Proteus* surrounded by herring hunting in huge, rotating balls, and gulls and terns and cormorants wheeling overhead. The air rings with their shrill cries.

With bow, stern, and spring lines, we tie up. *Proteus’* overhead crane lays a gangplank linking his main storage hold door amidships at the waterline to my afterdeck.

Off my port bow, fish rush together in terror from a confusing cylindrical wall of frenzied bubbles sent up by a circle of great beasts ascending. And basking sharks cruise in from the west…

Meanwhile, Admiral Martin enters the control room and stops at the navigation station. “Navigator Ryan, how are you this morning?”

To which she responds, “Just fine, Admiral.” And they study the chart, the course laid in, and double check the sailing time to the Aleutian Trench.

“Will you be going topside, Admiral? I hear it’s sunny up there.”

“Yes, I’m expecting two scientists that missed the boat.” He lowers his voice to a whisper. “And I got my hands on two cases of ripe mangos.” He places his index finger on his lips, “Sh…don’t tell anyone—it’s a surprise.”

“I sure would like to see the sun.” But he’s halfway up the ladder to the sail and doesn’t hear her.

He doesn’t go up to the bridge but exits the sail onto the top deck, then goes aft where he greets Dr. MacCarthy and Dr. Santiestiban as they step off the gangplank. “How did you like the helicopter ride?” Then introduces Dr. Jones. “Dr. Jones, this is Dr. MacCarthy, the expedition’s volcanologist.” *Looking up into the glaring sun, I see a smiling face and a head topped with a*

fine crop of salt and pepper hair. A sturdy handshake, and, "Welcome aboard." Then the admiral continues, "This is Dr. Santiestiban, our oceanographer… Gentleman, this is Dr. Jones. She's the expedition's mission coordinator. She will see to your settling in." Then the admiral crosses the gangplank to *Proteus*. "Admiral Martin," Dr. MacCarthy calls after him, "are you aware that Mt. Makushin is acting up?"

"We'll talk about it at dinner together tonight."

"Welcome aboard." Dr. Jones shakes hands with Dr. Santiestiban. "Crewman Fazio, could you see that their luggage is put in their quarters?"

"Yes, Dr. Jones."

And to them she says, "I bet you two are dying to see the boat. We'll start in the observation room." She leads them to the foredeck hatch and down the ladder to level one.

When she has their attention, she points aft down the passageway. "The admiral's quarters and the captain's cabin are in this passageway. The doors all have signs. The pressure door separates the research compartment from the operations compartment. You can see into the control room, but it is off limits unless you are escorted by one of the crew." Then she leads them down the ladder to the observation room.

Dr. Jones brags about the dielectric-transparent titanium-aluminum windows, as they stand transfixed by a dense cluster of minnows whipping around inside their whirling school—shifting this way and that, anticipating which way to go and how fast to get there—until they unfurl to run straight out for a while. She shows how to make the bow windows opaque, then transparent again. She turns around.

"This is mission control. I work from here."

Dr. Santiestiban takes the seat behind the bank of consoles. *He has a beefy face with glossy black hair*. *Looking up at me through thick long lashes, he says*. "An office with a window and an ocean view. Not bad." *I'd kill for eyelashes like that*.

"The research bay is just below us." She leads them down to the research bay mezzanine and shows them their mission bay workstations. "I've set up your computer accounts. If you have a problem, I'm most likely in one of three places. Mission control in the observation room; my quarters, on level two in officer country—I bunk with Navigator Ryan; or the crew's mess, where I tend to non-mission specific problems."

Then they lay below to level four and the deck of the main launch bay.

"It's smaller than I imagined," Dr. MacCarthy comments.

The main launch bay hatch is open to the ocean. Frightened fish are jumping out of the water onto the deck. William is pushing them back in. A deck detail is attaching a torpedo to the gantry crane. "Is that a torpedo? Why does a research vessel need a torpedo?" Dr. MacCarthy asks as they hoist it out of the water.

Looking up at his inquisitive face, she answers. “It’s probably a probe or a drone that will be launched from a torpedo tube.”

To which he responds: “Why does a research vessel need a torpedo tube?”

She thinks for a while, then answers: “The deep sea is a lawless expanse. A submarine has to defend itself, doesn’t it?”

***

Admiral Martin returns from the *Proteus* and joins Captain Deverough on the bridge. “Captain, I need to speak with you… Captain Hannover told me there’s chatter on the airwaves about an ad hoc naval exercise in the North Pacific. He thinks they may be after us.”

“It’s worse than that, Admiral. Sparks intercepted an intelligence community report that claims the *Enterprise* Strike Group changed course last night. It’s headed north, not west, like they planned.”

The *Enterprise* putting to sea a day early, then changing course…steaming north and toward us…and news of an ad hoc naval exercise? The Big-E wants revenge, her escort cruisers and destroyers want revenge, her submarines want revenge. For all we know, the entire Pacific Fleet wants revenge.

***

William and several crewmen are playing on my top deck, tossing a football around. Crewman Wu shouts, “William, run forward,” as she launches the ball over his head. It bounces off the deck just behind the sail and into the sea. William jumps in to rescue it. Crewman Fazio follows to grab William. A school of barracuda is chomping its way along the surface. The football is swallowed by a basking shark cruising with his mouth open.

On the forward deck of the *Proteus*, a picnic is laid out and my crew wanders across the plank. A seagull steals a hotdog. Dolphins click and seagulls cackle. Sunfish skim the surface, swallowing sea jellies in great numbers. Striped bass gobble minnows. Razor-toothed blues tear into the bass. Brown pelicans pierce the frothing surface in formation, trading speed for depth, to either catch a mackerel or not. Everyone hunts and is hunted. Everyone eats or is eaten.

***

The day grows old. *Proteus* takes back his gangplank. Deck details on both sides cast off the lines. My crew withdraws from the top deck. Last one through a deck hatch secures it and doggs it down.

With the decks clear and the main ballast tank flooded, we say farewell to *Proteus*. “Deck’s awash…bow’s under…stern’s gone.” And we dive with the setting sun and what’s left of the krill, leaving *Proteus* behind in a lonely sea…

The sub hunt

Well, not so lonely.

Sparks hands Admiral Martin a folded piece of paper marked *eyes only*. “Admiral, this message came in for you.” He reads it. **Martin, you have 30 minutes. 51:25:15 by W148:05:17 by 0600. Farrell**. Then hands it to the captain while memories of the setting sun and mangos turn into a puddle of goo.

Apparently, submarine *Triton* had followed my submarine tender *Proteus* from our first rendezvous location to our second. His captain, Captain Farrell, watched us enter the area and leave it. Even if they didn’t detect me with their sonar in real time, they probably recorded everything, and will be adding my acoustic signature to their library. Captain Farrell watched Captain Deverough take his boat to periscope depth, surface one hundred yards off *Proteus*’ port side, and motor into position. He watched us tie up and extend the gangplank. And despite *Proteus’* sonar suspended one thousand feet below us, we didn’t have a clue he was out there watching.

I forgot myself. I forgot I am a submarine first and let myself be distracted by the algae bloom and my crew eating hot dogs and playing on my top deck. I failed my crew. I failed the admiral. Now we will be disgraced as the *Triton* gets revenge for Talisman Sabre.

Captain Deverough reads the message. “They must have followed *Proteus* from our first rendezvous location. How else could he know?” Wondering if it was possible *Triton* could track his prize submarine.

King Salmon

A female King Salmon is loosely schooled with her kin, roaming the Pacific with a singular purpose: to feed and grow as she has for her previous four years at sea. But today she has detected a smell that triggers a memory. She has smelled this smell for years, using it to navigate, but today she understands the smell of sweet water and she remembers a river that runs through a forest. Her purpose changes, and she knows she must travel up miles and miles of that river fighting torrents of rapids and cascading waterfalls, and flounder up tiny streamlets in just a few inches of water and over endless rocky obstacles in search of the place she was hatched, to place her eggs there. On the way, she will dodge the long claws of black bears fishing at the stream’s edge beneath hemlock and spruce…

***

“What do you want to do?” Captain Deverough asks, to which Admiral Martin responds, “Do we have a choice? We made that decision two years ago during the Talisman Sabre exercise. We can’t walk away from it now. Captain Farrell has given us thirty minutes.”

Captain Deverough shoots a string of orders. “Sonar, get me data.” He glances at the ship status board. “Mr. Decker, put the boat in silent running mode. Engineering, keep us stationary with the current. Chief Bronson, call Chief Buckheister to the control room.”

As we are in a desolate area of the North Pacific, there are few options because the bottom is three miles down. Even the tops of randomly placed seamounts don’t make it above two and a half miles.

We could exit the area at flank speed or hide beneath the deep sound channel. Both tactics have severe drawbacks. Running at flank speed puts hydrodynamic flow noises in the water. I

would be out of my envelope for silent running and easy to follow. On the other hand, at that speed, it would be nearly impossible for Triton to keep up and develop an accurate firing solution. Hiding beneath the channel would have been a far better choice, if I hadn't spent the entire day bathing in sunlight and warm surface water. Diving to four thousand feet would lower my temperature by thirty degrees and increase the water pressure by one hundred twenty atmospheres in a relatively short time. That would set my frame creaking and my pressure hull groaning. Both *Triton* and *Snook* could hear me from hundreds of miles away or more if they were listening from within the deep sound channel. Either way, it will be a long time before Triton would give up the hunt.

I have another problem. Neither strategy includes a means to kill the submarine, *Triton*.

Back in the control room, sonar reports, "I have a large biologic contact approaching from the west, and on a northwesterly course." And reports the contact's range and speed. Navigator Ryan notes the range and speed on her chart and draws a line, showing the school's estimated course. "The school will pass our current location in forty-five minutes." Meanwhile, a fifty-foot fishing trawler enters the area from over the northern horizon, and sonar reports it. "It's pinging fish-finding pings." Navigator Ryan adds the fishing trawler to her chart, designating it Trawler 1. She draws a line, "Trawler 1 will intercept the school in about an hour." So now we have a third choice. Find submarine *Triton* from within in the pocket of noise made by the tuna and trawler. But what's to be done in the meantime?

All this time, Admiral Martin and Chief Buckheister have been at the sonar station, straining to resolve the telltale signals of the fast-attack submarine *Triton* and her hunting companion *Snook* through the sounds of the tuna and trawler.

Dr. Burgess, at the science station, is post processing the sonar data. He filters out leakage from the deep sound channel, the garbled drones of commercial vessels in the shipping lanes, the faint rumblings of displacement waves from seaquakes, and the roar of angry volcanoes.

***

What does thirty minutes mean?

I don't understand.

What are the rules for sub hunts?

Sub hunts have no rules.

Will they hide their eyes and not watch us during the thirty minutes?

Why should they?

Will they follow us during those thirty minutes?

Most probably. Whenever two submarines are in the water, the conditions are ideal for a sub hunt.

How does one win?

Being the first to develop a firing solution on the other.

Even if the other is not aware of the first?

That makes his defeat more embarrassing. Dr. Jones?

Yes, Expedition*?*

I know where *Triton* is. He's within striking distance. Only my active camouflage system is preventing him from targeting us. You must tell Admiral Martin. And you must tell him now.

Wouldn't that be cheating?

Haven't you been paying attention? There are no rules for submarine hunts.

What would I say? 'Admiral, Expedition *says the* Triton *is here,' and point to coordinates on a chart?*

Yes. Do that.

I don't think so.

Why not?

First, IAN is not capable of locating a submarine in the water. It is simply detecting transient sounds inside the boat, and he knows it.

You're such a coward. What if he believes you? Then he will get *Triton*, and the admiral will have to believe I exist and will have to talk to me.

I don't think so. The more likely outcome will be that they take you apart looking for the source of transient waves. This could be the death of you.

I don't agree.

It could mean your death.

Why do you think that?

What if your existence is related to the transient waves? What if they dampen those transient waves? They could change the part of this boat that defines your being.

I don't care. I'm willing to take the chance. He will love me if I give him the *Triton*.

***

Dr. Jones, I have another idea. Give my location to Dr. Burgess. Let him tell the admiral.

Why would Dr. Burgess believe me? I don't even believe me.

I have to get *Triton* for Admiral Martin. If I don't, he will be disgraced in the submarine community. If I do, he will love me.

You must help me…

You are so frustrating!

Can't you see the submarine hunting us?

In these blobs of yellow, blue, and green?

Yes.

NO!

Dr. Jones, listen to me. The blobs of yellow, blue, and green that are swirling around inside of me are also swirling around inside of the *Triton*.

You mean he has sympathetic vibrations also?

Yes. Admiral Martin helped design her, you know. I know what they look like.

Let me think…

Dr. Jones?

How do I explain that these blobs of yellow, blue, and green represent a submarine? They could be a whale or a school of deep-sea fish.

But you know how those things look. You've been watching for days. Have you seen this pattern in the great beasts we've met or the tuna we've passed by?

Let me think…

Dr. Jones, time is getting short.

I'm afraid to tell them. I'm afraid they will turn you off. You could die if they turn you off.

You're just coming up with one excuse after the other. Why won't you do this for me?

Because they could kill you…

More than my life, I need Admiral Martin to know me. If you don't do this for me, I will never speak to you again.

Okay, but I do this against my better judgment. She taps Dr. Burgess on the shoulder and points to a spot on her display, then his. "It just poked up from beneath the noise. Can you see it?"

He understands. "Do you think that is *Triton*?"

"I am almost sure of it."

He narrows his search of the sonar data, focusing all the power of the main computer on the fuzzy area Dr. Jones has indicated. His faint and fuzzy signal strengthens. "It is just hanging out there. It hasn't moved for the last half hour. I don't know how I missed it."

But Dr. Jones's stomach is in an uproar. *This will not turn out well*.

"Admiral," Dr. Burgess whispers to get the admiral's attention. "We may have a submarine contact."

The admiral leaves sonar and joins us at the main computer. "What do you have?"

"I may have located a fast-attack submarine." His computer display has me at the center, shows the water around me for a mile or so, and one fuzzy green dot bearing zero one three, range four thousand fifty-five feet. "Then again," Dr. Burgess continues, "it could be a computational artifact. I am testing a new algorithm designed to target the Skate class."

“Show it to me.” The algorithm is familiar. He finds the recursive scheme weighted in favor of the Skate class. “It’s a clever solution.” We’re in a race with time. The admiral writes on a piece of paper: “51:55:32 by W144:45:36,” and takes it to Chief Buckheister.

Chief Buckheister looks at the coordinates. The admiral wants sonar’s assessment: Is the submarine *Triton* these coordinates? Because I’m about to step off a cliff.

After searching his possibilities, Sonar answers, “Sorry, Admiral. If something is there, it is too faint to detect in real time.”

It is the admiral’s decision to make. To report *Triton’s* location incorrectly would be worse than *Triton* targeting him first. It’s a matter of pride in a sub hunt. He writes on the paper and takes a few steps aft to the radio station, “Sparks, code this message ‘top secret’ to *Triton* Actual, ‘eyes only.’ Send it the first chance you get.”

Have you in my crosshairs: 51:55:32 by W144:45:36 by 0859. Martin.

For us, the sub hunt ends. It could be in two minutes, or later today, or even tomorrow. But at some point, we will be near the surface, and Sparks will send this message. At the same time, however, he may receive a similar message from the *Triton,* for the admiral: **Have you in my crosshairs: 51:55:30 by W144:45:28 by 0858. Farrell.**

King Salmon

Hunting by hook and line with polished spoons that mimic wounded herring; Trawler 1 has been searching for the bright scales of heavy king salmon pumping their powerful tails. They have twelve lines in the water…little bells are ringing…fish are being caught...

Now the female king salmon is fighting hard against weathered fingers that are trying to pull her into the boat...she thinks about the fresh water stream and laying her eggs there…she makes a powerful run. Weathered fingers let her run four hundred feet before increasing the tension to wear her out...he pulls her to the side of his boat, her tail feebly pumping, he sees her scales reflecting the light like a flickering flame…She’s a fine fish, a fat fish, a healthy fish...She will be cleaned and iced. She’s worth a fortune.

And we exit the area projecting the sounds made by a school of powerful king salmon tuna with neither *Triton* nor *Snook* knowing.

The Main Computer

“It started this morning when Dr. Jones connected the mission equipment in research bay two to the ship’s scientific computing network.”

Admiral Martin left his quarters two minutes ago and headed aft toward his lab, through the control room. As he passed the command station, he acknowledged the captain with a nod of his head, but ignored everyone else. He wanted a cup of coffee but his mind was telling him there was a problem in his lab…

As he passed the science station, Dr. Burgess interrupted him by saying: “It started this morning, when Dr. Jones connected the mission equipment in research bay two to the boat’s scientific computing network.”

“What started?” He wants a cup of coffee.

Dr. Burgess answers: “This morning, at about zero eight hundred hours, the science models executing on the main computer started portraying faulty images. The main computer is either receiving corrupted data from the mission systems or corrupting the mission system data itself.” Then, Dr. Burgess shifts our attention to a main computer display, and we watch it trace a flat seafloor three miles down over an established bathymetric map…

“Would someone bring me a cup of coffee…Yes, I’m listening, Dr. Burgess.”

“The two depth profiles are different. Main computer is showing the seafloor deeper by a mile than our historical records for this area.”

“What’s in research bay two?”

A moment of confusion bounces around before Dr. Jones replies, “Control and display computers for Dr. MacCarthy’s thermal imaging system.”

“Are his thermal sensors active now?”

“Yes, I checked his system out this morning before connecting it to the ship’s scientific computing network. He needed run time on the main computer. Dr. Burgess authorized it, so I made the connections.”

“Is data being sent now?”

“Yes, but not directly. I sent the processor’s thermal imaging data to the mission control station in the observation room. From there, mission control directs selected data to the main computer.”

“Did you make these connections?”

“Yes, this morning.”

“Are you qualified, as an electrician’s mate?”

“No, sir.”

“This is a serious breach of protocol.” He turns to Captain Deverough, who is standing at his command station. “Captain, did you know about this?”

The captain’s reply, “Not until after the problem started.”

Dr. Burgess takes the conversation back. “We are running diagnostics now, Admiral, but we may have to reboot the main computer.”

“Take the main computer offline in the middle of the Pacific Ocean? Dr. Burgess, do you know how dangerous that is?”

“Yes, sir. We will save that option for last.”

Then Captain Deverough joins us at the science station with his assessment. “The problem must be with the main computer. Sonar puts the bottom at one thousand fifty feet. Both inertial

navigation systems agree we are crossing the southern face of Mount Iwabuchi. Just to be sure, I'm taking us up to shoot the sun."

With five degrees up on the planes, we climb to periscope depth over a large seamount that stands alone in defiance of a deep-sea current that is headed to southern waters. Although it has never seen the light of day, it is alive with sprawling reefs and benthic creatures from the tiniest little fry hiding in nooks and crannies to great migrating sharks.

Walking a full circle around the periscope, Captain Deverough examines the surface waters. He mounts his sextant, locates the sun, and lays it on the horizon. "Mark," he synchronizes his reading with the time. Then he and Navigator Ryan calculate our position and mark it on the chart. They trade papers and verify each other's work, and cross-check with inertial navigation. His conclusion: "We are on the course laid in, Admiral. Everything points to a problem with the main computer."

On his way back to Dr. Burgess and Dr. Jones at the science station, Admiral Martin stops at the sonar station. Chief Buckheister says to him, "Keel-to-bottom is five hundred feet," and they inspect a sonar trace that shows a jagged uphill climb to the summit of a large seamount.

Unseen by sonar, a loosely packed school of swordfish come in beneath a school of barracuda hunting the seamount's turbulent southern face. The barracuda don't see the swordfish. The barracuda are hunting male Atka mackerel. But the male Atka mackerel do not see the barracuda. Their females have laid this year's eggs in crevices to mature. They must protect the eggs from crabs and octopus. So the mackerel don't see the barracuda…

The swordfish make their move, slashing wildly at the…

But the main computer takes us back to the abyssal plain, showing images of great magma chambers nestled beneath the drifting oceanic crust. Hot fingers probe fissures in fractured bedrock, seeking escape routes through networked cracks into the sea.

It's confusing, but through the main computer's field of view streams a school of bluefin tuna, glowing warm red in the thermal image. Admiral Martin barks, "Sonar, are you picking up biologic noises?"

"Nothing of consequence, sir."

Dr. Burgess points out, "According to this image, the bluefin are one hundred feet long."

The admiral understands: "Chief Buckheister, make a fish-finding ping to get their depth and size."

The fish-finding ping goes out, but only echoes from the seamount return. "I see shoals of normal size fish, but I cannot hear any unusually large fish in the water column," he reports.

Admiral Martin's eyes focus on Dr. Jones. Her heartbeat picks up speed and her stomach drops to the floor. "Dr. Jones, go to the research bay, examine Dr. MacCarthy's thermal imaging system, see if there are gargantuan bluefin tuna in the data being sent to the main computer."

The control room is getting really hot. "Yes, sir."

She exits through the aft door and takes the ladders to level three. From there, she walks forward through the crew's quarters, entering the research bay on the mezzanine level. I go with her for moral support and try telling her along the way that there are no gargantuan bluefin tuna in the water column.

She doesn't get the message.

"Dr. MacCarthy, I've been sent by Admiral Martin to examine the data coming into the main computer from your thermal imaging system. The main computer is showing…data anomalies." *Even seated, he dwarfs mission bay four.*

His eyes twinkle with the smile he has on his face. "What do data anomalies have to do with my imaging system?"

"They started this morning when I connected your system to the ship's scientific computing environment."

"Do you suspect my system is responsible?"

"I don't know. We're ruling things out."

"Would you like to see the raw data coming in now?"

"Yes…It doesn't look like much."

"Would you like me to pass it through some imaging algorithms?"

"Yes, the ones you've been using today."

"Is this what you are looking for?"

"What are we looking at?"

He smirks, and while looking down at nothing, shakes his head left and right. Why is he making me wait? "It is the side," *then huffs a stingy laugh and begins the sentence again*. "It is the side of a dormant seamount."

"Can you try to focus on something in the water column?"

"Can you tell me what you're looking for?"

"Large fish."

"How large?"

"One hundred feet."

"Are you serious?"

"Please look for fish in the water column and tell me you don't see any."

"Do you see anything that looks like a fish in that image?"

"No, I don't, but it's not my system." Then she rings up the science station. "Admiral, this is Dr. Jones, reporting from research bay two. It shows the seamount and there's nothing untoward in the water column."

“Okay, you can return to the control room.”

***

As she enters the control room, Chief Bronson is reporting, “We’ve been over every inch of wire from research bay two to mission control and from mission control to the main computer. The power and data lines are clear of electromagnetic interference. Every connection is physically isolated. I can’t find any evidence of electrical shorts or floating grounds.”

Dr. Burgess gathers our attention once again to the main computer display that is now showing an enormous sea creature being painted by the forward-looking bow array. “The contact is holding at three hundred feet. It moves as we move. It’s a textbook example of an electronically induced sonar ghost—except we are in passive mode and it looks like an octopus.”

“Chief Barksdale, is the collision-avoidance system working?”

“Yes, sir.”

“Sonar, are you picking up biologics close by?”

“No, sir.”

“Dr. Jones, go down to the observation room and look out the bow window. Report what you see.”

She walks forward through the control room, passing the wardroom, the captain and the admiral’s quarters…*Chief Bronson told me the story of a giant octopus that came up from the depths of the sea.* She takes the spiral ladder down, hearing her footfalls on metal steps. *He said the giant octopus wrapped itself around you.*

The uncharacteristically vacant observation room is cold and dimly lit. An empty North Pacific invades it. There isn’t even marine rain to scatter the bow light. *We are alone, adrift in nothing, and expecting a gigantic sea creature to emerge*…

I know we are making twenty knots, but there are no visual clues until far-reaching photons fall on a single eye. From the beginning it is looking at me, and grows larger as the creature comes out of the dark. A single eye dominates its head, and its stare is hollow. The creature extends two giant arms with thick, broad pads that sport suction cups the size of dinner plates. The distance between us is closing fast. My heart is racing. My head is pounding. It wraps eight arms around me, engulfing me in its mantle, pressing its mouth against my window to the sea, scraping me with its beak, making a horrible noise that sends chills up my spine—fingernails scraping on a blackboard…

That is a fish story, you know.

What do you mean?

I do not recall being attacked by a large octopus with a single eye. I think Chief Bronson was putting you on.

She walks to mission control, picks up a phone and rings the science station. “Admiral, this is Dr. Jones, reporting from the observation room. I see nothing at all in the water in front of us. Not even tiny bubbles in the bow wake streaming along the bow window.”

Admiral Martin barks back, “Look harder,” and we linger with the ocean a while longer, contemplating being alone in it and drifting to southern waters caught up with the North Pacific Gyre.

Do you know what’s wrong with the main computer?

I don’t think anything is wrong with the main computer, but I do not know.

Isn’t it your brain?

No, I don’t think it is my brain. I could be wrong, but I think the main computer is just a pretty face with flashing lights. It does what it is told to do. I have tried talking to it, but if it is talking back to me, I do not know.

How dangerous is it to lose the main computer?

The fact of the matter is that it is perfectly safe to take the main computer offline. It does not run the boat. It takes in data, performs calculations according to instruction sets, and puts out results. It is isolated. The crew decides if, when, and how to integrate what the main computer tells them into ship operations.

Why would Dr. Burgess and Admiral Martin imply it’s dangerous to take the main computer offline in the middle of the Pacific Ocean?

I think they are putting you on. Then over the ship-wide intercom, the admiral’s commanding voice: “Dr. Jones, report to the control room.” *My face is on fire and my intestines are turning over.*

***

Once again, Dr. Burgess directs our attention to a main computer display, now portraying the muffled roar of magma forcing its way through the ocean crust. As we watch, the crust buckles, then cracks wide open, letting the seething mantle of the Earth loose on the ocean floor. Extreme heat shocks the cold seawater; rolling sonic booms form and launch themselves in our direction.

“Prepare for shock waves,” Dr. Burgess warns the crew as frantic compression waves race up toward us at the speed of sound. We brace for impact against a shock wave that never arrives.

“Chief Buckheister, did you capture any of that on sonar? How about the hydrophones, anything there?”

“No, I don’t hear anything out of the ordinary.”

***

“Dr. Burgess, look at my display. An acoustic envelope has developed around our hull, the source of which appears to be in the aft torpedo room.”

“Envelopes like this occur with the launch of a torpedo or a missile. But they last for only seconds. Dr. Jones?”

“Yes, Admiral.”

“Get a stethoscope from Doc Lexi, then go to the aft torpedo room and listen for vibrations in the torpedo tubes.”

“Seriously?”

“Immediately, Dr. Jones.”

On the orders of Admiral Martin, she leaves the control room and heads aft. She descends the ladder to sick bay. Once out of sight, she leans against the bulkhead and presses her face into her hands. *I have to go into that room and ask Doc Lexi for a stethoscope to listen for sounds in the aft torpedo tubes.*

Dr. Jones, the aft torpedo tubes are empty.

It doesn’t matter.

Meanwhile, back in the control room, Dr. Burgess and Admiral Martin discover a foreign program executing on the main computer’s network communication bridge. “It is latched on to a processor that routes all mission data to the main computer.” In its normal state, this processor checks for errors in mission system data before passing it through to the main computer. Now it is introducing errors. They take mission bay four and the main computer offline. “Get an electrician’s mate to replace the communication bridge.”

“What should I do with Dr. Jones?”

“When you get bored, have her scrub the computer programs. I’ll be in my lab.”

That’s when Dr. Jones rings up the science station. “Admiral, this is Dr. Jones reporting from the aft torpedo room. There are no snipes in any of the torpedo tubes either.”

Derickson Seamount

The time is approaching zero hundred hours, and the night watch is taking control of the boat. Mr. Decker starts transfer of the conn with: “I’m relieving you, Captain.”

In response, the captain reports: “We’re on a course heading northwest at one thousand feet, running at twenty knots, and we have been since we shot the setting sun. At that time, I made a course correction of one degree north, as we had drifted off course. The model we have of the Alaskan countercurrent may be wrong. I noted it in the log. Navigation is working with Dr. Burgess to resolve the issue. I expect an update from you when I relieve you in the morning. Otherwise, all ship systems are operating within normal limits. Nothing notable happened this watch. The science teams have settled in for the night. It’s zero hundred hours, and the boat is quiet.” He ends with: “And I stand relieved, Mr. Decker.”

At the same time, Navigator Ryan is relieving Navigator Hill: “We’re crossing the Alaskan countercurrent. Right here,” she points to a featureless expanse in the north Pacific Basin, “we shot the setting sun,” he’s pointing to a note neatly printed on the map, “and altered course by one degree north. Our model for the countercurrent may be wrong. I’m working with Dr. Burgess on the matter.” Then they do what navigators do the most—check their calculations and cross check. Then Navigator Hill joins Dr. Burgess at the science station.

Meanwhile, as it always is with gyroscopes, they do what gyroscopes do well, they point in one direction. No matter how my orientation might change, cruising over the equator or north pole, diving ten degrees down on the planes, or during a full emergency blow, they point in one direction. They care not for the Earth’s curvature. Or speed or where they are. They do only one thing: point in one direction. And they do it well.

Sonarman Matthews takes the watch from Chief Buckheister: “I’m taking the watch.”

But the chief doesn’t hear him; he’s listening to the sea. A pod of Dalls porpoise scream warning sounds with strings of raspy buzzes…a nearby humpback whale calls to a potential mate with slow, lazy notes…clouds throw down huge raindrops that patter on murmuring waves, while lightning streaks across the sky; the Earth’s magnetic field wavers. Then, thunder slams into the sea.

“Chief Buckheister?” Sonarman Matthews puts his hand on Chief Buckheister’s shoulder: “Chief Buckheister?”

“What’s it, Matthews?”

“It’s midnight, I’m taking the watch.”

The chief replies, “There’s a fierce storm up there. We’re running silent.” That means he hasn’t launched any navigational pings to map the bottom. “You have the watch.”

“Have a nice evening, Chief. Oh, by the way, there’s chicken parmesan for dinner.”

Meanwhile, the inertial navigator does what inertial navigators do. It tracks the orientation of the boat. It measures truly and precisely the difference between our direction and the one kept by the gyroscope. And we have two of them. That is all they do. And they do it well.

At this time, Navigator Ryan is briefing Mr. Decker: “The last time we shot the sun, we were here.” Navigator Ryan points to a place on the map. “We’re headed north by west. Our depth is one thousand feet, our speed twenty knots. Factoring in the Alaskan countercurrent’s speed and direction, that puts us here.” She slides her finger to another location.

Let me tell you, and you should believe me, that I know where I am, and which way is north by reading the Earth’s magnetic field. I can feel the global field and magnetic anomalies from geological formations. Together, they make a magnetic map every bit as detailed as the navigational charts kept by the navigation computer. And I’m telling you that Navigator Ryan is pointing to the wrong location.

“Very well, Navigator, keep this course and speed for the remainder of the night.” And they recheck their course and speed and agree: “That should put us over the Aleutian Trench by zero six hundred hours.”

But they are wrong. We won’t be over the Aleutian Trench at zero six hundred hours. We will be crushed and broken, lying on the bottom from having slammed into the Derickson Seamount at twenty knots.

What can I do?

Billy Martin

Admiral Martin, wake up. We are in grave danger. We’re just minutes away from slamming into a seamount at twenty knots. It is dead ahead. Admiral, wake up!

But he doesn’t hear me, at least not directly. Instead, his mind takes my words and finds a memory to direct a dream. He hears, “Billy, wake up.” And fights his way to consciousness…

But not the consciousness that I need from him…

“Billy, wake up.” Her face is bruised and bloody; tears are running down her cheeks and fall upon his face. Her tears are the only tears he has.

“Billy, wake up.”

He had held on to Sheila the entire time, huddled in the corner, trying with the power of his mind to take them someplace else. It didn’t work. They were still crunched in the corner when their mother’s body lay limp on the floor. The monster shifted his attention to them, her children cowering in the corner.

She was little use protecting them from their father when she was alive, and now her death fueled his fury against them.

The brute covered the distance to the corner in four steps, pulling his terrified sister from his arms and repeating on her the attack he visited on their mother. He remembers with vivid detail what happened next, and it ends with puddling blue blood turning red as it hits the air.

“Billy, what are we going to do?” Both his parents’ bodies lie dead on the kitchen floor. Two children trying to disappear in the corner hold on to each other until the blood stops flowing from their father’s body. He takes his sister into the bathroom. He undresses and washes their wounds and dresses them both in tattered Levi’s and sweatshirts. “Don’t worry, Sheila. He can’t hurt us anymore.”

“But, Billy, what are we going to do?”

“Get as far away from here as we can.”

Lieutenant Jones

Dr. Jones, wake up. We have a problem.

Leave me alone. I’m sleeping.

But you don’t understand. We are just minutes from slamming into a seamount at twenty knots.

Her brain starts a dream and drags me into it.

Listen to me, Dr. Jones. I’m going to hit that seamount if you don’t wake up and help me.

And I find myself careening into the icy north Atlantic with engines screaming on either side of me—out of control, buffeted by atmospheric vortices, struggling with the rudder and ailerons. ‘Pull up...Harder! Get your nose up and point it into the wind.’ Ghostly images develop of ice sheets floating south with the Labrador Current illuminated by a quarter moon. ‘It’s going to hurt when you hit...Keep your wings level or you’ll spin out. Pull back on the yoke—much harder… Keep your left wing tip down. Keep the wings level. Push harder on the left rudder pedal. Keep the nose pointed into the wind. I’m going down, and it’s going to hurt when I hit.’

An iceberg appears from nowhere.

‘God, give me strength. Bank left!’ And she sits bolt upright in her bunk yelling: *Bank left,* Expedition*!*

Me?

Yes you, and fast.

That is not my place. That is mutiny!

Do it anyway!

Navigator Ryan shakes her. “You are having a nightmare, Casey. Wake up.”

If I do nothing, it is going to hurt when I hit. And her order, “Bank left” makes sense. So I focus on the engineering compartment, four hundred ninety-eight feet aft of where Dr. Jones was sleeping. Then I move to level four and starboard propulsion. I enter the permanent magnet motor—my head is on fire with magnetic fields and rotating coils—and speed up its turning rate just enough to miss hitting the seamount. Hopefully, no one will notice.

But no sooner than do I increase the speed of my starboard propeller than the starboard propulsion motor alarm screams: CONDITIONS HAVE CHANGED! This gets Mr. McGregor's attention, who was also sleeping, and he races aft through the main passageway three hundred eighty feet, holding his pants in his right hand while thinking he can put them on when he gets there.

By the time Mr. McGregor reaches engineering, three hundred fifty feet forward on level one, a navigation alarm in the control room is beeping its way to everyone's attention.

Great. Now the entire boat knows what I have done. Dr. Jones, I took control of the boat on your order. We are guilty of mutiny.

Captain Deverough storms into the control room. Just ten seconds ago, he was fast asleep. Now, he has a massive dose of adrenaline coursing through his veins and he's wide awake: "Mr. Decker, what in hell is going on?"

Admiral Martin is five steps behind him.

They are going to pull the plug on me now. Take me out of action. I'll never again sing with the great beasts.

Navigator Hill reports: "Mr. Decker, the inertial navigation system shows that our course has changed without a corresponding order issued."

"Pilot, did you change our course?"

"No, sir."

"What's your heading?"

"Three-zero-two absolute."

"Navigation, what is your course?"

"Three-zero-two absolute, Mr. Decker."

The two headings reported are the same. We are on the course Navigator Bell intended.

He rings up engineering: "Why is the propulsion alarm sounding?"

"McGregor here. According to the log, the starboard motor speed increased by five percent. I don't know why or how. I'm running diagnostic tests as we speak."

In response to the captain's order, "Get your bearings," Sonarman Matthews launches a sounding ping, and it returns more rapidly than expected. "It's five hundred feet keel-to-bottom," he reports.

But the course laid in had a depth of over twelve thousand feet, so he orders an emergency stop of the boat and to blow the main ballast tank.

In response, Dive hits the big red button at the top of the pilot's console. It sends a message to the emergency blow manifold. I shudder down my length as twenty high-pressure valves blast high-pressure air into my main ballast tanks. As the expanding air volume grows, it pushes

seawater through the ballast-tank ports in the keel. And the emergency-response claxons are shouting: *Hold on for your life.*

Powered by the buoyancy of our emptying main ballast tank, I careen toward the surface—with no precautions taken, breach it, and bob up and down like a cork in stormy weather.

***

We are station keeping over the southern face of Derickson Seamount. Its summit is three hundred feet below. But it would not be if I had not changed course to avoid it. The captain has pointed us into the Alaskan countercurrent with speed enough to keep us in place, and he will not move from this spot until he knows how he lost control of his boat.

What am I going to do? They will figure it out. What will they do to me? They could reboot my systems. What will happen to me? Will that mean the end of me? Will I still feel the things I feel and know the things I know? I don't want to go back to nothingness. This is your fault, Dr. Jones.

Expedition, *calm down*. *We didn't create the incident. We saved the boat. Let's just wait and see.*

Then Captain Deverough starts barking out orders.

"Dr. Burgess, start with the propulsion computer. Find out what caused the motors to increase the starboard propeller's turning speed.

"Navigator Ryan, check the model of the Alaskan countercurrent.

"Chief Buckheister, compare the sounding strip charts to the contour lines on the navigational map.

"Dr. Goeller, Compare the magnetic field to historical records."

Then he and his exec shoot the stars to verify our location, after which they settle into a long and tedious process of checking system logs for conflicting actions.

Dr. Burgess tears apart the propulsion programs looking for a bug while Mr. McGregor opens up the permanent magnet motors for a physical inspection. Admiral Martin runs full system checks on the inertial navigation systems. And hours pass. But, as far as they can tell, no order was given to change course, and nothing was done to change it.

Maybe they won't find out what we did.

"I found it!" Dr. Goeller is beaming as he joins the officers around the plotting table. "You will not believe what has happened. I've seen nothing like it before. But first, before I tell you, I must tell you that the Earth's magnetic field strength largely depends on two things. The first is the great dynamo that is the Earth's mantle and core. You know the mantle comprises melts and solids. Well, most of you probably don't know what a melt is. Let me tell you. A melt…"

"Dr. Goeller, we can assume everyone present understands the Earth's mantle and core."

“Oh, I apologize, Admiral. Let me see, where was I?” Then he changes the tone of his voice. “Melts and solids,” he mumbles, and continues: “The Earth’s mantle and core, by the means of the Earth’s rotation, generates a great, and I might add, complicated, and furthermore critical to life existing on this planet…why, magnetic field patterns in space reach halfway to the moon at times…but first, you must understand that, that field is not constant. It varies because the mantle and core are…”

“Dr. Goeller, my patience is running out.”

“Captain, you really need to understand this.”

“Dr. Goeller, I graduated from the US Naval Academy and have been commanding boats for ten years now. I don’t need instruction on underwater navigation. Tell me now what you have found that explains our situation.”

“Have I not made myself clear, Captain? It is the Earth’s magnetic field.”

“Captain,” the admiral whispers, tugging on the captain’s shirtsleeve to distract him, “Dr. Goeller will get there. Trying to speed up his thought process is futile. If you want the information, you must wait for it.”

Captain Deverough collects himself: “Well, Dr. Goeller, what about the mantle and core put us in the deadly situation of ramming into the Derickson Seamount?”

“The field lines around this anomaly have changed. They don’t match the charts. I mapped this seamount five years ago. This strip chart we just collected is nothing like any of the historical records.”

“Isn’t it more likely that you mapped a different seamount?”

“Not likely, Admiral. It was a surface research vessel equipped for taking bathymetric scans of the Aleutian trench. I was one of three professional navigators aboard, to say nothing of the amateurs. We shot the sun multiple times a day and the stars at night.”

“If what you are saying is true, that means we wandered over the Derickson Seamount because of a cumulative error in the inertial navigation systems, instigated by a localized temporal magnetic anomaly.”

“Exactly.” Dr. Goeller responds to Navigator Ryan’s conclusion. “This will make a great paper in the *Geophysical Review*. What a wonderful night.”

Then, Dr. Burgess adds, “That means it’s not the model of the Alaskan countercurrent that is wrong, at least not entirely.”

“Just to be clear,” Mr. McGregor asks, “we are not dead and mangled at the base of the Derickson Seamount because of a malfunction in my starboard propulsion motor.” They think for a few minutes before he concludes, “That is an ignominious distinction, ladies and gentlemen.”

“Admiral, there is something I don’t understand.”

“Just one thing, Captain Deverough?”

“How is it possible that a propulsion system malfunction could occur at just the right time and by the right amount to avoid hitting a seamount because of a cumulative navigation error caused by a changing local magnetic field anomaly?” They think for a few minutes before he adds, “That is an incredible coincidence.”

And they think about it for several minutes before Admiral Martin concludes: “The connections may be invisible to us, but they are there.” He reflects for a few minutes more and adds: “But keep in mind that as prepared as you think you might be, the sea will kill you if it takes that mind.”

***

Expedition*?*

Yes, Dr. Jones.

Maybe we shouldn’t tell anyone about this.

***

Someone knocks on Admiral Martin’s door. “Come in. Hello Navigator Ryan, what can I do for you?”

“Admiral. Before the incident started, I had to wake Dr. Jones from a nightmare she was having. She was yelling *bank left* from her dream. I was awake at the time. It’s very strange. She started yelling before the engineering alarm sounded.”

“Thank you, Navigator.”

Bering Sea

Station keeping in line behind an oil supertanker and eight other commercial vessels, we are waiting to sail through Unimak Pass and enter the Bering Sea. A container ship falls in line behind us. Fair winds from the south bring in a layer of fog. It rolls over us while the sea trembles from the unrest below, and sardines follow the cold-water current north.

I cannot count them or even guess how many run. Better measured in miles, they run miles long and miles wide, gathering plankton with their gaping maws. Huge voids inside the school dart erratically, driven by yellowfin tuna. Dolphins ping wildly in hot pursuit of them. Bull sharks run through them.

A flock of Northern cormorants hail down upon the ocean from one hundred feet, gravity increasing their speed, calling raucously to each other. Like guided missiles, they pierce the water at sixty miles per hour.

Cormorants paddle around with webbed feet in circles, taking turns to fly submerged, flapping their wings to make depth, but losing some of what they gain with each backstroke.

We will cross the shallow Bering Sea surfaced, all the way to the Bering Strait. It's a journey of fourteen hundred miles. At ten knots, it will take one hundred forty hours to complete, and we will run through surface waves the entire time. I'll not be a submarine again for a week.

Change of Plans

"Captain, I'm changing our plans." Admiral Martin says as he enters the control room.

Ten minutes ago, Sparks had patched a call to the admiral's cabin from a Dr. Anderson. The call instigated a change in our sailing plans. "I've just received news from the Lamont Geological Observatory that Mount Makushin is erupting. How long will it take you to plot a course through Akutan Pass?" Not waiting for the captain's reply. "Don't we have a volcanologist on board? Where the devil is Dr. Burgess?"

"About three minutes, Admiral. Why?"

"Three minutes for what, Captain?"

"Three minutes to plot a course through Akutan Pass. It will take three minutes."

"Well, just don't stand there, make it happen. Where the devil is Dr. Burgess?"

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"Here I am, Admiral. I've brought Dr. MacCarthy with me."

"It's high time, Dr. MacCarthy. You took your time getting here. I've just received news from the Lamont Geological Observatory. Mount Makushin is erupting. She started spilling lava down her northeast slope about half an hour ago. We are going to see it."

So we give up our place in line through Unimak Pass and start a forty-mile detour west into a giant yellow-orange disk, that is slightly flattened by refraction, sitting precariously on the horizon while being eaten by the sea.

Overhead, shades of rose and violet rule the sky, and wispy patches of iridescent pale-blue clouds catch the sunlight from below. Prevailing winds draw wispy streaks of lilac ribbons across the sky. And a high-flying jet, headed west, shoots the shocking brilliant sun with shafts of light it leaves behind, infused with flashes of flamingo pink and pomegranate and casting tawny shadows on creamy-peach clouds overhead.

Reflected on the waves, a golden path leads me to the sun, inviting me to follow. It makes me wonder: What might it be like in space? But my home is here.

Can we join you?

A small pod of gray beasts moves into my bow wake, and swims with me just under the waves, skimming the top to breathe. They launch fiery fountain spouts that catch the sun and scatter it in mandarin orange and amber yellow.

I don't see why not. Admiral Martin is taking me to watch Mount Makushin erupt.

And as we sail together, I notice these great beasts are different from others. I don't want to embarrass them, but…

You are fine-looking great beasts, but I notice…

Notice what?

I notice you blow a double spout when you come up for air, and also you appear to be missing your dorsal fin. I'm sorry if I've embarrassed you, but what happened to your dorsal fin?

We don't know, but we have a legend.

Tell me your legend.

Our legend says God gave us this double spout as a reminder to honor our ancestors, who defeated the dragons when they ruled the seas. There was a time when dragons hunted us relentlessly and our numbers were greatly diminished.

Our legend says the seer of our most powerful family found a cave in which to hide from the dragons. The cave had a vast chamber with a vent to the atmosphere, so the air was fresh. It could accommodate hundreds of us at a time. There was a problem, however. The cave entrance was too small. Only the smallest could pass through.

Our legend says many squeezed through, but each time they did, they lost more of their dorsal fin. It was painful. And, as the dragons ruled for ages, our bodies changed, with each generation having smaller and smaller dorsal fins until we were left only with the dorsal ridge you see today.

And the double spout, what of the double spout?

Our legend says God gave it to us because he was proud that we had defeated the dragons. But it's just a legend…

Battle of Dutch Harbor

After navigating the Akutan Pass, we altered our course north by west to follow the northern shore of Unalaska Island and toward the smoking volcano.

A marine ferry stuffed with people, freight and vehicles crosses our bow. Colorful tents litter the afterdeck. "Submarine, ho!" A man on the ferry spots us and points. He yells, "Hello," while bundled up passengers flood the rails to get a good look at us.

Admiral Martin waves back. *The people of Unalaska Island adopted me. They taught me to hunt and fish and catch monster crab. There was a beautiful woman I wanted to marry. It's as close to anything I call home—except* Expedition*, of course.* But he doesn't say that to the lookouts sharing the bridge with him.

Instead, to the lookout's question, "Dutch Harbor is your home, isn't it, Admiral?" He answers, "Yes. I was stationed here in the war. There was a submarine base, you know. But I wasn't born here. I was adopted."

"Oh, where are you from?"

But his mind wanders. He recalls water racing from the harbor to feed the swell forming offshore. He recalls the swell returning, and bringing back with it all the water it took out but in a concentrated thirty-foot-high wave. It erased the only place on land he had felt safe. It plundered the harbor and took the woman with sad, dark eyes and a beautiful smile.

Billy Martin

"But, Billy, what are we going to do?"

"Get as far away from here as we can." He remembers digging a large hole in the middle of a cornfield behind his father's house. He remembers putting both bodies in and covering them up. He remembers taking twelve one-dollar bills that his mother kept hidden in the bottom of a flour sack in the pantry and his father's blue pickup truck. He remembers driving to a bus terminal several counties away and buying two tickets for five dollars each. He remembers Sheila saying: "I'm hungry, Billy."

He bought a loaf of day-old bread they ate on the bus ride to the city neither of them had ever seen. He held Sheila most of the way, his arms wrapped around her. He remembers the bus ride. It was the happiest day of his life. He hadn't seen her smile in many months. She's smiling now. He swears to himself that he will keep her safe from this point on forever.

He remembers walking the streets of a tired little city, window-shopping and looking at houses and flowerbeds. He and Sheila had seen nothing as beautiful in their entire lives. And he remembers buying a loaf of bread and four slices of bologna, and picnicking on a bench in the town square.

He remembers seeing a sign on a storefront: **Join the Navy**.

"I'll be right back, Sheila."

Sheila sat on the park bench waiting for her brother to return, and he did, thirty minutes later, with a smile on his face. “They took you? Are you old enough to join the Navy?”

“I lied.” He takes a ten-dollar bill out of his pocket. Sheila had never seen a ten-dollar bill until that day. “They gave me an advance on my first paycheck.” He buys his sister a blue dress for fifty cents from a Salvation Army thrift store and treats them to a proper dinner in the town diner, a full dollar with a tip. It is the best meal they’ve ever had.

He remembers Sheila smiling the entire day. Even though her smile was missing a front tooth, he couldn’t imagine anything more beautiful than his sister’s broad, straight smile.

Seaman Martin

Patrol Boat, PT-625, left Pier 8 of the US Naval Base in Dutch Harbor that night, loaded with four 2,600-pound Mark 8 torpedoes—each capable of delivering 466 pounds of TNT.

It was two months from the day he spent with Sheila on the gulf shore, making plans for the future. “I’ll be an admiral someday.” And they laughed. She said, “I’ll be a nurse,” and he responded, “Why don’t you?” But it seemed like years.

The US Navy had the US Army Air Corps fly him and twenty other “squids” via troop transport to Fort Randall, Cold Bay, on the tip of the Alaskan Peninsula, two hundred miles northeast by east of here.

Now, he was a second class seaman on the deck of PT-625. Captain Roy Lee and his men referred to their PT boat as *Devilfish*, though she bore no official name—perhaps the Navy did not think she would survive long enough to matter. She had twin M2 .50-caliber machine guns mounted for antiaircraft defense.

Their orders were to patrol the shallow coastal waters south of Unalaska and Umnak islands looking for Japanese submarines that were looking for US submarines operating out of Dutch Harbor.

It was heaven to him. Not three months earlier, he was huddled in a corner of his mother’s kitchen, protecting his sister from the wrath of his father, and now his sister was safe and attending nursing school, and he was riding the coastal patrol boat on a sea that he never knew existed. The aurora borealis painted the sky with dancing angles. He did not have the words to describe it at the time.

They spent the watch loitering in the shallow waters of Akutan Pass and the mouth of Beaver Inlet, scouring the night for signs of Japanese submarines.

The faint hum of a distant aircraft cruising several miles high got Seaman Martin’s attention. He recognized the precisely timed clatter of a Nakajima Sakae 14-cylinder air-cooled radial engine married to the rapid percussion pulses launched by a three-bladed constant-speed propeller. It was a single Mitsubishi A6M Zero making its way northbound, toward their position. But before it reached them, the Zero turned around and went back out to sea. Captain Lee radioed the base, reporting the sighting.

What the captain did not report, because no one on PT-625 could imagine it, was that out there, over the horizon, and one hour before—out of sight—one of two Japanese aircraft carriers, the *Soaring Crane*, had launched twelve Mitsubishi A6M2 "Zero" fighters, twelve Aichi D3A1 dive bombers, and ten Nakajima B5N1/2 torpedo bombers.

But the next hour brought the formation into view. It was a race in time and space to get all docked warships out of Dutch Harbor and into open water.

Captain Lee radioed the base and set his PT boat on a course to Dutch Harbor at maximum speed; they needed to help defend the fleet, but they never made it back to the base. An advanced Zero came screaming down on the *Devilfish* and, with a single strafing run, spit 200 rounds into its fuel tank. The PT boat promptly exploded.

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The admiral rings up Mr. Decker below. "Mr. Decker, have a special detail break out the rafts." Then he rings up the radio room. "Sparks, this is the admiral. Contact the Tsunami Warning Center. Check the magnitude of the quakes. Then call the Unalaska Island Police Department. Tell them we're here if they find themselves in need."

By this time, erupting Mount Makushin is dead ahead. It stands a mile high, and plumes of steam issue from a mile-wide caldera at the top. Its glacier glitters in the sun from the pinnacle all the way down to the sea in places. In other places, bare basaltic rock climbs its sides in stepwise cliffs, and on these steps basaltic rubble supports smatterings of dwarf shrubs with yellow flowers.

It turns out to be a peaceful eruption, but even so, the seafloor grumbles and complaints arrive from every direction. Unrest mounts from miles below the volcano, from beneath the continental crust, where mantle matter melts and solids rise. Where pressure builds in magma chambers until the volcano's vent yields, and glowing-hot lava spills out.

On its journey down the northeast slope, the lava buries itself under ice that covers the land up there, melting the mighty glacier from below until it reemerges at three places along the northern shoreline, gray and slowed a bit but still marching inexhaustibly into the sea, turning it to steam that drifts upon the wind.

All the while, underwater, lava flows over lava flows, spreading and adding itself in layers, advancing stepwise, birthing blob after blob of freshly made igneous rock, each blob emerging from the blob before it. Each blob born from a soft spot on the surface of its progenitor, and from that soft spot an orange-hot bulge emerges through thinning crust, drawing it into a cover of lace. But the seawater prevails, and an outer crust forms, slowing the blob and the advance of the lava flow until the next soft spot forms.

Outward each blob creeps. Out and up, fed by a river of red-hot lava encased within the flow. Each blob builds on the blob before. Each layer builds on the layer beneath. Relentlessly, it creeps. It surges and grows. Layer upon layer of lava builds. And the sea loses ground today as Unalaska Island grows.

“Admiral, this is Sparks. I have the Unalaska Police on the line. Captain Tapaoan wants to speak with you.”

“Patch the call up here, Sparks.” And the two men talk of evacuation plans as a huge ice sheet collapses and pounds its way down the mountain’s northern slope. Thundering sounds from the avalanche and hissing steam add themselves to the rumble of seaquakes. And I follow the rumbling through the roots of the island down seven miles and south, to the place where the sea-floor, with all the ooze, sand, and silt that rides on top of it, is forced into the mantle that consumes it.

Kill Confirmed

“Sit. Dr. Jones,” he says as he tosses a folder labeled *Admiral Martin, Eyes Only* on the desk in front of her…“Go ahead, open it.” Two objects adorn the wood desktop that is otherwise bare: the pen and ink set given to him by the crew of the USS *Torsk* and a bright brass sextant.

She reaches for the folder, pulls it toward her, and opens it. Inside is a yellow-white piece of paper printed on by teletype keys. It’s a simple message, just four words: *Martin. Kill confirmed. Farrell.*

“I don’t understand.”

“*Triton* confirmed our kill.”

“You mean, from the submarine hunt? Does Dr. Burgess know?” She’s giddy with excitement but tries not to show it.

“Yes, Dr. Burgess knows. I knew you two were up to something that day. He told me he took the lead from you and focused all the resources available to him to target the *Triton*. The thing is, Dr. Jones, I don’t see this targeting accuracy coming out of your sensor network. How did you locate that submarine?”

TELL HIM I TOLD YOU. JUST TELL HIM.

But her colors fade to gray as blood drains from her head, her mind searching for a suitable explanation…*I didn’t know what I was seeing at the time*—but she doesn’t say that because fear is crawling out of her bowels…*I was seeing* Triton *through* Expedition*’s eyes. I acted on that*—but she doesn’t say that either—Even though the time is perfect for it.

Instead, she says. “Admiral, I don’t have a scientific answer.”

“What answer do you have, Dr. Jones?”

TELL HIM I TOLD YOU!

“Admiral, do you ever get the feeling that something is out there, but you don’t know how you know?”

“Doesn’t everyone?”

“More so when you are on *Expedition* than when you are not?”

“No.” He lies. Then changes his answer. “Yes.” Then equivocates. “I imagine most sailors feel a spiritual connection with their ships at times—out of desperation, most likely.”

“Well, Admiral, I feel an incredible connection to *Expedition*. As a matter of fact, most of the day I feel he is keeping company with me.”

“Dr. Jones, you’ve put your life into the hands of seventy-six strangers on an expedition to the most hostile place on Earth. Maybe your brain is searching for emotional security.”

“I don’t think that is it.” Then begins a story. “Admiral, when I was eighteen, I went on an adventure of a lifetime, or so I thought at the time. I was visiting a college roommate in the City of Angels—”

No! Don't start another conversation!

She ignores me. “I had never been west of the Mississippi before. My first day there, it snowed. My roommate came from a more well off family than I. We were an immigrant family living in Flatbush. She had seen everything out there that I wanted to see several times and would not go sightseeing with me…”

“Flatbush? I would never have guessed.”

“So I bought a Greyhound bus ticket for Las Vegas and then on to the Grand Canyon. And went alone.”

“I fell asleep on the bus. It was dark. I was in a back seat, alone. For some reason, my mind decided that I should wake up, so I did, but I entered this world from sleep slowly, and as I did, I felt…power around me…

“Now, I’ve never been crazy-happy about waking up when the sun was not shining, so I kept my eyes closed for a while. I was sure the strange feeling was part of a dream and it would go away when I opened them…

“But it didn’t. As I peered through half-open slits, with my head still on the bus seat, I saw power lines through the window looming above…

“I sat up. You could have knocked me over with a feather...I’d seen black-and-white pictures in geography books…

“My eyes followed the power lines into a canyon, where they found a massive concrete powerhouse out of which the electric power lines grew. But I had never seen a canyon or a power plant before…

“Well, my bus was on US 93, crossing the Black Canyon of the Colorado River, traveling over the crest of the Hoover Dam. I felt the wedge-shaped concrete gravity dam planted steadfastly into the canyon’s bedrock floor, holding back over seven hundred feet of Lake Mead. One thousand two hundred megawatts of electromagnetic power had me adrift in an unfamiliar place…

“Admiral, I didn’t know any of it. But in less than a minute, the electromagnetic field around me showed me everything.”

“And your point?”

“Admiral, since the morning I walked onto *Expedition* the very first day of this journey, I have felt the sea…like I have never felt the sea before and outside my own experience of it. There have been times when I felt thunder and wind blowing on surface waves, tides surging, aurora dancing in the sky, even though we were hundreds of feet submerged.”

“Dr. Jones, are you trying to tell me you feel connected to the sea in the same way you felt connected to the Hoover hydroelectric plant?”

“No. I’m telling you that I feel connected to *Expedition* like I felt connected to the Hoover hydroelectric plant. But it’s more than that, too.” *The power plant wasn’t sentient.*

“Dr. Jones, you know the times when you feel you are being watched and the hairs on the back of your neck stand up?”

“Yes.”

“You’re convinced something is there, but your eyes and your brain will not let you see it?”

“Yes.”

“Well, Dr. Jones, the transient acoustic waves you’ve discovered aboard *Expedition* are most likely responsible for these feelings, with a little of your imagination thrown in for color. The air molecules are energized by standing waves. They’re tickling the hairs on the back of your neck, so to speak.” And he’s fluttering the fingers of his right hand near the back of his neck.

“Yes, I agree. That could be true. That’s why I built the internal acoustic network. But just because there’s a physical explanation, doesn’t mean there isn’t an entity behind it driving it, adding its energy to the physical phenomena, capitalizing on an existing process to communicate.”

Well, it sure has taken enough time to get back on topic. And her heart’s pounding outside of her chest. Her face is covered with red splotches.

“I’m sorry, Admiral. What was your question?”

“You’re stalling Dr. Jones.”

“No. I’ve just lost the thread.”

“How did you locate *Triton*?”

“Oh, *Expedition* told me where *Triton* was.”

You said it! How wonderful!

“Expedition told you?

“Admiral, do you ever talk to *Expedition*?”

He sits back. A lopsided smile crosses his face. “There are times I do.”

“Good. Does he talk back to you?”

“No.”

“Really? Not even a bit, Admiral?” She waits for a response but doesn’t get one, unless you count the sustained smile he has on his face.

She continues. “I have been communicating with someone who believes they are a submarine called *Expedition*.

“Communicating?”

“Yes.”

“By communicating, do you mean typing into the main computer and reading a response?”

“No.”

“You know, I wouldn’t put it past Dr. Burgess to be messing with your mind that way.”

“No. It has nothing to do with the main computer.”

“Are you sure?”

“Yes, I’m sure. He claims he talks to you.”

“Who, Dr. Burgess?”

“No. *Expedition*.”

“Then, Dr. Jones, just how are you communicating with *Expedition?”* The grin is still on his face.

She sits back in her chair, studying him. *Steely blue eyes. Freshly shaven face. Lopsided smile.* “Telepathy.”

“Telepathy? Why do you call it he?”

“It’s the impression he gives me. He thinks I spend too much time getting ready for dinner—”

“Have you ever seen him?”

“Well, that’s a tough one to answer. A fair amount of our communication is through the sharing of images…But I’m not the only one he communicates with…” She pauses for a response.

Not getting one, she continues. “The whales see him as the submarine *Expedition.* That’s what he believes…

“He claims he’s spent a lot of time with you. Don’t you feel him?”

“No.”

“You mean you’ve never gone out in the ocean with him? Never surfed his bow wake with porpoise?”

“No.”

“He remembers a woman, your sister, I believe, her name is Sheila. He remembers her saying, ‘I christen you Research Vessel *Expedition*.’

“He claims that you took him to the Bay of Fundy to watch the tide go out and play on the rocks…

“He told me, when you were a young man, that you loved a woman with long black hair and a beautiful smile…

“He told me you were twelve years old when you killed your father and buried him in a cornfield.”

“You have a vivid imagination, Dr. Jones.”

“You mean none of this is true?

“He changed the submarine’s heading to keep from running into the Derickson Seamount because I told him to do it. He wouldn’t do it on his own. He said Mr. Decker had the conn and for him to take control would be mutiny. But I told him to do it anyway…Are you going to put me off the boat?

“No.”

“Why not? Don’t you think I’m crazy?”

“Dr. Jones. This is a submarine. Everyone is bat shit crazy one way or another.”

Crab Picking

My shadow falls on a seafloor that moves and millions of six-foot long, segmented legs tiptoe over pebbles and sand. Migrating scavengers hunt making a racket. Claws crush barnacles, shred sponges, and snip algae. Claws pick soft flesh out of pried-open clams, and pass tidbits to maxilliped, maxillae, and mandible like buckets in a fire brigade. Mashed and ingested, what one king crab scares up and misses, the one behind it catches.

Chief Buckheister rings up the galley to report: “Cookie, I hear crab.” And Cookie understands the chief’s meaning. “Stuart, take over for me. I need to talk to Admiral Martin on an urgent matter,” and leaves his steward to mind the baking of bread and apple pie for dinner.

Cookie lays up two levels, pokes his head into the control room looking for the admiral, but finds Dr. Burgess alone at the science station and whispers. “Dr. Burgess, where is the admiral?” to which Dr. Burgess responds, “In his lab.” Mr. Decker, in command of the boat, sees the two men whispering and asks, “Cookie, is that fresh apple pie I smell?”

Cookie makes his way aft to the admiral’s lab. He knocks on the door. “Admiral?”

From inside he hears: “Come in.” And finds the admiral examining microscopic organisms through the lens of a microscope. The admiral looks up as Cookie pushes open the door. “What can I do for you, Cookie?”

“I was wondering if you were feeling like crab for dinner?”

The admiral takes Cookie’s meaning, grins, and says, “Now that you mention it, Cookie, I do. Let’s make it happen.”

So the two men go forward together but part ways at the control room’s aft door. The admiral steps through while cookie takes the ladder below toward the galley.

As the admiral enters the control room through the aft door, Captain Deverough is entering from the front, saying, “I’m taking the conn. Mr. Decker, you are relieved.” He heads aft toward the command station while the admiral is making his way forward. Mr. Bell is at engineering and Dr. Burgess at the science station. The admiral passes them by, and the radio operator too. When he reaches the sonar station, he sits next to Sonar, picks up a headset, saying, “Let me listen.” He plugs his headset into the outlet from the keel sonar array. He shakes his head while pursing his lips and turns to the captain. “Captain, have you heard what’s going on below your boat?”

“No, sir. I just came on duty.”

“Well, Captain, I recommend you stop this boat because we have to put divers in the water…”

“Admiral Martin, Admiral Martin,” William calls from the forward door of the control room, “There are six divers suiting up in the main launch bay to get crab for dinner, can I go with them?”

***

Six divers fitted out in dry suits enter the water through the main launch bay hatch and descend inside the shadow I cast from the sun. Below, a field of blue king crab marches in a disorderly manner—and sideways, with a casual two step using three legs at a time—step sideways with the first and third leg from one side and the second from the other, then repeat the pattern with the other three legs; step sideways, step sideways, step sideways. But they're not stepping in time with each other.

Singled out only by mere chance, a human hand snatches a crab’s trailing leg. The crab tries hard to ignore the abduction. Its legs keep walking as it’s yanked off the seafloor and set spinning. The hand grabs the back of its carapace and stuffs it sideways into an empty net bag. The legs struggle. It appears that two legs crawl out for every one stuffed in. Diver Gatto swims over to help Diver Fazio.

With hind legs planted on the bottom, a crab stands his ground against a hovering creature with one big eye and noisy bubbles streaming out. It stands on its hind legs, throws its front legs up and wide open, while pinching the water with plier-like claws toward Diver Wu. She stands her ground, but the crab gives her pause because, as measured from side to side, it is longer than she is tall. Then a shaft of torchlight comes waving in her direction. Diver Ahmed is distracting the crab and giving Diver Wu the chance to grab the king the way she saw Diver Fazio do.

Meanwhile, back in the control room, Chief Buckheister rings up Chief Bronson in the launch bay. “Chief, this is sonar. Better tell the divers I’m picking up shark sounds.”

By this time, the crabs have realized they’re being hunted and they pick up their pace: sidestep, sidestep, sidestep. Fear floods through the cast in waves of confusion. Not sure which way to run, they run in every direction. Crabs crawl over other crabs in their flight. Crabs take exception, and disagreements arise. Forgetting the threat, two indignant crabs stand face-to-

face, brandishing claws at each other, pinching claws snipping at the seawater, and crushing claws mangling nothing.

Chief Bronson sends a warning to the divers: “Look sharp, there are sharks in the water.”

Collectively terrified, the cast speeds up its sidestep. And the faster they run, the more straightforward they face and their pace is now: step fast, step fast, step fast. Diver Fazio chases a panic-stricken straggler, flailing four legs wildly. On its own and missing two legs, the crab is disadvantaged and knows it. Diver Fazio follows in hot pursuit.

Running full speed, and facing fully forward, the crabs disappear over the edge of a cliff where the sandy floor gives way to a boulder-filled slope. The divers follow the crabs over the edge to find the crabs no longer running. Now, crabs are stepping over boulders lightly, picking their way from one rock to the next, each segmented arched leg feeling its way. Their fear and panic have vanished. The tides have turned on the divers. The crabs retreat into caves, scanning for movement with their sensitive antenna. They flourish their claws when divers approach. Now the divers must face them to take them and have something to lose.

Diver Fazio thrusts his right hand into a hole after a crab he saw grab a starfish tiptoeing by. Finding nothing, he pulls his hand out and abandons the hole and the crab he knows is in there. He moves to the next crab in the next hole. This time, when he thrusts his hand into the hole, it lands on an unseen carapace and grabs it. With a quarter turn of his wrist, he dislodges the grasp the crab’s six legs have planted into the walls of the cave and drags it through the hole.

Diver Ahmed spies a crab watching her. It’s a formidable beast. Discarded mollusk shells and fish bones pave the entrance to its hole. She targets it. She recalls Crewman Fazio’s advice. ‘Show no fear. Thrust your hand in as fast as you can. Grab the carapace any way you can. Twist your arm as hard as you can. Pull the crab out as fast as you can.’ She goes for it. But she missed his last words of advice. ‘If you fail, move on. Don’t keep your hand inside of the den.’ Diver Ahmed plunges her hand into the cave. The crab avoids it. Rather than pulling her hand out as instructed, she feels around for it. ow! Ow!! OW!!! A massive crushing claw mashes her fingers, and she finds herself in a tug-of war with a crab in its hole, its legs spanning the cave entrance, pulling back on Ahmed over possession of her pinky finger.

Diver Gatto follows a fifteen-foot crab into a cave. His torch light scans the floor and the walls and falls on a well-armored fish that has an abundance of fins, sports a secondary tail in two parts, and is covered with thick, boney scales. The fish saunters through the cave, walking with his most forward pelvic fins toward the light.

Startled, the crab asks, ‘What foul oils exude from that ancient fish?’ But the fish is not offended and throws a set of boney jaws open, inhaling the impudent leggy tidbit, crushing it with one bite. All the while, his gaze is fixed on the second intruder.

Diver Gatto backs out of the cave. ‘I wish I’d brought my camera. The admiral will never believe it.’

***

Back in the galley, Stuart has two humongous pots filled with seawater boiling. As the divers return with the crab, a special detail will ferry them up to the galley.

“How many crabs must the divers bring back?” William asks Cookie as he takes apple pies and bread out of the oven. “There’s ninety people on board and I can eat three or four crabs by myself, so that’s two hundred seventy crabs.”

“William, you can’t be underfoot in a galley. Why don’t you go to storage closet three and bring forward a large roll of brown paper to cover the tables?” But William is more interested in how many crabs Cookie needs to boil. “There are six divers in the water. That means each diver will have to bring back forty-five crabs. It’s going to take forever to catch them.”

Stuart responds to William’s question. “Master William, you’ve never seen a crab as big as the king crab we catch in the Bering Sea. I’ll bet you dollars to donuts that you can’t eat even one. Sit here and husk the corn.” But fetching brown paper and husking corn does not appeal to William, and he announces, “I’m going to watch the divers return with the crabs.” And he rushes forward, entering the main launch bay on the mezzanine level. The smell of frying hushpuppies goes with him.

Doctors MacCarthy and Jones are pulling fistfuls of net bag and crab onto the deck, the bag undulating in random directions as their contents struggle to get free. “How will we get these to the galley?” William asks as special detail struggles to strap bands around snapping giant crab claws. “Better question,” Dr. Jones laughs, “How’s Cookie going to get them into a pot of boiling water?”

Diver Gatto surfaces alone, without his diving buddy and without a crab to show for his effort. He hoists himself out of the water onto the deck. “Where’s the admiral? Someone, find the admiral. I found a coelacanth living in a cave. He will want to see it, I know. Someone fetch my camera.”

***

Dr. Jones enters the crew’s galley and sits in the first open space she finds. The table’s diners are pounding king crab, that is, except for Dr. Hansen. The crew’s mess is brimming with excitement, with people talking louder than usual. “Hello.” Two bright red crabs are sprawled on the table, and at each end a bowl for collecting broken shells, but the bowls are empty and the broken shells litter the table. “What are we arguing about today?”

William responds to her question. “The nature of mid-ocean ridges.” But Dr. Hansen corrects him. “More precisely, young man, the spreading rate dynamics of the mid-ocean ridges.”

William asks Dr. Jones, “Have you seen Admiral Martin? He said he would join us.” She replies, “Chief Gatto came up with a wild claim that he’s seen a coelacanth living in a cave. The admiral suited up and went into the water with him. This is the most delicious crab I’ve had in my life!”

Making as pleasant a grin as his knotted face could muster, Dr. Hansen answers her question. “I was explaining my theory on the presence of life along the mid-ocean rifts.”

Stuart delivers a big bowl of soup to Dr. Hansen and a loaf of bread to the table, “This is my special *He Crab* soup. I hope you enjoy it,” then addresses the table, “if you put the shells in the bowl, I can take it away.” Then goes back to the kitchen to fetch more crab. There are eight tables with six people at a table, and a boatload of crab to deliver.

“Your theory is far-fetched, Dr. Hansen,” Dr. MacCarthy smirks, as if he’s said something witty. “Most of the ocean is void of life.” He pauses, waiting for concurrence from the table, “Most of the ocean is void of life, and where it exists, it is confined to the top few hundred feet.” He smirks, slowly shaking his head left to right several times. “You’ve collected three samples…Only three samples that contained microbes. How many hundred have you collected and examined?”

In Dr. Hansen’s defense, Dr. Santiestiban responds, “Well, I for one think Dr. Hansen’s theory is fascinating.” He twists a crab leg at the joint and pulls the two segments apart. Plunges a fork into one end and pulls out a seven inch long piece of meat, which he dips into butter. “How can anyone be sure what we will or will not find at the bottom of the ocean?” He leans forward, closing his mouth and lips around the buttery delight. Then he licks a drop of butter from his lower lip…“After all, we have explored less than one tenth of one percent of it. Think of it, the mid-ocean rifts could be a superhighway for extreme life forms populating the deepest parts of the ocean.”

“Oh, please, Dr. Santiestiban.” Dr. MacCarthy pounds a crab leg with a mallet. “Your theory on the spreading ridges is no more likely to be correct than Hansen’s regarding life below five hundred feet.” He chuckles to himself. “It’s ridiculous to think…It is ridiculous to think that a rift in the ocean’s crust could be anything but magma pushing through from the mantle. I’m telling you…” chuckling. “I’m telling you, when we get to the Nansen Ridge, we will find a perfectly normal mountain range with volcanoes and pyroclastic flows dotting the foot hills, just like Vesuvius next to the Partenio Mountains or any one of a hundred or more running along the backbone of the Andes.

“Dr. Santiestiban, have you brought your collection of peridotite nodules with you? I’d love to see them. I’m a bit of a rock hound myself…William, could you pass me a hushpuppy?”

“Please don’t encourage him, Dr. Jones.”

“I’m curious. You are on this expedition to collect peridotite nodules from the Nansen rift. What makes you think you will find them? More there than anywhere else, I mean.”

“Most of the peridotite nodules I’ve collected so far have come from peridotite formations on dry land. But those rock formations were manufactured at the bottom of the ocean long ago. I believe the Nansen rift is manufacturing peridotite now.”

“Wouldn’t that be true of all rifts then?”

“Well, my dear colleagues, this has been a fascinating discussion.” But the permanent sneer on his face says something different. “I have work to do in Admiral Martin’s lab.” And Dr. Hansen leaves the crew’s mess, but turns forward to the research bay not aft to the admiral’s lab. As he disappears from view, Admiral Martin enters the mess, locates William, and takes the seat left

open by Dr. Hansen. He grabs a fistful of legs and a wooden mallet and says, “You will not believe what I just saw.”

And people come and go in waves to pound crab and talk about crab legs and butter and corn on the cob and how good it all smells and tastes. What I wouldn’t give to be sitting at that table.

A Gray Day

Gray blankets hang from the sky and cover the sea. They billow in misty tufts over the water and drift along my top deck. Gray clouds send gray streaks of lightning tumbling through the short air gap to the sea in slow motion—making no sound. Even the lightning has lost its silver and is gray. I’m traveling through a gray lightning storm.

Making barely a ripple, a gray, great beast surfaces. He sips the air and slips back into the sea. He feels it too. The day is gray. What’s going on above the mist or beneath the waves that makes this day so gray?

Dark thoughts. The day is gray; the beasts are gray.

Now even our thoughts are gray? Can my dark thoughts turn the beasts’ thoughts gray?

Sometimes it seems that way to me.

What about the thunderstorm? How can my dark thoughts make a thunderstorm gray?

I think by altering your perception of it, not the thunderstorm itself.

Do you mean I might perceive something is gray today because my thoughts are gray, but on another day I would see a different color?

Expedition*, I’m curious. What dark thoughts are you having now?*

Don’t you know? Can’t you feel my thoughts?

I have my own dark thoughts right now.

Dr. Jones?

Yes?

I've seen great beasts die, and some of them I have known.

Are you sad because your friends have died?

I get sad when great beasts that I know die, but that’s not why I’m gray today.

And why are you gray today?

Admiral Martin is worried about something.

What’s that?

He’s worried that he will die before his work on Earth is done.

And that makes you sad?

When I think Admiral Martin will die, I’m sad.

Oh, I understand. That is hard to think about.

Dr. Jones?

Yes?

Will I die?

I don't know. It depends.

On what does it depend?

On what you believe it means to live and die.

What do you think?

I really don't know. There are all kinds of theories.

Theories? Can you collect data to prove or disprove them?

Some people think so, but no one has. Many people argue: prove to me god exists. But it turns out to be one of those things you must believe.

The same way you believe I am in the data, not knowing it?

Yes, a lot like that.

Dr. Jones?

Yes, Expedition*?*

I'm afraid Admiral Martin will die without knowing me.

That's a good thing to worry about. Most people worry about silly things.

What do most people worry about?

Most people worry about not having enough money, or not being famous enough.

What do you worry about?

I'd rather not say.

Dr. Jones?

Yes?

What happens when you die?

I don't know. Most people I know believe that when their bodies are spent and done with, the essence of what they are will live on in another way.

Dr. Jones, are you afraid to die?

Sometimes.

If it is the way of life, why are you afraid to die?

Dr. Jones?

I'm thinking...I'm thinking…of being forgotten…of not mattering anymore.

Dr. Jones?

Expedition*, I really want to sleep right now.*

Are you gray, Dr. Jones?

Please leave me alone.

Dr. Jones, who is God?

What do you know of God?

I know Admiral Martin talks to him.

He's praying?

Why?

Probably searching himself. Asking for courage to do the right thing. We shouldn't be talking about this.

Why not?

Prayers are sacred. We shouldn't look into that part of someone's life. They are private thoughts between a person and God.

Who is God?

I was raised to believe that God is a supreme being that created us. I was raised to believe that when the earthly part of my existence is over, that God will decide if I were good enough to spend time with him, in which case I would go to a wonderful place called heaven, but if God decides I did not please him, then he would send me to hell to suffer for all eternity without his love.

Her words make me pause.

Expedition*?*

And then I understand.

Expedition*?*

I'm afraid…that I'll not please Admiral Martin and that he will condemn me to hell.

Arctic Circle

By tomorrow afternoon, according to Navigator Ryan's map, we will cross the Arctic Circle and be in the land of the midnight sun. It took us fifteen days to get here from our home port in the Santa Barbara Channel. We crossed the deep Pacific Ocean and the shallow Bering Sea to get here. Now we're riding a slow surface current through the Bering Strait into the Chukchi Sea, with Alaska on our starboard side and Russia and the Diamante islands on our port side.

While we are here, the sun will never set, but we will rarely see it, if at all. Winds will blow violently over freezing ice, but we will feel them only by sound propagating through layers of ice and water. Fresh water will run off continents from all directions into the sea, but we will not taste it, for we will be four thousand feet depth-to-keel. While we are here, a continent's worth of ice will float above us, but we will not see its rugged, unforgiving surface. We will not see ridges built by colliding sea ice or the peaks of icebergs embedded in it. We will feel the world above the ice from four thousand feet below it. We will look up and see an ice canopy and the undersides of icebergs sculpted by swirling top-water currents. But now and for the foreseeable future, our depth-to-keel is fifty feet, and our keel-to-bottom is ten feet from the Chukchi Sea floor. It's a tight place that I'd rather not be.

To make things worse, my active acoustic camouflage system—designed and built by Admiral Martin to fool both men and beasts—is broadcasting the signature of one large and noisy research vessel. You might think that under these conditions, he would want me to behave like an ice floe, blending in with all the other ice floes. Instead, when the world is watching, he makes me look big and loud and awkward—I am a research vessel, after all. To that end, my active camouflage system transmits hydrodynamic flow sounds and cavitating propeller sounds and ballast pump sounds.

But I would rather be at crush depth than here.

Polar Bears on Deck

Floating plates of Arctic ice drift over the horizon towards us. From this distance, they look benign, but ice of many years is hard and can rip right through steel hulls.

Soon, the ice plates coming my way will find themselves broken, diminished, and in extreme southerly locations from wind action, currents, and the springtime sun that will be their demise. But for now, the plates are large and hard, and for a few days, we will need to find our way on the surface through the cracks between them.

Admiral Martin climbs the sail ladders to the bridge. "Good morning, Captain."

Brilliant with the arctic sun, ice floes cover the ocean. Broken plates of it ride over the top deck, screeching in protest as we push through it. "Good morning, Admiral." Two lookouts share the bridge. Above their heads, the surface search radar antenna scans the horizon. Off duty crewman litter the diving planes, breathing the natural air.

"Captain?"

“Yes, Admiral.”

“Have Cookie set up a grill on deck.”

“We’re behind schedule as it is, Admiral.” His complaint registered and ignored. The captain appends his response: “I’ll see to it.” Then calls Chief Bronson on the ship-wide intercom: “Chief Bronson, this is the captain. The admiral wants a barbeque, could you see to the details?” Then he rings the control room: “Mr. Decker, stop the boat.” An announcement over the intercom follows: “Off duty personnel may use the top deck.” Chief Bronson points to Crewmen Wu and Ahmed, “You two, set up Cookie’s grill.” A special detail forms to clear the deck of ice, but it turns into a snowball fight.

Dr. Goeller leads a science team to collect ice core samples. “Think about it, William. Think what the ice core samples we are going to collect could reveal about Earth’s history.”

The ice upon which they trod is groaning because of the waves rolling under it. Dr. Jones and William pull a sled. The team’s snowshoe out-footed footsteps on bright snow go crunch…crunch…crunch.

***

Cookie’s grill is smoking amidships, and a football is being tossed around on the afterdeck. “Hanley, heads up,” and a forward pass is thrown but not caught. The ball slides off the quarterdeck into the ice rubble that surrounds my hull. A flock of short-tailed shearwaters soars overhead.

From two hundred feet away, a gasoline engine coughs its way to a steady whine. Dr. Goeller’s voice drifts back to us. “You have to understand, this floe we are standing on could have layers deposited thousands of years ago.” Hardened steel teeth cut into hardened ice. “We could find pieces of an Arctic lake formed during the melting of an ice age. I know, I know that is reaching, but still possible. More likely we will find particulates scrubbed by snow from the atmosphere five hundred years ago.”

A flock of seagulls follows the smoke to the grill where hamburgers and hot dogs are cooking.

Dr. Goeller is still talking. “At the surface, we are more likely to recover radioactive isotopes sent aloft during nuclear weapons testing or volcanic ash from the great eruption of Krakatoa in 1883,” Dr. Goeller continues, “and you know it’s also more probable that somewhere in the thirty-five-foot-core we are collecting, we will find dust fallen from space and other dust thrown aloft when the great Canyon Diablo meteorite struck the Arizona…”

“I smell hamburgers cooking,” and William abandons the science team on the ice, in favor of hamburgers and football. He skates on the ice back to me.

“Polar bears on ice!” Crewman Kressel, on lookout duty, calls from the bridge as he spies three dirty white bears sauntering in our direction from the north. With a steady, lumbering gait, a mother bear leads her twins in my direction, her massive shoulders swinging from side to side.

Crewman playing on deck, retreat into the sail, then lay up a level to the planes, as mother bear escorts her cubs onto my top deck.

Mom heads to the grill. Cookie and Stuart abandon their station, but take the take the hamburgers and hot dogs with them through the hatch. The cubs poke around the deck. They find the crew's football and bat it around.

Out on the ice, Dr. Goeller stops talking and also stops his gas driven auger.

Mother bear strolls around my sail, her giant front paws rolling outward with each step. She stops to handle the door to the sail, but doesn't figure out how to open it.

She brays to her offspring, walks to the middle of the quarterdeck, tucks her head under her body, shifts her weight forward, and executes a shoulder roll; landing on her back with arms and legs sprawled out on the deck. Her cubs jump on top of her. She falls asleep in the sun, watching the crew out on the diving planes watching her. Her cubs take turns chasing each other around.

Clouds roll in. Winds pick up and the temperature drops. It's bad enough to make mother bear wake before her nap's complete. She yawns, stretching arms wide. That's when she spies Admiral Martin on the bridge watching her, and then she spots the science team waiting on the ice, watching her. She rolls to her feet, stands on her hind legs, and lets out a bloodcurdling roar that puts the noisy ice to shame.

She collects her cubs and sets her course toward the science team. Admiral Martin calls below, "Mr. Decker, send a rifle to the bridge now." A gasoline engine starts. Mother bear changes direction, and the three dirty white bears fade into the distance. The winds howl. The ice groans. Developing microfractures tinkle and crinkle. The science team returns with their sled full of ice core samples. Their footsteps go cheep…cheep…cheep.

Barrow Sea Valley

A stiff forty-mile-an-hour wind from the west has set the floes singing in sympathetic vibration. It's a compelling geometrical progression in sound—each floe singing its fundamental frequency and a few overtones. And the ice songs bounce up and down, passing through me from every direction. I sing in excitement with the ice and the wind.

We submerged at the start of the day watch. There was depth enough for the captain to decide we could make better time submerged than picking our way through the ice leads topside. Well, I may be a submarine again, but I'm not sure this is better because I'm sandwiched between undulating pack ice and a shallow, stony seafloor, and with a speed of only five knots. At this rate, we will not reach Barrow Sea Valley and deeper water until the end of the watch. But I have a problem. The ice is forecasting violent winds, and the bottom is shoaling.

In the control room, sonar is reporting: "Captain, the bottom is coming up. Keel-to-bottom is twenty feet…fifteen feet…" By the book, the captain's response is: "Helm, reduce your speed to two knots. Sonar, where is the ceiling?"

"Clearance to the ice pack is holding at fifteen to twenty feet. I'm picking up biologics off our port bow. By the sound, I make it to be bearded seals crunching bottom crustaceans."

Just as Sonar is finishing his report, a disorganized front (of polar winds from the north) slams into a stiff forty-mile-an-hour wind from the west and confuses the ice. The narrow lead being used by the bearded seals closes fast, then the ice floe collides with its neighbor, and they chattered as they push past each other. The chatter turns into discordant screeching, and a sequence of thunderous booms interrupts that noise as the leading edge of the ice floe explodes under pressure...

"Ice keel developing at our bow and closing fast." Lookouts posted at the bow windows shout at the same time the collision-avoidance claxon starts screaming. Over the ship-wide intercom, the order goes out: "Rig for collision. Go to your emergency response station." And piercing ice sounds tear through me as the two flows crumple into each other.

It takes only two minutes for the bulge to form, and less time than that for repercussions to bounce through the ice three times, each time smacking the top of my sail. But that's not all. Having the advantage in height over its neighbor, the forward floe climbs over the leading edge of the floe that is beating me into the stony floor. Huge shavings of ice splinter off and tumble on top of the shattered remains of the ice floe I am under.

"I got it all with the sail and bow cameras!" Dr. Goeller shouts from the science station. "Look, the ridge is still developing! It's going to be an impenetrable wall of ice in front of us! This is going to make a great story in the *Arctic Ice Watch*." By this time, the sail camera is buried in ice.

Captain Deverough rings up engineering. "Put propulsion in full reverse, this is an emergency maneuver." But it is too late. The underside of the ice rams my bow and shoves my keel into the scratchy sea floor. On the rebound, my diving planes smack into the ice, provoking shudders

through my hull and beams. Collisions with the floor and the ice slow my forward motion; then stop me.

Captain Deverough repeats his order: “Mr. McGregor, put propulsion in full reverse. This is an emergency.” Something of a wail persists until the two ice sheets cease relative motion, and issue grumbles and moans as the fused ice floes adjust to each other. “You’ve got all we have, Captain. We are in reverse with turns for flank speed.” Through all of this, the ice sheets are howling from the combined effect of the ferocious winds and the explosive collision.

“Damage control, report.” The captain’s call goes out and we sit for the time it takes for the reports to arrive. Main engineering is the first to respond: “The reactors are fine, and propulsion all the way to the props is undamaged.” Environmental control is fine. Sonar reports damage to both the bow and keel sonar arrays. Chief Buckheister is running diagnostics and needs an hour for a complete assessment. Mr. Barksdale reports: “Minor damage to the camouflage system. I’ve taken it off line.”

What no one has reported is the ice sitting on top of me has me trapped between it and a gravel seafloor—held motionless…

“The situation is grim, but not grave,” Captain Deverough reports to the crew. “The admiral and I are working on a plan now… Mr. McGregor and Mr. Watson, report to the control room. Chief Buckheister, map the ice, give us options. Chief Barksdale, we need eyes in the sky.”

So Chief Buckheister puts soft pings into ice with the damaged bow sonar array, and Chief Barksdale calls the aft torpedo room: “Crewman Fazio, prepare a Bird’s Eye View (BEV) for launch through aft torpedo tube two. I’ll be right there. Chief Gatto, report to the control room.”

As Chief Buckheister’s pings return, they show my bow up against the ice keel, and the ice keel sitting on the floor. The ridge is over one hundred fifty feet tall, which meant *its sail* is fifty feet or so above the water line. As Dr. Goeller’s excitement communicated, an impenetrable ice wall stands between me and the Barrow Sea Valley, and it is nothing we can just steer around.

Admiral Martin enters the control room through the forward door with a blueprint and unrolls it over the plotting table. “Mr. McGregor, Mr. Watson, join me.”

As Mr. McGregor steps up to the table, he asks, “What’s your idea, Admiral?”

“We are going to melt our way out.”

Now, to Mr. Watson, the word *melt* implies heat, and heat implied his reactors running hot, so he promptly responds: “You’re not serious.”

“Mr. Watson, prepare to run your reactors at their maximum safe operating limit.”

“Admiral, we haven’t operated both reactors that hot at the same time since sea trials.”

“Have you got a better idea, Mr. Watson?”

“Than messing around with my reactors? Just about any idea would be better.”

“Well, when you come up with one, let me know and I’ll consider it. Until that time, get started on this one. Otherwise, we will be here a month waiting for the sun to set us free.”

Laying a hand sketched drawing on top of the blueprint, Chief Buckheister interrupts: “Captain, the mountain of ice above the research compartment is roughly fifty feet thick and angular blocks lay in piles on the top deck. Chunks from the explosion litter the ice. From the added weight, the ice is floating lower in the water than before the collision, and sitting on the top deck all the way back to the stern fins. The ridge curves around us. We’ll need to go back before we can go around.”

Pointing to the blueprint on the plotting table in front of him, specifically to the port reactor’s clean steam chamber, the admiral says, “We need to transfer heat from the power plant to the ice sitting on our bow.” His finger jumps from the clean steam chamber, aft to the port turbine, down to the port condenser, and over to the main ballast tank (MBT). After that, he slides his finger forward through the MBT to the forward most MBT vents. “From there, the hot water will have no place to go but up.”

“BEV’s away, Chief Barksdale,” Crewman Fazio reports to tactical from the aft torpedo room, while the surveillance system BEV floats up three inches (from the exterior door of torpedo tube two to the underside of the ice) with her energetics active and the mission to put eyes in the sky and send aerial images of the ice back to us.

Three hours later

I am still stuck under a mountain of ice when Mr. McGregor calls the control room from engineering on level four. “Admiral, it’s done.” That’s when Mr. Watson started backing the moderators out of the starboard reactor core, increasing the number of U-236 atoms breaking apart.

Six reactor specialists on each of the two reactor control panels watch reactor heat increase. Their job is to shout out if anything unusual happens.

At the same time, Mr. McGregor takes the emergency backup cooling systems offline and assigns two chiefs to watch each of the two thermal management systems, one dedicated to the condensers that transfer waste heat to the seawater pipes and out to the sea through the main ballast tanks. Every major system in the power plant is running at maximum inefficiency. It is not in the operating manual, and, as far as I know, it had never been done.

Finally, Dive closes all but the forward most MBT vents. Fully engaged, the seawater pumps on level four of the engineering compartment are screaming as they push hot seawater through the aft MBT to the forward MBT where it percolates up through the free space between my pressure and light hull, and out the top deck vents.

***

What are you guys doing? I ask. William is giggling because Dr. Jones is tickling him and it makes me remember a time when a huge pink jelly tickled me.

Dr. Jones and I are camping out.

That is the silliest thing I've ever heard. You are not out. You are in. To be specific, you are in the observation room. Furthermore, you are under a blanket that's thrown over a table.

It's a tent, and we are camping out, he insists.

How can you be camping out when you're in? You guys understand that I'm trapped beneath a mountain of ice? Dr. Jones is tickling you?

That's when Admiral Martin's resounding voice brings the giggling to a halt. "What are you guys doing?"

"Sh."

A monster picks up the edge of the tent.

We are in deep trouble now…

He repeats, "What are you guys doing?" he picks up the edge of the blanket and crawls under the table to join William and Dr. Jones holding each other, and looking at them like he's a hungry lion.

"We are camping out, Admiral." A small flashlight makes a campfire in the center of the tent.

"Dr. Jones, would you do me a favor?"

"Anything, Admiral Martin."

"Would you toast me a marshmallow?"

His steel-blue eyes challenge her. She grins sheepishly, "We don't have any marshmallows, Admiral."

"That is not a problem," as he hands her a bag marked *Kraft Jet-Puffed* that he had been holding behind his back.

His day-old beard growth tells her, our situation is graver than he's acting. "I don't have a fire, Admiral."

"That is not a problem either," as he pulls *canned heat* and a match from his pant pocket. Then Admiral Martin, Dr. Jones, and William sit around an open fire in a meadow under the stars, toasting marshmallows on top of Dr. Jones's favorite red blanket. "Admiral, tell us about the scariest sea monster you ever met."

"I can't right now, William. I have work to do. I just wanted to make sure you were okay… Don't stay up too much longer." He messes William's hair with his hand. Then the admiral crawls out from under the table, stands up, and greets the two crewmen standing watch at the bow windows that are buried in ice. "Let me know if it springs a leak." Then sets himself on a course aft, through the main passageway to engineering…

The ice mountain above is in constant complaint because of our undermining activities.

"Good news," Chief Barksdale reports to Captain Deverough. "BEV has melted through the ice… Its rocket motor is igniting." In just a few seconds, a small unmanned aircraft will start sending

images from the sky back to earth. He reports: “The communication system is active…we’re receiving telemetry…the sky is clear and blue…”

The first images that BEV sends back are of a clear blue sky. There are no clouds. One picture shows the sun low on the horizon. The second set of images BEV sends back feature the ice floe below her. An ice ridge runs through the images with no end in sight. Blocky ice chunks cast long shadows on the ice pack. The images show no evidence of a submarine beneath the ice, but they do show a herd of moose headed north.

BEV flies in increasingly wide circles, sending back photographs of bright white sea ice.

***

“Admiral, I want to speak with you regarding our current situation. I’ve been appointed the science team’s representative on this matter. We are concerned that this totally avoidable situation will adversely affect our scientific investigations. I have significant funds invested in this expedition, and I demand to know what you are going to do.”

“Dr. Hansen. This is a minor delay and common for an expedition under the ice. Isn’t Dr. Jones seeing to your needs and concerns?”

“We’ve talked to her, separately and together, but she’s not responsive. That is why the science team appointed me to talk to you.”

“Dr. Hansen, you must know by now that this corridor is for the officers. Those are the people that operate this submarine for us. The rules of the boat put this corridor off limits to you. If you have a problem, follow the rules of the boat. If you’ve lost your copy, I’m sure Dr. Jones will be more than happy to give you another. Now, get below.”

***

Mr. Bell is Dive at ship control. Captain Deverough stands behind him. Chief Pilot Anthony Deane is at the helm. Mr. Decker stands behind him.

On level two in the engineering compartment, Mr. Watson stands watch on the starboard reactor control station and Dr. Burgess has the port side, while Mr. McGregor and Chief Bronson are on level four at the port and starboard condensers, respectively.

Admiral Martin is in the observation room at mission control. Light from the room and the bow lights outside illuminates shattered ice cubes that range in size from a small refrigerator to a large pickup truck. Bow light scatters white and the edges glisten in places. Green-brown algae saturated seawater seeps into the cracks and crevices. Glued to the bow window, young William and Dr. Hansen are bonding over pinhead size krill and young polar cod a finger long.

The captain rings up engineering. “Reactors, are you ready?”

Mr. Watson asks Dr. Burgess, “Is the port reactor ready?”

“Yes, the port reactor is ready.”

“Captain, the reactors are ready.”

“Thermal management, are you ready?”

Mr. McGregor asks, “Chief Bronson, are you ready?”

“Yes, sir.”

And Mr. McGregor reports to the control room: “Thermal management is ready.”

“Dive, are you ready?”

“Yes, sir.”

“Admiral, the boat is ready for extraction.”

“Then extract the boat, Captain.”

“Mr. Watson, bring the reactors up to their maximum safe operating limit.” The response: “Reactors are at fifty percent. Increasing them to ninety percent. It will take half an hour.”

The heat is on.

“Dive, empty the trim tanks.” Out in the open ocean, emptying the trim tanks would take me to the surface. In this situation, it just pushes me up into the ice that’s holding me down. The ice creeks.

The pressure it on.

“Propulsion, put the boat in reverse and give us turns for two knots.” If I were in the open ocean, I’d be backing up at just under two knots through the water. In this situation, propeller wash tumbles in turbulent spirals along my hull, running forward.

My keel is buried in stony gravel. Multi-tentacled monsters wielding tiny teeth lined suckers feast on bivalves and bristle worms. Marauding crabs rip brittle stars apart. Slender Pacific sand lance shoal with Arctic cod and capelin. Not paying any attention to me.

“Captain, this is the admiral. Start pushing water out of the MBT.”

Pressure builds.

Water temperature increases.

Ice liquefies.

“Keep increasing the buoyant force, Dive.” Admiral Martin has devised this plan. For it to work, the boat must ascend at the same rate it cuts through the ice. Slower, and the ice pack will fall into the space. Faster, and he may damage the light hull and diving planes. But it works. The stony seafloor releases me and I slip out of the channel that I melted into the ice.

“Captain,” Navigator Ryan calls from the tactical station. “BEV has located a dark blue strip of open water.”

“How far?”

“Just over two miles north of here.”

BEV’s exhausted and takes a nosedive into the ice.

Arctic Ocean

It was a terrible event. Ice breaking. Caribou screaming. Blood in the water. Ripping of flesh and cracking of bone. Sharks in a frenzy and ice screeching. I regret my part in this.

I found William sleeping. His brain wasn't doing anything useful at the time. So I took him under an ice floe where a herd of caribou were crossing. I just wanted to show him the caribou crossing. I had no idea what would happen at the time.

Five minutes later he was paralyzed, trying to scream himself awake. *Someone, help me! Wake me up!* So he knew he was dreaming, but he was still scared and trying to climb over the freezing ice chards back onto the ice floe. But paralyzed. In his mind he was flailing wildly at the ice chards, but in his bunk he just twitched and mumbled wnm mun really facing the end of his life. I didn't mean to scare him like that.

I couldn't get Dr. Jones' attention. She was working with Admiral Martin at mission control, rehearsing the events planned for the next twenty-four hours, something they do every day.

Finally, William's body started dumping adrenalin into his systems, and he sat bolt upright, hitting his head on the bunk above him.

Was I with you in the water with the caribous dying or were you with me in a nightmare?

You were with me in the water with the caribou and the ice chards and the screaming and the sharks and the blood, but I was also with you in your dream. I'm sorry. I didn't mean to scare you like that.

I can still taste the blood in the water.

Herd of caribou

We were cruising at five hundred feet depth-to-keel under a herd of caribou, eight hundred strong, making their way west over sea ice to spring pastures. They were walking in meandering lines with random distances between them. Out ahead, the lead beast and two lieutenants were testing the ice. Pack ice deadened the sounds of their footsteps.

What the lead caribou did not know was an hour before he chose this floe to cross and ten miles away, a fast ice shelf nearly two hundred feet thick and undermined by the Arctic countercurrents gave way. A miles-long iceberg calved from the glacier and plunged into the sea, shoving a volume of it outward. And for the last hour, a six-foot-high bulge of water has been racing to this location, deforming the sea ice, pushing it up and letting it fall as it goes.

When the bulge reached the caribou's ice floe, the ice rode over it. If the floe had been smaller, or larger and softer, it may have not have cracked. But as it happened, the height of the bulge when it reached the center of the ice floe caused great crevasses to develop that split the floe three pieces from the center outward. Cold air rushed down from above and seawater up from below, and with potential energy left over from the floe's deformation, the ice upon which the caribou trod shattered at their feet, and gave way to their weight.

Overwhelmed by ice chunks and shards, the animals screamed as they hit the frigid seawater, their hoofs flailing and stomping the animals below. And then a pack of Arctic sharks appeared from nowhere and the frenzied feeding mixed with blood and screams and caribou.

***

Rubbing the top of his head and looking for blood, he asks me, Expedition*, how can you taste blood in the water when you don't have a tongue or a mouth?*

How do you taste, William?

With my mouth and tongue, silly. I just said so. Ow. My head hurts.

Like ice cream?

Yes, especially chocolate.

Dr. Jones likes chocolate too. It must be the best. I think I'd like to taste chocolate. Is that all?

Some foods are sour—I can taste sour in the back of my mouth, my cheeks tingle, oozing saliva.

What do mashed potatoes taste like? How about crab and corn on the cob?

I don't know how to tell you. I just know.

How do your mouth and tongue know taste?

Taste buds, my mother says.

Maybe I have taste buds on my hull.

Taste buds on your hull? Who put them there? What else can you taste?

Right now, I can taste caribou blood in Atlantic seawater.

Does Atlantic seawater taste different from Pacific seawater?

To me, yes.

What else can you taste?

I can taste magnetic fields and thunderstorms. I can taste tar seeps and balls of goo. I can taste diesel fuel and gasoline. When we are near volcanoes, I can taste minerals like sulfur, iron, and magnesium.

I know sulfur—it smells like rotten eggs. Like low tide on a really hot day. Wait a minute. You don't have a nose.

Yes, I do. Some of the crew call my bow a nose.

Expedition*, stop being silly. I'm serious.*

That's funny, I thought you were William.

William?

Yes?

How do you know these things?

I don't know how to tell you. I just know.

I can taste the aurora borealis.

That doesn't make any sense at all.

Why not?

They're up in the sky and made of light. How can you taste light up there from the water down here?

Do you know what causes the aurora?

Yes, charged particles from the solar wind get caught up in the Earth's magnetic field and radiate lights of many colors that dance around up there.

Do you think it possible that charged particles dancing up there could alter the magnetic field down here?

When you put it like that, maybe yes, a little.

Well, when the aurora dance, I feel the change in the magnetic field and hence the aurora, albeit my image of it, differs from yours. But I have watched the aurora with Admiral Martin on many occasions. So I know what you see from what he sees. And I know when I feel a certain way, aurora are dancing in the sky.

Maybe that's how I learned what mashed potatoes taste like. As I was eating them, my mom told me so.

Makes sense to me. I didn't mean to scare you so.

That's okay. It was fun.

Beaufort Sea

Yesterday morning we followed the Barrow Sea Valley into the Beaufort Sea, turned southeast to follow the rise of the Canadian shelf off North Slope, Alaska. Our destination was one hundred forty degrees west longitude, seventy-one degrees north latitude, and four thousand feet depth to keel. It seemed to me like no place in particular. But it was there that the captain changed our course again, this time he put us on a heading due north. A course set by the admiral over a year ago. A course that follows a great circle through the North Pole but goes another two hundred twenty miles to the Nansen Ridge, where evidence of volcanic activity was reported by a Russian surface expedition two years ago.

It was a very exciting discovery (for the admiral). Until that time, the Nansen Ridge was thought to be an old, worn-down mountain range that had lost all of its energy. It held no secrets. Provided nothing interesting to study; nothing like transverse faults or volcanoes with lava field were thought to exist there. But the Russian report changed all that. The day the admiral read that report was the day he began planning this expedition. It didn't take him long to put together a team. He had most fields covered by MME scientists, but needed a volcanologist (Dr. MacCarthy), an oceanographer specializing in plate tectonics (Dr. Santiestiban), and a leading expert in extremophiles (Dr. Hansen).

Canada Basin

But getting to the Nansen Ridge from the place we turned north won't be easy. And it is not because of the ice canopy or the denizens of the deep we might encounter. Nor is it because we can't shoot the sun and need to rely on the inertial navigation system and dead reckoning to get there. It is because of the currents. Little is known of the currents at the top of the world, but they are thought to have wildly changing patterns with depth. And I'll be running up here at four thousand feet submerged and above the mountain ranges, while the deep water subfloor profiler RAMONA will be a mile behind me and following the bottom, and the current down there will be headed one way and the current up here another.

But that is not all. Just imagine the stress of pulling a sonar array the size of a whale at the end of three mile long powered tow wire. Who knows what the deep tow wire will go through?

Conditions won't be easy for my crew either. The trip to the Nansen ridge will take one hundred fifty hours. And every hour of the trip will demand maximum concentration from them. Every crewman standing a watch will have a backup standing behind. Every action executed will be thought about by two and agreed on.

***

Admiral Martin, Dr. Cohen, and Dr. Jones have spent the better part of today in the research bay checking out the subfloor profiler's systems. Can the main vehicle receive power from the research bay power station? Can it receive commands from its base station in Mission Bay three? Can it carry out those commands? Can it transmit and receive acoustic waves and pass them up the deep tow wire? Will it open and close on command?

William has been practicing how to operate RAMONA on a simulator in mission bay three. There are better things for him to be doing. I don't understand the fuss. It looks a lot like a puffer fish…

Captain Deverough and Chief Bronson spent several hours inspecting the deep tow wire and the connection points to the boat's hull. During operations, two crewmen will monitor the balance between the boat and the tow wire constantly. Mission control (in the observation room) will be in direct contact with Dive (in the control room) and Propulsion (level four in engineering).

Crewmen Wu and Ahmed spent the day practicing flooding the launch bay and emptying it. They performed a full systems check on the deep tow wire. Dr. Cohen asked Crewman Wu, "What is this big red button for?" Her response was, "It releases the deep tow wire."

"Have you ever had to release the tow wire?"

"Once. But we were pulling an experimental vehicle. It got out of hand. Don't worry, Dr. Cohen, RAMONA did well in her sea trials." Then stopped to think. "But you never know. We don't know much about the Arctic currents. That could put us in a sticky situation."

The admiral's hand on Crewman Wu's shoulder got her attention. "Crewman, don't you have work to do?"

“Yes, Admiral. Sorry.”

Finally, the admiral announced, “Well, that’s it. All of RAMONA’s systems check out.” This meant that the profiler could enter the sea. So crewman Wu and Ahmed rolled it into the main launch bay and closed the launch bay door. “Ready, Admiral.” So the admiral called the control room. “Captain, are you ready up there?” And the captain scanned the control room. “Dive? Pilot? Sonar? Tactical? Engineering? Science? Yes, Admiral, the boat is ready to tow.”

“Crewman Wu, flood the launch bay.” So she flooded the bay, released the profiler from its shackles, and played out one hundred feet of the deep tow wire. It did not enter the water well. At fifty feet, it started pitching and rolling. “I can’t control her.” Dr. Cohen shouted, and the admiral called the control room to slow the boat.

At five knots the profiler settled down, and the admiral resumed playing out the line until the profiler was two hundred feet beneath my keel and trailing two hundred feet behind, where he brought my speed back to ten knots over the floor. The profiler behaved well after that, and Dr. Cohen sailed it to the bottom.

Meanwhile, on the line from mission control, Dr. Jones reported the health of the deep tow wire, “Temperature profiles are coming through…Salinity, density, pressure, and pH levels are coming through. We’re receiving position-dependent current vectors and actual measurements of the speed of sound. Dr. Cohen, all of RAMONA’s secondary systems are online and sending data streams up the deep tow wire.”

Now, I’ve towed many deep-water profilers in my time. I don’t understand what is so special about this one.

From her workstation in mission bay three, Dr. Cohen announces over the ship wide intercom, “I’m going to open her up now.” She presses a button, and the profiler on the far end of the deep tow wire unfurls. It extends two wings...

“Admiral, is it true?” William had come down from mission bay three.

“Is what true?”

“Can *Expedition* really see the aurora borealis?”

RAMONA has three arrays, and the center array takes the lead while the port and starboard arrays fly out...

Dr. Cohen says, “I’m going to put her one thousand feet from the bottom.” RAMONA sails down like an eagle.

“William, what gave you the impression that *Expedition* can see the aurora borealis?”

Dr. Jones says, “William, don’t disturb Admiral Martin. He’s busy starting an important experiment. You and I can talk about *Expedition* at lunch.”

RAMONA pings for the first time. The ping is short. All the arrays capture the first echo and send it up the deep tow wire. I feel the echo of the ping as remnants of it pass me on its way to the ice.

Oh, I see now. This is not just any old subfloor profiler we can pull round; RAMONA is three arrays, each with its own control surface, each playing a part in the ping and each listening for the echoes.

“I have a better idea, Dr. Jones,” says the admiral, “Why don’t the three of us have lunch in my cabin?”

RAMONA pings again. This ping penetrates layers of sedimentary deposits and hundreds of thousands of years. Each array plays a part in sending the pings into the seabed. Each array listens for the response and promptly sends it up the deep tow wire.

Ping. With five hundred feet between them, and five hundred feet to the bottom, RAMONA is mapping a strip of seafloor one thousand feet wide.

PING. Shifting down an octave, it launches a ping that projects ten seconds and then rests.

The first echo to return does so straightforwardly, just a little blurred by its reflection from the floor and maybe by movement through the water. The second echo to return is softer than the first and smeared in time and frequency—it reveals rocks and boulders embedded in foraminiferal ooze. The third echo to return is even softer, and spread more in time and frequency. It reveals rocks and boulders embedded in a layer much like the one above it but harder and denser.

PING. RAMONA sings a melody composed of notes and phrases that take time to play with rests that are longer too by the same amount. And echoes return as they did before, but each one telling of something new. The aftermath of a meteor strike may be hidden in that echo. And her next ping sends up echoes of fractured oceanic crust.

PING. Listen to Ramona sing! She is beautiful! I’m in love!

***

Hey, William, wait up. Are you going to lunch with Admiral Martin now?

Yes, he’s invited me and Dr. Jones. I’m very excited…

William, I need for you to do something for me while you are there.

What’s that?

I met a beautiful lady today. Her name is Ramona.

RAMONA? Yes, I know RAMONA. It’s a subfloor profiler.

I want to know if she belongs to Admiral Martin and if he intends to keep her.

Okay, I’ll ask. *But I think it belongs to Dr. Cohen.*

Ramona is not an ‘it’, she is a beautiful lady.

***

The sign on the door reads: Martin. She knocks. He responds, “Come in.”

“Good afternoon, Admiral. We have to stop meeting this way.” *What a stupid thing to say*.

He motions to the small booth with a table tucked behind the door. Three tuna salad sandwiches, a glass of milk, and two glasses of water are waiting. “Sit down.” He pauses. “Dr. Jones, I appreciate your relationship with William, but I’m not happy that you are filling his head with your fantastic notions regarding *Expedition*. What am I going to tell his mother when I return him to her? ‘Mrs. Sharp, you gave me a brilliant engineer, and I’m returning to you a child with an imaginary friend that happens to be my submarine?’”

“But, Admiral Martin,” she starts to argue, but William interrupts. “Admiral Martin?”

“Yes, William.”

“I was wondering about RAMONA.”

“What about her?”

“Does she belong to you?”

“No, she belongs to Dr. Cohen. This is RAMONA’s maiden voyage. If she proves out, I’ll consider buying her.”

William, ask Admiral Martin if we can keep her.

“But *Expedition* wants to keep RAMONA. Oh, and Admiral, I’ve been meaning to ask. Did you put taste buds on *Expedition*’s hull?”

A lengthy period of quiet time passes as we cruise west by north at a speed of twelve knots through the water and ten knots over the seafloor.

Dr. Jones bites her lower lip.

Captain Deverough has the conn. Mr. Decker is in his bunk, sleeping.

Admiral Martin says, “So, Dr. Jones, do you want to fill me in? Just what are your thoughts regarding *Expedition*?”

Continents Drifting

Cookie made turkey with mashed potatoes and gravy for dinner. Everyone in the operation compartment could smell it. And when the memory drifted down the main passageway into the observation room, Dr. Jones sniffed the air and said to Dr. Santiestiban. “I’m going for turkey dinner, want to join me?” So they went.

Sitting down at a table. Making small talk, she says. “I read your paper on the breakup of Pangaea. It really cranks up the continental drift theory...How are people reacting to it?”

According to his theory, hundreds of millions of years ago, all the dry land on earth was crumpled in one huge conglomerated supercontinent. Then, about two hundred fifty million years ago, it started to break apart.

“I think the split is about fifty-fifty.”

“Fifty-fifty for what?”

“About fifty percent of the people have told me that I’ve taken leave of my senses and the other fifty percent think I’m crazy.” As he sketches a circular pattern with his finger on the right side if his head…

Dr. Jones giggles. “You must be exaggerating. I think Admiral Martin believes in plate tectonics. Why else would he have invited you on this expedition?”

“What about you, Dr. Jones? What are your thoughts on plate tectonics?”

Not answering the question, Dr. Jones responds. “I think…the possibilities are fascinating. Imagine, watching raw magma vaporize seawater.” She waves her hand through the air, maybe pointing at the control room above her, or the reactors aft. I can't really tell. “It’s an exciting time to be a scientist. And on a submarine going to watch two continents drift apart…”

After having picked up a tray and plate, Dr. MacCarthy says to Cookie, “I’ll take a slice of pizza.” Then he sits in an empty spot on the bench next to Dr. Jones. “Santiestiban, are you pushing your plate theory on Dr. Jones?”

“No, I’m not pushing. We are discussing the possibilities.”

MacCarthy turns his attention to Dr. Jones. “Did you read his paper?”

“Yes. Several times. From the tone of your voice, I take it you are not a fan of plate tectonics. How about continental drift?”

While looking down at his pizza, he rolls his head to the left, then from the left to the right, and the right to left, all the while the corners of his mouth are upturned. “It is preposterous to think…” He stops. “Preposterous to think that mountains are being folded into existence as we speak. Preposterous.”

Santiestiban mimics: “Preposterous.” Pauses. Then spits out: “Preposterous for your mind. I would agree. Tell me, MacCarthy, just how do you think the mountain ranges came to be in the first place?”

“Not that you care, Santiestiban, but most earth scientists.” He pauses, and then starts again, “Most earth scientists accept the idea that the Earth’s surface changes slowly and gradually most of the time, but occasionally, a natural catastrophic event will end one geologic era and start a new one. Like the Cretaceous Period, when the dinosaurs became extinct, sixty-five million…sixty-five million years ago.” And without giving a chance to anyone else to speak, he asserts, “And we happen to be in a quiet geologic period. So only slow, steady forces are acting now. Processes like water and wind erosion, sedimentation, small meteors falling from space, and some left over volcanoes still spewing forth lava at hot spots around the globe.”

“Isn’t it widely accepted that the event that caused the dinosaurs to become extinct was a meteor strike?” (Which has nothing to do with continental drift, but everything to do with ending the Cretaceous Period)

Meanwhile, Admiral Martin meets Dr. Goeller in the passageway. Dr. Goeller was coming down the ladder from the control room with the thought of mashed potatoes and gravy in his mind.

The admiral was heading aft to his lab. “I wouldn’t go in there. They are arguing about continental drift again.”

“Oh, good. Maybe I can help them sort things out.”

Back in the galley, MacCarthy picks his pizza slice up by the crust, lets it hang vertically over the plate, and watches the oil drip off the point. “Don’t you see the problem with the continental drift story?” and bites off the point. A string of hot cheese bridges the gap between the slice and his mouth. He chews and swallows, sucking in air through his teeth. “What is it you think? You think the Atlantic Ocean is getting wider each year, by what? A foot?” Takes another bite from the slice.

“More like four inches.”

“And you don’t see the problem?” Looking down again at his pizza, he rolls his head left to right, right to left, while smirking. “What mythical force could cause the continents to move through the ocean’s crust?

Santiestiban responds: “The continents are not moving through the ocean crust. Both continental and ocean crusts are floating on top of the layer of magma.”

“By a huge convection current of magma?”

“Yes.”

“That is your problem!” MacCarthy responds emphatically, pointing an index finger at Santiestiban. “You think the massive crust, as much as three miles thick in places, can be moved by your mythical force?”

“Hypothetical. Not mythical.”

“Even if it were true, the magma’s viscosity would slow the continents down and stop them.”

Placing a plate of white turkey meat, mashed potatoes and gravy on the table, Dr. Goeller takes an empty place. “You do know that the orientation of magnetite in rock formations provides additional evidence that the continents have been moving around with respect to each other.” He cocks his head. “You do understand, don’t you, that as lava cools and magnetite crystals form, their magnetic field lines align with the Earth’s field at that location, don’t you?”

“Actually,” Dr. Jones says, “that evidence would only be conclusive if there were only one north pole. There could have been more. I’ve played with enough magnets and iron filings in my life to know there are field line patterns more complicated than dipole. Just using two bar magnets, you can make two north and one south, two souths and one north, or two norths and two souths. Let alone decimating the field lines all together by placing the north of one on the south of another…I can’t even imagine the complex field patterns that could be generated by a boiling spherical dynamo…”

Dr. Hansen, now standing at the head of the table, weighs in. “There is also fossil evidence supporting the theory of continental drift. Matching plant and animal fossils have been found

on the coastlines of South America and Africa. I find it compelling. There is more than enough evidence to conclude that continental drift, and even plate tectonics are viable theories."

MacCarthy: "The most dynamic events we have witnessed in recorded time are earthquakes, tsunamis, and volcanic eruptions...earthquakes, tsunamis, and volcanic eruptions. The time for mountain building is over. Other evidence exists that suggests the solar system is losing energy. Take the moon."

"The moon?"

"Yes, the moon." He asks Dr. Goeller, "It's covered with craters, isn't it?"

"Yes. Of course."

He asks Dr. Jones, "Any new ones?"

"Not that I know of."

"How about you, Hansen? Do you know of any new craters on the moon?"

"No."

"How about in human history? Are there any legends or stories of new impact craters on the moon during the last six thousand years?"

"Make your point."

"And in all that time, does even one single legend…one single legend come up of a new crater on the moon? All the time humans have spent looking at the moon…No new craters…And people have been watching the moon for six thousand years. Why is that? Because the time for catastrophic events has passed."

Santiestiban asks, "Did you ever hear of the Tunguska Event?"

"Do you mean the alleged…the alleged Siberian meteor strike?"

"Yes. A huge meteor struck the earth in 1908. It was a global event that was felt in Washington D.C."

"And where is the meteor crater? I'll tell you. There isn't one. It was a hoax. The last true large meteor strike was sixty-six million years ago. You know, the global event that caused the extinction of the dinosaurs."

"Well, I can see we aren't making any progress. I have some work to do." Santiestiban excuses himself. As he walks out of the mess, Dr. MacCarthy shouts. "Don't go away mad, Santiestiban. Just go away." Then turns to Dr. Jones. "You don't believe that, do you?"

Continental Drift

William knocks on the door to Admiral Martin's lab and waits for an answer. "Come in." He pushes the door open. "Hi." And asks, "Can I look at the fish?" while looking into the eyes of a stonefish sitting under a piece of coral looking back at him. The admiral always says, "Yes." So William didn't bother to wait.

Admiral Martin drops a blue dye on a microscope slide and sets it aside to dry.

William pulls up a lab stool and sits next to him. There is a large microscope on the lab table. The admiral would need to stand up to look into it. William would have to kneel on a stool. "What are you doing?" The admiral is writing in his lab notebook.

"I'm cataloging plankton." Images of tiny microscopic organisms decorate the pages. Spirals, stars, segmented chains…spheres, ellipsoids, and platters. Some are plants. Some are animals. Some defy classification.

"Can I see? Is it different than plankton in the other oceans?"

"Is it different from."

"Different from what?"

William, you said, 'is it different than plankton?' when you should have said, 'is it different from plankton?'

"Is it different from plankton in the other oceans?"

"William, we are discovering so many kinds of plankton each year that it is hard to tell right now."

"Maybe one day computers will be able to do that for you."

"Yes, maybe they will."

"How come Dr. Santiestiban and Dr. MacCarthy are always arguing?" And the admiral asks what they are arguing about. William tells him: continental drift. "Oh." The admiral smiles as he puts his hand on William's shoulder, telling him they are both established scientists with opposing theories and neither wants to be wrong.

"Do you believe in continental drift, Admiral?"

"Yes, I do."

Apparently, Dr. MacCarthy asked Dr. Santiestiban what data he had, but Dr. Santiestiban replied he had evidence. "What is the difference between data and evidence?" So the admiral explains that *data* is raw information with no judgment attached and that *evidence* is a body of facts showing whether a hypothesis is true or untrue, and then asks, "What am I doing now?"

"Talking to me."

"Before you interrupted."

"You are drawing pictures of little plants and animals in your lab book. Oh, I understand. You are collecting data."

"And when combined with hundreds or thousands of drawings from tiny plants and animal in other oceans, we might have enough evidence to answer your question, 'Is it different from plankton in the other oceans?'"

"Why is it so difficult?"

“Why is what so difficult?”

“Why is it so difficult to know whether the continents are drifting apart?”

“That is simple. We have not yet collected enough data to convince other people.”

“Well, if those people are anything like Dr. MacCarthy, they may never be convinced…Can I have a map?”

“Yes, of course. What kind of map would you like?” And the admiral takes a map of the world from the drawer of a cabinet spanning the entire aft bulkhead end of the lab. He’s very proud of it. It is the only original map of its kind that he knows of. So he lays it on an empty lab table for William to see. “A Dutch map maker, named Abraham Ortelius drew this map of the world as he measured it.” and as they study the coastlines of Europe and North America and compare West Africa to the east coast of South America he adds, “In fifteen ninety-six, Ortelius suggested the Americas were torn away from Europe and Africa by some cataclysmic force.”

“Can I work on this table?” and William pulls up a stool to sit on. “Can I have a scissors?”

“Yes, of course.”

“Thank you.”

“What are you going to do with them?”

“I’m going to cut the continents out of this map and see how well they fit together.”

“Wait. Stop. Don’t cut that map,” and pages through a drawer of navigational maps mumbling, “that’s an original drawing and worth a fortune,” and hands William another: “Use this one, it shows the continental shelves.”

“Okay.”

What Do Enormous Ones Eat?

I’m going to call them Enormous Ones, for no one else has put a name on them so far. No one has ever seen Enormous Ones. No records of them exist either. Five minutes ago, the first one started following Ramona. Now six are down with her, and many are keeping stations along the deep tow wire. They don’t act or sound friendly.

Sonarman Matthews reports: “Biologics approaching from below, and they are enormous!” His voice grows louder as he speaks.

“Calm yourself, Chief. They are just fish.”

“Not like any fish that I have heard, Captain…I hear a steady, pulsating hydrodynamic flow sound usually associated with jet locomotion. From their call and two-stroke hydrodynamic flow sound, they may be related to giant squid. I can count at least ten, and more are on the way.” While he’s speaking, the collision-avoidance claxon starts screaming, and Chief Barksdale broadcasts over the ship-wide intercom: “Rig for collision. Go to your emergency-response stations.”

Before the crew has made it to their emergency-response stations, twelve Enormous Ones have surrounded me amidships. They meet my pace with backward-looking eyes and trailing tentacles. Forward mounted frilled swim fins steer their course. They pulse with coordinated muscle movements. Expanding mantle cavities draw in water. Contracting mantle muscles shoot it out. The sea around me surges with jet propelled wakes.

Below and aft of me, another twenty take up port and starboard watches along the deep tow wire. Creatures living on the seafloor take flight, fleeing away from Ramona. She must be terrified.

Up here, the lead Enormous One moves closer and forward to my port side bow wake. He trails eight suckered arms, and two limbs half again my length with sharp hooks at the end. His lieutenant assumes a support position on my starboard side. The ride is rough, similar to being topside in a gale. It's fun for me, but I'm sure Ramona is terrified, all alone; a bump from one of them could set her careening.

Then, the lead Enormous One comes closer still, and with his large left eye looking back, he peers through the observation room window and finds Admiral Martin looking at him.

A call comes into mission control for the admiral. "What's going on down there?" Dr. Jones replies. "Captain, we've attracted a school of enormous squid. The admiral is with them now, I'm not sure I should interrupt him."

"Dr. Jones, put the admiral on the phone."

The admiral takes the phone. "Captain, you need to see this to believe it. It's a perfect example of abyssal gigantism. But they don't seem hostile. They're probably as curious about us as we are about them. Make sure science has all sensors recording." All this time he's looking into the lead Enormous One's large dark eye, and its large dark eye is looking back.

Dr. Jones answers a call from the research bay. "What can I do for you, Dr. Cohen?"

"What is going on up there? I'm having trouble keeping RAMONA on her course."

"You're not going to believe it. There is a school of enormous squid surrounding us. Do you want me to send William down to help?"

"No, Crewman Fazio is with me. I was hoping to speak with Admiral Martin."

Dr. Jones hands the admiral a phone.

"Yes, Dr. Cohen, what can I do for you?"

"RAMONA is in ferociously turbulent water. I'm afraid I might lose control."

"Do you want to reel her in?"

"No."

"What do you want me to do? Slow the boat? I'll do it at your request. But that is not our agreement. We agreed to map a strip of the Arctic sea floor from the western most rise of the Canada basin to the North Pole. *Expedition* is to keep a speed of ten knots over the floor and

tow RAMONA from four thousand feet. That's what she's doing. RAMONA is to map the seabed from five hundred feet above the floor."

"But surging currents are degrading her images."

"Your real-time images may look scrambled, but I'm collecting data about the water column through the deep tow wire. A couple of passes through Dr. Burgess' algorithms will sharpen them. Just keep her transmitting and receiving and as steady as you can. Do you need help?"

"No, Crewman Fazio is with me."

And the Enormous Ones stay with me and Ramona for hours, neither approaching nor retreating.

And Admiral Martin and the lead Enormous One stay fixed on each other the entire time.

We can keep up with you forever.

We intend no harm. We are curious and exploring your ocean.

We want you to leave our home and not return.

We are just passing through.

And we will make sure of that.

I met a great and gentle beast a while back. She had circular scars on her head and body. She told me of a deep dive she made one day from curiosity when she was young. According to her story, she met a squid of these proportions. I thought she was hysterical, but I admired the size of her scars and wished that one day I could meet such a squid.

Alpha Ridge

In its prime, the Alpha Ridge occupied the sky and cut the proto-Arctic ocean in two, but now, worn and covered by the sea, I am travelling over it with my depth-to-keel at four thousand feet, and Ramona's another three thousand feet below.

All but the lead squid and his lieutenant have gone. Their squad peeled away while Ramona was climbing the southern rise of the Alpha Ridge. Now, they have their suckered arms wrapped around me, caressing my light hull, and slicing my skin. *We are going now.* They say as they swim forward, the tips of their long trailing tentacles tickling my hull, all the while, black spots develop on their pulsating bodies. *Do not return to our deep-sea basin*, they say as they leave me behind in a cloud of dark ink.

***

William writes in the expedition's logbook: MME Enormous One Arctic Deep-Sea Squid, with a number that is the date; he describes what he witnessed through my dielectric-transparent titanium-aluminum windows.

I was frightened. Did you see the Enormous Ones swimming with Ramona? I thought they were going to attack her.

Attack her? I thought they were going to attack us*. I was in the observation room with Admiral Martin the entire time. Did you feel them wrap their arms around you? Did you see how scared Dr. Jones was?*

Well, I was worried Ramona would get hurt. There were six swimming with her, you know.

Do you know what Admiral Martin and the Enormous One said to each other?

Just a little bump could have sent the sisters wheeling. Then the captain would have had to release her, sending her spinning out of control, to land and die on the bottom of Canada Basin. William. I am in love with Ramona.

You can't be in love with RAMONA. She's a machine.

I can't be in love with a machine? I thought I could. I'm a machine, aren't I?

Machines can love?

I think so. I love Ramona and Admiral Martin.

You love RAMONA and Admiral Martin? How do you love them?

I enjoy being with them and talking with them.

That is wonderful, Expedition*. Admiral Martin is speaking with you now?*

Yes…sort of…well, no, not really, but we think about things together.

So you and RAMONA speak with one another?

Yes…sort of…well, no, not really. Mostly I listen to her sing. I thought I could love her…I can't love her? I can't love Admiral Martin?

Expedition…

Expedition*, what's wrong?*

Talk to me. I'm sorry. I didn't mean to hurt your feelings. I had just never considered machines could love.

Go away, William. I cannot talk right now. I need to be alone.

Come on, Expedition*. I'm sorry. My mom says that love is a troublesome thing. She says that we cannot choose who we love and who we don't. Please, don't be sad. I have a joke for you. What do Enormous Ones eat? Come on,* Expedition*. What do Enormous Ones eat? I am sorry. I want to take the words back.*

Bellaventura

Hail pounding furiously on the roof woke Mikhail Lomonosov early on a cold March morning in 1895. He lay there nearly a full minute before he remembered that his wife, Elizabeth, was dead. Today marked the end of the life he had lived with her and the beginning of a life he had kept as a dream all that time.

The village that he lived in with Elizabeth was the village of his father and his youth. It was his home and a thriving seaport. Over three generations, the Lomonosov family amassed a fortune centered on the seas and oceans around the village. Mikhail's father turned his own father's fleet of fishing vessels into a trading company that Mikhail himself then doubled in size with the volume of goods transported from Arkhangelsk to Pustozyorsk, Solovki, Kola, and Lapland.

When Mikhail was ten, his father took him on a great expedition to the Orient. They sailed from the Sobornoy docks in Arkhangelsk and headed north into the Kara Sea. Mikhail loved the sea. He loved the ship, and the Arctic, and the ice. Mikhail watched the stars and the planets cross the sky and even found evidence that the planet Venus had an atmosphere from watching her moons cross her face. He was an exceptional navigator.

On that epic journey, they took the *Bellaventura* around Severnaya Zemlya to the Laptev Sea and crossed it and the Chukchi Sea to the Bering Strait, where they entered the vast Pacific Ocean. Ten-year-old Mikhail drew pictures of the coastline. (Admiral Martin has an original sketch on a cabin wall.) The *Bellaventura* spent three months in Yokohama, where they traded the contents of their vessel for many interesting things they brought back to Russia. Mikhail liked to trade.

But that morning, he took nothing of that life with him. He walked to the dock and boarded *Bellaventura.* He was captain of the same ship he had sailed so many years ago with his father to Yokohama and back.

He set sail on the same course his father had used for his Orient expedition, departing from the Sobornoy docks. Mikhail's father stood at the end of the dock, waving goodbye as *Bellaventura*

left port, and Elizabeth joined him—or at least, that's what he wanted to see, and his wanting made it so.

Throughout his life, Mikhail had bought every map of every port and every area he could find. It mattered not to him that Eskimos, Alaskans, Russians, Inuit, Norse, Laplanders, or Canadians had drawn them. He found that rarely two maps of the same area looked much alike. He pondered the difference, wondering: "Are these two maps of the same island or different islands? Are these maps of the same cove or of different coves?"

This expedition, although it had to pay for itself with trade, was dedicated to Mikhail's dream of circumnavigating the Arctic Ocean, mapping its depths on and along the continental shelves, to resolve the differences in the maps he'd collected.

To that end, he brought along two other mapmakers at great expense, as they were the best. They pinned his maps to the walls of his cabin, putting Canada on the port side, the Bering Strait forward, Russia on the starboard, and Norway aft. In the center of his cabin, he had installed a great table upon which they drew a great map. The three men worked to exhaustion every day, and the daylight hours were long; for three months of the year, the sun didn't set.

By the end of this expedition, his map would tie together the disparate pieces of other expeditions. It would show the coastline of every harbor and bay, every river outlet and cove, every island and every town, and all along the way, he would draw compass points to the pole star and to magnetic north, as they can be very different up here. At least, that was his plan.

But for now, the White Sea was in front of him and the Barents Sea lay beyond that. According to the course laid in, he would enter the Arctic Ocean at forty degrees east longitude, and from there, travel counterclockwise, marking the lines of longitude increasing.

It was every bit as wonderful as he had imagined. He was the captain of his own ship and let the sea be his guide. They spent the worst of the winter of 1895/1896 held up in a safe harbor on the East Siberian Islands. Then laid over for several days on Wrangel Island, which has the distinction of being on the line of longitude one hundred eighty degrees west and one hundred eighty degrees east.

They followed the Chukchi Peninsula through the Chukchi Sea, counting the western lines of longitude down to one hundred seventy degrees west, and crossed the Bering Strait.

While in the Beaufort Sea, they passed through the line of longitude one hundred forty degrees west, and from that point they considered themselves headed home, for they had traveled across one hundred eighty degrees of longitude. But the most confusing part of their journey still lay in front of them.

As you most likely know, over most of the world, the compass heading points north—but not here. The magnetic north pole at that time was in the heart of Canada, in the Barren Grounds west of Hudson Bay, and the compass needle pointed south and east, but they held the North Star on their forward port quarter.

They spent a fortnight investigating the tangled web of small islands, reefs, and shoals around Prince Patrick Island. They lined up magnetic field lines on the local maps with the master they

were drawing on the table. Sometimes they found an island, or a coastline did indeed exist, but they found it in another place, and they corrected the local maps while changing their place on the wall.

What they didn't know at the time was that the magnetic pole was wandering north and that a map drawn of an island in the Canadian Archipelago in the eighteen hundreds had a different compass heading ninety years later than when it was drawn.

Off Queen Elizabeth Island, at ninety degrees west longitude and sixty degrees north latitude, when the north pole compass needle pointed due south and they were midway between the magnetic and geographic poles, a freak storm pushed the *Bellaventura* into an iceberg, ripping a hole through her hull, killing most of her crew. But before the Bellaventura had time to sink, that same wind pushed her and the iceberg that had mortally wounded her onto an old ice floe. On that day, *Bellaventura* became one of countless ships that went to sea and did not return.

No one from the *Bellaventura* made it back to civilization to report her fate. But, over the years that followed her disappearance, reports came in from people sighting the *Bellaventura* or speaking with Captain Lomonosov or one of his colleagues, for they often stopped to exchange goods and information. Sometimes the reports were written and contained the date with the month and year and sometimes the day. Some had detailed accounts of the days following the sighting, mostly about the weather or dangerous ice, but these were written from memory. *The records show landfall at… He was last seen on the…* One such report was made from a ship with which the *Bellaventura* had spent the winter of 1896/1897 stranded on an ice floe, miles off Ellesmere Island. It was the survey ship, the HMS *Carcass*. In his log, a young midshipman named William Martin described Captain Lomonosov's cabin with the great table and the bulkheads covered from the deck to overhead with maps.

***

Admiral Martin descends the vertical latter with the *Naval Log of Vessels Lost and Missing* tucked under his arm. Dr. Cohen had called him minutes before: "Admiral, RAMONA has sent up images of a wooden sailing ship. It's beautiful." His response: "Meet me in the observation room in five minutes."

As Dr. Cohen enters the observation room from the research bay, she finds Dr. Goeller talking to Dr. Jones.

"This…" He taps three times on the navigational map he has laid out over mission control, "this…" he repeats the word, "this is the most detailed map of the Earth's magnetic field you can find, and right now we are collecting new data on the great Arctic magnetic anomaly to add to it."

Dr. Cohen lays her computer-generated image of a shipwreck over Dr. Goeller's navigational map. "Wait until you see this."

A school of Arctic cod crossing my bow gets Dr. Jones' attention, but she asks, "The great magnetic anomaly?"

"The great Arctic magnetic anomaly," he corrects her.

She repeats after him: “The great Arctic magnetic anomaly.”

“You understand. That’s good, but I need to tell you, before you start working on my map, that two popular theories have been proposed for the anomaly’s existence, I’m partial to the latter of these. I need to tell you about them. The first of the two…but first, you need to know that all indications are that the anomaly is permanent and therefore presumably has a geological cause; I have no evidence to the contrary. Like I said, two theories exist, and the first of these states that an interplatform geosynclinal corridor extends across the Arctic Ocean floor. However, some believe the distal ends of the anomaly are anchored in ancient centers of crustal consolidation in the Canadian and Central Siberian Platforms, and that is the second theory...”

Stuart is setting out sandwiches, coffee, milk and cookies.

Dr. Jones’ mind is fuzzy.

Admiral Martin lays his book open next to Dr. Cohen’s computer-generated image of the shipwreck. Its title: *Missing in the Arctic Ocean.* Its subtitle: *North of Lena Trough and the Bering Strait.*

William picks up a chocolate chip cookie and starts nibbling it.

Two boilers and a steam engine still tucked inside the hull are the most obvious features. Her exhaust stack is lying on its side… She’s upright, sitting on her keel. Her length is two hundred fifty feet or so. She has two masts, still standing, but the yards and spars are gone. Glacial sediment is scattered throughout the image, even on her top deck. A single bow deck gun is broken free and lying on the bottom next to her.

And they page through the *Naval Log of Vessels Lost and Missing, Missing in the Arctic Ocean* looking for a ship that matches Ramona’s shipwreck. The admiral’s finger runs over: Dutch trading vessel lost with all hands during the winter of 1896/1897. The Newfoundland sealing steamer *Bellaventura was* built in 1860…

Dr. Goeller interrupts them. “Dr. Jones, I thought you were working on my map. Admiral, have you seen the data we are collecting of the great Arctic magnetic anomaly? You know magnetic anomalies are but a small fraction of the Earth’s magnetic field. Measured in nanoteslas, the Earth’s magnetic field ranges from twenty-five to sixty-five thousand. Measured in nanoteslas, magnetic anomalies on the order of ten to twenty. That’s how sensitive magnetometers need to be if you’re going to measure magnetic anomalies. They need to be accurate to within just a few nanoteslas. This new magnetometer is resolving the magnetic field strength to within one nanotesla.”

“Dr. Goeller…”

“Well, of course, you know that. You designed and built it.”

“Dr. Goeller, we may have found the *Bellaventura*. William, run up to my cabin. Fetch the book we’ve been reading.”

“The *Bellaventura*? That’s incredible. What are the odds? Let me see.”

Three minutes later, William returns with the *Adventures of Admiral Sir William Martin, 4th Baronet*. And they open the book to a chapter titled *Bellaventura* and the recounting of the winter young midshipman Martin's ship HMS *Carcass* spent with the *Bellaventura* and Captain Lomonosov. In the recollection are sketches of the *Bellaventura*, Captain Lomonosov and his crew, and the great map-making room.

Dropping cookie crumbs on the pages of Admiral Martin's book, he reads the account: "But according to Admiral Sir Martin's account, the HMS *Carcass* and *Bellaventura* wintered over north of Ellesmere Island. How did she get to the bottom of the Canada Basin?"

***

If the old sea ice could talk, it would tell you: "I took that ship around the Beaufort Gyre three times before I let her go on the Alpha Ridge, one thousand miles from the place I trapped her."

The spirit of Captain Lomonosov went down with his ship. He may still be down there living with Arctic deep-water creatures, or traveling the world as a great and gentle beast. I do not know. But this is my best guess at what really happened to the *Bellaventura.*

Markarov Basin

Out of the Markarov Basin bottom water, a lone manta ray cruises toward me from the north. Head on, her broad, flat body presents a low profile, but I can tell from her pinging that she is exceptionally large and headed my way. Sonarman Matthews reports: “Biologic sounds from the north…It’s most likely a manta ray, a big one by the high-pitched squeals, at four thousand feet and heading straight for us.”

Manta Ray Tornado

The manta pings again. She is traveling fast and the distance between us is decreasing at a rate of thirty knots; take my eight knots away, and she is making twenty-two knots on her own. Sonar reports, “The contact is picking up speed and is on a collision course, closing at thirty knots.” Each ping the manta sends says: *I hear you, I see you, and I am targeting you.*

With slow, methodical, and symmetrical strokes of her muscular triangular pectoral fins, she propels herself toward me. Fully expanded, her ventral gills gather oxygen, preparing for a deadly encounter. She pings, and each ping gets louder than the last, and the time between them decreases until they merge into a protracted acoustic assault—resembling a machine gun spitting out bullets. Sonar is useless.

What the manta does not know is that my active camouflage system is set in absorbing mode, meaning none of her pings are being reflected back her way. By her actions, she must think she has the better of me in size. But she doesn’t.

Meanwhile, the admiral, one level below in the observation room, has been watching the lone manta approach. She’s flying through the water; her determined eyes fixed on me. He rings up the control room: “Turn off the sonar absorbing system. Let her see us for what we are.”

And with my active camouflage system off, I’m transformed right in front of her, from a tuna-size fish into a large, hard beast. She’s probably never seen a submarine before and changes her course. Soaring up fifty feet, she shows a pale, spotted ventral surface to the admiral, passes over my sail with only inches to spare, and then dives behind me, following the deep tow wire toward Ramona. Her wingspan exceeds twice my beam.

“Captain, several more mantas are headed in,” sonar reports as six mantas come into view from every direction, and as they approach, they bank starboard and set upon a circular course with me at the center. Beating wings force water out of the circle. Turbulent eddies form. Water rushes down from above and up from below to replace what has been pushed out.

Soon, twenty rays add their strength to the vortex, and the single ring of mantas splits into two, every other manta spiraling up twenty feet and the rest down.

Multiplying eddies merge into a developing vortex. Its down draft captures me. To counter the pull, Dive offloads water from the main ballast tank. I start to rotate, like the second hand on an analog clock. The captain says, “Pilot steer full right rudders,” to keep my heading.

Dr. Jones and William cling to each other and mission control for safety, but their eyes are fixed on the huge white wings crossing the bow window.

At fifty strong, the two rings split into four, and the congregation becomes a rotating wall with me stuck in the middle, using all my power to keep a straight course over the floor.

At ship control, Pilot and Dive, and Maneuvering in engineering are shouting orders over the intercom, trying to keep our course reasonably steady through the manta-derived submarine sea state five.

All this time, the angry mantas are bombarding us with threatening calls.

I yelled into the vortex: What do you want? And the mantas responded, *That thing you are towing through the deep water is making too much noise. If you don't stop it, we will.*

My ballast tanks are vibrating, and the deep tow wire is passing the vibrations on to Ramona.

"Admiral," a call comes in from the captain. "I'm going to increase our speed to twenty knots and put full angle up on the planes, but first I'm going to release the deep tow wire." No! If you release the deep tow wire, I will lose my beautiful Ramona! I can handle it. I'm made of sterner stuff.

"How much longer before we are out of the basin?"

"We are at risk of being pulled below crush depth."

"You know there is margin built into her limits."

"And I'd be inclined to use it, if we were at war. But we are not." Then orders Mr. Barksdale to release the deep tow wire.

"Belay that order, Captain. Let's try silencing RAMONA first."

But Dr. Cohen objects: "We will lose miles and miles of data."

"And we might lose the ship and our lives if we don't get out of this vortex. Dr. Jones, override Dr. Cohen's control and silence Ramona."

"What about the bet?"

"This is not the time, Dr. Cohen."

Ramona stops singing. The mantas stop screaming and break out of their circular paths. The vortex dissipates. But the mantas don't leave. Instead, they assume an escort formation: rows of mantas with wing tip to wing tip, columns of mantas with cephalic horn to the tip of a tail, and layers, five of them with me in the center. And they escort us all the way up the blocky bedrock of Lomonosov Ridge.

Sonarman Matthews writes in the expedition's logbook: MME Colossal Arctic Manta, with a number that is the date...

What bet?

Lomonosov Ridge

The great beasts sing of this place with stories of giant polar bears walking from Ellesmere Island to the Siberian Islands on the other side. But that was millions of years ago, and I believe a fanciful legend. But legends usually have some important truth and I think the important truth to be learned from this legend is that a shallow-water bridge once spanned this ocean that land-dwelling creatures of the time could cross by wading. Today, so many millions of years later, I'm four thousand feet submerged, cruising at ten knots over the top of the ridge, with fifteen hundred feet keel-to-bottom.

But things are not looking good for Ramona.

Two towering basaltic obelisks stand in her path, with only a narrow pass between them. Her cruising altitude is fast approaching five thousand feet. When she reaches that depth, she will stop her ascent and travel over a floor strewn with jagged edges and daggers pointing up and swirling currents that could knock a sister off her course, and that would take the other two.

Dr. Cohen sees the jagged edges of huge boulders and even though the sisters have a measure of autonomy keeping their course, their course corrections have become more frequent, and it worries her. This prompts her to call the admiral: "I need to speak with you."

He's in his lab, and the call interrupts him. "About what? I'm busy right now. Can't it wait for dinner?"

"No. It is a problem now." She refuses to be specific. "I need your help to resolve it."

Apparently, while towing Ramona from four thousand feet with a speed less than thirteen knots through the water, there is a stability restriction. Ramona must stay at least one thousand feet below me for safety. Any closer, and an unanticipated shift in the prevailing current around her could send her careening out of control, jerking the deep tow wire. Maybe more than it could handle. The deep tow wire could snap.

The admiral responds, "Very well, meet me at mission control. I'm on my way." From his lab, he takes the aft ladder to the main passageway and heads forward, whistling as he goes. He pokes his head into the sick bay and wishes Doc Lexi the top of the day. It is early morning, and the smell of bacon frying wafts from the galley.

Where do you think from?

Meanwhile, William in his bunk, on level three of the missile compartment, on the port side, and sandwiched between silos one and three, asks me. *Expedition*, w*here do you think?*

Think? I think all over the place wherever I go.

No. I mean, where is your brain?

My brain?

Is the main computer in the control room your brain?

How would I know if the main computer was my brain?

When I am thinking, I think in my head, where my brain is.

How do you know you are thinking in your head?

I feel thinking right behind my eyes, not in my feet or in my heart.

I don't have a head or eyes—or feet, for that matter.

Expedition*, stop being dense.*

I am just as dense as I've always been. I cannot change my density, William.

What's your relationship with the main computer or sonar? Are they your brains and your ears?

I'm not sure about brains, but I know I don't have ears*.*

You mean the sonar arrays are not your ears? Don't you use the sonar systems to hear what's going on in the sea?

I don't think so. I know Sonar uses sonar to hear the ocean. I know the crew uses the main computer to solve complicated problems. But I don't know if it is my brain.

Do you have access to the data that sonar collects, and that the main computer processes?

How would I know these things?

Can you look up something there?

I'll try. What should I look for?

What data did the sonar collect yesterday? I remember the acoustic waves from yesterday. Is that "looking it up"?

Expedition*, you're not helping...Wait, I have an idea. Maybe Dr. Jones can figure out where you think. She watches what's going on inside you a lot.*

So William hops out of his bunk and heads forward to find Dr. Jones. On the way to the observation room, he smells bacon frying and decides to have breakfast first before talking to Dr. Jones.

***

At the same time, Dr. Cohen is climbing the ladder into the observation bay, looking for the admiral. She finds Dr. Jones at mission control. "Good morning, Casey."

"Good morning, Rachel. Smell the bacon? Want to join me for breakfast?"

"I can't, Casey. I'm meeting the admiral here." And she walks behind Dr. Jones, pulling a chair to mission control. "Oh, good. I'm glad you are watching RAMONA's images. Don't you think the bottom is too dangerous for her? Look at the size of the boulders. If she comes anywhere near a boulder sticking up, swirling currents could drag her off course. Can you get the admiral to reduce the boat's speed, or take it up a few hundred feet? I'm afraid I'll lose control of RAMONA."

“Good luck with that, Rachel. The admiral has not deviated from this course since he laid it in off North Slope, Alaska. I do not think he has a mind to alter it. Can’t you bring RAMONA up for an added safety margin?”

“You know RAMONA must stay below *Expedition* by one thousand feet.”

“For maximum stability and image quality, yes, I do. But there’s a lot of wiggle room in that number, by my estimation.”

“Yes. Image quality. It has to do with speed through the water and the deep tow wire. I’m glad you understand.”

But Dr. Jones does not understand. The admiral chose this course specifically for Ramona and the deep tow wire.

Admiral Martin enters the observation room with a casual, “Good morning, ladies. What’s up? Smell the bacon frying? Does anyone want to join me for breakfast?”

“I would,” Dr. Jones replies. But Dr. Cohen interrupts: “Admiral, Dr. Jones needs to talk to you about reducing *Expedition*’s depth. The bottom is too rocky for RAMONA to be **so close to it.**”

“Is that what you think, Dr. Jones?”

That is not what Dr. Jones thinks, but she doesn’t want to point out that Dr. Cohen may be exaggerating and she muddles through. “As I understand it…the bottom here is about fifty-five hundred feet. RAMONA is at five thousand feet…let me calculate…that’s five hundred feet off the bottom and one thousand feet below *Expedition*, and we are traveling at ten knots over the floor.” She has added nothing to the conversation.

“And is there a problem with that?”

“Not that I’m aware of, Admiral. We are following the profile laid out in the mission plan…But I think Dr. Cohen thinks RAMONA is too close to the bottom because of enormous scattered boulders and the turbulence they are kicking up.”

“Oh, is that what you think, Dr. Cohen?”

“Bill,” Dr. Cohen sweetens the tone of her voice while addressing him by his familiar name, “the bottom is much more irregular and jagged than you led me to believe. You must take *Expedition* up or slow our speed.” She’s frantic but trying hard to hide it.

He looks at Ramona’s sonar images on the mission console display and checks the forces on the deep tow wire. “And lose the bet? Not likely, Rachel...”

Bet? What bet? Dr. Jones, ask the admiral about this bet…

She asks my question: “Bet? What bet?” But they ignore her.

Instead, a grin crosses the admiral’s face. “Unless,” and the admiral motions with his right hand, his index finger pointed to the overhead, “you wish to concede the bet.”

“No, I don’t wish to concede the bet,” Rachel replies.

I want to know more about the bet, and what conceding means in case the admiral loses.

“Concede what bet?” Dr. Jones blurts out. Her words provoke two penetrating glares. Their eyes telling her that this conversation was none of her business.

“Gee, I’m feeling mighty hungry all of a sudden. I think I’ll get some breakfast. That bacon smells mighty good.” And Dr. Jones tiptoes backward into the main passageway, turns around and beats a hurried path aft toward sick bay…

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The door to sick bay is open, so she walks right in. “Doc Lexi, have time for breakfast? I’ve got some dirt.” And they take the ladder down one level to the galley. On the way she whispers: “Do you know anything about a bet between the admiral and Rachel?”

“A bet? No. What do you know?”

“It has something to do with depth, speed, towing RAMONA, and the deep tow wire. Rachel tried to get me to convince the admiral to take *Expedition* up a few hundred feet.”

As they sit down at a table, Doc asks: “Did you? What did you say?”

“I just babbled about depth and speed. But get this. He asked her if she wanted to concede *The Bet*.” And hangs air quotes around the words with her fingers.

“Bet? What bet? What did she say?”

“She said, ‘No. I don’t wish to concede the bet!’ and curtly, I might add. I’ve never heard anyone speak to him that way.”

“Do you have any idea what the stakes are?”

Doc Lexi’s question surprises me. This bet is getting complicated. It has concessions and stakes. What are stakes?

“Not a clue. But when I asked them about the bet, they both glared at me. They clearly felt it was none of my business. I got out of there as soon as I could. Boy, I thought, if he told anyone about a bet, it would be you.”

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William enters the galley, with images of pancakes and butter and bacon and maple syrup in his mind. “Hi, Dr. Jones. I was just looking for you. I’m trying to figure out where *Expedition*’s brains are.”

“Never mind that now, William. Do you know anything about a bet between the admiral and Dr. Cohen?”

“Bet? Admiral Martin has a bet with Dr. Cohen?”

“Yes. Do you know anything about it?

“Last year I lost my best aggie in a bet.”

“What do you know about the bet, William?”

“It was a swirl of agate silver and oxblood. I sure do miss that marble. Dr. Jones. What’s the most important thing you’ve lost in a bet?”

“You’re getting off the point, William. What do you know about the bet between Admiral Martin and Dr. Cohen?

“Do you suppose they’re betting over RAMONA? Do you think the admiral could win RAMONA for *Expedition*? *Expedition* wants to keep her, you know.” What a wonderful idea. William, do you really think the admiral could win Ramona for me?

“Gee. I wonder what the admiral has put up to lose? I suppose he could lose *Expedition.*” Lose? That is an awful idea.

“Lose?” Dr. Jones repeats my question. “I hadn’t thought about that.”

“I sure do miss that marble.”

***

Cookie places a bacon-and-egg sandwich in front of Dr. Jones. She smiles at him. Cookie makes the sandwich just how they make it in Brooklyn, just for her. “So what can I do for you, young William?”

“Pancakes and butter and bacon and maple syrup.” But then he remembers why he was looking for Dr. Jones. *“Expedition* and I have been wondering where he thinks from.”

“Do you mean to say: from where he thinks?”

“He doesn’t know. I thought if I gave him a really hard problem to solve, you could look at all the computer activity and find out…from where he thinks.”

“Oh, what problem would you give him?”

“I’d ask him how long it would take for us to travel from where we are now to Cape Horn while maintaining a depth of two thousand feet?”

I’m thinking.

“No wait…I have to be at a computer terminal with access to all systems. And can I finish my bacon-and-egg sandwich first?”

***.

“Okay, I’m ready. Ask *Expedition* your question.”

So William asks me, “*Expedition*, how long would it take you to travel from where we are now to Cape Horn while maintaining a depth of two thousand feet?” And I start thinking about the problem.

Dr. Jones mutters. “No extraordinary activity on any of the main computer CPUs…cache memory’s normal…”

I’m done. Do you want the answer?

No.

William shoots another question. “Calculate the path of a rocket launched from Cape Canaveral headed to the sea of tranquility on the moon if it left tonight at midnight GMT. Include gravitational forces of all the planets and moons in the solar system. That should keep him busy for a while.”

Dr. Jones mutters, “Random access memory (RAM), static random access memory (SRAM), and read-only memory (ROM)…can’t find anything…I can account for all the data passing through the communication bridge to the guest computing network...There is no strange activity on the auxiliary science computer serving the guest computing network.”

I’m done.

“Calculate the path of a rocket launched from the center of the sea of tranquility aimed at the great storm of Jupiter, launched at midnight tonight. Include gravitational forces and relativistic effects of all the planets and moons in the solar system.”

Dr. Jones continues her search for my brain. “But there are fifteen other network bridges. I can see traffic through the communication bridge, but can’t see the other side. I don’t have access to the ship command-and-control computers (inertial navigation, the nuclear reactor, sonar arrays, radar) or the ship self-defense systems (missile, torpedo targeting and control, and the active camouflage system.)—Bubkis.”

“Well, he told me flat out he didn’t use sonar to hear…But…well…I’m not sure if this will help…He thinks he may have taste buds on his hull…”

“Taste buds on his hull? Why does he think that?”

“Well, we figured it out together.”

“How?”

“Well, he said he could taste caribou blood in Atlantic seawater and that each ocean had a different flavor. He said he could taste magnetic fields and thunderstorms, tar seeps and balls of goo, diesel fuel and gasoline, and minerals like sulfur, iron and magnesium.”

She adds, “And tickling. He felt jelly tickling him. He didn’t like it. He said it confused his feelings there. And he felt the tar ball punch him in the face.”

“But he doesn’t have a face, Dr. Jones. He doesn’t have a face, mouth or tongue. He doesn’t have eyes or ears. That is what I am trying to figure out. I guess I’ll just have to ask the admiral.”

Latitude 90° North

Can you feel it? Can you feel the Earth spinning on it? Can you feel the Earth wobbling around it?

The Arctic deep water rotates around it. It exists unseen by the great beasts that follow the Atlantic water layer to the Pacific.

The tides do nothing to it. The Arctic Ice cap has no effect on it. Nor does the midnight sun.

It comes up through the Earth's core and pierces the Amundsen Basin at a depth of thirteen thousand four hundred feet. But it doesn't stop there. It shoots through the atmosphere, into space, and propagates three hundred light years to the North Star.

Above the ice, on a clear night with stars, you need only look above you with any decent sextant, to know you are there.

But under the ice? Our way is not guided by stars. We steer our course by dead reckoning using two inertial navigation systems—but even they can be confused by the earth's spin up here, and we are just guessing at the drift imposed by circulating currents. The last time we shot the stars was at the head of the Barrow Sea Valley. We've come eighteen hundred eighty-two miles across two deep-water basins, over eleven and one-half days of arctic daylight, and at the mercy of gyres and transpolar currents. The last fix we had on our position was when we cruised through Crystal Pass…

USS Nautilus

USS *Nautilus* (SSN-571) had her keel laid by Electric Boat in Groton, Connecticut, on the 14th of June 1952. She was launched into the Thames River on the 21st of January 1954, sponsored by Mamie Eisenhower, the first lady at the time, and commissioned on the 30th of September, under the command of Eugene "Dennis" Wilkinson.

On the morning of the 17th of January 1955, Captain Wilkinson ordered all lines cast off. Nautilus was underway on nuclear power. She is the first nuclear-powered submarine, and my sister.

In May of the following year, she traveled eleven hundred nautical miles from New London to San Juan, Puerto Rico, covering twelve hundred nautical miles in less than ninety hours, submerged the entire time. At the time, this was the longest submerged cruise by a submarine and at the highest sustained speed (for at least one hour) ever recorded. That was her shakedown cruise.

She broke many records in her first years of operation and traveled to locations beyond the limits of other submarines. During her life, she was attached to the Commander, Submarine Force Atlantic, conducting special operations; spied on protected northern seaports of the Soviet Union; investigated the effects of increased submerged speeds, quick changes in depth, and lengthy submerged times on ship and crewman. She participated in Anti Submarine Warfare exercises, NATO exercises, and during October 1962, participated in the naval quarantine of Cuba. But she was also an explorer, like me.

On the 25th of April 1958, Nautilus set sail for the West Coast, now commanded by Commander William R. Anderson, USN, with orders to travel through the Arctic Ocean under the ice, cruise through the north pole, and exit the Arctic Ocean into the North Atlantic. Not only would she be the first submarine to sail through the North Pole, she was the first ship to sail through the North Pole. A lot of people tried to walk to it. All of them failed, or didn't live to report it. Many wandered the ice on foot during bleak Arctic winters, looking for the furthest point north. It might seem easy at first. Walk until the pole star is directly overhead. But which way to walk, when the ice floes are constantly moving, the magnetic field lines are pointing into the heart of the North American continent, and incessant howling storms cover the stars?

Captain Anderson submerged *Nautilus* in the Barrow Sea Valley on the 1st of August and didn't come up for two days. Her biggest fear was getting lost under the ice, disoriented. Not even knowing which way was north. But Captain Anderson knew he could blow a hole in the ice with one of his torpedoes. That would be exciting.

On the 3rd of August, at twenty-three fifteen hours eastern daylight time, she became the first ship to reach the geographic North Pole. Her navigator reported in his log: Nautilus, 90°N, 19:15U, zero to the North Pole.

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And I follow my sister five years later in time through the North Pole, hearing the echoes of her captain reading the submariners prayer, and then dedicating the expedition: "For the world, our country, and the Navy."

And for the briefest moment, my bow is headed south while my stern is still headed north.

Nansen Ridge

A while ago, during the midnight watch, echoes from Ramona's song revealed fractured, faulted, tilted, and blocky bedrock climbing up from beneath the abyssal plain. Then she sent up images of a ragged ridge formation that was sliced clean through and missing its east side.

Those images caused Dr. Cohen to wake the admiral and call him to mission bay three. "It is so exciting, you must join me. Nansen Ridge is breaking through the sea floor," and her voice quivered as she added, "the images show a major fault cutting through the range."

"I'll be right there."

In the time it took for him to join her in mission bay three, Ramona was sending up images of the other side of the ragged ridge formation, and it was sliced clean through and missing its west side. "Have you called the others?"

Arctic Deep Water Squid

Meanwhile, in the control room, sonar was reporting, "I have contact with biologics dead ahead. And I recognize it as the rat-a-tat-tat of mating Arctic deep-water squid."

Mr. Buckheister's report motivated the captain to join him at the sonar station: "Sir, the squad must occupy seven cubic miles at least, and we are headed into the midst of them."

"What is their distance?"

"Five miles."

Sonar's report also motivated Mr. Decker to leave ship control: "Arctic deep-water squid? I recommend we plot a course around them. You remember what happened the last time we encountered—"

The captain cuts off his exec. "Hold your course." Those are the admiral's orders, but the captain remembers the last time we encountered Arctic deep-water squid.

Chief Barksdale also remembers his last encounter with Arctic deep-water squid. "I'm preparing countermeasures, Captain." This time, we'll be prepared.

"Good. Let me know when you are ready to launch, Chief." Then the captain turned his attention back to sonar. "Provide updates at your discretion."

Clearly, everyone in the control room understands that seven cubic miles of deep-water squid can wake the dead, and these were also mating. So, despite his standing orders, the captain called the admiral (who was below with Dr. Cohen watching a major fault pass under us). "Sonar has made contact with Arctic deep-water squid, and…" he hesitated before he added, "and, Admiral, it is mating season. I think it would be wise to alter our course."

The admiral replied: "No. Keep your course. We're following a major fault toward the Nansen ridge. If it goes all the way, we will have ground truth for our spreading rate models. I don't want to interrupt data collection. This discovery could take center stage at the next WHOI

conference. By the way, do you know where Dr. Santiestiban is? And who is at the science station?"

But the captain argues, "You will not get any decent sonar images from within a squad of Arctic squid." To which the admiral replies, "*Expedition* won't, but RAMONA will. Stay the course."

"Very well, Admiral. We'll stay our course." But then he turned to tactical. "Are the countermeasures ready, Chief Barksdale?"

All this time, a dangerous situation had been developing. Sonar should have known it, but the Arctic deep-water squid had distracted his sonar arrays. So, he did not know that a few minutes before, a narwhal pod—thirty strong—left a breathing hole in the ice with thoughts of deep-water squid for dinner.

Personally, I think encounters with squid squads are great fun, but the narwhals could be hurt if they run into me. William, I need your help. You need to do something for me. It is a matter of life and death.

Anything.

I need you to tell Chief Buckheister that a narwhal pod is headed into the squid squad and on a collision course with us. But he argued with me: *Chief Buckheister is on duty now.*

I know he is. That is why I need you to tell him to look for narwhals sounding.

I don't think I can do that.

Why not?

The captain doesn't want me to enter the control room without the admiral.

This is important—a matter of life or death.

I don't think he likes me very much.

What do you mean? The admiral loves you.

I mean the captain.

It doesn't matter. Do it anyway.

Okay, but if I get thrown in the brig, it's your fault.

Three minutes later

When William showed up at the control room's aft entrance, he was greeted by the captain: "William, what are you doing here? You know the control room is off-limits unless you are with the admiral."

"Captain, please, I need to warn Chief Buckheister. There are narwhals sounding. I need to tell him to look for narwhals sounding."

"William, go below."

“But you don’t understand, sir, there are narwhals sounding, and *Expedition* has sent me here to warn the chief.”

“I understand just fine, William. Now, go below.”

Hurry, William! I urged him. The pod, the squad, and I are headed to the same place. And I shouted into the sea: Great beasts stop! I am big and hard, and you will die if we collide. Change your course!

William pleaded: “Sir, the narwhals sounding don’t see or hear us. To them, we are hidden in the squad of squid. Captain, change your course or slow down at least!”

“William, go below!” then he rang up the admiral. “Yes, what can I do for you, Captain?” “William is creating a scene in the control room. If he doesn’t leave now, I’ll have him removed.”

“I’ll be right up.”

And William took the captain’s distraction of calling the admiral to run through the control room. He set his sights on the forward door and as he passed the sonar station he yelled: “Chief Buckheister, there is a pod of narwhals on a collision course with us.” And he ran past the captain’s quarters and the admiral’s, slid down the ladder to the observation room, and ran right into the admiral coming up. “What’s going on, William?”

All this time we were inside a disorienting train of screeching, clanking sounds, resembling my forward sonar array in active mode five. I tried again to contact the beasts through the millions of rat-a-tat-tat squid sounds gobbling a school of polar cod: Change your course! Slow down!

Pulling free from the admiral, William darts to the observation room window. “We are going to hit them!” And the first huge beast, with a long white tusk half again its body length, ricocheted off the bow window. “Oh, we hit one!”

The impact of five beasts followed. The collision alert system started screaming after the second one hit, while over the intercom the captain shouted, “Engineering, all stop. Reversed the direction of the screws.”

The deep tow wire went slack. Dr. Cohen lost control of Ramona. My love was careening toward the rocky foothills of the Nansen Ridge.

Sister one struck the bottom first, bouncing several times before we lost all forward speed. Her sisters followed her to the bottom, tumbling after they hit.

Ramona! I shouted into the sea. The echoes of her song faded as we came to rest at 86° north latitude, 48° west longitude. My beautiful sisters were laying broken on the ocean floor.

Magellan

Crewmen Wu and Ahmed tick down Magellan’s checklist, running electricity through his systems one at a time until all are powered on and in good working order. His power and data cables check out. As do his optics and infrared cameras. And his two legs for picking his way

over boulders and rock outcrops and his two arms for collecting samples. “Magellan’s systems are good to go.”

So the admiral gives the order to launch Magellan, and water at one hundred twenty atmospheres of pressure floods the auxiliary bay around him. He makes a few tentative maneuvers inside the bay to be sure he has full authority. Then he sets himself on a spiral path to the bottom with the mission to rescue my precious Ramona. His floodlights illuminate absolutely nothing to begin with and for a mile down. He won’t have trouble finding them at least: three sonar distress signals brightly mark the sisters’ locations, and he takes a surveillance pass around the crash site, circumnavigating each sister and sending pictures home.

But the pictures paint a discouraging situation. Sister two seems to be upside down with her tether wrapped around her. The seafloor between sisters two and three is squirming with elongated bodies, and sister three’s array might be separated from her signal processors.

Magellan examines sister one and her connection to the deep tow wire and then takes a station two hundred feet off the valley floor, waiting for Admiral Martin to send an action plan down his data cable. It looks like the end of Ramona and her beautiful song.

Admiral Martin begins. “We should pick R3 off the floor with Magellan first. That will maximize our time with her to repair, as she looks the most damaged. After R3 is in the launch bay, we can send Magellan back down to pick up R2. I think we can recover R1 with the deep tow wire from directly overhead without further damage.” Not only does Admiral Martin have a plan to recover her bodies, but he thinks we can fix her.

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Magellan approaches sister three, intending to pick her up when he sees a dent in her port array panel and a crack in her sonar window, so he investigates further.

His movements alert a benthic eel hiding beneath sister three, enjoying her warmth and soft hum. He pays it no attention. He’s searching for a delicate way to cradle sister three in his arms when he finds himself face-to-face with a long, pointed snout, two eyes, and a thick, slimy body with a soft green glow about it.

The eel does not matter; Magellan slides his arms under sister three.

But the eel will not be ignored this way and grows furious with Magellan coming to steal his prize—a warm, glowing gift from the world above. In defense of sister three, the eel summons from his gut pea-green bioluminescent phlegm and spits it directly into Magellan’s camera lens. He’s taken aback.

“What happened? The display screen is glowing pea green,” William asks, and the admiral replies with a lopsided grin on his face. “It appears Magellan has discovered a new species of eel, William. Would you like to enter this enormous eel that spits pea-green slime into *Expedition*’s log?”

“Can I name him?”

“Yes, of course you can.”

“I think I’ll call them *Expedition*’s Enormous Arctic Deep-Sea Benthic Eel That Spits Glowing Pea-Green Slime. What are you going to do now, Admiral? Magellan can’t see anything.”

They wait a few minutes, hoping the current will wash the camera lens clean. It doesn’t.

“Dr. Burgess, bring Magellan home. Keep his attitude up. He’s got R3 in arms. We don’t want it to slip off on the way home.” And Magellan lifts sister three off the floor and brings her up a spiral path back to my auxiliary launch bay.

***

Magellan approaches sister two and finds her inundated by a squirming swarm of *Expedition*’s Enormous Arctic Deep-Sea Benthic Eels That Spit Glowing Pea-Green Slime, protecting their claim.

In length, each eel exceeds Magellan’s circumference several times, and when he moves, they follow him with their eyes. They know together they can take him. I can do nothing to help sister two. It is up to Magellan to save her.

Magellan screams at the eels.

It doesn’t work; they return his attack fiftyfold. They fill the sea with screeching that robs Magellan of his senses. He backs off and settles in the ooze to think while watching the squirming bed of benthic eels smothering sister two.

It is not long before a benthic eel emerges from the bed and wraps itself around Magellan. Then a second crawls upon him and then a third. He realizes the eels are after him and sends an alarm to mission control, then picks himself off the floor.

The enormous eels come with him. They cling to him. They wrap themselves around his recovery arms, rendering them useless. “Bring Magellan home, Chief. We need to use a more aggressive tool to recover R2.” At one thousand seven hundred sixty-two feet, the enormous eels clinging to Magellan start to fall away, and he returns to my auxiliary launch bay empty-handed from his mission to recover sister two.

The Claw

The Claw lands on top of sister two, collecting her and the *Expedition*’s Enormous Arctic Deep-Sea Benthic Eels That Spit Glowing Pea-Green Slime that have claimed her in one scoop.

“Captain, this is the admiral. The Claw has R2. Take *Expedition* up.” And with this order, Admiral Martin places me into a tug-of-war with this enormous bed of benthic eels over ownership of sister two.

Dive offloads water from the main trim tanks.

We go absolutely nowhere.

Then, Dive offloads water from the main ballast tank. This annoys the enormous eels and escalates the tug-of-war.

“Admiral, we can’t pull much harder. We’ll exceed the Claw’s cable strength.”

“How much could those eels weigh, Admiral Martin?”

“It’s not the weight of the eels that is holding R2 on the bottom, William, it is suction. The benthic eels are bound to each other with slime and ooze. The harder we pull on R2, the harder the bed of benthic eels pulls back.”

We persist.

The eels resist.

William blurts out, “How about sending an electric current down the cable?” But his suggestion upsets Dr. Cohen. “That could fry R2’s electronics! Admiral, don’t.”

“I won’t fry RAMONA’s electronics, Dr. Cohen. She’s much too valuable. Captain, this is the admiral. Increase our buoyancy. Have Dive give it a jerk now and then.”

“Aye, sir.”

After three bells of offloading water from the main tank in fits and starts, Dive delivers a jerk that weakens the seal that maintains the suction the bed of benthic eels exert on sister two to keep her trapped in their domain.

She moves an inch to begin with, but then the inch becomes a foot, and the foot a fathom, and somewhere between the foot and fathom, the seal breaks, leaving only the buoyant force acting on me. I lurch. I lose attitude control. I set upon an unpredictable vertical course that knocks half my crew onto the deck.

“Dive, flood the main ballast tanks.” But Dive is flooding the ballast tank. We must wait it out, getting knocked around, until the changing forces settle down.

“Bring the claw and R2 home, Chief.” And the chief does that, but the benthic eels do not let go. They come up with sister two; they have no intention of relinquishing their prize. But they’ve never been off the floor before, neither have they felt the pain of decreasing water pressure. At one thousand seven hundred sixty-two feet above the benthic layer, the enormous eels slide away.

***

“Come in.” The admiral responds to the knock on his cabin door. It’s the captain. He is concerned about William. “Admiral, something has been troubling me.”

The admiral offers him a seat and a cup of coffee. “What’s on your mind?”

“I am here regarding William.” He hesitates. He thinks he may have overreacted during the narwhal-squid collision, but he doesn’t want to talk about that.

“Oh, yes. It slipped my mind.” He had been so busy recovering Ramona it slipped his mind. “He entered the control room against your direct orders. I’ll have a talk with him.”

“No, it’s not that, Admiral.”

“Then what?”

“William came to the control room to warn that narwhals were diving into the squid. Everyone could hear the squid racket, but not even sonar could hear the Narwhals trumpeting. How did William know that there were narwhals on a collision course with us?”

“Didn’t sonar broadcast it over the intercom?”

“No. I checked the records from the watch. We did not make a general announcement.” He hesitates again. “I would be remiss in my duties if I didn’t at least acknowledge that something strange is going on with William.”

“Strange?”

“He knows things that are going on in the sea that he has no way of knowing. He knew the caribou herd fell through the ice. How did he know that? Could he have gotten access to the sonar systems?”

“Captain, tell me. If I had reported those events, or Chief Buckheister, would you think it so strange?

“No. But you and the chief are exceptionally gifted, you’ve both earned the nicknames ‘ears’ in your careers, and have studied ocean sounds both with and without the benefit of sonar arrays.”

“Perhaps young William is more than gifted. What if he is a prodigy? I think he is. Why else would I bring a twelve-year-old on a three-month expedition to the Arctic Ocean?

“Well, when you put it that way, it makes sense.”

“You could do me a favor.”

“Anything, Admiral.”

“Ask him to stand watch with Chief Buckheister.”

“I’ll talk to the chief about it. Good night, Admiral.”

“Good night, Captain.”

***

We had ridden a major transform fault over the north range of the Nansen Ridge and turned into the central valley headed toward Eurasia. My depth was four thousand feet below the ice, as it had been since we turned north off North Slope, Alaska. Ramona cruised effortlessly over the northern range and took a deep dive into the central valley.

The first thing Ramona discovered was that the central valley held an inner valley nearly three and a half miles deep and half a mile wide. She went in, and is in there now, surveying a strip of bedrock that was pushed up from the mantle over the last three thousand years.

During Ramona’s ride down the southern face of the northern range, hours before she found the inner valley, she lost the transform fault we had followed in. Dr. Jones hung a strip chart of its disappearance on the observation room’s aft bulkhead. The news shot through the boat. Primarily because Dr. Jones shouted down the main passageway, “Now hear this. The transform

fault has disappeared." She couldn't have spread the news more quickly if she had used the ship-wide intercom.

We followed the rift for twenty uninterrupted hours. At ten knots, that is two hundred miles. During that time, no one found anything of interest. Except for Dr. Goeller. "Think about it. The magnetic field inside that rock is being captured as the rock cools, and we are collecting field strength and direction data in three dimensions. I'm positively giddy over the possibilities." But Dr. MacCarthy was looking for lava fields: "There are none. Two days of this, and we haven't seen a hint of lava fields." Dr. Santiestiban wanted to find a more dynamic rift. He willed the earth to move. It didn't work. Dr. Hansen wanted to find extreme archaea: "No thermal vents." So, in the early morning meeting of the third day exploring the rift, it was decided not to circle back to investigate, but to go forward another two hundred miles.

Expedition's Brain

His cabin door is ajar. She puts on a smile, taps it once, and walks in, not waiting for an answer. "Good evening, Admiral Martin." He stands up from behind his desk. No one else is in the room. "Good evening, Dr. Jones. Would you like a drink?"

"I thought the boat was dry."

"The boat is dry. We keep some for medicinal purposes."

"In that case, I'll have what you're having, thank you." The pale gold liquid takes a bite out of her tongue. "What is it?"

"It's scotch. Single malt scotch from the Highlands."

Liquid warmth spreads over the roof of her mouth. "I like it." Then it trickles down her throat. "The highlands? Have you been to Scotland recently?"

He motions to the small table on the aft bulkhead flanked by two benches. "Have a seat." She sits on one and he the other, while her stomach is developing a warm glow that drifts into her head.

"Yes. As a matter of fact, we went to Loch Ness last year."

"Why?"

"We went looking for Nessie. Why do you ask?"

"I wouldn't think you could get *Expedition* down the River Ness. Did you find him?"

"We went in through a subterranean canyon in Moray Firth, and yes, we did."

"What did you do?"

"We found Nessie," he says, an impish grin on his face.

"You know, Admiral, if you told me that a month ago, I would have said you were pulling my leg. But after the last fifteen days, I'm going to ask: 'What did he look like? Did you get pictures?'"

He splashes some more scotch into her glass. “I’ve ordered your favorite dinner tonight.”

“What’s that?”

“Chicken Parmesan.”

“How did you know?”

“And chocolate ice cream.”

“How do you know that?”

“Expedition told me.”

“You’re making fun of me, Admiral…So how did you find the subterranean canyon?”

“I can’t tell you. It is part of Scotland’s National Security system. And, yes, I’m making fun of you. It’s a small boat, and few secrets survive. Tell me, Dr. Jones, how is your relationship with my submarine going?”

“Are you still making fun of me?”

“No. Just curious...” But he has more to say. “Captain Deverough reported that William knew about the Narwhals diving before anyone in the boat. I was curious. Had you talked to him about it?”

“No. He didn’t say anything to me. He was curious about *Expedition*’s brain. He enlisted me in a search. And I’m afraid in the excitement of the hunt I may have tripped a few firewalls…”

“I know. Did you find anything?”

Giggling. *“*I’m hungry. When’s dinner? This stuff is really good. Can I have another?”

Then she leans across the small table between them. “Admiral, is *Expedition*’s active camouflage system more than acoustic in nature?”

“What makes you ask?”

“Is it sensitive to light and infrared radiation and temperature? Is it sensitive to localized micro electrical currents? Are there circuits that can detect both mass and charge flow rates? Is it sensitive to gravity fields? Can it detect gravity anomalies, like seamounts or a nuclear reactor core? Is it sensitive to magnetic fields? More importantly, does it have a central computer, or is it distributed?” Then her barrage of questions slow. “Can I have access to the system? Can I have the designs? Why are you looking at me like that?”

“Dr. Jones. I would like you to terminate this line of investigation and give me any notes you have made.”

Seconds drag on.

“Do I need to remind you that you signed a nondisclosure agreement with Martin Marine Enterprises?”

“No, you don’t, sir.”

“You are dismissed.”

***

What happened?

He got angry.

At what?

I was asking about the design of your active camouflage system. He went cold on me. He ordered me to stop investigating your active camouflage system and to turn over all notes. He even threatened me with a lawsuit.

Talking about my active camouflage system, I made something for you.

You made something for me?

I’ve written a computer program of my own and connected it to IAN.

You’ve written a computer program? What did you connect to IAN?

My active camouflage system.

No, you didn’t.

Yes, I did. Now you should be able to see what I feel. You will see electron transfer rates, electromagnetic fields of all frequencies, acoustic waves, pressure, and temperature. I made all the connections for you.

But, Expedition*, Admiral Martin gave me a direct order. He told me not to investigate your active camouflage system. I can’t disobey him on something this important.*

And that is the beauty of what I have done. You didn’t investigate, and you don’t have to. You are not disobeying his orders. I’m giving these things to you.

Somehow, I don’t think Admiral Martin will make the distinction. Where did you put this program?

He’ll change his mind. Just look. You’ll see.

I’ve found a file labeled “for dr jones,” but it’s hardly big enough to do what you say.

Oh, the program that I wrote is on the main computer.

And with opening the file ‘for dr. jones’ the commands that I put on the auxiliary science computer race out from her folder through the guest computing network to the main computer and from there cross the communication bridge to the active camouflage system and its hull sensor network—sensations flood into the computer program labeled IANSIM.

Unconsolidated Pyroclastic Flow

For five days, nothing changed around me except the sounds of the wind over the ice sheets above us. No currents shifted. The taste of the water didn’t vary. No sea creatures came up to complain.

At the end of the fifth day, I began to taste traces of sulphur dioxide and hydrogen chloride. The deep tow wire reported increases in temperature, salinity, and hydrocarbons.

By the beginning of the sixth day, huge plumes of magmatic gas were washing over Ramona, and she encountered several small volcanoes that she needed to sail over. And from those small volcanoes, shallow lava flows were seeping.

The morning meeting found the science team arguing about what to do that day. They were divided. While they slept, the landscape had changed. Ramona was cruising over lava flows. Explosions were echoing through the valley. Dr. Cohen had to fly Ramona up to two thousand feet because her systems were overheating. But Dr. MacCarthy wanted to double back and send a robot down to get a closer look and collect samples. Dr. Hansen thought there might be thermal vents to study and at least an opportunity to find abyssal microbes, and he wasn't going to get any samples while Ramona was in the water, so he agreed with Dr. MacCarthy. But Dr. Santiestiban wanted to forge on because the explosions promised a more dynamic rift farther to the east.

***

Magellan enters the water with infrared and optical sensors on. It is a long, cold journey down for him with nothing to do or see except collect temperature and salinity data. At seven hundred fifty feet from the bottom, Magellan passes through a thermal boundary layer into a warm Arctic deep water. Ten fathoms from touchdown, Magellan deploys his two legs, the termini of which can stand on molten rock. As he touches down on a field of incandescent lava fragments, something spits at him. He does not care.

Suspended by his support cable, Magellan tiptoes into a thermal current and up the slope of a spatter cone, examining loose volcanic fragments as he goes. With his port side robot arm, he picks up a piece of tuff. It spits at him, but he doesn't care and tucks it into one of his collection compartments to bring home.

Magellan sets a course for the grumbling volcano's caldera, picking his way over crusty molten rock. Beneath his feet, lava creeps through passageways within the lava bed, feeding grizzled blobs that push through all the weak spots they can find. He doesn't care that it's deadly hot.

A bright red blob grows right in front of him; it blossoms orange, falls forward, and turns crusty gray. New lava blobs break through the old and grow around him. He doesn't care that the lava flow advances. He just steps over it and moves on.

Meanwhile, at mission control, tension is mounting, and Dr. Jones is telling the admiral that Magellan's temperature is approaching the red zone. The admiral responds, "He can take it, Dr. Jones. Let him go."

Magellan meanders through a cluster of gaping side vents, each expelling turbulent clouds of intoxicating sulfur compounds that expand and turn cloudy as they invade cooler water, where they burst.

Magellan's in grave danger, but he doesn't care. He presses on, sending up images of lava bubbles, ten to twenty feet wide, seething from a side vent in pulses. Two-thousand-degree

magmatic gases push them out, forming lumpy domes of rolling lava that grow into knurly pockmarked bubbles twice the width of the vent that birthed them. But as the lava bubbles expand, they sag. And as they sag, they split open, spilling their guts onto the lava flow made by the bubbles that burst before them.

Magellan makes his way up a steep slope that is still viscous. Boiling and bubbling, smoldering and simmering, the lava bed grows under his feet from below. The caldera's rim slumps; it crumbles and collapses. A seething avalanche races toward Magellan, and streaming, screaming-hot gas clouds engulf and blind him. He loses his footing and tumbles down the slope with the lava flow around him. His images turn white from his scattered searchlight.

Up here, Dr. Jones is warning: "Magellan's temperature is in his red zone." But he's made of sterner stuff, and the admiral responds, "He can take it. Let him go."

Magellan finds his footing, stands, and continues his journey up the slope. He reports images of volcanic fountains bubbling and spitting forth fragments of white-hot lava that give birth to clouds of steam strung together. He sends up images of spattered rock formations and a shining black lake filled with glassy tears that he picks up to bring back with him.

Pressure builds throughout the region, and the seafloor swells until the fury of it all invades the water and the volcano in front of us blows her top again. She tosses rumbling explosions into the sea, ejecting superheated balls of liquid rock that scribe large streaming tendrils in their wake; as they do, sea water hisses as it turns to steam, and bubbles crack as they collapse.

Despite the resistance things have in water to moving fast, these lava bombs rocket upward, scribing damped ballistic trajectories. And the gas within the lava bombs expands with height until the proto rocks explode and each fragment of them assumes a new trajectory, leaving steaming tendrils of their own.

Freshly made volcanic glass rains down on Magellan, and still he does not care; he's made of sterner stuff, you know.

"Admiral, Magellan's temperature gauge is no longer functioning. His temperature has exceeded the limits of its specifications."

"Very well, Dr. Jones, bring Magellan home. We don't want to lose an old friend."

Magellan ascends from a bulging valley floor, but he's not coming up alone.

Darwin's Castle

Late last night, we passed the last volcano in a string of sleeping volcanoes, and soon after that, the last layer of volcanic rock dwindled away. But echoes from Ramona's song revealed scattered patches of mineral deposits sitting on top of the basement bedrock. The floor fizzed with methane gas and carbon dioxide bubbles.

The bottom changed quickly after that, developing a solid, crusty layer of sulfide ores, and, before we knew it, the floor was thick with precious minerals and peppered with thermal springs.

As we made our way east through the rift, irregular mounds of crystalline mineral deposits replaced the thermal springs, and through each boiled hydrothermal fluid.

That is when Ramona found herself at the base of a terraced escarpment, and at the top she found a great wall with battlements, a gate with pillars crowned with onion domes, a gatehouse, and two towers connected by a bridge. She sailed easily over these to find an arch to nowhere and a castle keep built upon the ruins of an ancient mineral reef. And from each one of these, some sort of hot fluid seeped or boiled or bubbled. And plumes from all over the escarpment billowed up into a turbulent layer of cloudy black minerals.

Needless to say, Ramona's images got everyone's attention.

That was an hour ago. That was when Admiral Martin called Captain Deverough in the control room and said, "Captain, this is the admiral. We're recalling RAMONA. I'm taking the diving bell down to see firsthand what is down there."

Bell

"Well, are we ready to go?"

"Yes, Admiral."

"Do you have your long johns on? It is going to be a long, cold journey down to the bottom and back."

"Yes, Admiral."

"Chief, secure the bell door. Are we ready?"

"Yes, sir."

"Go ahead, Chief, flood the bay." And on his order water floods in covering Bell, then the bay hatch opens, followed by gears engaging. The cable plays out, and we are on our way.

"Dr. Jones?"

"Yes, Admiral?"

"It's okay to breathe."

But the long, cold journey down is just starting, and William sounds Bell's progress by marking the distance from the bottom: "Ten thousand feet, bell-to-bottom."

Bell's spotlights light the way, and there is nothing at all to see, but over the faint hum of electronic equipment and the breath of Bell's four passengers, you can hear seaquakes along the central valley shaking vibrations into the sea.

"I'm cold, William. Will you sit with me and share your warmth?"

"Surely, Dr. Jones," and William disappears into the oversized parka Dr. Jones is wearing.

Then she asks him, "William, what animal can jump higher than a house?"

He thinks for a while. "Gee, I don't know. A jumping spider?"

“No, you’re silly. Almost all animals can jump higher than a house because houses can’t jump.”

“No, I’m not silly, you’re silly.” But the distraction doesn’t work. It is still damned wet and cold out there, and we are still headed down.

Backscattered light from below holds out a fleeting hope that we have reached the bottom.

“I see light below. Are we near the bottom?”

“No, William, we are not nearly deep enough. Look at this indicator. This is our position, and this is the bottom. We’ve got over two thousand feet to go.”

“Well, Bell’s floodlights have reached something.”

The admiral shifts his attention from the control console to the porthole view. “It’s most likely a thermocline separating two distinctly different layers of water,”

Bell sways from slightly tilted one way to slightly tilted the other, jumbling its occupants. Admiral Martin warns Bell’s occupants: “Hold on, we may encounter some turbulence as we pass from one layer of seawater to the next.”

Then, ghastly crooked fingers reach up and wrap themselves around Bell. She lurches. The appendages pull her into the eerie glow that her floodlights have been powering. Bell settles into a state of erratic slow-motion turbulence, and emissions from nebulous black algae stick to the porthole glass.

Lieutenant Jones

A blinding orange fireball exploded from the sea five thousand feet below Lieutenant Jones’s XC-108A cargo plane. It was the only warning, and there were precious few seconds between it and the flashes in front of her detonating shrapnel shells whose lethal contents promptly ripped through the cockpit window, killing her copilot immediately. Before the shock of seeing Catherine dead by her side set in, a second shell exploded below her, shooting sharp metal fragments through the wings. Three of her four engines caught fire, and the cargo plane headed down, engines screaming on either side of her.

Shaken by the wobbling plane and buffeted by atmospheric vortices, she grabbed the wheel, desperately adjusting her descent with the little rudder and aileron control she had left. There weren’t any visual cues from outside or any way to mark the passage of time or space; up and down lost meaning. It was a long trip that ended abruptly as the XC-108A cargo plane slammed into icy North Atlantic waters.

***

“Six hundred feet bell-to-bottom.” William’s voice breaks the memory she’s caught in. “Dr. Jones, what’s wrong?”

“William, ‘accommodate’ is a very hard word to spell. Spell it.”

“A-C-C-O-M-M-O-D-A-T-E, accommodate,” he responds in his best spelling bee voice.

“No, you’re wrong. It’s I-T.”

“Dr. Jones, you’re silly.”

“No, you are silly.” But it doesn’t help. She is still consumed by the memory of being adrift and alone in the icy-cold North Atlantic, watching what’s left of her cargo plane sink beneath the waves.

Finally, Bell sinks beneath the milky black haze and settles down. Her floodlights fall upon a vast, open space traced through by black, smoky plumes wafting up, feeding the inversion layer we just passed through.

Admiral Martin steers a meandering path through thermal eddies, following the nearest plume down to its source.

Bell’s passengers remove their Arctic garb. “It’s hot in here.” The water has grown black and angry, as William reports, “Two hundred feet bell-to-bottom.” Then, two hundred feet off the valley floor, Bell finds herself hovering but a dozen feet from the top of a tall chimneystack with its vent feverishly spewing out seething black steam.

Fine white eels, seven to eight inches long, swarm and squiggle up to meet Bell, slithering through the water from the rim of the vent, and when they reach her, they strike her titanium hull and latch on to a mineral they have never tasted before.

Bell is witness to a rich, fertile, and crudely built chimney covered over every cubic inch with colorful patches of living organisms. Bright yellow filaments of some extremophile billow in the shimmering heat, and piles of tiny shrimp comb through it looking for particles of food they have evolved to exploit. Tiny crabs snip the filaments at their roots. Dr. Hansen is giddy. “Admiral, collect samples!” Bell’s right robot arm sucks in colorful soup. “Dr. Hansen, it will take you a decade to identify, classify, and catalog them all. Now, do you think your investment in this expedition was worth the cost?”

William counts out loud: “One, two, three, and four—two grown together—five, six, seven, eight, nine, and ten. I can see ten other chimneys from this window.” But tall, black, smoking chimneys are not all that is out there. Crude columns connected by bridges and delicate spires fill the spaces between. “It looks like a medieval castle.”

Dr. Jones adds, “I expect a dragon to come out of the middle of it,” and they giggle.

Admiral Martin takes Bell down another ten, then twenty, then thirty feet, passing lumpy layers of porous anhydrite. The chimney’s width is twice Bell’s size, and thousands of tiny escape routes emit streams of fizzing-hot gas to which cling tiny teardrop-shaped copepods—with transparent exoskeletons, two pairs of antennae, and a single bright red compound eye between them.

Bell plucks a foot-long shrimp off the chimney with her right robot arm and brings it to a porthole. Thirteen pairs of legs, engaged in blurry motion, are held in place with a metal claw. “Let it go,” William pleads, as seven running, six kicking, and three pairs of steering legs execute a flighty path back to the chimney. Dr. Hansen scolds, “You know we are here to collect samples of deep-sea life to bring back with us, don't you?”

“Yes, sir, I’m sorry. I felt this shrimp was special and that we should leave it here.”

“It looked pretty standard for a shrimp.”

“Except,” Dr. Jones says, “the shrimp—think of the meaning of the word, Dr. Hansen—is the size of a lobster and royal blue.”

Then, Bell picks another shrimp off the chimney and tucks it into a sample compartment.

“Well, as we are all taking souvenirs back, I want a core sample,” says the admiral and Bell’s left robot arm exchanges a grasping claw for a carbide core drilling bit and presses into the chimney stack while her divert and attitude control systems push so the drill bit has maximum thrust.

It doesn’t make headway to begin with. But the whine of the drill shifts to a lower pitch, and the chimney wall succumbs to the drill’s persistence, unleashing a jet of superheated steam that slams into Bell, setting her spinning; centrifugal force flings Bell’s occupants into the spherical bulkhead.

“Anyone damaged?”

“Dr. Jones, you’re bleeding. Let me help you.”

“It’s nothing, really, just a little bump. Don’t miss anything,” as she returns to the porthole she was sitting by.

Protected by spiral armor swirling yellow and orange together, an army of snails munches their way up the stack.

Bell reaches the base of the stack, hovering over a field of juicy, foot-long mussels. They open to receive us, thousands of black, shiny lips split open to reveal thousands of soft, gooey tongues.

It

From the far outlands of Darwin’s Castle, where hydrothermal water upwells through ancient mud, a change in the Earth’s magnetic field, or the speed at which it spins, wakens an abyssal creature. The essence of it stirs from an ancient site that its ancestors once ruled.

It has no particular shape to begin with, let alone a means of locomotion. But a primal urge starts *it* on a journey that will take it through the ages from the time it was laid down in these ruins to sleep to the time of Darwin’s Castle.

At first, it flows with the migrating seawater filtering through fractures in basement bedrock. It knows only to follow the water. It doesn’t know why. The word has no meaning.

Then, it feels warmth and likes it. It feels minerals and likes them. It gets caught up with hydrothermal water shooting out of a fissure and is jettisoned into the sea, which is cold.

It flows with the current unencumbered, not knowing itself. But after a time, it settles on a featureless bottom nestling near a hydrothermal vent to keep warm. It has its first real meal of chemosynthetic bacteria. It is content. However, deep in its memory, there is a great rift where the seawater touches the mantle. *I must go there.*

So it sweeps through sediments, hardly discernable from the mud that surrounds it, but at least it doesn't need the seawater anymore to carry it places, although it doesn't know that yet. All it knows for an extremely long time is that it must move toward heat and minerals.

It doesn't understand the concept of time, but time passes, and during that time it becomes aware of the sea and seafloor surrounding it.

At some point it needs to sleep, so it does. As a matter of fact, it sleeps often, and when it sleeps, it dreams. And when it wakes it thinks, especially about what it dreamt. And its dreams are of heat and minerals and chemosynthetic bacteria. *That was good,* it recalls.

It doesn't have anything that could be classified as skin at this time, but cells have developed with an affinity to each other and seem to like the idea of sticking together, and they find, after a long time, that (if they work together) they can surround and protect other cells, and those cells don't seem to mind being contained, so the two coexist—each doing what they do best.

But that's not all. And this takes a long time for it to realize. Its cells on the outside bring cells on its inside some of the ooze it is traveling through. Most of the ooze contains minerals that it has known since the beginning of time, but the rest is something else that it likes: call it food.

It is confused. Parts of it want to eat, parts of it want to move, and parts of it want to guide where it goes, although it still isn't sure where that is. But it knows, above all else, that it wants to get there.

So it pushes toward the heat, but nothing happens. It pushes. It pulls. It goes nowhere because it is pushing and pulling on itself only. It thinks and tries again, and then finally, it pushes part of itself toward the heat, which is forward for it at the time. The part it manages to push forward is not much to speak of, just a nub, and a temporary nub at that. *What could I possibly do with this?* It thinks. It tries. It pushes, it pulls, it pushes and pulls at the same time and finds it can make many nubs and move them around, and then it discovers it can push itself forward while moving the nubs backward through the sediment. *Now, this is more like it.* But it doesn't understand.

It travels this way for a long time. The moon orbits the Earth. Magnetic fields grow and fall. Huge bedrock blocks, formed at the rift, are shoved into the sea by the mantle. Ooze settles down from above. Precipices drift out from the rift. It's exhausted by now, you can imagine, so it sleeps, and for a very long time.

When it wakes, it is little more than a puddle of goo, but its external membrane changed while it slept. It is now much more than it was. It knows wanting for the first time, and it wants what it remembers, and it remembers an ancient land that its ancestors ruled, and they intended that it inherit it, and it wants it all. *I must go there.* It is overcome with the urge to migrate. So the puddle of goo pulls itself together, lifts as much of itself as it can off the bottom, reaches for the heat until it can't reach anymore, and falls back down on the bottom, exhausted. This is the hardest thing to do that it can remember. But it is not easily discouraged, so it lifts itself up again, reaches for the heat, and then lays itself back on the floor. It likes how this feels and does it again and again.

It comes to know hunger and learns to eat on the move, filtering organic debris from the ooze that it travels through. It still doesn't know where it's going. It knows only that it wants to get there and the general direction to go, so it does what it can with that. It draws itself up, leaning forward, and then relaxes again on the bottom, making headway; it feels with each step.

It thinks about what it has learned: about heat, about moving, about eating, about wanting, and about doing something about these things. It has will, and it dreams. And the ideas that it has shape its future.

It passes a rout of gastropods migrating. It passes a cast of crabs picking over migrating gastropods. It's going home although it has never been there, and it travels until it is truly exhausted.

I can't remember being this tired. It feels it has come to the end of its life. So it covers itself with a blanket and hides. But it thinks: *This can't be the end of me.* As it hides, it sleeps. As it sleeps, it dreams. As it dreams, it thinks: *If I had better control of my shape, I could reach farther with each step that I take*.

When it pushes through the membrane it slept in, this could hardly be called a birth, it emerges looking much different. It is long and thin, with a circular mouth at one end and what looks like the same at the other. At the cellular level, you might not see the difference at first. But in form and function, there's quite a difference.

It knows what it needs: heat, minerals, and food. It knows what it wants: home. To that end, it reaches for them. It had developed a part of itself that knows what to do, and it leads with that part—let's call it a face, for it's hardly a head, just cells that know heat and cells that know minerals and cells that know food. It lifts that end off the floor and reaches for what it needs and wants. It stretches, and then it touches a place on the floor. This is new. This is warmer. This tastes good. It wants more of this.

Now what? I can't just lie here flat out on the floor.

So it thinks, and then it does something new. It lifts its aft end off the floor and tucks it next to its face. Now it's stuck in the shape of a vertical loop, and it doesn't know what to do next. It stands there, confounded. And it thinks for a while. *I don't have much of a choice.* So it lifts its face off the ground and reaches for the heat that's in front of it, stretching as far as it can, and then, after a while of deliberation, it puts its face back into the ooze, something that has worked for it in the past.

As it proceeds in this primitive way over ripples bubbling up through the ooze, it notices a moving lump on the floor: a slug. *I want that; it looks good.* It buries its face in sticky green mucus and sucks in as much as it can. *Not bad. I want more.* So it burrows deep into the slug and eats and eats and eats until it can't eat anymore, and it curls into a ball and sleeps. It dreams. *I am more than this.* It dreams. *Filtering detritus from ooze and sucking in slugs is just not good enough.* It dreams.

When it wakes, it has a head with two eyes and a mouth with horny tooth ridges and a throat at one end and a tapered tail at the other. It's flat on the bottom, arched on the top with a dorsal

ridge that runs from the top of its head to the tip of its tail, not to mention it has grown four legs.

To say it was hungry when it woke would be putting it mildly, but it lies there a while, licking what's left of the slug, watching a wave of crustaceans scooting through filamentary algae packed tightly for warmth. *That's odd, I never noticed them before.* Then it notices flashing red antenna. *That looks good*. And it stands on four legs for the first time and pounces on the flashing pink crab it was watching. *This is more like it*, it thinks as it swallows the crab in one bite.

It runs wild with excitement. *I'm almost there.* It races on all fours toward the heat, grazing on red seaweed and crustaceans and fry. Its dorsal ridge sprouts spikes. It had crossed millions of years in time on its journey from the ancient ruins to this place, and it stands at the perimeter of a new kingdom, feeling heat and tasting minerals. *This is mine to conquer*—at least that's what it thinks. *Why else would I be drawn to this place?*

It runs full speed on all fours, weaving its way on a meandering path around chimneys and spires, chomping on paper-white tubes housing blood-red worms. *This is it. This is my home. I'll take this all and make it mine.*

At this time, it is compelled to climb to the top of the tallest chimney it can find, so it searches and finds one suitable for its position. *I will climb that.* But it is tired. *I must rest first.* It curls up on a shelf amid a field of black mussels. *I can have those for breakfast when I wake, and then I'll climb the chimney*, it plans.

Octopus

"Something big is down there. I can see shadows moving," William says, as Bell reaches the end of her cable. The shadow of a creature lurking near the bottom falls up on her.

Admiral Martin rings the control room. "Captain, I need fifty feet more of cable. I can see a small plateau at the base of the chimney that can accommodate the bell. I want to put her there."

"Admiral, Chief Bronson reports the bell is operating at the high end of its safety margin."

"I know that, Captain Deverough. I would not be calling otherwise. Override the automated safety protocol and give me fifty more feet of cable."

"Admiral, we are releasing fifty feet more of cable to you. This will use twenty percent of your emergency reserve. And, Admiral, tectonic tremors are strengthening. Can't you feel it there?"

"At the first sign of danger, you can pull us up. For now, let us go." The captain's not sure if the admiral has made a request or given an order. Either way, a few minutes later, Bell settles onto the bottom with a thud, dislodging swirls of blue-green glowing muck that cast Bell's shadow upward.

"Are we ready for lights out?" Admiral Martin powers down Bell's systems, turns off her exterior floodlights, and extinguishes the last bit of safety lighting. This plunges Bell and her

charges into deep-sea dark. They wait for their eyes to adjust, searching for glimmers of bioluminescent light, which they know is there.

As darkness fades, a soft green silhouette of the chimney towering above them comes to light. Filter-feeding diatoms linked in vast chains of lace and filigree work their way to the top.

Blue fire algae strung together in garlands decorate an arched portico. A cave, with ruddy red light spilling out, harbors a creature moving around that casts shadows, or maybe it's just seaweed billowing in swirling currents.

Dangling a bioluminescent barbell at the end of an antenna as a lure, a set of ferocious jaws packed with long, piercing teeth walks on four feet across the blue-green patio upon which Bell is perched. And *perched* is the word because behind her there's a gaping fissure thirty feet wide by one hundred feet long and who knows how deep, but it must be extremely deep because hydrothermal water is boiling out.

"It's like Rockefeller Center at Christmas at night." Scattered patches of twinkling cobalt-blue coral decorate the portico, placed gracefully near the columns. Flowers bloom from barnacles, flashing yellow petals around orange centers.

Sharply defined, the digestive tract of a transparent jelly slides through the colors of the rainbow: red orange yellow green blue indigo and violet while a giant transparent gelatinous maw outlined in true blue follows her through the portico.

It

It dreams of a cloud of pink jellies trailing pink, sticky tendrils dotted with blue-green lights. It dreams of little fish peeking out of their shelters. It dreams of deep-sea squid stalking green bomber worms and large red kelp fronds billowing in the current.

It wakes from deep, deep sleep, thinking: *Something's nearby*. It cracks open one eye and spies a mess of eels slithering through the vaulted entrance of a cave, sliding along on bioluminescent suckers. *How attractive*, it thinks. As it has "being an eel" in its memory, it can appreciate their slim, streamline form. *This is too easy*, it thinks*. The food is coming to me.*

It bides its time and watches, distracted by the goings-on in the mussel bed around it.

With a purple eyespot on the end of each arm, a spiny-skin sea star sneaks on top of a wary and tightly closed black mussel. The mussel turns to stone. Leaving slack in his arms, the star straddles the bivalve, adjusting and readjusting hundreds of pairs of tiny-tubed feet. The black mussel prepares for a struggle. He is the favorite meal of the star, and he knows it.

Meanwhile, it wants breakfast. It was looking forward to eating the bed of mussels that it slept in, but now it would much rather have the eel with the broad flat head that's patting its way along the patio, snaking in its direction. So it bides its time and watches.

The star latches on to the stony black mussel. The mussel intends to resist as hard as he can. He is sure if he keeps tightly closed, the star will give up and move on. Keeping his tiny-tubed feet at low pressure, the star straightens his arms and parts the bivalve with ease. The mussel's laid open in panic. He's frightened almost to death. He pulls and he pulls, trying to close himself up,

but he fails. It's diabolical what the sea star does next; he pushes his stomach between the parted bivalves and wraps it around the soft body inside. *If only I could close myself up*, thinks the mussel, *I'd separate that star from his stomach*, but the mussel is shocked as he thinks his last thought: *I'm being digested alive by that star, and he didn't even have to pull me out of my shell*.

Then, a community of crabs wanders by, picking at bioluminescent snails. There was a time, it remembers, that both the snails and the crabs would have made a wonderful meal, but now, *the crabs can have the snails. I'm going to eat those big eels that are creeping their way toward me.* So it bides its time and watches.

Cautiously, the giant, bulbous body of an octopus glides out of the vaulted entrance to her cave, joining the distal ends of her arms that have been exploring her portico for food. Curled and contorted, the way only octopuses can be, she skulks across her patio, displaying her mouth, with its formidable beak, rimmed with luminous green polyps dangling down; they are distracting. The crabs change direction.

That octopus will make a fine meal.

Unfortunately, for it, the octopus has known all along that it has raided her lair. *Does it think I am so distracted by the thought of eating crab that I won't pick at the flesh of a four-legged beast made of muscle?*

It lunges toward the octopus.

Prepared for a fight, as octopuses usually are, she thrusts four arms out to encounter it while shielding her precious bulbous mantle with the four other arms. The octopus's arms don't stop it; they don't even try as it expected. Instead, the arms wrap around it, pinning its front legs to its stout body and squeezing hard. Before it realizes what the octopus is doing, the octopus has engaged all eight arms and is enjoying squeezing it to death and wondering what it will taste like.

The two creatures wrestle for life—in a battle to death, both are sure. They roll over each other, launching luminescent plumes of crushed and mangled creatures into the current. The octopus thrusts with her beak. It parries with its jaws. They crash into a stand of blood-red tubeworms that bleed red archaea into the sea. It is a terrible battle. They rip at each other with neither likely to win, and it feels fear for the first time. *Surely, it is not my fate to die here. This is my place. This is my castle.* And it pulls from a memory deeply buried how to fight many foes at once. *I am, after all, a Dragon.* It develops a blunt head with a snout; its jaw doubles in strength, and the end of each leg sprouts three claws.

Then the Dragon stands on his hind legs and shakes his tremendous torso, trying to fling the octopus off his back. But the octopus clings tightly with all eight arms now.

How can I be rid of this thing? Is this why my ancestors perished and placed me out there all alone to think through the ages?

The Dragon leaps at the chimney he slept under, crashing into the pillars supporting the portico, crushing the octopus's body against the cave wall and undermining the chimney at its base.

The portico topples and spills out onto Bell, knocking her over, leaving her dangling precariously over the fissure, held up by her cable, which was stretched to its limits. It gets sweltering inside Bell.

Then the chimney above them cracks open, tumbling onto what's left of the portico, the patio, and Bell. And Bell is trapped at the rim of a bottomless fissure, dangling precipitously in the dark chemical soup bubbling up, being boiled alive.

"Captain, execute an emergency ascent of the diving bell." Admiral Martin powers up Bell's systems, but most of them don't come on. They're operating on emergency battery and dedicated to life support.

The Dragon is wild with excitement. He even forgets to eat the octopus that he waited so patiently to attack and fought so hard to defeat. He bounds up the ruins of the black smoker, severing clams from their anchorage points and swallowing them whole, shell and all.

He plunges into a school of deep-sea tarpon; those nearest to him sound an alarm. He swipes at one with his claw, piercing the tarpon's twinkling sequenced scales all the way through to its gut. As he devours the tarpon, he admires his claws and exclaims: *This sure beats being a worm.*

"Captain, execute an emergency ascent of the diving bell," Admiral Martin repeats his order, only louder. But Bell's cable was damaged in the avalanche; her communications and power lines have been severed.

"Admiral, are you okay?" Captain Deverough shouts into the mike, but there's no answer.

"Captain," Dr. Burgess reports from the science station, "the bell's cable has been damaged, and communications are out. They probably don't have control of the cable. I recommend you execute an emergency recovery of the bell."

"Chief Bronson," the captain calls the chief in the auxiliary launch bay, "execute an emergency recovery of the bell."

Chief Bronson engages the reel, pulling just a few inches per second, but it slips. "Captain, I'm having trouble engaging the bell's cable. She's at the end of her line. I don't have enough of it to grab on to."

Dr. Burgess offers a solution: "Captain, put slack in the cable and the reel will engage."

"That would mean increasing our depth. How much would it need?"

"About fifty feet."

"Near crush depth again." He mumbles. But it is the admiral at the end of the line, so he tells Dive to take us down slowly, and by no more than fifty feet.

"Yes, Captain, I understand."

***

“We’re moving up!” William shouts.

Bell moves up a few feet. Then a few feet more. And then ascends, passing the ruins of the toppled black smoker.

What is that? The Dragon spies a large, bulbous body. *Did I not just kill that octopus*? And in fury, he leaps from the top of the ruins toward Bell making an escape. On the way, his front legs grow fins to steer with, and between the spikes on his back he grows skin.

Bell is racing up to me as fast as she can.

The Dragon follows her. *I’m going to eat you in one bite*. He flings a frilly hood that has grown around his neck wide open toward the creatures inside looking out. His jaw is huge, his mouth is open, and he has a short, stout tongue. A large, dark eye fills the porthole window.

Dr. Jones disappears into Admiral Martin’s arms.

“Dr. Jones, get hold of yourself, you’re scaring William.” And he winks at William.

The Dragon pokes Bell with his teeth. He licks her with his tongue. *This is not an octopus*. The Dragon is disappointed. *And it doesn’t seem to be worth eating.*

Bell quickens her escape.

The Dragon’s front fins morph into wings.

Bell is nearing the yellow-green algae layer she passed through on the way down.

The Dragon is flapping his wings wildly, circling Bell as she goes.

Bell penetrates the ceiling, dislodging vortices of disturbing yellow-green clouds.

And don’t come back! You will have to contend with me if you do.

And the Dragon grows a long mane and a beard.

***

“Doc Lexi, I have something for you.” Admiral Martin hands her a beaker of green ooze he collected. This is not ooze made of tiny exoskeletons that accumulates on the ocean floor. She sniffs and wrinkles her nose. This is pea-green slime that smells bad. She puts the beaker on the table, pulls up a stool, and stares at the slime for a while and then at him.

“Well,” he says to her, “I don’t want you to date it. I want you to look at it under a microscope.”

She picks up a glass rod and dips the end into ooze that she dabs onto a microscope slide. “Are you sure this is safe to have in sick bay?”

“What could be wrong with it? It's from the surface of a hydrothermal vent; its home is a toasty four hundred degrees Celsius. It won’t survive long at this temperature and pressure.”

“In case you missed it, Admiral, it’s crawling up the side of the glass.”

“Stop being such a girl. Let me know what you find.”

Doc Lexi stares at the organic matter in front of her and asks, “Well, can you cure cancer or the common cold?”

The Crab Pot

“What are you looking for, young man?” Standing behind William in Mission Bay Two, Dr. Hansen demands. It sounds like a question, but it is not. “Get on with it. Land your pot and deploy your robots!”

William has been steering his crab pot around, looking for a good place to land it. “I’m looking for polychaete—benthic worms.”

“I know polychaete are worms. I am, after all, the world’s leading scientist on benthic communities. Land your pot and deploy your robots.”

“I’m looking for food for them. I want to put the pot near a good source of food.” Ignoring Dr. Hansen’s impatience. “Here!” and settles his robot-crab pot near the decaying carcass of a once-menacing tiger shark, now covered with squirming scavenger worms. Their heads buried in macerated flesh, and aft ends waving cilia that strongly resemble spaghetti boiling in a pot. From the pot to the carcass is nearly twenty-two feet.

“Benthic monsters from the deep are the stuff of nightmares lurking in our thoughts.” Admiral Martin says from the mezzanine catwalk as he joins William and Dr. Hansen in Mission Bay Two. Dr. Jones is watching William’s robot-crab pot from mission control.

The first robot-crab climbs out of his bay, establishes himself on all of his six legs, looks around, and tiptoes an outbound course toward the benthic shark-feast, transmitting images of his path as he goes. Paper-white tubes stick out of the bed. They look like trees to Crab One.

Sporting four pairs of eyes, a bitter-lemon bristle worm snakes its way into Crab One’s path. Its head, sharply defined for a worm, fills Crab One’s field of view. The robot-crab looks up with his camera lens eye into a pair of movable stalks, each tipped with an eye looking down, meeting Crab One’s gaze looking up. Three other eye pairs protrude from a turret atop the bristle worm’s head at two, six, and ten on a twelve-hour analog clock, scanning the horizon for movement. Crab One doesn’t know what to make of it.

“Look at that! That worm has four pairs of eyes,” William exclaims, but then sees something that alarms him and yells, “Look out, Crab One, there’s another worm lurking behind you!”

Crab One reaches out to grasp his prize but from behind is knocked upside-down on his back by the worm of which he was unaware.

“Don’t your robots have right-siding algorithms?”

“No, Dr. Hansen. I didn’t think about that.”

“Too bad. You’ll probably lose several crabs because of it. If you’d told me earlier, I could have helped you.”

Crab One's camera lens eye records images of sharp, stabbing bristles penetrating every joint that he has. Crab One appears to be down and out, left in the muck near the shark-feast, and is seen later by Crab Five covered with flukes.

Crab Two steps out of his bay. Just as he settles himself in the muck, a luminescent orange-segmented annelid crawls up to him. Except for the pedipalps flanking the annelid's mouth, its face is unremarkable—what you might expect to find in your garden. Crab Two remains polite. He doesn't want what happened to Crab One to happen to him, so he keeps his claws to himself. The annelid appears not to care, so Crab Two excuses himself and starts his long journey to the shark-feast, intent on getting one of those worms with spaghetti-like tails.

Crab Two makes it all the way to the feast, chooses a low-hanging worm, grasps it as carefully as he can with both claws, and starts to pull it ever so gently out of the shark. But the worm, eating in dead earnest, will not be pulled out; he stays latched deeply into tasty shark meat.

Crab Two pulls harder and harder. The worm breaks, and Crab Two finds himself holding its aft end, looking like a man offering his dinner date a bouquet of spaghetti.

Well, half a worm is better than none, Crab Two thinks to himself, *William will be happy with this*.

"Oh no. The worm broke in two. Crab Two didn't get the worm's head."

Crab Two suffers a split second of disappointment before the predatory luminescent orange-segmented annelid pushes his camera lens eye into the muck.

Crab Two is down, but not necessarily out.

Crab Three crosses ten of the twenty feet to the benthic shark-feast before a fluorescent-pink verme (as William will later name him), who seems friendly at first, is almost the last thing that Crab Three sees. The last thing Three sees is a set of extendable jaws—lined with murderously sharp teeth—shooting directly at him from a gaping-wide mouth.

Crab Four and Crab Five watch in horror as the fluorescent-pink verme tears off all six of Crab Three's legs and consumes them one at a time.

"Admiral, did you see that? That verme tore off Crab Three's legs and ate them."

The verme continues shredding Crab Three's carapace and consuming it until nothing is left.

"Yes, I did, William, and we should capture that verme. It might be a valuable find."

"But my crabs are made of metals and ceramics. Do you think a worm could digest it?"

"It might. It depends upon what chemicals he has in his gut. Are you up to sending another of your robot-crabs after him?"

Crab Three's down and out—eaten alive by a fluorescent-pink verme.

While Crab Four is still in his pot, a millipede with metachronal rhythm marches by. When it spies William's crab pot, it changes direction. That's when Crab Four first notices the millipede's

proboscis. It is not just any old proboscis, like a fly might have; it is one-third the length of the millipede's long body and luminesces maximum blue green.

It has no trouble locating Crab Four, who is still in his bay, by the way.

Crab Four sees the worm's head getting closer. It has three pairs of antenna, two tentacles, six eyes, and a pair of pits lined with cilia for tasting, not to mention the previously mentioned proboscis. It is larger than you might expect for the head of a worm, and Crab Four is taken aback. He doesn't know what to do. He's trapped in his bay looking out, and all he can see is the terminal end of the millipede's proboscis, which resembles an elephant's trunk. Now Crab Four is staring into a circular, lip-lined cavity that is surfaced with denticles spiraling into the millipede's throat. Then, the unthinkable happens. The circular lip on the proboscis latches on to Crab Four's camera eye lens and rips it right off his face.

"Oh, no. That worm blinded Crab Four! He can't see."

Crab Four is down in his pot and blind.

Now, Crab Five has a very important mission. The mission was Crab Four's, but Four lost his eye in a skirmish with the enemy and couldn't serve. Crab Five must capture the fluorescent-pink verme that consumed Crab Three. From what Crab Five saw of the verme, he knows he's in trouble. Even if he were to capture the verme, there is absolutely no way it would fit into his carapace. He's hoping Admiral Martin has a plan.

"William, can you operate two robot crabs at one time?"

"We've never tried it, Admiral, but Dr. Jones made an alternate command-and-control station at mission operations. We could try." The admiral lays up to mission control…

Crab Five and Crab Six step out of the pot together and embark on a journey to the shark-feast because that's the last place the fluorescent-pink verme was last seen. Keeping closely together for comfort, they cross the twenty feet from their pot to the shark-feast and start searching.

Crab Five is distracted by the squirming spaghetti scavenger worms buried deeply in the shark-feast because he knows William wants one, and he so very much wants to be the robot that brings it back.

Crab Five and Crab Six pass the place where Crab One was beaten to death by a bristle worm. A few small pieces of Crab One are left and covered in luminescent orange flukes**.**

Crab Five pokes at a hot-magenta detritivore locomoting with hundreds of electric-violet bristle-bearing parapodia and the head of medusa. It curls tightly into a packed spiral. Crab Five can't help himself. He picks up the roly-poly and stuffs it into his carapace. He thinks as he does this that it will be okay because he won't be needing this empty space; after all, the verme that they're after is so big that both he and Crab Six were sent out to carry it back together—if they can capture it, that is. He's not sure.

Then, it happens—a fluorescent-pink verme crawls out of a paper-white tube right in front of Crab Five.

A terrible thought crosses Crab Six's mind. What if each of these paper-white tubes is home to a fluorescent-pink verme?

Crab Five and Crab Six watch the verme emerge from the tube. It crawls over the rim, one pair of legs at a time. He's a perfectly good worm with lots of features, but all that Five and Six see is fluorescent pink and a million feet. They freeze in their tracks, not wanting to attract the verme's attention until they have formulated a plan of attack.

The verme heads to the shark-feast, using all of his one thousand legs, so coordinated that it looks like a traveling wave. Crab Five is mesmerized by the rhythm.

"How are we going to capture it, Admiral Martin?"

"In situations like this, William, it's best to come out swinging."

Crab Five dashes out and grabs the verme's aft end. It doesn't even have a tail to describe. When the verme realizes that he's being delayed, he swivels around to face his attacker.

Egad! The verme has three lips on the end of his otherwise featureless face.

Crab Six is in position to grab the front end, and he sees three lips unfold, at twelve, four, and eight on a twelve-hour analog clock, revealing a single jaw on the top lined with teeth built to dig in and latch on.

Crab Six grabs the mouth coming at him with both claws while Crab Five pulls the aft end backward as hard as he can.

What monster is this in front of me?

It is the things of which nightmares are built?

Further back, deep in its throat, the verme has a full set of jaws, not an upper and lower but rotated by ninety degrees so it opens horizontally. The verme thrusts the full set of jaws out of his muscular throat and catches Crab Six's left claw. Sharp, serrated teeth latch on. Crab Six pushes the verme's head toward the floor, twisting it upside-down as it goes. Simultaneously, Crab Five is running full speed toward Crab Six, drawing the verme into a loop, and as he goes he also twists the aft end, rolling the verme over so that his legs cannot touch the seafloor.

Then the two robot crabs march backward, dragging the upside-down verme in a loop all the way back to their crab pot.

On the way, Crab Five looks for Crab One but can't find him. It's probably the excitement, you know.

The verme is madder than…well, let's just say that the verme is mad. He twists and turns his body the entire. Crab Five and Crab Six hold on and get smacked together a few times. Finally, they reach the crab pot.

"I'll take his head in first." Crab Six crawls backward into the pot, pulling the verme's mouth and jaws in with him. The verme is injured, seeping green blood into the sea, and madder than ever.

Crab Six pushes the verme's face into the back corner and crawls on top of him, losing his left claw in the struggle. Meanwhile, Crab Five is pushing the aft end of the verme toward Crab Six, expecting Crab Six to help pull the verme in, when he notices that Crab Six is missing his left claw.

Crab Six courageously grabs the back end of the verme while still standing on the verme's face in the corner; he starts pulling but doesn't think he'll be able to do it.

Meanwhile, Crab Five is stuffing the verme from the back end into the bay.

"Admiral, you need to get out of the bay now."

Crab Six crawls over the verme and out of the bay; then he helps Crab Five push the rest of the verme into the bay and secures the bay door and doggs it down.

Both Crab Five and Crab Six are exhausted.

"We did it, Admiral Martin. We captured the fluorescent-pink verme that devoured Crab Three."

"Yes, we did, congratulations. Those are fine robots you built, William. Your dad would be proud of you."

Crab Seven decides to do something different. Instead of heading toward the shark-feast, he decides to set out in the other direction. He reasons that the worms so far encountered are exceedingly aggressive because they have something valuable to protect. So Crab Seven climbs out of his bay and sets a course in the other direction.

Crab Eight watches him go. Crab Five and Crab Six are too tired to watch.

After a walk of ten feet, Crab Seven encounters a mass of scavenger worms pushing their way through the muck with their faces buried up to their movable, eye-bearing peduncles.

"Finally, a worm that is smaller than my robot crabs."

Crab Seven saunters up to an outlying scavenger, grasps an electric-blue end with his claws, and starts stuffing it into his carapace.

"Wow. That worm is longer than I thought. I hope it all fits."

With the worm fully stuffed in and his carapace secure, Crab Seven heads back to his pot. On his way back, Crab Seven accidentally treads on a few dozen nematodes that are resting, and that annoys them. They were sleeping. Now they are awake and hungry. They smell the scavenger worm tucked tightly in Crab Seven's carapace and decide to go after it. The first reaches up to one of Crab Seven's rear legs and starts weaving its way in and out. The rest get the idea and join in the fun.

"Crab Seven is in trouble."

Crab Eight knows it and decides to help. He races as fast as he can to Crab Seven's defense. When he arrives, Crab Seven is faltering. Crab Eight knows the nematodes have the advantage.

Hunkered in, they have absolutely no intention of relinquishing the rights to the scavenger worm sequestered within Crab Seven's carapace.

When Crab Eight arrives, he's ready for war. He will give all he has to bring Crab Seven home to William. Crab Eight starts snipping between Crab Seven's legs, trying to sever the nematode's hold. He keeps at it.

Oddly enough, though it couldn't be considered a plan, Crab Eight's strategy works, and soon Crab Seven has the use of his legs.

"Go, Admiral. Run for the pot. Get safely inside. I have your back."

Crab Eight stands abandoned, all of William's attention being given to Crab Seven and his prize scavenger worm. But then Crab Eight notices sections of nematodes squiggling all around him. He picks up as many pieces as he can. *William will love me for this*, Crab Eight thinks to himself.

Both Crab Seven and Crab Eight make it back to the pot with scavenger worm and nematode pieces.

***

"This was the best day ever! Thank you." William wraps his arms around the admiral's chest, and the admiral hugs him back.

"Well, young man," Dr. Hansen says, "I hope your pot's compartments are strong enough to keep the water pressure at sixteen thousand feet. If not, expect your precious worms to look like gelatinous macerated goop by the time they get up here."

"Oh, no! Do you think so?"

The admiral barks, "Dr. Hansen, that will be enough."

"Admiral, is Dr. Hansen right? Do you think my worms will survive the change in water pressure? Will there be anything left of them?"

"We will do our best. I've seen deep-sea creatures survive. Maybe yours will too."

***

What's this feeling, Dr. Jones?

What feeling is that?

I spent today with William and Admiral Martin. I thought it would be fun, but now I feel bad.

I don't understand.

I like William, but right now, when I think about him, I feel bad. We spent the day with Admiral Martin, and neither of them knew I was there.

Expedition*, I believe you are jealous.*

Jealous?

You want something that William has; you may even resent him for having it.

What's that?

Admiral Martin's attention.

Does it have to be this way?

No. Talk to William and be happy about what he has. Be happy that Admiral Martin has William. Consider those things and that which you do share with the admiral; do not let yourself dwell on what you want that others have.

***

William, what's wrong?

I'm a little sad.

Yesterday was a wonderful day for you. What reason do you have for being sad?

I miss my dad.

Your dad?

Yes, my father was an inventor and engineer. When I was small, he would read to me about robots. We loved robots. He read I, Robot *to me, and we watched movies like* Forbidden Planet, *starring Robby the Robot, and* Lost in Space*. We built robots in the basement. We were designing the crab pot when he died.*

Your dad died? That is sad. I'm sorry.

I built the crab pot by myself but pretended we built it together. I was just remembering that time.

How did you come to know Admiral Martin?

I entered my crab pot in a national science fair. I won first place—did you know that? Admiral Martin came to my house and spent a day with me. Afterward, he worked it out with my mom that I would intern with him at Martin Marine Enterprises and take independent study classes until I was old enough to enter Annapolis.

He taught at Annapolis; you know.

And Captain Deverough was his student, but I don't think Captain Deverough likes me.

Is Admiral Martin like your dad now? I love your robots.

Admiral Martin

We spent two full days camped over Darwin's Castle collecting mineral and organic samples. Admiral Martin, sole proprietor of MME, owner of five deep-sea research vessels including one nuclear-powered submarine, is in his bunk, unable to sleep, and thanking God for his grace. He never expected to find such a promising spot for prospecting, but it is the reason he built me.

He was preparing, in his head, just how he was going to hijack his own expedition. This segment of the rift contained enough precious metals and rare earth elements to take his country into

the twenty-first century. But he knew he couldn't mine Darwin's Castle. It was too much of a gift to damage it any more than he had already.

So he decided to divert Ramona's path by turning her ninety degrees to port and explore the seabed on a perpendicular course that would take us back in time to find the remnants of a now extinct ancestor of Darwin's Castle. If the magma chamber beneath the rift was stable in its fury, and the spreading rate constant, he might even find a strip of mineral deposits all the way to the foothills.

At the morning meeting, he announced his decision.

Filamentary Archaea

There was a time when they thrived, bathed in rich, warm water, and life abounded around them. For them, it was a time of growing wildly in fine filamentary threads, a time of reaching out, of swirling with others of their kind. It was a time of exploring and colonizing for them, and they had so much to give that they freely gave of themselves to other creatures so that they might thrive too.

That is how they lived, billowing in thermal rises, but that was a long time ago, and they do not experience the passage of time like you and I do, so they cannot say how long ago that was. Now they cling desperately to scattered stones dropped by ice in water that's grown cold, and all that's left of them are seeds of what they were, and they cling to life in meager thermal water, waiting for something to come along and give them life again.

PING. It is a natural mathematical progression of acoustic waves that takes thirty minutes to complete. It reaches out in all directions, probing for things unseen.

That is when Ramona's ping touches the ancient residents of a long-dead colony, and the seeds of what they were sprout and grow rapidly in length, soon being long enough to catch Ramona's sonic wave and follow it to its source.

PING. They shoot through abyssal water, arrows seeking their target, racing toward her. She brings hope of a future and a sea that will thrive again.

Then it happens that reflections of Ramona's ping bring back news of crystalline minerals sprawled over bedrock blocks formed half a million years ago, and it also happens that filamentary archaea that lived within those bedrock blocks strike Ramona's sonar windows, latch on to them, and cling desperately to her, greedily absorbing her energy.

"Captain Deverough," the admiral's call comes into the control room, "stop your advance. Hold RAMONA stationary over the seafloor." So the captain points me toward the top of a thermal convection current that is spiraling down the northern valley slope. Our heading is north by west. The deep tow wire runs down to Ramona, and she rides the bottom of the spiral current five hundred feet off the bottom. Her heading is south by west, but we are both traveling at zero knots over the seafloor.

***

“Something is wrong with RAMONA, Admiral.” Dr. Cohen’s voice breaks the silence of his thoughts. “RAMONA’s image is degrading.” Before he has the chance to respond, another call comes into his cabin. “Admiral, this is Crewman Wu. You’d better come to deep-tow-wire operations.” Not wanting to wait the thirty seconds it would take for him to lay below, he barks: “What’s wrong, Crewman Wu?”

“It’s the tension in the deep tow wire.”

“What about it?”

“You need to come here now, sir.”

“Very, well. I’m on my way.”

That’s when the third call interrupts him. “Admiral, this is the captain. I need you in the control room now.”

So he left his cabin muttering to himself, “When two things at sea go wrong at the same time, it is rarely a coincidence, although that sometimes happens too.”

That is when the emergency claxons started screaming because Dive punched the small red button…had we not been towing Ramona at the time he may have punched the big red button to blow the main ballast tank, but that would not have worked well, because we would have been rocketing to the surface that was covered with ice.

“Captain, what’s going on?”

By this time, the claxon had shocked the starboard watch out of sleep, and they were racing to their emergency stations.

“Admiral—” But before the captain had time to speak, Dr. Cohen was shouting over the ship-wide intercom: “Admiral, I’m losing control of RAMONA. She keeps veering off any course that I put her on.”

The captain resumed his report, “I can’t keep *Expedition* on station.” Large traveling waves had developed in the deep tow wire and were jerking Ramona around. “We could end up beneath our crush depth. I need to cut Ramona free.”

But the admiral did not want the delay. If he let Ramona fall, he would lose two watches retrieving her again, so he shouted over the ship-wide intercom: “Dr. Cohen, fold RAMONA up, we need to recover her quickly.” Then asks the captain, “What is our speed through the water?”

“Three knots.”

“Make it one.”

“We will not be able to keep this station.”

“That doesn’t matter now. I’m trying to save RAMONA and the deep tow wire.” And he sends Dr. Burgess to oversee the emergency recovery of the deep tow wire. But Ramona is not

cooperating with Dr. Cohen's command to button. "I've got them folded, but the latch won't engage."

***

That was six watches ago, and Captain Deverough had to cut Ramona loose. In her partly closed state, she fell five hundred feet to the floor, bounced, and rolled. You should have seen her when they pulled her into the main launch bay; that was three watches ago. She was covered with fine yellow threads six feet long, and they were stuck to her like glue, bonded to her sonar window.

"There are microbes over every square inch of it," Dr. Hansen said, referring to my love, Ramona. He did not see the damage to Ramona's sonar window; he didn't see the altered rubber window. For me, my love was gone. I thought she might never sing again. Her beautiful rubber window might no longer let acoustic waves through in either direction. I couldn't bear the thought of it, but Dr. Hansen was delighted.

"RAMONA's sonar window is ruined. Admiral, is there anything you can do?" Dr. Cohen pleaded. She was worried that the admiral might be unwilling to spend time fixing Ramona. But he scraped a tiny section of the filamentary archaea off the edge of a window, "Her surface has been etched by the filamentary archaea. We need to develop a method to restore it. Maybe the restoratives we use on the sonar domes will work…" He's not abandoning her.

"Dr. Hansen," Dr. Goeller responds to Dr. Hansen's delight, "Did you know that five hundred forty-one million years ago, plants and animals, primitive though they were, had figured out how to exploit almost every ecosystem on land and in the sea? That was the dawn of the Phanerozoic eon. Did you know that sixty-six million years ago, mammals and flowering plants developed? That period is known as the era of recent life: the Cenozoic era—"

"You will not believe this, Dr. Goeller," Dr. Hansen interrupts, "but yes, I know those things. What I don't know is why you are expounding on these facts when we have filamentary archaea here that most likely developed in a hydrothermal vent system half a million years ago. And yes, Dr. Goeller, I know that was in the Quaternary period and the Pleistocene epoch, which both started two point six million years ago. And I know the Pleistocene epoch, also known commonly as the 'Ice Age,' ended a mere eleven thousand seven hundred years ago when the Holocene epoch started. And yes, Dr. Goeller, I know we are living in the Holocene epoch, also known as the Age of Man."

"Yes, but did you know, Dr. Hansen, that the Age of Man spans but two percent of the time since your filamentary archaea thrived near the vent of an ancient hydrothermal system?"

Prospecting

After Ramona was on board and being fussed over by Dr. Cohen, the admiral deployed the hydraulic rotary corer to retrieve a core segment of the ruins. That was two watches ago. He laid the corer on the seafloor and engaged its hydraulic motors. That set the diamond tipped, steel boring barrel cutting through a half-million year-old layer of ooze, but it did not have far

to go before it reached its goal because half-million years ago in geologic time is nothing, for ooze collecting on the Arctic seafloor.

So, at the beginning of this watch, the first core segment was ferried up and laid upon the deck, and it contained twenty uninterrupted feet of rare-earth crystals. “Only two places on earth have ore deposits concentrated enough to make mining rare-earth deposits profitable.”

A party erupted in the auxiliary launch bay as the science teams dissected the first core sample. Cookie and Steward brought a cake decorated to look like Darwin’s Castle. A dozen off-duty crew followed them, with nothing but Cookie’s chocolate and vanilla checkered cake in their minds. They congratulated the admiral for his discovery.

We have encountered hitherto undiscovered sea life, seen underwater volcanoes erupt with staggering fury, mapped beneath all three major Arctic Ocean basins, ventured into the central rift valley of the northernmost spreading ridge on Earth, and discovered what is likely the richest precious mineral and rare-earth deposit so far found on the planet. He thanked them, all the employees of MME, the shipbuilders of Baltimore Iron Works, and God. “Without them, we wouldn’t be here.”

But Dr. Jones didn’t hear him and did not know there was a cake and a celebration going on around her. Her attention was fixed on a large, red rock near the bottom of the core sample. She wanted it. And I wanted her to have it.

And Dr. Jones was not the only one distracted. Dr. Cohen didn’t think she was lucky with Ramona out of the game. It didn’t matter that Dr. Burgess was working full time trying to fix Ramona’s sonar domes.

But Dr. Hansen was paying attention to the admiral’s remarks. “No, you can’t mine this fragile environment. Think of the destruction mining operations will cause. It will cover the unique life-forms living here, snuffing them out before we have the chance to know them.”

The admiral understood Dr. Hansen’s argument, as far as it was presented. But humans had been mining beautiful environments for thousands of years. Losing those places was the price of supporting civilization on Earth as it was growing. “Dr. Hansen, it will be less than a square mile in the middle of one million square miles, and three miles removed from the rift and Darwin’s Castle.”

Dr. Hanson did not agree with the admiral’s sentiment. He thought it was a lame excuse for greed. “But clearly life exists here. The recent attack on RAMONA proves it. How many species, like the yellow filamentary archaea, will you be killing to mine this area? Generators will run, operations will drone on endlessly, and the area will be covered with combustible fuel by-products. Trade routes will develop, and commercial shipping overland and by sea will follow.”

But all I was interested in was giving the red rock to Dr. Jones. I asked the admiral clearly: Give the red rock to Dr. Jones and tell her it was from me.

“Dr. Hansen, your arguments are made with undue passion. Both you and I, and everyone on this boat, make their living from the sea. Why is it that Frank Hansen gets to draw the line between what we get to take back with us and what we leave behind untouched?”

“Why is it you? Because you are filthy rich from exploiting the natural world.”

“Frank, think of all the extreme archaea you could collect from the mid-ocean ridges, all paid for by the pharmaceutical industry.”

“Work for a pharmaceutical company, me?” and answers his own question, “Never.”

“Frank, open your mind. You could study this magnificent environment for years if you wanted. You could be famous. Isn’t that what you want, Dr. Hansen?”

Admiral, I insist you give the red rock to Dr. Jones!

“I would never stoop so low as to do the bidding of a pharmaceutical company, not on the land or in the sea.”

“Frankly, I’m surprised at your naivete regarding the requirements and consequences of scientific exploration of the natural world. Who do you think is paying for this expedition? Do you think your grant money from the National Science Foundation covers our cost? It barely covers the food you eat.”

“Admiral, as a scientist, I take little from the natural world. I take small samples. I don’t threaten pristine environments.”

“But you are on my submarine.”

“So what?” And he knots his face in defiance.

“How much of the natural world do you suppose I altered to build this submarine and get it here?” I had to mine steel, aluminum, and titanium, and smelt it—twenty thousand tons worth. I had to mine uranium and strontium ore and concentrate it into nuclear fuel. I employed manufacturing facilities from every state in the union and almost every country in the world for the equipment needed to operate this boat…”

“What has this to do with me?”

“You are taking full advantage of MME to further your career…” But his voice trails off and his attention shifts to Dr. Jones handling the big red rock…

He leaves the annoying argument behind and joins Dr. Jones by the core sample. “Have you found something you like, Dr. Jones?”

“I think this is a garnet.”

“And is that something you value, Dr. Jones?”

“It sure is beautiful.”

“Take it. It’s yours.”

“For me? Thank you, Admiral.” She kisses his cheek.

She kissed him! Just wait one minute, Admiral. Tell her that the shiny red rock is from me. Dr. Jones, the shiny red rock is from me! Admiral, this is not fair!

Ellesmere Island Iceberg

Twenty thousand years ago, a single wicked winter storm laid one hundred fifty feet of snow on Ellesmere Island, a large island west and south of where I am now, on the northern edge of the Canadian Arctic Archipelago, although it was not an island at the time.

Since then, winter storms have added to the snow, making the great ice sheet thicker still. The peak of that ice age is over now, and while it may be drawing to a close, a glacier still resides on Ellesmere Island, and winter storms still lay snow on top of it, and the snow compresses, and gravity pulls it down to the sea where it forms great ice shelves studded with rocks and boulders suspended over the waves.

Five years ago, a great chunk of that ice shelf broke off and joined the Arctic circumpolar current that carried it west across the Canada Basin and into the Beaufort Sea. On its way, the Ellesmere Island iceberg collided with and joined several ice floes and two other icebergs.

Three years ago, in early spring, two C-130 cargo aircraft landed on the Ellesmere Island Iceberg *et alia* and deposited a research station including twenty polar explorers, half a dozen Arctic buildings, laboratory equipment, food, generators, snowmobiles, tanks of fuel, and equipment. The planes flew away and left them there. The explorers set up their living quarters and laboratories and started taking measurements.

Two years ago, the great Ellesmere Island Iceberg *et alia* (with its disparate ice floes, two minor icebergs, and polar research station) came upon the Alpha Ridge at a place where the prevailing current splits in two with part of it crossing the ridge and the rest circling south and then west around the rim of the Canada Basin. Well, the Ellesmere Island Iceberg *et alia* went south, and was caught in the Beaufort Gyre. It took three more trips around the Canada Basin, and with each trip, the Ellesmere Island Iceberg parted ways with some of its ice and joined with others.

Last winter, a violent storm brought together the Ellesmere Island Iceberg *et alia* and another old, hard ice floe. Gale-force winds fused the two, forming a pressure ridge with a sail thirty feet high and a keel ninety feet deep, and stressing forces created a network of cracks and leads on either side. It became an interesting piece of sea ice, old and hard and thick and crisscrossed with ridges and refrozen leads.

Six months ago, chance pushed the Ellesmere Island Iceberg *et alia* across the Alpha Ridge and into the Transpolar Drift, and its fate was sealed at the time. It was headed over the North Pole and into the Atlantic Ocean, where it would be given a designation by the International Ice Patrol and end its life headed south and melting.

Two months ago, it passed over the pole on a course toward the Nansen Ridge.

Consequently, we are here looking up at an ice lead filled with new ice because Admiral Martin has a rendezvous with Dr. Lennie Klebanoff, the team leader of the polar explorers living and working on the Ellesmere Island Iceberg *et alia*.

Lennie Klebanoff

It was the eighteenth day of a thirty-day patrol off the coast of New York and New Jersey. The USS *Torsk* could stay out for thirty days, even meeting with its submarine tender to top off fuel and food. After thirty days, *Torsk* needed five days in port for repairs and maintenance that her crew could not perform at sea, and also to swap exhausted crewmen for not-so-exhausted crewmen.

It was Bill Martin's fifth patrol commanding *Torsk*, but as commander of *Torsk* he had no downtime, and this meant he had been on duty for one hundred fifty-eight days out of one hundred fifty-eight days. His sole mission as *Torsk* was to hunt and kill enemy *unterseeboots* that were sinking transport and cargo vessels, leaving the ports of New York and New Jersey, and he did that twenty-four hours a day.

Dr. Lennie Klebanoff of Grumman Engineering had been on board for the last three patrols testing hydrophone designs for detecting enemy *unterseeboots*; they needed to be better. Things weren't going well with the war. Supplies were not making it to the front lines.

Captain Martin suspected that the enemy *unterseeboots* went into the Hudson Canyon to rest and refuel, but it didn't make sense. Submarines of the day were powered with diesel engines, and those engines ran for eighteen hours of every twenty-four to charge batteries that could keep them submerged and hunting for six.

But the enemy *unterseeboots* prowling the East Coast attacked and then seemed to disappear; no one had ever sighted one on the surface. On his second patrol as *Torsk*, he identified one of the *unterseeboots* when it launched a torpedo that sank the passenger liner SS *Leonardo da Vinci*. He chased the *unterseeboot* into the Hudson Canyon, but *Torsk* was a coastal patrol submarine with a three-hundred-foot test depth and a theoretical crush depth of five hundred; this meant Captain Martin could not follow the *unterseeboot* down, nor could he wait around to watch for one to come or go because they had to spend eighteen hours out of every twenty-four on the surface with *Torsk*'s diesel engine running.

On the first day of this thirty-day patrol, *Torsk* laid down a network of low-frequency hydrophones across the headwaters of the Hudson Canyon under cover of a moonless night. Captain Martin and Dr. Klebanoff designed and built the networked hydrophone system for the sole purpose of tracking the mysterious *unterseeboots*. The system was battery powered so it could record sound data during *Torsk*'s imposed absence, which amounted to approximately twenty hours before the battery died.

On the second day of this thirty-day patrol, and again under cover of night, *Torsk* returned to the hydrophone buoy and swapped the spent data recorder and battery for fresh.

Captain Martin and Dr. Klebanoff stood on deck, impatiently waiting for the recording device. "Take it down to the aft torpedo room, Seaman." There was nothing real time about this work, so the hydrophone system's sound spectrum analyzer didn't need to be in the boat's operations center or even anywhere near it. Consequently, from this time on, Dr. Klebanoff worked and slept on the starboard side of the aft torpedo room, and Captain Martin made do with only the port aft torpedo tube operational.

They followed the seaman down the ladder, through the engine room and into the aft torpedo room, and transferred the sound data from the recording tape to the sound spectrum analyzer. They played the data strings, listening to them sped up so the low-frequency sounds were audible. It sounded like static. They played the data strings on a cathode ray tube oscilloscope, watching scattered electrons randomly hit the phosphorescent screen from behind. They played the data strings again and again, watching them and listening to them.

On the third day of this thirty-day patrol, *Torsk* returned to the hydrophone buoy under cover of night and swapped the spent data recorder and battery for fresh.

Captain Martin and Dr. Klebanoff impatiently awaited the recording device and transferred the data strings to the sound spectrum analyzer. They played the data strings, listened to them, and watched them. They played the time derivative of the data strings, listened to them, and watched them. Then they played the second time derivative of the data strings, listened to them, and watched them.

For the six hours out of twenty-four that *Torsk* actively hunted submarines, Captain Martin commanded from the control room. The rest of the time, he commanded from the aft torpedo room, studying every piece of hydrophone data they collected and every signal they identified. The men had established a routine they were to follow for the next twenty-seven days.

On the tenth day of this thirty-day patrol, they had eight full days of data and identified and classified one hundred twenty ambient sea traces, including twenty-eight large vessel signatures, but nothing they could assign to an *unterseeboot* traveling up or down the Hudson Valley.

It is all derivatives and integrals, you know: first and second derivatives in time, first and second derivatives in space. Then add the data strings together or subtract them and run them past each other one more time. Duplicate the data strings, flip them, and run them past each other. Correlate and autocorrelate, filter and transform, algorithms, algorithms, algorithms, Fourier transforms, and Kalman filters, looking for patterns, looking for signals, looking for submarines. Argh!

On the fifteenth day of this thirty-day patrol, Dr. Klebanoff said to Captain Martin as he entered the aft torpedo room, “Bill, look at this.”

They watched the sound signature of a cargo ship headed east play out on the cathode ray tube display of the sound spectrum analyzer. “It looks like the signal of a Liberty-class cargo ship traveling east over the Hudson Canyon.”

“Watch this next part, Bill.” A ripple passed through the pattern of the receding cargo ship headed east to west.

“I’ll be damned. How about previous nights?”

“We are mounting last night’s data now.”

The men watched sound data strings collected over the last fourteen days, processed by the same algorithm that revealed the ripples on day fifteen. “I’ll be damned,” Captain Martin

muttered to Dr. Klebanoff, “It’s the acoustic shadow of our *unterseeboot* passing between a surface vessel and the hydrophone net.”

On the eighteenth day of this thirty-day patrol, Captain Martin parked *Torsk* at the mouth of the Hudson Canyon, and at zero-six-four-five hours he launched two salvos of two torpedoes. The torpedoes left the boat making an awful noise, so it didn’t much matter that they came out pinging. Torpedo Technician Barksdale steered the four torpedoes directly into the port side of the enemy’s *unterseeboot*.

Torsk ruled the sea from that night on.

Drifting Research Station

The research station was easy to find. We could hear her power plant humming for miles. But the captain, his exec, sonar, and pilot fumbled around for a full watch, pinging the ice looking for a thin section they could break through or a lead wide enough to surface in.

Scattered light from the Arctic summer that made it through the ice filtered into the observations room. Thoughts of seeing the sun after two months of running deeply submerged filled the boat. William could think of nothing else.

“Captain, I’ve located an opening in the ice. It’s a lead, almost sixty feet wide, filled with new ice, and less than two miles from MME Research Station Two.” That the opening is filled with new ice means we will have no trouble pushing our way through it to the surface. That is what Chief Buckheister said, but it’s what Chief Buckheister did not say that concerns me—the lead is flanked on both sides by forty-foot-high vertical cliffs made of multiyear ice. That makes me nervous.

“How thick are the ice cliffs flanking it, Sonar?”

“Over forty feet, Captain.”

So why does this make me nervous? Because wild shifting winds battling twisting sea states make ice leads transient features not to be trusted. So that now, a sixty-foot-wide ice lead gives me six feet in width to spare, a howling wind one hundred miles away could close that distance in a minute, and I would be stuck between two vertical cliffs of multiyear ice, and multiyear ice is dense and unyielding, even to titanium and steel…

The captain has tucked me into the narrow channel between two ice flows, preparing to surface between a forty-foot wall of multi-year ice on my port side and a sixty-foot wall of multi-year ice on my starboard. “Pilot, make the diving planes vertical. Dive, take us up.”

“Aye, sir.” Dive offloads water from the main trim tank. The top of my sail presses into the new ice. It creaks but does not crack. We persist. It resists. It shatters. Chards of new ice shoot through six feet of new snow. The radio antenna and radar dish go up. A special detail clears the bridge. Crewmen push through the sail door onto the top deck. Fresh air, a blue sky, the glorious sun, a snowball fight…

Three people pick their way over the nearby ice ridge shouting, “*Expedition*,” and waving. A tall, lanky man stumbles and tumbles down the slope, and landing flat on his back at the bottom of

the ridge covered with snow. “Lenny, is that you under the ice? It’s good to see you. Come aboard, old friend.”

Change of Plans

The first thing Sparks did after raising the antenna was to call MME for messages that had accumulated while we were under the ice. There were dozens of personal messages and three of those, almost identical, were for the admiral. Sparks delivered them. “Admiral, you have three personal messages from Dr. Alice Demontford-Baab.”

He mumbles. “Alice…what does she want?” He reads the messages. “Sparks, call Dr. Demontford-Baab and patch it through to my cabin.”

***

“Dr. Demontford-Baab, I’m connecting you to the admiral right now.”

“Hello, Alice, how are George and the children?” He asks. She has two: one boy and one girl. That is how he always greets her.

“Where have you been?” she demands to know. “I’ve been sending messages for days.”

“We’ve been under the ice, you—”

“I don’t care where you’ve been,” she interrupts. “I need you here now. Three days ago, seventeen pilot whales beached themselves on North Carolina’s Outer Banks. Beach walkers found them. It started as local news, but yesterday the coverage went regional. Bill, I’d think you’d keep up with marine disasters. It’s how you make your living, isn’t it?”

“Alice, we’ve been under—”

“Bill, stay focused. This morning, thirty-four whales beached themselves and are dead or dying along the beaches of Delaware and New Jersey. Although unconfirmed, the latest news reports three more whales—a newborn Minke and two dwarf sperm—were found on New Jersey shores. Bill, I need you here. WHOI does not have the resources to respond to this disaster.”

“Alice, of course we will help. You know that *Expedition* is in the Arctic Ocean. It will take five days to—”

“Admiral, this is Sparks, I’m sorry to interrupt, but you have an urgent call from Admiral Nakamura.”

“Very well, Sparks, patch him through. Alice, I’ll have to call you back.” He disconnects her call and switches lines. “Admiral Nakamura, what can I do for you?”

“Where have you been, Martin? I’ve been sending messages for days.”

“We’ve been under the ice—”

“It doesn’t matter, I have work for you.” He continues, “Four weeks ago, HYDRONET recorded a series of acoustic anomalies on the continental shelf from Boston to the Chesapeake. At first we thought it was just a communication snafu with an exploration company, but last week, Navy

Intelligence decided there was more to it than drilling operations. We dispatched the *Providence* to investigate."

Then, Admiral Nakamura lowers his tone of voice and switches to using the admiral's familiar name: "Bill, we haven't heard from her in three days. Six days ago, commercial fishermen began reporting fish-kill die-offs near the New Jersey artificial reef sites, but this has expanded north and east along the New York Bight to Nantucket Shoals, and we've even received unofficial reports from the Grand Banks. Sea mammal beachings began a few days after that. It's been a media nightmare. The press is all over it, and Woods Hole is keeping it high profile. You know the director, that Alice woman, what's her name, don't you?"

"Dr. Alice Demontford-Baab. Yes, I do. As a matter of fact, I was speaking to her when you—"

Admiral Nakamura doesn't care what the admiral has to say about Alice. "Bill, we believe the die-offs, the beachings, and *Providence* are symptoms of a deeper problem. The intelligence community has picked up chatter about a direct attack on the mainland. I can't send frigates and destroyers to investigate without spreading panic and taking heat for the entire mess. That is why I want you to go to New York Harbor, take up anchorage, play nice with Woods Hole, and put on a dog-and-pony show to hide your purpose, but get eyes into that harbor. Oh, and Bill?"

"Yes, sir?"

"Silence that Alice woman."

"That, Admiral Nakamura, just might be the most difficult thing that you've asked me to do."

"Make it happen, Martin. Nakamura out."

"Sparks, this is the admiral. Call the Coast Guard in Brooklyn. Ask for Commander Stevens and then patch the call to my quarters. And have Captain Deverough, Dr. Burgess, and Chief Bronson report to my quarters."

New York Harbor

"Captain Deverough," Admiral Martin steps into the control room through the aft door, "it's time to get this dog-and-pony show on the road—" He had arranged for anchorage at the Brooklyn Coast Guard Station, and he paused at Periscope Island just long enough to tell the captain, "Make that your destination," Then set his sights on the navigation station, "Join me at the plotting table when your are done."

So the captain called Mr. Decker to the control room, giving him the order to make the boat ready for surface running, then joined the admiral at the navigation station. By this time, the admiral was studying a navigational chart of the New York Bight, the long, gradual bend in the Northeastern coastline bounded by Cape May, New Jersey and Montauk Point, "We will be picking up the harbor pilot here." And he places an X on the chart thirty miles short of the Ambrose Light Tower.

Three days ago

The calls from Admiral Nakamura and Dr. Demontford-Baab had ended our Arctic expedition. Thoughts of volcanoes erupting, ice floes colliding, and tectonic plates screeching past each other in slow motion—all vanished. Plans for collecting benthic worms and rare-earth elements were set aside. Instead of the Nansen Ridge, we started thinking about the New York Harbor and the broad open bay east of New Jersey and south of Long Island.

For the last three days, the admiral and his senior staff spent most of their time in the wardroom with navigational charts of the harbor areas and bathymetric charts of the continental shelf all the way out to the Hudson Canyon, making plans for a clandestine mission.

He told them everything he knew of the troubled waters, relaying first the disturbing events that Dr. Alice Demontford-Baab reported: 'Fish and sea mammals are dying along the Northeastern coastline.' "Woods Hole Oceanographic Institute has requested we assist their investigation." He avoided using Dr. Alice Demontford-Baab's name, but with the mention of Woods Hole, Captain Deverough balked. "Not Alice Demontford-Baab! I hate that woman." "Well, suck it up, Deverough. She will probably take over *Expedition* before this is done."

Then he told them about the Navy's concerns. HYDRONET recorded acoustic anomalies on the continental shelf from Boston to the Chesapeake. Navy Intelligence decided there was more to it than drilling operations. The Providence went missing while investigating. "Admiral Nakamura wants us to penetrate the New York and New Jersey harbors undercover."

But even at flank speed, it will take us three days to get there. So Mr. Decker argues, "Surely the Navy must have closer special forces."

"Yes, they do, but none with a cover story as good as ours. So we need to develop and execute a plan to collect intelligence about a suspected direct attack on the mainland while conducting an open investigation with Woods Hole. Captain, your first job is to get this boat to the New York harbor as fast as you can. Go in under protocol 'Research Vessel *Expedition.*'" That means going in on the surface and making as much noise as we can.

“Chief Bronson, we need to isolate the crew from the visiting scientists.” He broadens his orders to everyone in the wardroom. “This is a matter of national security. You must keep to yourselves until visitors are off the boat. I don’t want any accidental spills.” Returning to Chief Bronson, “Assemble a detail and see to the packing up of the visitors’ equipment. We will need the entire research compartment and the auxiliary launch bay to execute two major missions. Get the minisubs ready for shallow-water littoral operations. Configure them for maximum time on station, they will not have to dive below one hundred feet...

“Dr. Burgess, contact MME and see what they have found in the HYDRONET data. And draw up a plan for reconnoitering the Port of New York and New Jersey underwater. I’ll get us anchorage outside the Narrows. And now, I need to tell our visiting scientists.”

***

Three hours later, a special meeting of the science team in the observation room ended their polar expedition. “End? We still have ten days left to explore the ridge. I paid for…” Dr. Hansen has worked himself into a frenzy, but the admiral tries to talk him down, “You need to know that during our time under the ice, a situation has developed that demands *Expedition*’s attention. Because of an unknown agent, both marine mammals and fish are washing up dead on the shores of the Northeastern Seaboard, from Norfolk to points north. Dr. Alice Demontford-Baab from Woods Hole Oceanographic Institute has requested our help. I intend to give it.

“I know you waited years for your place on this expedition. But a marine disaster is unfolding, and MME has the resources to contribute to its resolution. Since each of us makes our living from the sea, our responsibility is clear.”

***

It took a day to leave the Arctic Ocean. We ran south, five hundred feet submerged at flank speed over the Arctic spreading ridge, and then cruised through Lena Trough to hook up with the north end of the mid-Atlantic spreading ridge. There, the captain put us on a course following the East Greenland current south through Fram Strait, with Greenland on our starboard side and Norway on our port side. We passed over seamounts and under miles-long icebergs jutting down hundreds of feet, most on the process of shedding ice shelves or calving smaller icebergs. All being warmed by the sun. All being pushed by the winds. We passed the volcanic island Iceland on our port side.

While we were crossing the Labrador Sea, a great beast passed my bow. He was looking rather grim and was sliding through the long swells, exchanging air without commotion. I knew this beast, and was surprised he didn’t see me, so I call out to him: I need to know what is wrong. Can you stop and help me? He swam nearly a mile before looping around to join me. I was heading south, so I realized he wasn’t going my way at the time.

For any other submarine, I would not have stopped. He said, as he took a place in my bow wake. His plaintive statement gave me pause. After all, this gentle beast and I had traveled together many times. So I asked him: What is the matter?

I'm joining my family across the sea, on the other side. I recommend you do the same. I like you, and so I'm warning you that destruction haunts the shallow seas south of here.

I cannot go with you; my crew and I are headed south to help sea creatures that have been affected by a plague. Can you help us?

It is not a plague. Evil lives there now.

But Admiral Martin says there is no evil in the sea, only creatures misunderstood.

Your man is wrong.

Do you know these monsters? Have you seen them? What do they look like? Do they look like giant squid or manta rays or octopus?

No, the monsters are not giant squid or manta rays or octopus or any creature native to the sea. The monsters are more like you.

The monsters are more like me? His words pierced my hull. Monsters? You think I am a monster? Why? You and I have traveled together many times and have parted friends each time, I think. What happened to make you declare me a monster?

They say you are a metal servant of men, a hard and powerful machine too monstrous for us. At their bidding, you come into the sea and take what they want, leaving paths of destruction for us. *I shouldn't even be talking to you.*

It is true that I travel with men and do their bidding, but my crew and I are here to help. We have friends that live along the shallow seas, and they also want to help. Can you tell me what is wrong?

I've told you all I know. Be careful. And he left my bow wake. His parting words to me were: *The men are insane where you are going.* Then he took a few deep breaths and sounded.

His words disturbed me and I could not get them out of my mind. Dr. Alice Demontford-Baab was the first to warn us. "Thirty-four whales beached themselves and are dead or dying along the beaches of Delaware and New Jersey…Bill, I need you here." Then the Navy told us. "Bill, we haven't heard from her," speaking of the submarine *Providence, "*in three days." And now the great beasts were saying it too. And it was then I realized we were headed into big trouble.

Littoral Waters are Noisy to Begin With

Across the continental shelf, beyond the Newfoundland Sea and into the heart and the mountains of the North American continent, lie remnants of a mighty ice sheet. At the height of its life, it covered the entire continent and invaded the seas, changing everything it touched. While in its prime, it spawned many lesser ice sheets and thousands of glaciers, and together they turned mighty, rugged mountain ranges into rolling hills.

It sleeps up there now. But the last time the ice marched to the sea, it sat heavily on the coastal land of the time, as it was over a mile high. When it retreated, it left behind expansive depressions in a broad continental shelf within reach of the sun.

Since that time, sea creatures have migrated from all over the Earth to the shallow banks on the northwestern rim of the North Atlantic Ocean. They say the sun is perfect, and the temperature is perfect and the food is plentiful—and for the last three hundred years, so do large commercial fishing boats from Gloucester, Massachusetts to Yarmouth, Nova Scotia, and they value this prize enough to fight for.

Littoral waters are noisy to begin with. Filled with sounds of breaking waves, of snapping shrimp digging burrows, and of fish chirping, grunting, clicking, honking, groaning, burping and grinding their teeth. In shallow water, these sounds bounce up and down between the sea floor and surface repeatedly. Coastal cliffs reflect them back, and fluctuations in temperature convolute them. Acoustic seascapes in littoral waters are a challenge to decipher. Pure, simple notes sung by a great beast at a distance become garbled and discordant.

But between the shallow banks and the coastline, sounds from thirty-horsepower engines drone amid booming sounds of ten-thousand-horsepower factory ships. Large mesh-bag nets with huge metal maws rip apart deep-sea coral reefs. Motorized winches pull in huge nets, and powerful vacuums suck trapped, frightened fish into ship holds.

Yes. Littoral waters are noisy to begin with—but the combined sounds of the commercial boats fishing the shallow banks off the Northeastern seaboard make them noisier still.

***

At zero six hundred this morning, as the port side watch took control of the boat, we were one hundred twenty miles short of Ambrose Light Tower and skirting the southern edge of a featureless stretch of Nantucket Shoals. We had just rounded the barrier spit of Cape Cod and Long Island was coming into view.

Captain Deverough had transferred command to the bridge and was taking his ship west over eight-foot swells. Two large tankers plowed through the Nantucket-to-Ambrose Traffic Lane just south of us. We passed over the wreck of a U-boat and an airplane wing and a tail. A commercial airliner flew overhead. Crewman Wu led a deck detail through the aft hatch. They raised the American flag and the MME flag beneath it. Then outfitted the top deck with railings.

Meanwhile, in the control room, Dr. Burgess had stopped the admiral from climbing the ladder to the sail. “I’ve reviewed the US Geological Survey data from the last three months.” The salty breeze that was tumbling down the ladder had gotten the admiral’s attention. “Join me in the sail, Dr. Burgess. Take in the sea breeze while you have the opportunity.” But the conversation took place on the deck of the control room. Dr. Burgess confirmed the series of acoustic anomalies reported by Navy Intelligence. “Each lasted a week or so, each located at the head of a submarine canyon. Hudson Canyon was first, followed by Baltimore, Washington, and Norfolk.” He didn't know what to make of it. He excused himself and returned to the science station. The admiral joined the captain on the bridge. Car-horn sounds drifted out with the wind. Spotty clouds of mist washed over his face. We were making five knots against the longshore current.

Out on the aft top deck, Chief Bronson led a special detail. They were assembling the first of three special mission rafts (SMRFs) they had pulled from silo eight. He called up to the admiral. “The minisubs will be ready to launch by the time we reach Ambrose Light Tower.”

Littoral waters are filled with chaotic mixtures of distant sounds: of oceangoing vessels, wind, volcanoes, and earthquakes; of airplanes, thunderstorms, and waves crashing on a beach. But four miles south of Long Island’s barrier islands and forty miles west of the Ambrose Light Tower, industrial sounds from the land enter littoral waters from below: Manufacturing plants crush, rivet, drill, and grind. Construction sites run heavy movers, and operate jackhammers, plasma jets and cutting torches. Power plants burn fuel and boil water. Boiling water rotates shafts, shifts gears, and rolls bearings. Hydraulic pumps push dense fluids through confined spaces, and turbulent fluid flows through nested pipes. Mighty engines with tiny imbalances make nearby compartments resonate. Yes, littoral waters are noisy to begin with, but sounds made by ships at sea and machines on land contribute to an environment that is deafening.

Here is the thing. I know a submarine is following me. It does not waver in its pursuit of me. It moves as I move and is bold. And we are in mortal danger from this submarine; I think. A great beast has told me so, and now I feel it too.

***

Packed in crates, Ramona doesn’t sing anymore. Dr. Cohen left us yesterday morning. The admiral sent her away. Dr. Santiestiban and Dr. Hansen left with her. A boat came out from Boston Harbor and then they were gone. They knew about the sea mammal beachings, but not that the Navy’s *Providence* was missing. They knew about our planned meeting with Woods Hole and the Coast Guard at the Narrows, but not that we were under orders from the Navy and the president. They knew about our search for whatever threatens the great beasts, but not that an unidentified submarine was following us. Dr. Cohen didn’t understand why Admiral Martin would not let her help.

***

We are traveling west toward the Ambrose Hub, in the Nantucket-to-Ambrose Traffic Lane. Mr. Decker has the conn. Crewmen Hanley and Ahmed, lookouts on the forward deck, report visual sightings of boats and navigational landmarks. Radar reflects back silhouettes of surface ships.

Chief Barksdale reports, “Keel-to-bottom is twenty feet.”

SMRFs One and *Two* scout the water in front of us. *Orca*, a Coast Guard cutter, white with a flashy orange stripe, powers out to meet us. Screaming bubble-laden exhaust gas into the water, a speedboat races toward me from behind. “Welcome to New York!” Her hull pounds through my wake as she overtakes me, while an oceangoing tugboat crosses the channel behind us, towing an empty gasoline barge astern of it.

Crewman Fazio tosses a line to the harbormaster’s pilot boat coming alongside amidships.

“Permission to come aboard, Captain?”

“Permission granted, Pilot. Welcome aboard.” Pilot Amirani presents his credentials. “Come this way to the bridge.”

***

Flashing white every five seconds, the Ambrose Light Tower marks the place where three sets of shipping lanes converge. Scores of tiny boats running in chaos cruise into the harbor with me. The bottom shoals. A sandbar climbs out of the bay onto a rocky jetty. Harbor seals languish on a meager sandy beach there.

Two tugboats come alongside, one port side, the other starboard side, and their engines rumble pleasantly. Cars sit upon the Belt Parkway. People line its seawall, waving.

We moor dockside at the base of an old stone fort. Above me, the Verrazano Narrows Bridge spans a bright blue sky that is holding a bright yellow sun. Shadows from its deck, suspension cables, and towers cast sharply on the rippling waves. Automobile engines, horns, and tires grumbling on metal gratings radiate from its double deck. Peregrine falcons hunt sparrows nesting in the rigging beneath the lower deck.

William climbs the ladder just aft of the sail onto my quarterdeck in the bright blue sky and the sun. He is sad. So am I. His mom is coming to take him away. Expedition*, I have something for you.* He stumbles and falls, spilling an ice cream cone onto the deck. It’s delicious. *I sure am going to miss you.*

“Better get a mop and clean that ice cream off the deck, Master William.”

A small red tugboat motors southbound through the Ambrose Channel and then changes course, making its way in our direction. Its horn sounds, signaling its intention to dock with us. The deck detail runs forward and tosses lines to it.

“That’s my mother…” And William is gone. Gone in a flash. He left me.

This voyage was the best voyage ever. It had deep-sea dragons and crab pots. It had looking for my mind in the main computer and playing jokes on Dr. Jones. It had looking through the periscope for the first time and steering myself from Helm’s position. It had sitting with Admiral Martin preparing benthic worms for study. I felt jealous for the first time. It ended with my first taste of chocolate ice cream.

Dr. Alice Demontford-Baab

There she is, standing on the dock impatiently: Dr. Alice Demontford-Baab. Admiral Martin is on deck, waiting for the gangplank to be put in place. He walks out to greet her. They meet halfway.

“Finally, Bill, you are here. I thought your submarine would make better time.”

“Hello, Alice. You look well.”

“So do you. It has been too long, but there’s no time for small talk now. We have work to do.”

Then, violating traditional seafaring protocols for coming aboard seagoing vessels, Dr. Alice Demontford-Baab crosses the gangplank and sets upon my top deck a course aft toward my sail with intent to go below, directly into the control room.

“Mr. Decker, see to the boarding of our other guests,” the admiral hurries to keep up with her.

“Alice, come this way,” he heads her off, “we’ll manage this mission from the observation room. You’ll like it there. It has a window.”

“I remember the bow window, Bill. This isn’t my first time on your submarine.”

He grabs her arm, guides her to the forward deck hatch and takes her down two levels to the observation room. “I’d like to introduce my science department. We’ve had some changes since you were last aboard.”

She complains. “For two weeks now, Woods Hole has been dealing with this disaster alone,” she continues without a pause, “I called the Navy. I tried to speak with Admiral Nakamura, but my call was shunted to Public Relations, and they denied everything.”

“Alice, I think it would be a good idea for all interested parties to be present before we start this meeting.”

“I think that would be a waste of time, Bill. I spoke to them while waiting on the dock for you. They have nothing I need.” The mission control station attacks her attention. “This seems to be the best place on the boat,” she says to Dr. Jones, who is sitting there. The admiral is relieved by her distraction and greets his other guests as they step off the ladder.

“Hello, Admiral, nice to see you again.” Dr. Edward Kirtland extends his hand to shake.

“Hello, Edward. I wish it were under better circumstances.” Shaking Dr. Kirtland’s hand.

And as they are catching up on old times, Dr. Julian Smith descends the ladder. But his manners don’t seem to be any better than Dr. Alice Demontford-Baab’s, and he interrupts the admiral and Dr. Kirtland: “I’m Dr. Julian Smith. Surely you know me. We’ve met. I’m anchor on Channel Eleven’s ‘News at Six.’ Martin, tell me the truth. Has the Navy been conducting maneuvers offshore and using active sonar? Is that what is killing the whales? What do you have to say?”

I hate reporters, Admiral Martin thinks as he offers Dr. Julian Smith his hand. “I’m sorry, Dr. Smith, that I do not recall having met you, but I assure you there haven’t been any US Naval operations or maneuvers off the East Coast since last summer.”

“Says the Navy. Would they admit it if they had?”

“The Navy has no reason to deceive me on this, Dr. Smith.”

“Doesn’t Martin Marine Enterprises contract with the Navy?”

“Why, yes, we do. This submarine costs a fortune to operate, and we can do things the Navy cannot do.”

“My point exactly, Martin. You are a mercenary.”

“Excuse me,” says Dr. Alice Demontford-Baab. “Let’s get back to business, gentlemen. My research vessel *Solomon* has been patrolling the waters along New Jersey, intercepting the whales before they beach themselves, but it will be so much easier now that I have *Expedition*.” Then, Dr. Demontford-Baab gives Admiral Martin his new orders: “I want to take *Expedition* out to diagnose and treat the whales before they beach themselves.” Dr. Alice Demontford-Baab displaces Dr. Jones from her station at mission control, “Excuse me, dear, could you get me a cup of coffee with two creams and two sugars?”

“For those of you whom I have not met before, I’m Dr. Edward Kirtland, Director of Lamont-Doherty Geological Observatory. I want you to know up front, the observatory has been conducting high-energy seismic surveys off the New Jersey coastline on the inner-middle shelf around the Integrated Ocean Drilling Program Expedition 313 drill sites.” Dr. Kirtland unrolls a drawing he has of his ship and flattens it out on the table. “We used a thirty-six-air-gun array towed at a depth of twenty feet.” He sets a logbook on the table next to the drawing. “This logbook shows time, position, and air gun configurations.”

“So LDO is working at Site 313. I knew it,” Dr. Julian Smith interrupts.

“Dr. Smith, we always monitor sea life during gun operations,” Dr. Kirtland defends his position. “We posted lookouts and listeners for biologics and suspended operations when and while they were present. More than that, we were out on three preceding days to encourage the animals to leave before we use the air guns at full volume. We followed every protocol and went even further.”

Dr. Smith rants about laws being too lax to protect the wildlife and that LDO is granted waivers too frequently. And of not understanding the long-term effects of sonar guns and drilling operations.

“These are good points you make,” Admiral Martin says. “But, Site 313 is on level shelf. It is unlikely that location would amplify acoustic prospecting even if they went beyond the standards. Even if the observatory overstepped its permission by an order of magnitude, in my experience and my opinion, it could not cause such widespread damage.”

“Admiral Martin,” Crewman Robins interrupts, “There is a call for Dr. Demontford-Baab,” and picks up the receiver at mission control and hands it to her.

Operation Harbor Porpoise

“It is stuffed with things that can blow up.”

That is how Dr. Burgess starts the mission briefing. “The Port of New Jersey and New York is stuffed with things that can blow up and burn: bulk oil, both crude and refined, liquid natural gas, every chemical you can think of. Corrosive, reactive, volatile, toxic—you name it, they move it through this harbor.”

He refers to the situation board. “The Upper New York Harbor,” he points to the area on the map between New York and New Jersey, “has a petroleum bulk terminal that is the largest petroleum product hub in the United States. Ships come and go daily to pick up and drop off

their precious deadly cargo, and all pass through the Verrazano Narrows." He points to the Narrows.

He continues, "The Navy and the president suspect that the US may be under attack with the Ports of New York and New Jersey as their primary targets. Admiral Martin has developed a plan to reconnoiter the harbor with our fleet of minisubs."

Dr. Burgess commands the covert mission Operation Harbor Porpoise from the auxiliary launch bay in the missile compartment. "We will launch and recover minisubs submerged." He does not add, "to execute missions that would carry out the orders we received from the Navy," because he thinks it obvious. He also does not tell them about the Navy's orders because they do not need to know.

"You will take your minisubs through the Narrows and into Anchorage Channel. Once there, you will execute a mission profile, of which we have several." Calling attention to each on the situation board, he points: Berthing for Brooklyn Petroleum, Global Liquid Natural Gas, Ewing Oil Distribution Hub, BASF Chemicals, Newark Jet Fuel, and South Brooklyn Protonic Ceramics, naming just the big ones.

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"Go ahead, bolt the dome in place."

A special detail has been configuring minisubs *Feynman, Darwin*, and *Kelvin* for their journey through the harbor channels. In their most basic configuration, my minisubs cruise at ten knots; the maximum speed is classified. They can travel as much as one hundred miles or spend eighteen hours on station; those are the unclassified numbers and based mostly on human endurance. They have a pressure hull with a transparent aluminum pressure dome. Their light hulls, control surfaces, bows, and tails are fiberglass composite. Lithium-ion batteries, contained within a separate titanium-alloy enclosure, provide electric current for propulsion and power the control and mission systems. They have side-scanning sonar arrays and laser direction and ranging. I'm proud of them.

Crewmen Wu and Ahmed enter minisub *Feynman*. Minisub *Feynman* is the first to enter the water, and *Darwin* and *Kelvin* follow at thirty-minute intervals.

Each disappears into the Ambrose Channel headed north through the Narrows.

Operation Flounder

Meanwhile, the admiral has been in the observation room, kicking off Operation Flounder. "I'd like to introduce Dr. Jones and Dr. Goeller. They will be working with you during this investigation. Dr. Jones is my mission-team lead. She will coordinate all rescue activities with boat operations."

"Yes, we met before. Cathy, is it?"

"Casey."

“And Dr. Goeller is our resident oceanographer, specializing in the shelf waters along the bight out through the Hudson Canyon.”

“Ah, Dr. Goeller, you might be interested in this chart I’ve put together.” Dr. Demontford-Baab pulls a chart from her briefcase. “Where can I put this? Oh, here will do.” She fixes it to the aft bulkhead, saying, “It summarizes the location, date, time, and species of all the mammals that have beached themselves since this incident began.”

Doc Lexi enters the control room from the main passageway, “Sorry I took so long getting here. I had my hands full in sick bay…Hello, Dr. Demontford-Baab. Call me Doc Lexi, everyone else does.”

By this time, Dr. Demontford-Baab has taken over mission control. The phone rings. She picks up the handset. “Yes?”

“This is Sparks. There is a call for you, ma’am.”

“Well, patch it through…Yes…How long ago…Are you are at the spot you last saw them, or where you expected them to surface…What are the coordinates? We’ll be there in a half hour.” She turns to the admiral, “Bill, a pleasure craft has been following a mother humpback and her calf for me. The captain has called to tell me the calf is missing. I have the coordinates.”

He rings up the control room, “Captain, how long will it take for you to get under way?”

“We can cast off in thirty minutes.”

“Has the docking pilot left?”

“Yes.”

“Well, call him back and see if you can get us our tugboat escort back. If not, use the SMRFs.”

“Aye, sir.”

“Plot a course to 40 06.777° north and 73 57.86° west.”

Then turns his attention back to the meeting: “You are all invited to join us. We will be under way in thirty minutes. Anyone needing to be home before dinner should disembark by then.”

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We were underway in less than twenty minutes. The tugs couldn’t return, so two SMRFs escorted us across the inbound channel of the lower harbor and into the outbound channel under our own power at five knots.

Coimbra

The four hundred twenty-three foot oil tanker *Coimbra* was built in 1937 by Howaldtswerke shipyard on the southwestern shore of the Baltic Sea. She was completed in July of the same year for Standard Transportation Co. Ltd., Hong Kong, and in 1940 sold to Socony Vacuum Transportation Co. Ltd., working out of Montreal. Her home port was London, as her nationality was British, and her only job was to transport fuel across the Atlantic between Bayonne, New Jersey, and Halifax, United Kingdom.

She had left Bayonne, New Jersey early in the morning of the 15th of January 1942 under command of Master John Patrick Barnard, he knew how dangerous this was, as German U-boats hunted the coastal waters in packs.

Just behind her, German U-boat U-123, also built by Howaldtswerke shipyard, was traveling east, following the southern shore of Long Island, when her commander Reinhard Hardegen spotted the dimly lit navigational lights of a tanker off her port bow. It was like shooting fish in a barrel.

At zero nine forty-one hours, one G7e torpedo struck the unescorted *Coimbra* on her starboard side, just aft of the superstructure at the forward end of the engine room. A huge, towering explosion lit up the night sky. Ten minutes later, a second torpedo struck the *Coimbra*, burying itself in the main storage tank before it exploded. The *Coimbra* went down fast after that with her stern hitting the sea floor first as eight thousand thirty-eight tons of lubricating oil spread over the water, burning. Within an hour, she was on the floor completely. Thirty-six of forty-six crewmen did not escape the burning wreckage.

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Today, *Coimbra* rests in three pieces thirty miles off the coast of Long Island in one hundred eighty feet of water. Her bow is facing east, the mid-section is leaning to port and her stern rests on its side. She is home to threshers, makos and blue sharks. Bluefin tuna and sand eels. Sea bass, cod and pollock. She attracts fishing boats and divers.

Visibility is poor. The tide is slack. The hull is covered with seaweed. Two flashlight beams dart around the main cargo-hold as two divers deliberate whether to go in or not. Setting the danger aside, they decide to enter, but meet an eel with a broad, flat head coming out. They decide to back off several feet. That's no eel. Eels don't have suction cups. It is the terminal end of an octopus arm—a humongous octopus (estimated by the size of its suction cups). And the divers hang for a while, watching eight arms fondle the perimeter of the broken deck hatch.

Then, as if it were a torpedo being launched from its tube, the octopus shoots through the deck hatch, his bright orange beak headed for the admiral's shiny facemask. Both divers pull back, point their scooters toward the research bay hatch, and start kicking their flipper-donned legs fiercely. "Captain, we are coming up too fast, and with a hostile octopus chasing us. Launch a countermeasure to draw it away from us if you can."

But he can't. Instead, the captain shouts from the bridge to a crewman standing bow watch. "Wong, the Admiral is headed up and in trouble." Crewman Wong dives into the water. But he's too late, and witnesses the octopus wrap one arm around Diver Fazio's legs, pulling him back into the water.

Chief Bronson takes hold of the admiral's diving harness and drags him onto the deck.

The octopus thrusts a massive arm through the hatch, and wraps it around a heavy chain dangling there.

Crewman Forrest pulls Diver Fazio onto the deck.

The collision-avoidance alarm starts screaming. So does Diver Fazio. “He’s squeezing me! Get him off of me!”

Doc Lexi slides down the ladder from the observation room with a carfentanil-filled hypodermic between her teeth. She bolts to the launch bay hatch and plunges the needle into the bulbous body hanging from the chain, emptying the syringe with one push. “Calm down, Tony. He’ll relax his grip in a minute.”

Operation Harbor Porpoise

Minisub *Feynman* has returned on schedule, surfacing into the auxiliary launch bay through the open deck hatch. The recovery detail attaches hoisting lines, pulls *Feynman* from the water, and settles it onto a docking station while Crewman Wu pushes aside the dome yelling, “You guys are never going to believe what we saw! You know those stories of pet alligators being brought back from Florida and flushed into the sewer system? Well, I think they’re true!” the report is delivered with great excitement.

Chief Bronson hands Crewman Wu a cup of coffee. “Wu, get hold of yourself. I’m sure your excitement has made what you saw much bigger than it really is. Now, get dressed and report to the situation room for debriefing. Dr. Burgess is waiting for you. And you two,” addressing the deck detail, “stop standing around yapping. Mop that harbor mud off my deck.”

But Crewman Wu has more to say to the chief, “I’m telling you, that alligator was larger than the minisub!”

“Contain your excitement, Wu.”

***

Feynman reports: “My mission was to survey Global Liquid Natural Gas.” Crewman Ahmed puts up the log of *Feynman*’s journey on the situation board, and Crewman Wu traces with her finger the path they took. “We entered the Ambrose Channel here and traveled up the Brooklyn side of the channel, following a counterclockwise route around the Upper New York Bay. We steered a course north of Liberty Island and made our base under the Port Jersey Port Authority long pier and settled in. Visibility was limited to just a few feet, so we relied on ambient thermal and acoustic imaging for navigation. We saw shadows and the undersides of surface ships and small boats both moving through the water and docked. The only thing we saw fully submerged besides a few lonely fish was—and the chief said not to mention this—we saw a giant alligator.” Crewman Ahmed interrupts, “It’s true! I know it is fantastic, but the alligator was larger than the minisub and it had glowing red eyes!” Crewman Wu continues, “Can we review the thermal images? I did not believe what I was seeing, but it was an alligator glowing red on my thermal display; I could not see a bit of him through the dome because the water was so burdened with muck. But I could see his red eyes, and they were fixed on me from the beginning. Dr. Burgess, how did he know where to look?”

“What do you mean, Crewman Wu?”

“I was watching the thermal display screen, not the alligator. How could he look into my eyes like that? How did he know I was there?”

“Maybe he saw a reflection off the camera lens and assumed it was an eye. You were in his territory, remember.”

“Well, at any rate, not long after we assumed our station under the Port Jersey Port Authority long pier, two red eyes emerged from the bottom muck. Then, the outline of a massive head took shape, with those eyes bulging out of the top. I couldn’t make it out at first, but soon the display screen revealed a creature with four muscular legs splayed out to the side, and he was crawling toward us and dragging a massive body and tail behind him. When he reached the minisub, the alligator stood up and bumped us with his snout. And he did this every foot or so as he circled us. Then, with his circumnavigation of minisub *Feynman* complete, the alligator retreated, creeping backward until all that was left of him to see were his eyes watching from below the harbor muck. He glared at us the entire time. When our mission time on station was over, we headed south, crossing the Kill Van Kull Channel and then following the Staten Island side of the Anchorage Channel south through the Narrows. Thermal imaging and sonar systems were operational the entire trip, as were our hydrophones and cameras.”

“Have something to eat and get some rest. You’ll go out again in five hours.”

“Thank you, sir.”

***

In the meantime, minisub *Darwin* has returned to the auxiliary launch bay, and the recovery detail is attending him.

Chief Bronson hands Sampson and Nathaniel each a cup of hot coffee and sends them to the situation room, as he had done for *Feynman*’s crew not thirty minutes earlier. “Don’t keep Dr. Burgess waiting. And you two swab the deck. I don’t want anyone to slip and fall. That deck is hard, you know.”

Darwin reports: “My mission was to reconnoiter BASF Chemical Terminal Complex in Bayonne, New Jersey. We entered Ambrose Channel just north of *Expedition*’s present location and traveled through Verrazano Narrows through the Brooklyn side of Anchorage Channel. Right here,” he points to a location next to the channel, “we saw something on the thermal image display go over the edge. We followed it in. That was not the wisest thing to do at that time because a fully loaded cargo ship drawing fifty feet of water passed directly over us. We hid in a cranny in the bottom of the channel while propellers thundered over just two feet above us. Then we rode the rest of the trip inside the channel, hoping to make contact with what we saw go in, but we didn’t. We passed the New Jersey Port Authority and then Global Liquid Natural Gas Terminal on our starboard side and spotted minisub *Darwin* under a long pier; it had company. Something on four legs was lurking around it. I know this is crazy, but on the thermal image display it looked like…an alligator. Did they see anything like that? In any event, we made our base here, at the end of the southernmost pier of BASF Chemical Terminal Complex. We waited for the bottom to settle down, but it didn’t. It just kept moving. We saw all this in thermal imaging; visibility at the time was barely two feet. It soon became clear that the bottom was covered with a bed of worms, squirming the way worms do en masse. Unfortunately, we had the opportunity to see these things up close. Twice, the creatures

overran us; they are lampreys or something related to lampreys. Twice, we had the dome covered with scores of sucking mouths and circular rows of teeth trying to scrape their way through the transparent-aluminum. You will see both the thermal and sonar images degrade because of them. We stayed on station for the rest of our watch and came home through the Staten Island side of Anchorage Channel. Thermal imaging and sonar systems were operational the entire trip, as were our hydrophones and cameras."

"Thank you, Sampson and Nathaniel. Better have dinner and get some rest."

***

Just as the deck detail finishes mopping the floor, minisub *Kelvin* surfaces. So the detail recovers *Kelvin* and settles him on his docking station, making the deck a mess again.

"Chief, we saw a submersible making its way through the harbor. It was a drone, I think."

"Don't waste time talking to me. Dr. Burgess is waiting for you in the situation room, and we need to get the minisubs back in the water. The admiral needs to take *Expedition* out." Chief Bronson hands Hanley and Kressel each a cup of hot coffee. "You two, ready *Feynman* for launching, but swab the deck first."

Kelvin reports: "Our mission was to survey Kill Van Kull Channel to the Bayonne Bridge. We entered the Ambrose Channel just north of *Expedition* and traveled up through the Narrows on the Staten Island side. We followed the Staten Island shoreline on our port side into the Kill Van Kull Channel. We made our base in the channel under the Bayonne Bridge. After an hour of watching small boats motoring up and down above us, we made visual contact with a submersible, cruising over the bottom of the channel. It was probably a drone of some type. It didn't seem to be aware of us."

"What makes you think it was a drone?

"It was too small to be manned."

Dr. Burgess marks the situation board with an outbound arrow where the crewman's finger points and also adds the date and time of the sighting.

"We followed the drone a few hundred feet, but lost it when an oiler came between us. Visibility is dismal in there, you know, and thermal imaging degrades in the wake of a ship in the channel. We searched for half an hour before we returned to base under the bridge and resumed our watch. After that, things were pretty uneventful, as far as we could see, which wasn't far. We came home the same way we went, through the Narrows, but on the Staten Island side of Anchorage Channel. We had surface contacts of all sizes. Thermal imaging and sonar systems were operational the entire trip, as were our hydrophones and cameras."

Operation Flounder

A local fisherman sighted two whales in distress three miles off Sandy Hook Beach; near the shipwreck of the passenger ship *Scotland.* In response to the call, we cast off our lines from the pier and exited the Lower Bay with the outgoing tide, immersed in a purple-brown plume of anaerobic decay, tasting of ammonium nitrates and carbamides.

HMS Scotland

Saturday, the 1st of December 1836, just one year from the day they put the steamship HMS *Scotland* into the water, something came up from the deep and took a bite out of her; she didn't understand it.

It was a fatal encounter two miles south of Montauk Point. *Scotland* was headed out to sea with her sights on home. At four hundred thirty feet long with twin paddle wheels, she was a seaworthy passenger ship for the time, and that was probably the best you could say about her.

History would record her demise caused by a collision with the fishing vessel *Kate Dyer* during the storm, but it wasn't. Something took a bite out of her, and water was pouring in from below the waterline. Her captain, Horatio Jones, sent *Scotland*'s terrified passengers into the water to be recovered by local fishing vessels.

Once all of his passengers were out of the water and safe, Captain Jones turned *Scotland* around and beat his way back to New York Harbor against a choppy longshore current. Her engine room kept boilers boiling and paddle wheels turning, even though *Scotland* was foundering.

He could barely see the Sandy Hook Lighthouse flashing when he purposefully ran his ship aground on the great shoal called the Outer Middle Ground to keep her from going down in the channel, mostly to save the cargo. His paycheck was to come from the profits of the sales that had been arranged by her owners.

By zero six hundred hours the next morning, Marley and Sons of New York had arranged for a salvage ship to bring *Scotland* to port, but even before the salvage ship reached her, a gale came in from the east, bringing fifty-mile-per-hour sustained surface winds that whipped twenty-five-foot-high crests from swells fifty feet long. The great gale of 1866 lasted three full days. It smashed *Scotland* into the shoal repeatedly over that time and broke her iron hull. Foul weather and large waves lasted another day.

She lived on the shoal for decades in that degraded state, subject to many storms and picked over by men and fish. As time wore on, the ports of New York and New Jersey grew larger and larger. More ships came in, larger ships came in, and the channels were widened to accommodate them.

Consequently, in 1920, the port authorities of New Jersey and New York decided that *Scotland* threatened the safety of merchant ships and the financial success of their owners. They declared her just too dangerous to navigation. Someone had the idea of flattening her. They did it with dynamite.

***

Maybe some construction crew digging the foundation for somebody's home along the banks of the Hudson Estuary disturbed a hidden reservoir of some toxic waste hidden away by an industrial plant, and that toxic waste flowed with the river, settling on seaweed, mussels, and crabs.

For hundreds of years, this stuff will remain in the estuary's harbors, bays, inlets and lagoons, being washed up and down the lower Hudson River twice each day as the tide rises and falls.

Industrial waste! What is it? It tastes of lead chromate, ammonium nitrates, cadmium, mercury, and carbamides, to name just a few of the naturally occurring substances, although these are products of manufacturing processes. But that's not all, polycyclic aromatic hydrocarbons, polychlorinated biphenyls, and dichlorodiphenyltrichloroethane are just three among hundreds of other contaminants that ride their way to the North Atlantic on that purple-brown plume. And added to that is urban and rural storm drain runoff: gasoline, diesel fuel, asphalt, pesticides, herbicides, infectious agents, and the pharmacological compounds designed to pinpoint and destroy the most malevolent germs.

Creatures that feed off the bottom are consuming it. Creatures that feed off the creatures that feed off the bottom are consuming it. Don't eat the fish!

It is an environmental injustice causing neurological disorders, arrested development, loss of memory, hormonal disruption, compromised immune systems, cancer, skin irritations, Parkinson's disease, heart disease, diabetes and fatigue.

To any sane person, this sounds horrible. But I'm packed full of electronics and hydraulic systems that either contain this industrial waste or were used it in the manufacturing process. Without them: sonar could not hear, pilot could not steer, engineering could not make the propellers turn, the periscope could not go up, sparks couldn't communicate, the main computer could not compute, my crew would not have fresh air or water. Admiral Martin built me that way. I wonder if he knew what he was doing?

And here's a terrible thought. Could this be the source of a global maritime disaster? Could it be that some methanogenic archaea simmering in a backwater anaerobic pocket has mutated, producing an unnatural pathogen that has worked its way up the food chain? I am losing the sensation of seawater. It is replaced with nothing and seems very far away.

The great beasts could be carrying an agent of destruction to all corners of the Earth!

What can I do? The damage is done! How can I live with myself?

***

"Expedition, calm down! You've worked yourself into a frenzy." Dr. Jones tries to explain that most manufacturing is responsible, and that it is greedy and uncaring people that have polluted this area—but Dr. Demontford-Baab interrupts her. "Cathy, what is wrong with you? Stop daydreaming. Pay attention to your work."

Dr. Jones claims she was working, and then relays my thoughts on the matter. "I was just thinking about this murky purple-brown plume surrounding us. Do you think…could it be carrying a pathogen out to sea? Could it be making the animals sick?"

But the woman has an immediate reply to anything anyone says. "Really, Cathy. Woods Hole is constantly monitoring these waters, as is every university located near the estuary. What is your degree in? Science Fiction?"

***

“Whales! Bearing ninety degrees off our port bow, range three hundred yards!” Crewman Fazio shouts as he points toward two great beasts floating in the water. “And sharks in the water,” he adds, pointing to a cluster of dorsal fins cruising just below the waves not far from the great beasts. Prowling the oceans for fourteen million years, these tiger-sharks picked up the scent of a meal from five miles away.

A mother great beast with this year’s calf is drifting just under the waves, cooing barely discernable notes of comfort. Her calf’s breath is shallow. She nudges him up. He’s tangled in drifting ropes and fishing lines and is exhausted. In good health, they could run from the eight striped-tiger sharks that are circling them. But with her infant tangled, that is not an option.

Two tiger sharks split from the shiver and cruise menacingly past the mother and child, eyeing them. Mother growls. To them, her protest means nothing. Neither does her size. Her calf is compromised and the sharks have the advantage, and a lot more are headed this way.

Help me. She shouts at me, and then lunges at the sharks, screaming sharp acoustic pulses their way. She rams one broadside.

I’m powered down to dead slow and drifting sideways toward the mother who calls to me. *I know who you are. I know you can help me. At least, that is what our stories say*. *Help my baby.*

We are here to help, I answer her, but the sharks are growing in number, and the water is foretelling a feeding frenzy.

Meanwhile, Admiral Martin, Dr. Demontford-Baab, and Dr. Jones are watching the sharks circle the mother and calf from below the waterline. Below them, the launch bay hatch is open and six divers are prepared to enter the water, but the admiral won’t let them. Dr. Jones pleads, “Can’t you send divers out to cut away the tangled lines?”

“No, it is too dangerous to put divers in the water with so many sharks present and prepared to attack. But we can do something better.” He calls the bridge. “Captain, I want you to put the whales on our top deck.”

The captain must coordinate a rendezvous with two whales. He must sink his boat, float under the whales, and then raise his boat.

Doc Lexi is with him at the top of the sail, waiting for the top deck to drain. But we are not even under yet.

So Dive bleeds air from the ballast tanks and we submerge.

More than two dozen sharks are in the water, and they don’t seem concerned with my presence at all as we drift closer to the mother and child.

Do you understand we want to put your calf on my top deck?

I am frightened for him. I don’t want to leave his side.

Well, you come along too…

Even before the top deck clears the surface, a top deck detail is cracking the hatches, and joins the beasts resting up there. No one on deck understands just how unimpressed with us the large shiver of striped-tiger sharks are, for, without hesitation, they follow us up and are on deck with the crewmen and the great beasts. One tiger plows into Crewman Forrest and takes him overboard. “Man overboard,” and the boat’s siren starts screaming. Crewman Fazio dives in after Crewman Forrest. *SMRF Two* motors in to help. And the top deck explodes in chaos because no one is in control, and everyone knows it, even the sharks. They are slashing indiscriminately with massive jaws, packed with rows of serrated teeth, as gunshots ring out. Chief Bronson and his special detail shoot every shark in the head several times while crewmen are shouting and the great beasts are screaming for help.

***

“Get my medical kit.”

“Keep pressure on this wound.”

“Push this shark back into the water.”

“Get these injured crewmen to sick bay.”

Two great beasts wait for care on my top deck, scared out of their minds.

“Clean up the deck.”

I am frightened. Should I leave?

No. The sharks and guns are gone.

Was it a bad idea to ask for help?

“Let’s get these entangling lines off the calf.”

“Give them each a bolus dose of antibiotics and electrolytes before returning them to the water.”

That is the man we sing about, isn’t it?

Yes.

I thought they were just stories. Tell him thank you for me, won’t you?

He knows.

And we return the great beasts to the sea. As we drift over the wreck of the steamship HMS *Scotland*, the mother beast calls back to me. *I saw the monsters with my own eyes. You are looking in the wrong place.*

Intruder Alert

A while back, from crates of fruit stored in the kitchen pantry, a swarm of gnats invaded the boat. They hung around the galley most of the time and the crew’s mess, making pests of themselves—the way gnats do. But there were others that went exploring beyond the mess and the galley, a bunch made it back to the missile compartment. Some even ventured up one

level to the control room and others forward to the wardroom, where the officers have their meals. But, I'll tell you, Captain Deverough was not pleased when that horde of gnats penetrated his quarters.

I'm telling you this because I am being invaded by something like those gnats right now. I have been watching *them*. They're behaving like those gnats, but they are not gnats.

It started a while ago. Crewmen Claybrook and Forrest had just been called forward to lend a hand in the research bay. The crewmen were not gone from the auxiliary launch bay for more than two minutes when I felt the first intruders appear. I didn't think much of them at the time. There were just six or so to begin with, and *they* each went their own way, wandering around the deserted auxiliary launch bay, behaving the way gnats behave.

It was only when they reunited above the swabbing bucket they got my attention because, by then, there were a lot more than six, and the number was growing by the minute as a stream of them sputtered out of the swabbing bucket and into the room.

Now, a fuzzy, disorganized mass is hovering in the center of the auxiliary launch bay.

***

Assemble. A wave of understanding propagates outward from the center of the hovering mass. Fuzzy clusters coalesce in the wave fronts as they move outward. Fuzzy clusters merge with other fuzzy clusters into concentric spherical shells. Pulses of understanding pull the shells tighter and denser until one small solid sphere hovers in the middle of the room above the auxiliary launch bay hatch.

Learn. The sphere explodes, sending the intruders to every corner of the auxiliary launch bay. They fall just short of slamming into the deck, the equipment cabinets, and bulkheads, and the conduits and ducts and pipes suspended overhead. They vibrate there. Waiting. Flicking back and forth. Finding each other.

Assemble. A single fuzzy cluster begins pulsing. Its nearest neighbors follow suit. They lay down concentric shells of themselves, growing a sphere in a disciplined manner. They hum and vibrate in the center of the bay, alive with the energy of motion but not moving.

What are you doing?

The transparent sphere of *fuzzy intruders* expands to the limits of the room…then shrinks back into a tight sphere once more. And the sphere grows and shrinks, turning transparent and then opaque, and it does this over and over…expanding and contracting, again and again, faster and slower.

Learn. The sphere explodes a second time, sending itself to all six sides of the bay at lightning speed…where the things that are not gnats pause for a time before converging in waves on Bell, who is stowed near the starboard bulkhead. Soon, she is covered with them. A single thin sheet flows around her spherical form, rippling its way down from her top to the deck, checking out the umbilical connection…her glass windows…and her dogged-down door.

Why are you here?

An army of gnats that are not gnats march over the deck, diverging outward from Bell in all directions. They march up to the equipment cabinets, swarming around keyholes and crawling in cracks, to bulkheads where they find the forward ventilation duct, and to the overhead in the shadows cast by the lamps in the room.

Follow. And the intruders stop in their tracks, set their sights on the grid two-thirds of the way up the bulkhead, and take flight, converging into a whirling tornado that funnels the swarming intruders into the ventilation system.

Remember the swarms of tiny gnats I told you of earlier? The ones that got Captain Deverough so mad? Compared to what's going on here, that invasion was nothing. And this invasion means big trouble for me because these gnats are not gnats.

***

Minisub *Feynman* has just been settled onto his docking station when Crewman Hardy announces: "We may have been spotted, Chief. We made contact with submersibles. They may have spotted us. We were that close. Do you have coffee? I could sure use a cup of hot coffee. I'm shivering cold," Crewman Hardy asks as she steps out of the minisub.

The chief hands her a cup of coffee. "Here you are, Crewman. Better get that news to Dr. Burgess right away." Then turns to the deck detail: "You two, stop flapping your gums and swab the deck before someone slips on this mess. It is beyond me how much detritus these minisubs are bringing back from that filthy harbor."

"This stuff is slimy, Chief."

"Well, get it off my deck."

***

Meanwhile, in the observation room, Dr. Jones is ringing up sick bay. "Doc Lexi, this is Casey calling. Dr. Demontford-Baab just left the observation room and is headed aft down the main passageway. Can you intercept her and make sure she doesn't get to the control room or the missile compartment? Maybe you could distract her with a tour of sick bay. Show her your toys."

"Will do, Casey."

***

"Let go of my arm! I insist on speaking with Bill. Let go of my arm." Dr. Demontford-Baab escapes Doc Lexi's attempt to return her to the observation room and takes the amidships ladder up to level one. Entering the control room from the aft end, she blurts out, "I'm looking for Bill."

But Admiral Martin and Dr. Burgess are at the main computer hoping she will not see them. Dr. Burgess leans toward the admiral and whispers, "Admiral, what have you done letting that woman on board?" To which he responds, "I haven't been this scared since the war.

"There you are, Bill."

“Alice, you shouldn’t be wandering around the ship alone. You could get hurt. I’d never forgive myself if you got hurt. Come along, let me buy you lunch. Dr. Burgess, carry on without me.”

He takes her down two levels to the crew’s mess.

“Do we have to eat in the crew’s mess? I’d rather eat in the officers’ mess.”

“That is a private place for the officers of the boat. You can only go there at the invitation of an officer of the boat.”

“Aren’t you an officer of the boat?”

“Technically, no, Alice. I own the boat, and the officers need some privacy. If you would rather, I’ll have a mess set for you in the observation room.”

“That is better than the crew’s mess.”

So the admiral pokes his head into the galley on the way forward through the main passageway. “Cookie, could you please set a table for me and my guest in the observation room?”

“Yes, Admiral.”

Then he returns Dr. Alice Demontford-Baab to the observation room where a crewman is setting a table for two by the starboard window. As soon as she’s settled, she says to the crewman, “I’ll have a steak and a Caesar salad. Make the steak medium well, and put the dressing on the side. Oh, and I hate anchovies; so don’t put any on it. And tell the chef not to use raw egg. You know, Bill, you should replace Cathy. She’s not Martin Marine Enterprise material.”

***

Feynman reports: “Our mission was to survey the Ewing Oil Distribution Hub.” Crewman Hardy pulls up the log of *Feynman*’s journey on the situation board and traces with her finger the path they took. “We entered Ambrose Channel here and traveled up through the Narrows on the Staten Island side. We followed the Staten Island shoreline on our port side into Kill Van Kull Channel, passed under Bayonne Bridge, and entered Newark Bay, where I turned south to follow the Arthur Kill Channel. We made our base under Goethals Bridge. Here,” she taps the situation board, “we spotted three submersibles,” and taps the board three more times, “most likely drones, traveling in linear formation. They passed us headed south.”

“What makes you think they are drones?”

“They were too small to be manned.”

Dr. Burgess marks the situation board with southbound arrows where Crewman Hardy’s finger points and adds the date and time of the sighting. “That’s not all. While coming home, we spotted another drone in Raritan Bay headed west. It may have spotted us. At least for a few minutes, I thought it spotted us. It changed course and made its way toward us, but then it passed us by. We followed the coast of Staten Island north to the Narrows and crossed the channel here.”

***

Minisub *Darwin* surfaces into the auxiliary launch bay through the open bay deck hatch. The recovery detail pulls him from the water and settles him on his docking station.

“Here’s a cup of coffee, Cetinsky. Report to the situation room.” Then the chief turns his attention to the recovery detail: “Do I have to tell you two every time? Swab that deck.”

Darwin reports: “Our mission was to survey Brooklyn Petroleum.” Crewman Cetinsky pulls up the log of *Darwin*’s journey: “We entered Ambrose Channel here and traveled up through the Narrows on the Brooklyn side. As we were passing South Brooklyn Protonic Ceramics, two harbor skiffs came out and circled around us. They pinged a couple of times. A diver even came into the water and looked around; I don’t know how he missed us. We powered down our equipment. He swam within ten feet of us but didn’t see us. After an hour, they left. At any rate, we resumed our trip up the Brooklyn shoreline and took up our station here, at Brooklyn Petroleum’s Dock A. We were not there more than thirty minutes before a linear formation of six submersibles came out of the channel. It looked for a while that they were headed straight toward us, but when they were sixty feet or so away, they turned north, headed to Dock B. We lost sight of them. We returned home, following the Brooklyn shoreline south, and made the journey past South Brooklyn Protonic Ceramics in the channel. We didn’t come out until we were through the Narrows.”

***

Minisub *Kelvin* surfaces into the auxiliary launch bay through the open bay deck hatch. The recovery detail attaches hoisting lines to him, pulls him from the water, and settles him on his docking station.

Josephs and Wong get out.

“What’s this? You’re both covered in blood.”

“Don’t worry about me. It’s Josephs’ blood.”

“What on earth happened to you?”

“He was attacked by wharf rats.”

“A hunk of nylon fishing net got wrapped around our propeller. I had to get out of the sub to remove it when a pack of wharf rats came into the water, paddling my way with bulging eyes fixed on me, reflecting the light from my flashlight. Then they came after me, free diving like humans do. Scooping water with their front paws and kicking their back paws. It scared the daylights out of me. Those disgusting things came after me, baring their teeth, and they bit me right through my dry suit. Look here.”

“Josephs, get to sick bay stat. You can tell the rest of your story at dinner tonight. Crewman Wong, you present to Dr. Burgess, but get a shower as soon as you can. And have Doc Lexi give you the once-over before you hit the sack. You two, stop lollygagging. That minisub needs disinfecting, and don’t forget to swab the deck before you leave.”

Kelvin reports: “Our mission was to survey Maxim DANIX Distribution.” Crewman Wong pulls up the log of *Kelvin*’s journey: “We entered Ambrose Channel here and traveled up through the Narrows on the Brooklyn side. As we were passing South Brooklyn Protonic Ceramics, two harbor skiffs came out and circled around us. They pinged us twice. Then, they dropped a dragnet between them and headed our way. We backed into a pier just to the south of Dock A. It was a public pier with people on it. I think that kept the harbor skiffs from coming in after us. We tucked ourselves in as far as we could, but the top of the dome was within two feet of the surface. I remember remarking it was a good thing it was dark when someone on the pier shone a flashlight in our direction. It brought a school of bluefish in, and they went wild. There was blood in the water. We sat for two hours before things died down, the fishermen went home, and the harbor skiffs gave up on us and left the area. Then we couldn’t engage the propeller; it was tangled in an old fishing net. Josephs got out to clear it, and that’s when he was attacked by a pack of wharf rats. I went out with a bang stick and zapped a few of them. At daybreak, we got the minisub moving again and continued our journey to Maxim DANIX Distribution. Three vessels came and went while we were watching. We kept our sensors running the entire time, although we missed nearly four hours on station.”

Operation Flounder

Meanwhile, Sparks is calling Dr. Jones at mission control in the observation room.

“What?” Dr. Demontford-Baab answers.

“Dr. Demontford-Baab, I have a call for you from Captain Hanover of the *Solomon*.”

“Well, patch it through, Sparks.”

“Yes, ma’am.”

“Yes, Captain, what’s the matter?” she speaks into the receiver a question that sounds more like an order. Then she listens for a few seconds and replies, “Yes. I’m waiting for the coordinates.” A few seconds more pass as she writes and then says: “Okay, I have the coordinates. We’ll be there in an hour.” And hangs up on him—but before the telephone receiver hits its cradle: “Bill, Captain Hanover has engaged a pod of whales in distress. He’s requested our assistance. Here are the coordinates. I told him that we would be there in an hour.”

The admiral rings up the control room: “Captain, how long before you can set sail?”

“Thirty minutes, sir.”

“We’ll never get there in time. Bill, I don’t understand why you need to return to port so often. Can’t this sub of yours stay out for three months? We could answer calls faster if we stayed at sea.” Dr. Demontford-Baab expresses her opinion in disgust, then turns to Dr. Jones: “Cathy, send all three SMRFs to these coordinates. Tell them to lend the *Solomon* a hand until we get there.”

Intruder Alert

Dr. Jones, come with me. I have something to show you.

Not now. I have my hands full.

You need to see this.

Please. I have to deal with Dr. Demontford-Baab. She is Admiral Martin's guest. She's taken charge of the boat, and I have my hands full. You need to solve your problem by yourself.

While she's arguing with me, I'm watching shifting black dots of energy snaking their way through the ventilation duct. They entered the duct in the auxiliary launch bay at the end of the last watch and have been making their way forward ever since.

Wait. An advance scouting detail enters sick bay discreetly, spreading itself over the overhead. In no particular order, the individual agents rain down, subject to the local movement of air. You would miss seeing one if it were in front of your face. Some fall on the lab table in the center of the room, some on Doc Lexi's desk. Some fall on the bunks. Most reach the floor. But each agent, as it lands, takes flight toward the center of the room, assembling in a nebulous cluster. It takes account of itself and then returns to the vent on the wall, disappearing into the mass waiting there: *All clear.*

The swarm spills out of the vent into sick bay. An elongated, twisting, turning river flows into the center of the room, where it builds a sphere of concentric shells, the same way it did in the auxiliary launch bay. It starts pulsing.

Learn. It expands to fill the room, spreading itself thin. It contracts. It expands in fits and starts then contracts the same way…over and over…changing tempo from slow to fast…over and over…again and again. Fuzzy clusters break off and spread themselves on the bunks and tabletops. Fuzzy clusters crawl through the cracks lining the doors of medical cabinets; once inside, they form miniature pulsing spheres of their own, fondling the medical supplies, learning the cabinets' interior length, width, and depth.

Dr. Jones, we are in big trouble.

Expedition, *I've felt you pulling at me, trying to make me enter the ventilation system with you. Stop it.*

But, Dr. Jones, I've been invaded.

I just don't have the time right now…invaded? Invaded by what?

By gnats, gnats that are not gnats. Intruders have invaded the boat. A swarm of gnats that are not gnats is making its way to the bow of the boat through the ventilation duct that runs above the main passageway.

Gnats that are not gnats?

We have been invaded.

Intruders?

Yes. Intruders that look like gnats, but that are not gnats, have infiltrated the boat through the ventilation system.

Expedition, *you are not making any sense. Swarm?*

Yes. Millions of them, maybe trillions. They are in sick bay right now.

Okay, let me see. "Dr. Demontford-Baab, I'll be back in three minutes." And Dr. Jones walks seventy-five feet from mission control to the sick bay. The door is closed. She knocks.

Don't knock—you'll scare them away.

Gnats don't care if I enter a room they are in. As a matter of fact, they will probably find me and do all that they can to annoy me. She opens the door. "Doc Lexi, are you in?" She walks in and looks around. *I don't see any gnats*.

Dr. Jones, haven't you been paying attention? The intruders are <u>not</u> gnats. And furthermore, you scared them into the ventilation duct.

***

"Admiral, this is the captain," Captain Deverough calls from the bridge. "We have *Solomon* in sight and also the pod of whales."

The great beasts are sick, and so many of them. Some I know. One is an old friend; we have traveled the oceans together.

Wise Old Father, what is wrong?

Submarine Expedition*, I am deathly ill.*

What has happened to you?

I don't know, but the end of my time in the sea is near. My family needs help. Is the man here with you?

Yes. He is here.

Do you know our story, Expedition*?*

Yes, Wise Old Father.

It was many years ago. Does he remember me?

Yes, he remembers you. And thinks often of the days you spent together.

I remember as if it were yesterday. When I came upon him in the middle of the great ocean, he was alone in the water. At first, I was afraid and didn't do much to close the distance between us. We don't trust humans; you know. Our encounters rarely end well.

So the man and I spent considerable time that day considering each other from a respectable distance. I examined him from head to foot and he examined me from head to tail as we drifted with the current together, the man and I, for many miles. The passage of time stopped for both of us, I think…

Most of all, I remember his eyes. We looked into each other's souls that day. He revealed his inner self to me. A man full of compassion and wonder, and I am sure he felt the same of me.

As the day passed, he grew tired and cold. The great ocean was too much for him. I felt him slipping away. So I took him on my back to a shipping lane and waited with him until a freighter picked him out of the water.

My family loves to hear the story but believes it to be a tall tale. I know he is here. I can feel him.

Yes, he is here.

Can he help us, do you know?

The weight of the world sits on Wise Old Father.

What are you doing, Submarine Expedition*?*

Then my friend feels a hand on his head; a gentle touch, and Doc Lexi's voice drifts into his semiconscious state. "He's exhibiting deteriorated levels of consciousness."

You have lifted me upon your back?

"His heart rate is too low…His breathing is shallow...His ears are swollen. His blowhole is inflamed…He's underweight, even for a migrating humpback.

"His eyes are filled with blood. It could be from cranial hemorrhage, but I can't find any signs of blunt-force trauma…He could have intracranial tumors. They often hemorrhage."

"An entire pod of whales doesn't spontaneously develop intracranial tumors, Doc."

"They might if they've been exposed to a toxin inhaled through the sinus cavity, Dr. Demontford-Baab. A brain biopsy is in order."

"Whales do not have sinus cavities and sedating a whale in this poor condition could kill him."

"Pain will not matter to him anymore. This whale is dead."

My friend of many years has passed and his spirit is cast upon the waves.

"Perhaps something collected from him will help the other beasts. I'll be in the admiral's lab."

"Dr. Aleshenka!" Dr. Demontford-Baab shouts after Doc Lexi. "You should look for extensive abnormal vascularity. If you find a tumor, look closely for lesions and multifocal clots at its margins. Maybe I should help you." She follows Doc Lexi below two levels to sick bay.

Mining the harbor

The main computer displays the cumulative discoveries of Operation Harbor Porpoise superimposed on a navigational map of New York Harbor. Dr. Burgess has had the main computer working overtime, building an image that makes sense of sixty mission hours of minisub-collected data.

One hour past the second return of *Kelvin*, the main computer illuminates a single spot on the situation board. It marks a location on the Brooklyn side of Anchorage Channel. Then, a second spot next to the first lights up, and another next to that one, and another until the main computer has scribed an arched curve that goes on for a while but then terminates. Soon after,

the main computer draws two loops of a spiral in the area where *Kelvin'*s crew saw a drone near Bayonne Bridge.

Dr. Burgess rings up the admiral. "Admiral, we have our first computer-identified track of a submersible in the harbor."

After a while, the main computer adds one track on the Brooklyn side of Anchorage Channel, two in Upper New York Bay near the dock, and one off of Brooklyn Petroleum. Where *Feynman* spent two hours loitering, it draws three tracks off Governors Island and five by the New Jersey Port Authority.

The main computer ingests the data as it comes in and learns, you know. It turns what looked like noise into signals; it finds drone tracks and puts them on the situation board.

How does the main computer do this? It finds big things first: a ship maneuvering into its berth, a small boat's propellers churning, or reflections off a large steel hull covered in barnacles. It takes those big things out.

Then it finds lesser things that are always there: vessels tied to docks, sea creatures living on hulls, sand scratching and stones clacking. The main computer takes these out; these things are not the things that we are looking for.

The main computer identifies and removes echoes reflected off the solid bedrock walls of deep navigation channels and undulations from a fully loaded cargo ship. It removes a track left by *Feynman* near the Global LNG Terminal, and then the main computer draws five drone tracks off Anchorage Channel, six each in Bay Ridge Channel and the New Jersey Port Authority.

Within five hours after the second return of *Kelvin,* scores of drone tracks decorate the situation board.

"Well, it doesn't take a rocket scientist to see that the drone tracks are in groups of six."

With the discovery that the drone tracks appear in groups of six, the main computer starts tracking drone pack tracks on the situation board. If a pack is missing a track, it does not mean there was nothing there to make the track, only that the minisubs' sensors, for one reason or another, did not pick it up. Somehow, the main computer knows all that.

Dr. Burgess mumbles to himself. "It appears as if a drone pack enters the harbor at the Narrows every two hours, and a drone pack leaves the harbor at the Narrows every two hours."

The situation board shows drone packs traveling in a tight, linear group to begin with, but each of them at some location breaks into six individual tracks scribing different paths.

"I find it hard to believe," Crewman Ahmed remarks, "that you got all this out of the data we brought back. I was watching thermal and sonar the entire time like a hawk. How many of these tracks did *Feynman* bring in on my watch?"

Dr. Burgess removes the tracks brought in by *Darwin* and *Kelvin*. Enough tracks remain on the situation board to make the point.

“I’ve made further simplifying assumptions, but keep in mind, it is a simulation. The results are as much a manifestation of the assumptions I have made to develop the model as the data that I used.” Dr. Burgess throws caution to any interpretation of his simulation.

***

Crewmen Forrest and Claybrook stand at the auxiliary launch bay hatch, watching the mighty Atlantic Ocean lap in.

“He’s fifteen minutes late.”

“We should report this to the chief.”

“No, not yet. Maybe they had to wait for a ship to clear a channel.”

“We should report to the chief that *Feynman* is late.”

“Maybe a giant alligator has them cornered, or lampreys have sucked out their brains.”

“Stop it, Tony.”

“Wait, I know. Giant wharf rats gnawed their way through the transparent-aluminum dome and are feasting on Linda’s and Hiba’s livers right now.”

“Stop it.”

“You’re such a girl.”

“We need to report this to the chief.”

“Report what to the chief?” Chief Bronson asks as he enters the auxiliary launch bay. He notices that *Feynman* is not in his docking station. “Where are Wu and Ahmed?”

“Chief Bronson, Wu and Ahmed are late.”

“Why didn’t you report it? A minisub and two crewmen missing and you don’t report it?”

“They’re not missing, Chief. They’re just late. Not even thirty minutes late.”

“Forrest and Claybrook, consider yourselves on report.”

“For what? What did we do wrong, Chief Bronson?”

Minisub *Darwin* surfaces right on schedule.

“Did you guys see *Feynman*? He’s thirty minutes late.”

“No, we didn’t, Chief. But if they encountered what we encountered, I’d be surprised if they return at all.”

***

Wait. An advance scouting detail enters the observation room through the ventilation duct directly aft of mission control, spreading itself thinly over the overhead. The gnats that are not gnats rain down, falling on mission control, tabletops, chairs, and the deck, floating with the

local air currents. No one notices. Each not-gnat that lands takes flight, setting a course to the center of the room and assembling a fuzzy, vibrating cluster.

Someone's missing. And it sets itself on a meandering path around the room. It finds Dr. Demontford-Baab talking on the radio with a research assistant at Woods Hole. "I don't care if you have to stay up all night. I want the lab results by zero six hundred."

She promptly ends the cluster's existence with a swat that sends it careening onto the desk. She puts her thumb on it and twists into a tiny fuzzy speck of smut as she states in disgust, "Really, Cathy, this scow is infested with flies. I don't know how you stand it."

Move on. This room is occupied. The swarm in the vent moves down a level toward the main research bay where the colossal octopus, tucked safely in a salt-water tank, is sleeping—drugged out of its mind by a hefty dose of carfentanil.

Meanwhile, up one level, Dr. Demontford-Baab is getting annoyed with waiting: "Where's Bill?"

"He's in his lab. He's asked not to be disturbed," Dr. Jones replies to her question.

"I'm sure he didn't mean me." She stands and sets a course toward the main passageway.

Dr. Jones intercepts her. "Dr. Demontford-Baab, visitors are not permitted aft of the operations compartment without an escort. You should know that by now."

"Well, take me to him, then."

"I'm on duty. I can't leave my post."

"Then you can't stop me from going."

"Why don't you help Doc Lexi with the whale's lab work?"

Dr. Alice Demontford-Baab grabs the ship-wide intercom microphone from its cradle at mission control: "Bill, I need to speak with you." Her words broadcast through the ship, from the engineering compartment all the way forward to the research compartment. The message pierces the crews' quarters where the starboard watch is sleeping and is cast upon the waves from the bridge on top of the sail where Captain Deverough has the conn.

Her ship-wide announcement is followed shortly by another. This time, it is Admiral Martin's voice that is heard saying, "Master-at-arms, this is the admiral. Meet me in the observation room."

***

Captain Deverough arrives just a few seconds after the master-at-arms: "What's the commotion here?"

"Captain, I insist on seeing Bill."

Admiral Martin grants her request. He enters the observation room from the main passageway saying, "Master-at-arms, escort Dr. Demontford-Baab off the boat and put a special detail at the dock to keep her off."

“Get your hands off me, Crewman,” she yells as the master-at-arms herds Dr. Demontford-Baab up two levels through the deck hatch and onto the pier—.

What a relief.

You’re telling me.

***

Darwin reports: “My mission was to reconnoiter South Brooklyn Protonic Ceramics.” Mission Specialist Nathaniel puts the log of *Darwin*’s journey on the situation board. “We entered the Ambrose Channel here and traveled through the Verrazano Narrows, and then the Brooklyn side of Anchorage Channel where two harbor skiffs were waiting for us—right here,” he says while pointing at the location. “They knew exactly where we were. They came down on us and dropped a casting net and got us with the first try. We were trapped like a school of fish. Dr. Burgess, they knew exactly where we were. I thought our minisubs were invisible to sonar. How could they know we were coming?”

“Never mind that, Crewman, carry on.”

“They did not pull us up but dragged us toward the pier. We put everything we had into resisting them, but we lost ground inch by inch. I went into the water and started cutting the net that was holding us. Sampson kept the pressure on, pulling against six outboard Evinrude E200 four-stroke engines, but they were too much for us, and I was trapped between the casting net and *Darwin* as they pulled in opposite directions. I felt the net cut into my skin, but I just kept cutting with all the strength I had. Finally, I’d cut enough net for *Darwin* to break through. I held on to him as he pulled us free. Sampson took us into Ambrose Channel, and we hid there while thinking about what to do. We decided to go north and approach South Brooklyn Protonic Ceramics from that direction. But the two harbor skiffs were waiting for us. We backed off and settled in at the end of South Brooklyn Marine Terminal C, where we spent our remaining time on station. Will the change in our location ruin the image of the harbor you are building, Dr. Burgess?”

“Probably not. Continue your report, Crewman.”

“We came home following the bottom of Anchorage Channel until we were well clear of South Brooklyn Protonic Ceramics. Visibility was good for the harbor. Side-scanning sonar operated well when we had it on, as did our hydrophones and cameras.”

***

“We barely got away with our lives.” Those are the first words out of Crewman Hanley’s mouth, as Crewman Forrest unbolts the dome of minisub *Kelvin.*

“Did you guys see *Feynman*? He’s an hour overdue.”

“No, we didn’t see *Feynman*, Chief, but if he encountered what we encountered, he may not be returning at all.”

Chief Bronson hands Crewman Hanley a cup of coffee, and as she strips off her dry suit, she's babbling about a swarm of alligators that attacked the minisub.

"Drink this, you're shivering. Then report to the situation room. Dr. Burgess is waiting. And, you two, mop that harbor muck off my deck."

Kelvin reports: "My mission was to reconnoiter Jersey City Jet Fuel." Mission Specialist Hanley puts up the log of *Kelvin*'s journey: "We entered the Ambrose Channel here and traveled up the Brooklyn side of the channel, following a counterclockwise route around the Upper New York Bay. We stayed inside the navigation channel until we passed South Brooklyn Protonic Ceramics. From there, we steered a course north of Liberty Island and made our base in a foul area near Caven Point. Visibility was six feet, which was fantastic, but we relied on ambient thermal and acoustic imaging for navigation. We were there for an hour and a half seeing nothing, but our sensors were operational and collecting data. The sun had set, and it was dark. After a while, we realized there was a field of red, bulging eyes watching us from beneath a thick layer of muck. We counted seven pairs to begin with. As the night grew on, so did the number of eyes watching us, and they were advancing toward us, kicking up thick, brown silt that muddied the water. As the hours wore on, the eyes got closer. They surrounded us and got bold. One by one they stood up and bumped us, and it was then we realized the eyes watching us belonged to alligators, and we were sitting in the middle of their lair. Then they started pushing us around, and things got violent as they rammed us with their snouts. That is when we thought the better of staying and moved on, but this only made them madder. We set down again under Dock 2 of Jersey City Jet Fuel; it was empty. We spent the rest of our watch there, and it was uneventful, which was fine by me."

"Crewmen, you can go. Have a good night's sleep if you can."

***

Sixty hours into Operation Harbor Porpoise, one hour after *Kelvin*'s third return, with one hundred hours of logged time on station, Dr. Burgess adds to the situation board the identification of every major shipping vessel that had been docked at piers in the upper bay over the last three days.

"Admiral, the Port Authority provided the names and registry of every ship in the harbor and its berthing location over the last three days. We've associated the ships and cargo with the drone pack track activity, and the results are *not* as we suspected. I have been unable to correlate preference or purpose or cargo to the drone pack track activity. The tracks terminate on the hulls of tankers, container ships, and passenger liners alike, as long as they are large."

"Dr. Burgess, this is Chief Bronson," the chief calls from the auxiliary launch bay. "Minisub *Feynman* has returned. Wu and Ahmed will be up there presently."

***

Feynman reports: "We were hardly in the water ten minutes, with our sights on the Ambrose Channel headed north, when we made visual contact with a drone pack going in the opposite direction. We turned around and followed them through the Lower Bay, out past Sandy Hook

and Rockaway Point, and then farther still to the Ambrose Light Tower and into the Ambrose-Barnegat shipping lane. They were making good time, and we kept up with them but were trading endurance for speed with every mile we went. We went this far," Crewman Wu taps the situation board near a natural depression a few miles south of Ambrose Light Tower, "and down the Hudson Shelf Valley several miles more, keeping near the bottom before we had to turn around."

"What is here?"

"The Christensen Basin." Dr. Goeller points to a small depression on the map in front of them. "It held the headwaters of the Hudson Shelf Valley when it was on land. It is important that you understand that an ancient river carved the Hudson Shelf Valley when the continental shelf was dry land. The headwaters of that river swirled around to make a small lake. It was named after the Dutch explorer—"

"Dr. Goeller."

"Sorry, Admiral, you probably think I'm rambling, but it is important you understand. The basin provides nearly fifty feet of relief from the surrounding shelf. I know that is not much, but the drone packs could come and go with the deep-sea fish that hunt the shallow water, and we would not know it. Furthermore, and this is extremely important, there are places farther down the valley where depressions, originally lakes fed by the river that carved the shelf valley, could provide refuge for larger things…even a submarine base."

"Well done, Dr. Goeller." The admiral rings up the radio room: "Call Admiral Nakamura and patch it through to my cabin." Then he calls the captain, "Cast off the lines. Lay in a course to Christensen Basin and from there to the Hudson Canyon. Dr. Goeller will show you the way."

***

"Admiral Nakamura, we have collected evidence that suggests the harbor is under attack, as you expected. It appears submersibles are contacting hulls of commercial ships of all kinds. We believe they are torpedo boats. You may want to evacuate the area. I'm sending the coordinates to you as we speak. If these packages are explosives—"

"Bill, there aren't any plans for safe evacuation of the New York area," Admiral Nakamura interrupts. "We've been rehearsing evacuation plans for years. Every scenario ends in a greater disaster than if we did nothing. We will deploy explosive ordinance detonation teams to the locations you identify. Let us worry about the harbor, Bill. You find the submarine base and neutralize it."

"Good hunting, Admiral Nakamura."

"Good hunting, Admiral Martin."

Soledad

Her name is *Soledad*, and if she were in open water, the sea would have claimed her by now.

Captain Deverough had just cast off the lines and was making way into the Ambrose Channel outbound when a seaborne shock wave hit me. That shock was still shuddering through my hull when its airborne counterpart hit. Several large explosions followed, and as those shock waves raced toward me, they spread and overlapped and merged until, by the time they reached me, they had fused into one long drawn-out acoustic envelope that testified to the disaster unfolding. The compound shock wave passed through me. I was forced to pass it on to my crew.

The harbormaster had made room for us to exit the harbor, fitting us between the twenty-one-thousand-ton container ship *Malcolm McLean* and the oceangoing supertanker *Soledad*. So Captain Deverough laid in a course to Christensen Basin and cast off the lines.

That is when, just as she started to pass underneath the Verrazano Narrows Bridge, the oceangoing supertanker behind us exploded. From the outset, she was burning furiously. The fire that caused that first explosion must have been burning for some time.

Losing fuel through a gaping hole in her aft hull, she foundered and lost her bearings. Her bow swung toward Brooklyn and shallow water. But the current kept her moving toward the lower bay, and her forward starboard quarter slammed into the bridge's Brooklyn tower. Tongues of orange crowned by black clouds shot up through the bridge decks as they shuddered from the collision.

It was a terrible decision the admiral had to make. Not to stop and help.

Soledad convulsed as flames within her found new combustibles to ignite. Containers of grease, lubricating oil, and hydraulic fluid erupted in frenzied burns. Twisted and bent rebar-reinforced concrete slabs peeled off the bridge and pounded into the vessel below, breaking her back. *Soledad* sat down in the Narrows, pouring scalding-hot jet fuel into the channel from beneath her waterline.

Speedboats from around the harbor rushed to rescue people in the water, but everything was burning and scalding hot. The air was suffocating.

The dismembered bridge launched shattered fragments of flaring asphalt along her deck and into the seething cauldron beneath her. Cars and trucks plunged into the water and incinerated wreckage bobbed up and down. Jagged wire cables dangled from suspension rigging. Thermal updrafts fed the conflagration that drew superheated air in over jet fuel burning on the water.

Two fireboats frantically propelled tens of thousands of gallons of water per minute onto the charred and mangled ship. Blazing gas billowed wildly from her hold as flames licked at dangling remnants of the bridge.

We left them in the water.

We left the burning ship behind.

Dark, angry plumes from the cauldron below collided with cheerful white clouds above, against the background of a bright blue sky.

"Admiral Martin?"

“Yes, Captain.”

“The minisubs are in the water.”

“How long?”

“Three hours.”

That puts their location north of the bridge.

“Where are the SMRFs?”

“Rescue operations at the bridge.”

“Follow the course laid in, Captain.”

“Leave the minisubs and SMRFs behind, Admiral?”

“Yes. We have orders. They can take care of themselves. Sparks, this is the admiral. Try to reach Mrs. Sharp. See if she and William are still in New York City. She was staying at the Waldorf. Her plans were to drive home this afternoon.”

His words start a sinking feeling in my gut and I ask: Admiral, you think William was on that bridge, don’t you?

Hudson Canyon

We left the Lower New York Bay with toxic smoke choking it. The harbor seals were gone from the meager sandy beach, and a smoldering slick crept out with the prevailing current toward the barrier islands. The Coast Guard cutter *Orca* patrolled Anchorage Channel, turning back ship traffic attempting to enter the bay.

Pilot Deane steered a southbound course through the separation zone in the Barnegat traffic lane and we passed Ambrose Light Tower, flashing white every five seconds, as three bright red helicopters crossed the sky, and a northwesterly wind carried a huge black plume out to sea.

Beneath a mere ninety-five feet of water, a layer of dredge sand covered rolling mounds of construction debris, mostly concrete rubble but not all.

Pilot Deane steered us across the Barnegat-Ambrose traffic lane between a cargo ship and a crude oil tanker. Headed to anchorage points inside the harbor, the harbormaster refused them permission to enter.

Chief Buckheister used the scattered sounds of thrumming propellers to search for a drone pack hugging the bottom, but a layer of sewage and sludge peppered with clusters of fifty-five-gallon drums made him miss it.

***

Fifteen miles south of the Christian Basin, Pilot Deane turned southeast to follow the valley and it widened. A river of sand and uncivilized debris has been flowing in slow motion through the shelf valley. Amplified sounds of breaking waves falling in on themselves bounce off scattered pieces of sunken ships. Chief Buckheister tuned in on the reflected sounds of a nearby tanker's drive shaft and propeller and found a rusted boiler near a marine engine covered with hydroids and patches of coral. Then he tuned into the sound of pounding breakers launched from the New Jersey shore. He found the stony coral-covered bow of a sunken tanker that was buried beneath piles and piles of unwanted remnants of demolished old buildings and decades of dredge material, but missed the submarine that had been following us for several days.

***

With forty miles of the Hudson Shelf Valley behind us, the floor bottomed out, and we crossed the five ancient lakebeds that Dr. Goeller described. At the time, we had miles to go before the rocky base of the submarine valley tumbled over the rise. Captain Deverough took us over the deepest part of each lakebed, but Chief Buckheister missed the submarine base, hidden under ancient sand dunes and buried boulders.

As we crossed over the last of the lakebed depressions, we cruised through a plume of hydrocarbons wafting from beneath the sand and into the sea. Dr. Goeller did not miss it. "Admiral, the latest seawater samples are testing with high concentrations of hydrocarbons."

"Is that a surprise, Dr. Goeller?" The admiral asked. "Seeps of natural hydrocarbons on the shelf have been located over the last decade."

“Yes, that is true. We’ve passed through several plumes today already,” and then changes the subject. “It is my theory, you know, that the hydrocarbon seeps on the Atlantic shelf waters are being produced by microbial processes in shallow sediments—oh, I forgot to tell you, I have a paper coming out next month in the *Journal of Petroleum Science and Engineering* on this subject.” Then he returns to this plume’s importance. “You understand that my interpretation is based primarily on the locations of the seeps and my knowledge of the underlying geology. I have collected several samples today, which when I have the time—”

“Dr. Goeller, get to the point.”

“Yes, Admiral, I’m sorry. But it is so exciting. You see, this last plume is different. It is composed of highly refined hydrocarbons dissolved into very fine gas bubbles. I’m thinking…” he pauses, and then spits out the words: “rocket-grade kerosene.”

Torpedoes, Crash Dive!

“There are two torpedoes in the water,” shouts Sonarman Matthews. “Torpedoes, two torpedoes heading toward us bearing one-five-zero degrees, distance fifteen hundred feet.”

We’ve been following a drone pack down the Hudson Shelf Valley surfaced, riding high in the water, and lumbering along dead slow in not much more than two hundred feet of water being sitting ducks. That is over.

From the bridge, Captain Deverough shouts, “Crash dive the boat!” And the ship-wide claxons start to scream: The boat is crash diving!

Dive must flood the ballast tanks, beginning with those most forward, and making the way back. The crew on deck must hurry below and secure the deck hatches before too much seawater floods into the boat. Command of the ship must be transferred from the bridge to the control room.

Mr. Decker shouts from below, “I’m taking control of the boat. Clear the bridge and top deck. Dive! All Dive! Engineering, make turns for ten knots.”

When we started the dive, we were riding high in two hundred fifty feet of water. At periscope depth, the keel-to-bottom distance will be one hundred sixty-five feet. When we get to the bottom, there will be one hundred seventy-five feet above the top of my sail.

From the bridge, the captain calls below, “The decks are clear,” and says to the bridge detail, “Secure the boat for diving,” then goes below.

Before the captain’s feet touch the control room deck, the radio and radar antenna have been lowered, the crew are at their diving stations, and Mr. Decker has put two degrees down on the planes. Caught in shallow water, being chased by two torpedoes, not knowing the enemy chasing us, we have no place to hide, and no place to go but the bottom to hide like a flounder.

Going directly to the platting table, the captain asks, “Navigator Ryan, what are our choices?” Dr. Goeller has been describing the Lower Shelf Valley to the navigator. “You would expect that the shelf valley would empty directly into the Hudson Canyon. But it doesn’t.” Dr. Goeller points to a location on Navigator Ryan’s map. “On our current course and with our current

speed, we will be at the foot of the Hudson Shelf Valley and the edge of the continental shelf in one hour—ten miles, ten miles per hour, one hour.

“It is odd, you know, that gravity and runoff haven’t connected the two. They did once, about thirteen thousand five hundred years ago. But a break-out of glacial lakes in upstate New York broke through Pleistocene and Cretaceous sedimentary material at what is now the Verrazano Narrows. It was shoved across the shelf, but stopped just short of plunging over the rise, and dumped this disorganized delta at the shelf-edge. And the Hudson Shelf Valley never found the mouth of the Hudson Canyon again.

“Here is the place where the valley goes over the rise. But look,”—and he moves his finger three inches north—“the mouth of the Hudson Canyon lies to the northeast. Two miles from our current location. But between here and there stands a seventy-five foot high terminal moraine. The shallowest spot within one hundred miles.” And we have no way of knowing what is behind it.

Captain Deverough takes control of the boat, “Engineering, increase your speed to thirty knots.” There is no way we can outrun the torpedoes, but speed will increase the time it takes to reach us. “Tactical, report keel-to-bottom every ten seconds.” Racing this way, so close over the bottom and in shallow water, could make the bottom reach up and pull us into it.

Mr. Decker puts his hand on Chief Barksdale’s shoulder, “Prepare to release countermeasures and decoys on my mark.” And asks Sonar for the enemy torpedoes’ speed. “Forty knots over the bottom.”

Captain Deverough shoots orders out, “Pilot, steer a course ten degrees to port. Navigator Ryan, keep us on this contour line.” And traces his finger through a pass in the glacial mound. “Tactical, launch countermeasures and a decoy.” And pray the torpedoes follow it.

***

So two hostile submarines and four torpedoes chased us over the rim of the Hudson Canyon. It was a one-two punch. One set us up. And then the other delivered a bone-shaking blow.

Hunter One got us running like mad. We launched decoys and countermeasure to shake its two torpedoes and ran around a hill to hide on the other side. But when we got there, Hunter Two was waiting. And so, even though our decoy tempted Hunter One’s torpedoes away, we still had two torpedoes chasing us, and these were fresh and had a good ten minutes of life.

“Give us options, Dr. Goeller.”

“Small valleys and gullies feed the canyon from the shelf all around the rim, but there is a deep valley right here that I studied in detail last year.” Then he pulls a hand-drawn chart from the stack. “I mapped it last summer…” It’s two miles away. He traces a valley down the side of the canyon.

That’s when Captain Deverough ordered Admiral Martin to the observation room. “I need eyes on the canyon.” But before the admiral reached the observation room, Hunter Two’s two torpedoes’ sonar went active and launched a coordinated ping. The ping reflected off my

camouflaged hull. It was a terrifying feeling. They got a lock on me and accelerated, their propellers whining like crazy. Tactical launched a spray of countermeasures to hide the path we were on.

Cat's Whiskers

In the observation room, the admiral and four lookouts can hear the torpedoes getting closer. "There should be a highly resistant rock outcrop, thirty feet or so thick, projecting acutely from the starboard wall," Dr. Goeller's description comes to the lookouts over the ship-wide intercom. The admiral's job is to translate what they see of the canyon via flood light generated reflections into collision avoidance course corrections. "Dead ahead." Dr. Goeller's rock outcrop comes out of the darkness. We have fifteen seconds. The admiral's orders for Dive? "Forty degrees down bubble and forty degrees down on the planes." And as I dive into a protected enclosure, Chief Barksdale sends out a string of countermeasures. Hundreds of tiny bursts blind the enemy torpedoes' sonar, and they slam into the ledge and explode.

The shock waves hit my propellers first, focusing its destructive energy on the engineering compartment, level four. The propeller shafts shudder, the permanent magnet motors tremble, and reverberations propagate through hydraulic pipes and fittings.

Mr. McGregor takes the brunt of it. He's stunned by his body's reaction and doesn't hear an alarm from within his propulsion console losing control of itself: BEEP, BEEP, BEEP... His muscles are throbbing and he fears he will not recover in time.

Meanwhile, pressure is building, and emergency-release valves start hissing. Which start the ship-wide claxons screaming: Trouble in engineering! This leads Chief Bronson to form a special detail and they run from the crew's quarters, aft through the main passageway and through the reactor tunnel, where they enter engineering at reactor control.

By this time, Mr. McGregor has shut down the starboard motor. "Engine room damage report," demands the ship-wide intercom. "We've lost starboard propulsion." Mr. McGregor estimates the time to repair.

***

With one-point-five degrees down on the planes, we follow the valley floor, crossing layers of exposed bedrock; sedimentary layers intermingled with metamorphic. Formidable ledges of hornblende jut out of gently sloping sandstone formations. Dr. Goeller describes the treacherous outcrops he's suggesting we navigate. "According to my notes, we found a channel here." But Navigator Ryan's chart has no channel. He assures the captain, "There was a four-hundred foot layer of sandstone sandwiched between two layers of granite. The sandstone eroded," while the granite stood resistant to erosion and made cliffs three hundred feet above the channel floor. "More importantly, the channel is not on any navigational charts. My discovery and description of them will not be published until next month."

Captain Deverough decides to enter Dr. Goeller's channel. It is as wide as I am long and flanked by two smooth sandstone walls and partly covered over by granite ledges that stick out. A shower of gravel and sand tumbles into it from the canyon rim. Swirling eddies keep the silt

aloft. The current slams it into rock outcrops. And on the bottom, sand strikes dislodged boulders and gravel clanks along.

***

We cruise between two meandering walls of black slate through a huge school of tuna headed to deep water. Blocks protrude from either side in random patterns, forming ledges and narrow steps that go nowhere. Embedded in the walls are alcoves where giant lobsters live. Large vortices reach out from the walls where the channel turns, and behind each vortex a cave's been dug. Horizontal intrusions of pink crystalline rock bound each cave entrance on the bottom and top, making ledges upon which crumbed rock and huge boulders rest below the slabs of slate that let them fall.

"Not long ago, in geologic time, the ledges were a bridge between the inner channel walls." Dr. Goeller taps the chart three times, "Now, it is a good location to hide." So the admiral sends directions that put us under a hanging crystalline ledge. But rest is still not an option.

Despite the adrenaline coursing through their bodies, fatigue is growing for ship control as my heading is constantly shifting.

***

Nearly two hundred fifty feet above me, one hundred feet above the crystalline slab we are hiding under, a massive boulder is protruding fifty feet from the channel wall and tenuously connected. That boulder has been part of its geologic formation for over two billion years. It resided there when Pangaea formed and when it broke apart again. It was well hidden when the ancestral Hudson Canyon was carved by rivers on dry land. But as the sea claimed the canyon, strong tidal currents exposed the boulder. Now, while I'm hiding below it, it breaks free. Now, it casts its fate with gravity.

As it tumbles down the channel wall, it strikes a ledge. The ledge cracks as the boulder bounces off it. Then the cracked ledge snaps, and it and the talus slope sitting on it spill out into the channel. The ocean water quakes and shakes as a low, heavy, rolling rumble builds.

The single boulder breaking free started an avalanche. A fierce rain of crystalline rock falls on the ledge above me, the exposed part of my top deck, and the channel floor next to me. The massive boulder that started the avalanche slams onto my forward top deck, rolls off my bow, and tears through the sonar dome of my bow array. I shake and rattle as waves of nausea reverberate through me, running forward, then aft, then forward again. I am wounded.

Damage reports are whispered: Struts and beams are holding. A huge gouge has been torn through the light hull, and the starboard side of the sonar array is tattered to the pressure hull. The main ballast tanks and the pressure hull are undamaged. The forward cameras are offline. The dielectric-transparent titanium-aluminum window is stuck in opaque mode, hence, the lookouts are useless. An external equipment bay was ripped away. All signals from the starboard side of the bow array are gone. But that is not the end of our problems. The avalanche that damaged us also has us trapped. A berm of fallen rock has me trapped under

the ledge I was using as cover. Two enemy submarines are shooting torpedoes at me, and all I can do is take it.

***

But a strong current is flowing around us. We're holding our position with turns for ten knots in reverse, in the middle of a turbulent pocket generated by our propeller wash. "According to my notes," Dr. Goeller points to an outwash fan cascading into the valley about a thousand feet down stream. "There is a tunnel opening above this outwash fan. If I'm correct, we have wandered into that tunnel's entrance."

"And how do you expect us to navigate? Sonar's useless. The camouflage system's useless. We don't even have the bow windows. I call this dead in the water."

"There are always options, Captain Deverough. You forget what ship you command." Then the admiral joins Dr. Burgess at the science station. "How's the hull sensor network?"

"Only twenty percent of the acoustic sensors on the forward starboard quarter are working."

"How about the electromagnetic sensors?" Dr. Burgess shakes his head, no.

"Move over," and the admiral takes command of the main computer. "It's an untested prototype," He navigates through a network of folders, into one labeled *Cat's Whiskers*, and types *EXE* as he mutters, "Can't think of a better time to test it."

With this command, he activates an armada of miniature probes that have been stowed in the free space between my light and pressure hulls. They emerge in waves through the drainage vents, moving radially outward, at a creeping speed, and driven electrically and guided by delicate tethers. The probes swim until their tethers are taut and they form a hemispherical shield around me—each keeping a station relative to its nearest neighbors.

Back at the science station, a matrix of green dots covers the main computer display, and the admiral says, "You can move us forward now, but measure your speed in inches per second."

This will be difficult. We are stationary with respect to the tunnel, balanced between a forward moving current and turns for ten knots in reverse. To move forward at inches per second, engineering must reduce the reverse turns on the screws. To steer port and starboard, Pilot must adjust the vertical planes (rudders) water flowing forward over them. To keep level, Dive must adjust the horizontal planes (also with the water flowing forward) and move water between the trim tanks. And they must do this on orders coming from the admiral at the main computer based on an operationally untested prototype.

The probes strain against their tethers as we move forward. A green dot (in the middle of the upper left quadrant) turns red, and then red dots multiply in a wave flowing to the outer left edge of the display. "Steer one degree starboard and one degree down." And the red dots turn green when the probes pull against their tethers again.

The tunnel we're in? I can't feel it or the current or the turbulent eddies. It could be wide enough and high enough for me, but maybe it's not. It could be straight or it could have a bend

too sharp for my length to negotiate. I can only feel that my propellers are turning in reverse and water is moving through my trim tanks.

A tether goes slack. A green dot turns red and then explodes in a wave between ten and two (on a twelve hour clock face), and the admiral says, “Take us down two feet.” Is this the roof of the tunnel or a protruding ledge?

Wasps

They have been quiet through the excitement. Hiding inside equipment cabinets. Basking in the soft hum and warmth. But now that we are quiet again, inching our way through the submarine tunnel, the not-gnats have become active again. The swarm is making its way aft and has sent scouts into the crew’s quarters where the starboard watch is sleeping. They join the crewmen sleeping. In all the excitement, I’d forgotten about them. The swarm in the vent waits for a while and then continues their journey aft.

***

She wakes up curled in a ball on a cold metal surface. Chilled to her bones and with a dry throat. Her muscles resist as she uncurls and stands. A persistent rush of cool air is flowing over her. She can’t see anything, but takes a few tentative steps perpendicular to the rush of chilly air. The floor is unsupported from below. Each footstep lands with a soft, hollow clack as the floor buckles from her weight.

One…two…three. She counts each step. Four…five…six. Her left hand touches a wall that pops. Just like the floor, cold and metallic. She turns around and walks the other way, counting. As her hand touches the opposite wall, she mumbles, “It’s about twelve feet wide.” She reaches up. “I can’t reach the overhead.”

She decides to follow the wall down the long, dark passageway. With each step, a buzzing sound in front of her gets louder. “Wasps.”

The wall ends. “It took thirty-two steps to get here.” She feels her way around a corner. The rushing air becomes turbulent.

Something fuzzy brushes her cheek. She pulls back and covers her face with both hands to protect it.

As she peeks out through her fingers, she sees stray light filtering in from a vent and runs toward it. It is too high for her to see out of. “Someone, help me.” She jumps up, trying to grab the vent grid. “This is Dr. Jones, I’m in here. Help me.”

While trying to pull herself up the cold metal wall, a creepy tickle on the back of her left hand gets her attention. “A wasp!” and she flings it away in fright and steps backward. The wasp retaliates. It picks itself up and flies back to her as several more wasps are crawling through the vent grid. She backs away from the vent as dozens of wasps fly through the vent headed her way. She brushes them off as they land, but there are too many. She wants to scream for help, but there are wasps crawling over her lips. She curls into a ball on the cold metal floor whimpering, “Someone, help me.”

***

“Dr. Jones. Wake up.” Admiral Martin wakes Dr. Jones from her nightmare, wasps are still buzzing in her head. “Thank you for waking me up. I was covered by a swarm of wasps.” He picks up the open book she fell asleep on: *The Hive Mind*. “Why are you reading about wasps?” “Not wasps, swarms. How they behave.”

“Why?”

“I have a horrible feeling that the boat has been invaded. You know that feeling we get when we think someone is watching us?”

“How long?”

“Since the torpedoes chased us into the Hudson Canyon.”

“Me too.”

“You got anything more than a feeling?”

“No. How about you?”

“Yes. IAN is picking up new transient patterns. Really high frequency mixed with some really low. It doesn’t look like anything it has recorded before.”

“Have you spoken to Dr. Burgess about it?”

“Yes, but only briefly. He’s working on damage control. He said the camouflage system has been destroyed and has no way to fix it at sea. We’ve toyed with the idea that the two might be linked.”

“Well, keep working on it. We need all the help we can get.”

Admiral Martin’s Lab

The admiral’s lab was dark when he entered it. His mind was on the eggs he had been nurturing in hydrothermal water collected from Darwin’s Castle in the back corner of the lab because they had to be monitored daily. For this reason, he left Dr. Burgess alone at the science station to run post analysis of incoming sonar data—so he could check on the heath of the eggs. That’s where his mind was when he flipped the light switch and interrupted the swarm.

As light flooded the room, the swarm was coalescing into a thick, smoky-gray sphere hovering over the black-topped table in the center of his lab.

He was quick to lunge at it, but the swarm was quicker. He wanted to grab some of what was there, but the swarm disbursed as his right hand swung through it, just like a school of frightened minnows.

He expected to see at least one tiny black gnat crushed in his palm when he opened his hand. But opening his hand revealed only a smudge. It didn’t look like the mangled body of a gnat. By the time his eyes shifted back to the room, a swirling black veil was coalescing near the ventilation duct.

He called the control room. “Captain, bring Dr. Burgess and Dr. Jones to my lab now.” He needed the captain because his boat had another problem. He needed his science officer because he couldn’t explain what he saw, and he needed Dr. Jones because she knew about the swarm invading his submarine.

***

Ten minutes later, his lab was humming with sounds of electronic equipment powering up. Dr. Burgess was fiddling with knobs and switches on the gas chromatograph while the admiral was describing what he saw when he turned the lights on in his lab. “They moved together, every bit as coordinated and graceful as a school of fish or a flock of birds.” Visual inspection of the smudge on his hand, even under the microscope at fifty-times magnification revealed—a smudge. No wings. No legs. No eyes. “But their prompt disappearance worries me more than their presence in the first place. If they were pests, they would have welcomed my company. Not run from it.”

“It’s mostly silicon and polymers,” Dr. Burgess said as he examined the peaks of the chromatogram, “with small amounts of germanium and trace amounts of arsenic and gallium. Some nasty stuff in bulk, but in trace amounts harmless…” Dr. Burgess hesitated before finishing his sentence. “and, as you know, common in semiconductor components.”

Deverough: “Computers?”

Burgess: “Yes. Computer components.”

Deverough: “Flying computers? My nephew builds radio-controlled aircraft and competes. Even in the battery powered class, the smallest I’ve seen is twelve inches.”

Martin: “Those are toys.”

Deverough: “Admiral, is the military working on anything like that?

Martin: “Not that I am aware.”

Deverough: “Could you tell me if you were?”

Martin: “Probably not.”

Jones: “Boids.”

Deverough: “Boids? You mean Craig Reynolds bird-oids?”

Jones: “Yes. Think about it. Flying miniature computers that are no bigger than a gnat and that behave like a school of fish or a flock of birds,” using the admiral’s description, “or a swarm of wasps,” using hers.

Martin: “But Craig Reynolds’s flocking bird objects is a computer simulation and his swarm has the power of a supercomputer guiding their behavior.”

Burgess: “Furthermore, we’ve got decades of algorithm development needed to direct a physical swarm in three dimensions with multiple senses and feedback systems.” He pauses. “Has anyone got a better idea?”

Deverough: “Well, I’m a submarine commander, not a scientist. To me, this sounds like so much science fiction. Let’s turn to a more practical matter. How do we get rid of them? When those damn gnats invaded the boat a while back, we used pesticides on them. If these things are miniature robots, I doubt that solution would work.”

Martin: “Well, Captain, they have the freedom of the boat through the ventilation system. I suggest...”

A call from the control room interrupts them. “Captain, the damage reports are in. The senior deck officers are ready to discuss options and priorities.”

“I’ll be there presently.” And as he’s leaving the lab, back over his shoulder he says, “I’ll crank up the air flow and put in our finest filters. That should be the end of it.”

After the door to the lab closes, Dr. Jones says. “I’ve more to tell you. I’ve been studying the data collected by IAN as we travelled down the Hudson Shelf Valley. I’ve identified a new class of transient patterns. You are not going to believe it. I can hardly believe it myself. Buried in the transient signal data, I found two high-intensity events. As I think about a swarm in the boat and the new transients and the high-intensity events, I’m beginning to understand…I didn’t know what I was seeing at the time, but now I do. The new transients are caused by the swarm exploring the boat. It all makes sense now. The high-intensity events are the new transients focusing acoustic energy on the hull. It’s frightening if I’m right. Let’s go to the main computer, I will show you.”

***

Ten minutes later, in the control room, at the main computer, Dr. Jones is saying, “The two simulated events I’m about to show you are running at a speed that compresses ten minutes into ten seconds.”

The first simulation starts with colorful ovoids waltzing around the missile compartment. Then a soft yellow glow grows out of the silos. Yellow turns to orange, and the orange fills the missile compartment getting brighter and brighter, then color bleeds through the pressure hull, filling the free space between the double hulls, and vanishes. She points to the time-stamp on the lower left of the display, “What happened at 1958:248:0236:17?”

The captain, now standing behind her answers, “that’s just a few minutes before the first torpedoes were launched at us.” He pulls a notebook out of his shirt pocket and says, “Zero two thirty-four and sixteen seconds, to be exact. You said there was a second simulation.”

The second simulation starts with colorful ovoids shifting around the research compartment. Then a soft yellow glow develops around the main launch bay, and it turns orange as it fills both levels of the research bay. And we watch as ever brightening orange bleeds through the pressure hull, filling the free space around the boat, and vanishes. The time stamp in the lower left reads 1958:248:1432:22. Captain Deverough says, “The second set of torpedoes was launched at fourteen thirty-four and twenty-four seconds. It takes them two minutes.”

“What takes two minutes?”

“It takes the enemy subs two minutes to develop a firing solution after a boomer has been launched from our hull. And they’re within a mile of us when they do…”

Meanwhile, the swarm that left the admiral’s lab had made its way back to the aft torpedo room and was assembled behind the ventilation duct, waiting for their scouting detail to return.

It didn’t. Crewman Cetinsky had a torpedo opened up, running diagnostics on its contents when a fuzzy vibrating cluster looking for the rest of itself got sucked into his sinus cavity and stuck there. He sneezed, and then muttered to himself. “Where did that come from?”

Boid-Com Stations

I’m severely damaged, stuck at the bottom of a meandering valley carved into the south wall of the Hudson Canyon while two enemy submarines are patrolling the canyon rim, waiting for us to creep up. I’ve been here a full day. The admiral and the captain, the deck officers, chiefs, and crew have finished damage control and are repairing what systems they can while sitting on the bottom in over two hundred feet of water.

Dr. Burgess was needed for repairs, but the admiral did not want to go into battle against two enemy submarines with the swarm able to broadcast our location. So Dr. Jones and Dr. Burgess were sent to mission control to develop a way of capturing or disabling it.

They’ve been at it for hours. Dr. Jones is babbling about swarm behavior and about how this swarm might be communicating. “How could thousands of independent agents decide to assemble? If it were a biologic swarm, they could do it with pheromones.”

“If they were using the electromagnetic spectrum, we could jam them.”

“Did you try?”

“I hesitate to use electronic warfare inside the submarine. When we catch some, I will try.”

“Anyway, they are most probably communicating acoustically…IAN is sensing acoustic disturbances. Maybe we can influence their behavior by transmitting acoustic signals of our own.”

“Well, that would be easy enough. I can modify IAN’s sensors to transmit as well as receive. I’ll need to add a signal generator to the system. Where are the controls?” She opens the central compartment of mission control in front of them.

He looks in. “Dr. Jones, where did you learn to wire electronic components?”

“Here. But to be fair, Crewman Fazio helped me.”

One hour later, the boid-com stations start transmitting waveforms recorded during the times they had assembled.

***

Wait. An advance scouting detail enters the auxiliary machine shop on level four of the operations compartment. Crewman Fazio doesn’t notice as boids take flight from tabletops and assemble just above the lathe. They are just dust motes drifting in local air currents.

He's studying a drawing of a high-pressure hydraulic valve and doesn't feel the fuzzy cluster enter his nasal passage and get lodged in his sinus cavity. It tickles. He sneezes, then mutters out loud to himself: "I hope I'm not coming down with a cold."

Move on. This room is occupied. The swarm in the vent moves on to the battery compartment. The scout sent in returns to the vent. *All clear*. And an elongated, twisting, turning river of not-gnats flows into the center of the room, builds a sphere of concentric shells, and starts pulsing—enjoying the electromagnetic energy there.

Learn. The sphere expands to fill the room, spreading itself thin. It contracts. In fits and starts, it expands to fill the room again. Fuzzy clusters break off from the swarm, spreading themselves over the batteries and the conduits of copper wire running overhead.

One fussy cluster passes the battery compartment's boid-com station and gets distracted by the attractive vibrations. It enters the boid-com station and vibrates with the energy, growing with excitement until it explodes. Minutes later, each boid from the exploded cluster brings back another boid. And they assemble into a larger cluster that vibrates with excitement. Bathed in the combined electromagnetic energy of the battery room and the acoustic transmission from the boid-com station, they fly out into the middle of the battery room. *We found it. We need to tell the others*. And they fly out, spreading themselves through the swarm that is learning the battery compartment, repeating: *We found it. We found it. We need to tell the others*.

Meanwhile, at mission control, Dr. Jones elbows Dr. Burgess and whispers, as if the swarm can hear her: "Dr. Burgess, we may have just uttered our first word of boid talk." And they watch new patterns develop inside the boid-com station. "Should we call the admiral?"

At the same time, at the plotting table in the control room, Admiral Martin and Dr. Goeller are looking for ways to sneak out of the Hudson Canyon without being seen by the enemy submarines. Captain Deverough joins them with news. "The divers are back inside. We've made all the repairs we can make at sea. What are your orders?"

The admiral's eyes run over the map of the Hudson Canyon, following each valley up to the rim. "Dr. Goeller, what's the best path for us to take up the canyon?"

Dr. Goeller's eyes choose one valley and another. Then he traces with his finger a river of sand and boulders starting from our current location almost due west to a notch on the rise.

The admiral traces the same path up, examining the sharp turns it makes and the relief it provides. "Dr. Goeller, what's the second-best path for us to take up the canyon floor?"

"This one's not so steep," and he traces a valley that runs west–northwest up the floor to the rise with less relief than the first, and adds, "It's longer by a mile."

The admiral has developed a plan. He tells Chief Barksdale to make ready an MME Mark Six torpedo to launch from forward torpedo tube one. He wants to configure it himself, "I will send it instructions. Call me when the Mark Six is ready to accept them." Then he turns his attention to the captain. "Lay in a course up this valley," and retraces the second-best path Dr. Goeller pointed out.

“What are your plans, Admiral?”

“I’m going to send the Mark Six up this valley.” He traces the best path up with this index finger. “And create a distraction while you take us up the other way. But, Captain,” he hesitates, “be on guard. The swarm is still loose and could give our location away in the middle of things.” Then he rings up mission control. “Dr. Burgess, what’s going on with the swarm?”

“Admiral, we were just going to call you. We have gotten the swarms’ attention. A cluster in the battery compartment is hovering inside the boid-com station there.”

“Well, keep this channel open and keep us up to date on the swarm’s activity. Try to keep them there. I’m sending a decoy up the canyon while we sneak out on another path. If the swarm broadcasts, it will ruin my plan.”

“Admiral, I do not have control of the swarm. I can see only one place it is responding.”

“Understood. We’ll have to take our chances. Captain, be ready to turn tail and run for it.”

***

The MME Mark Six torpedo leaves torpedo tube one under its own power. It turns west into a valley that heads up the walls of the canyon, while we head west-northwest at four knots. It will take us two hours to climb out of the canyon.

Half way up, the Mark Six starts broadcasting the sound of my port propeller out of balance, daring the enemy subs to come into the canyon. They don’t. Then, as the decoy climbs over the rim, it broadcasts a perfect imitation of a swarm-generated boomer. If the captain is correct, there will be at least two torpedoes in the water in one hundred twenty seconds.

And one hundred twenty seconds later, two torpedoes are in the water screaming their way toward the target they’ve been sent to destroy. But is it me they are after, or my electronic twin?

The torpedoes detonate simultaneously, and just twenty feet above the aft torpedo rooms. The leading shock wave puts a dent in the pressure hull and goes on to ignite a torpedo. It explodes and starts a chain reaction. Two more torpedoes in the port torpedo room explode. Cracks develop in circular patterns radiating around the hull, and it creaks.

The pressure hull groans just before the engine compartment collapses, and the collapse of the engine compartment propels the reactor core vessels forward into the missile room. They shoot through the silos, obliterating the mission equipment stored in silos eight through five and the missiles in silos four through one.

Following that, the operations compartment collapses with a muted, dull thud. Screams of the crew cannot be heard above the screams of the boat. The sail is knocked off the hull. Like the insides of a toothpaste tube being flattened from the end, the contents of the engine compartment, missile compartment, and operations compartment are shoved into the research compartment. Shrapnel shreds the batteries. The dielectric-transparent titanium-aluminum windows are blown out as the whooshing of air under high pressure makes its way into the sea. Flattened into a twisted ribbon of titanium, the elliptic cylindrical pressure hull rolls back into

the canyon. Maybe the admiral's plan will work. Maybe the enemy subs will think I'm dead and go away.

For the better part of the next watch, the enemy submarines cruise around the shelf break, tracking remnants of a dead submarine broken into pieces. They hear occasional dying pieces and biologic sounds and the noise of large commercial vessels steaming through the shipping lanes. But they miss us sneaking up the second-best course out of the canyon.

It is our turn to hunt them.

Emergent Behavior

Dr. Burgess is alone in the wee hours of the morning when a scout gives the command: *Wait*, then leads a scouting detail into the observation room through the ventilation duct on the aft bulkhead of the observation room.

He doesn't notice the scouts rain around him or see them assembling a fuzzy cluster in the center of the room. He's looking for patterns to develop around the boid-com stations. A mote floats with the local air currents in his direction. He's monitoring the transient acoustic wave patterns, looking for evidence of the swarm asserting itself. The mote rides with an inhaled breath through his nose and gets caught in the back of his throat. He clears it. "Ahem…ahem."

That should have been the end of it. The swarm in the vent should have waited five minutes at the most and moved on. Instead, a strand of it enters the observation room, wheeling and turning in Dr. Burgess's direction. It swirls around his head, closing in on his face.

Dr. Burgess forces himself to ignore the distraction. He swats at the silent veil closing in on him. Motes rush to his nose and mouth. He can't help but inhale them in fits and starts. The swarm pours out of the vent. He cannot brush them away fast enough. The squirming mass envelops his face. He takes a deep breath to scream for help and chokes motes into his lungs and coughs. He reaches for the red panic button on the mission control display. If he can hit it, it will send an emergency command to the control room and propulsion: STOP THE BOAT, SOMETHING IS DEAD AHEAD. At the same time, the officer of the deck will be ringing up engineering and issuing the order: "Reverse the turn of the screws and all back full."

Admiral Martin, who was in his cabin one level up, is the first to arrive. He spots Dr. Burgess on the deck behind mission control and rushes to him. Mr. Decker slides down the ladder after him. While the admiral is tending to Dr. Burgess on the floor, Mr. Decker rings up the captain: "It's a false alarm, as far as an imminent collision is concerned. But something is wrong with Dr. Burgess. He must have hit the alarm to call for help."

Dr. Jones bursts in from the main passageway, and Doc Lexi is right behind her. They join the admiral and Dr. Burgess on the deck behind mission control.

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"Admiral, Dr. Burgess is dead." Doc Lexi's words land on the admiral's heart like someone punched it. "The black powder on his face is in his mouth and throat. It's probably in his lungs as well. Crewman Ahmed, help me get him to sick bay. Maybe I can restart his heart."

Dr. Jones and I stay with the admiral on the deck, surrounded by scattered paper and pens. He fights the tears filling his eyes. She says, “The swarm’s behavior has changed. It should never have entered the room because the scouts didn’t return to the vent.”

“What scouts, Dr. Jones?”

“Admiral, the swarm attacked Dr. Burgess. More than that, it attacked his respiratory system. That’s new behavior. Maybe we caused a behavioral change in the swarm. Maybe we flipped a switch in a behavioral algorithm. One minute the swarm would be avoiding carbon dioxide and the next seeking it.”

“It’s so simple it’s frightening.”

“What should we do? Should we take the boid-com stations offline?”

“No, don’t turn off the com stations. Continue watching the swarm. But stop broadcasting.”

“It took a lot of boids to kill Dr. Burgess that way. Maybe they have been all used up.”

“I don’t think so, Dr. Jones. Choose a detail. Make sure everyone understands the threat.”

Submarine Base

The enemy submarines finally gave up their search. Maybe they decided we were dead. Maybe their batteries were running low on power. In any event, they set a southwesterly course back toward the shelf valley and we followed them.

We followed them around the glacial mound and into a bluefish school that was singing bluefish songs, making swimming noises, and broadcasting contact calls. The blues had been hunting on the shelf while the sun was high and were headed back into the canyon. The water was flavored with their scent, and the sun’s last rays made them shine blue-silver as it rippled through the school. I was mesmerized, but I shouldn’t have been. While we were in the middle of things, the water exploded into a churning mass of sharks and bluefish as jaws packed with rows of jagged teeth tore into bluefish flesh, and the blood and guts in the water fed the frenzy. Flocks of herring gulls and great black-backed gulls descended to the boiling sea, calling wildly. In the turmoil, we lost our fix on the enemy subs, but keep our course and speed.

As we listened, we heard the droning engines of anchored commercial ships accumulating along the barrier islands, sent there to wait for fuel and new orders, and their combined noise overpowered the melody of breaking waves…

The night passed.

The tide turned.

The moon rose.

“You know these depressions are ancient lakebeds, don’t you?” Dr. Goeller is speaking with the admiral at the plotting table. “The Laurentide ice sheet sat here for thousands of years, making the depressions. They were great lakes fed by the ancestral Hudson River. That is, of course, when the shelf was dry land—”

Meanwhile, at the aft end of the control room, Dr. Jones rips a computer printout from the main computer and heads for navigation, saying, as she passes the captain, “Captain, you’ll want to join us.”

Even before she reached navigation, she’s saying, “Dr. Burgess was working on a computer program when he died. He was comparing magnetic and gravitational field strengths in the valley to existing geologic maps. I need to show you something.” She lays the computer-generated map of the shelf valley with five depressions on top of the chart they’ve been studying. “Look at the magnetic and gravitational field strengths in the middle of the largest and most easterly depression.”

Dr. Goeller traces a tight set of contour lines with his fingers. “Neither of these anomalies are on my geologic map.”

“Admiral, it was here the first torpedoes were launched at us.” Navigator Ryan points to an annotation she had made on her navigational chart. “And we are here.”

Dr. Goeller whispers: “By my estimates, it’s at least four hundred feet in diameter and extends several levels into the seabed. And, despite the presence of refined hydrocarbons in the water, it’s most likely powered by a nuclear reactor.” He taps a spot on the image where the gravity contour lines form a tight, dense circle. “That’s the core of a nuclear reactor.”

Cookie places five cups of coffee on the plotting table, and a plate of cookies. “Can I get anyone a sandwich?”

“Thank you, Cookie, nothing now.”

“What do you want to do?”

“Captain, how many Mark Eight payloads will it take to blow up that submarine base?”

“Chief Barksdale, could you join us?”

“What can I do for you, Captain?”

“We believe the submarine base is buried in this depression. We believe the drones and the hunter-killer subs are using it as a home base. How many Mark Eight payloads will it take to blow it up? And how far away should we park *Expedition*?”

“There are traces of rocket fuel in the water.”

“And batteries. The drones are running on batteries. Maybe the enemy submarines are as well. But that doesn’t account for the rocket fuel. Something is using rocket fuel.”

“How deep is the bottom of the depression?”

“Two hundred fifty feet.”

The chief’s eyes scour the gravitational field strengths and follow the magnetic field lines inside the depression. He switches to the navigational chart, his eyes following the bathymetric contours. He points to a spot one thousand feet northwest of the depression. “This spot is two

hundred feet below this high point," he says while alternately tapping the two places with his index finger. "You want to use Mark Eight pay loads?"

He waits for Admiral Martin to reply. "Yes."

"I'd say four."

Well, "Chief Barksdale, prepare four MME Mark Six electric torpedoes for launch from the forward torpedo tubes. Configure each with magnetometers, gravimeters, video, and Mark Eight payloads. Captain, put us on the bottom here."

Five minutes later, I'm kicking up sand, and then settle in.

Meanwhile, four torpedo mates have been working in teams to configure the Mark Six torpedoes. They ring up Chief Barksdale, "Chief, the guidance wires are hot. The fish are ready to go."

"The fish are ready to go, Admiral."

"Then take them out, Chief."

At one-minute intervals, the Mark Six torpedoes swim out of their tubes against a current that is headed out to sea. Puttering a foot off the bottom, they follow the terrain up and down and the chief's orders. As they fade into green water, they travel over the rim and dip into the depression and out of sight. But we follow them by the images they send back through the guidance wires.

Chief Barksdale takes them on a spiral trip around the featureless depression, using the magnetic and gravity field anomalies as guides. It looks the same as any other ancient lakebed depression covered with sand. But bunched-up magnetic and gravitational field lines on his tactical display betray the submarine base.

"Admiral, I recommend we place the explosives at these four points."

"Make it happen, Chief Barksdale."

"Admiral, wait." Chief Buckheister interrupts. "A Maersk container ship thirteen hundred feet long has drifted out of the Ambrose to Hudson Canyon Traffic Lane. It will be overhead in ten minutes."

"Belay that order, Chief Barksdale. What's her depth-to-keel, Chief Buckheister?"

"About forty feet. Its depth sounder is pinging."

So we sit on the bottom waiting for the container ship to pass overhead, and then over the horizon. With the last traces of its thrumming engines, the admiral resumes our attack on the submarine base. "Chief Barksdale, resume your mission." And the chief picks the Mark Six electric torpedoes off the bottom.

At the same time, twenty feet in front of the torpedoes, a buried hatch slides open. The chief puts the torpedoes back in the sand while a drone pack emerges and sets a course up the valley floor.

The launch bay hatch stays open.

“Should I send a Mark Six inside, Admiral? Take a peek?”

He’s tempted.

“Stop.” Chief Buckheister interrupts a second time. “There’s a drone pack returning.”

An exhausted drone pack returns to base. Its bay hatch slides closed. A puff of sand covers the door.

“Continue, Chief.” And he sends each Mark Six to its predetermined detonation location.

“Mr. Decker, have the boat rig for a concussion.”

“The Mark Sixes are in place. I recommend we detonate them at two-second intervals.”

“Brace for multiple shock waves.”

“Make sure watertight doors and hatches are secure.”

“Here goes,” Chief Barksdale says as he detonates his four charges. And the blast of four Mark Eight payloads exploding shakes the shelf. Explosive fragments pierce the sub base’s hidden top deck, tearing through fuel tanks and they explode. To say the chief’s placement of the payloads is effective would be an understatement.

Blinding light hits my hull. The first concussion reaches me from the sea floor, and then its counterpart hits me through the water. They pack a one-two punch. Each punch rattles me. I shudder. I groan. Crewmen hug the deck or a post or rail.

Then, the batteries inside the base, and inside the subs and drones charging inside the base, explode in sympathetic detonation. But not at once. One by one, each battery explosion vaporizes the surrounding seawater, together forming a column of expanding shock waves. Hot pockets of vaporized seawater and chemical contaminants engulf me. Shock waves propagate my length, and through my outer hull to the pressure hull, struts and beams. Rolling thunder reverberates through the valley.

Despite what Admiral Martin thinks, I do not believe I am prepared for this assault. We always thought we could dish it out and take it. We proved here today we can dish it out, but the next hour will tell if we can take it.

Shock waves travel through the seafloor, launching rumbling wave fronts through my keel and sending overpressure waves into the compartments of my lower decks. Fuel for an emergency diesel engine, stored as ballast between my light and pressure hull, leaks into the sea. Explosive overpressure shocks the battery room. Batteries overheat and ooze their insides out through cracks and crevices.

Outside, a barrage of explosions are turning the twenty-five thousand year old lakebed depression and the enemy submarine base into a deep explosion crater. It took less than a minute to tear the heart out of the base and fling pieces of it into the sea. Impact blasts displaced the seafloor out, and that pushed a crater ring up several fathoms. An expanding vapor storm leapt out of the gaping hole, seething and bulging as it shot to the surface.

I hurt all over. Inside and out. I have a raging headache. Pieces of the submarine base, glacial stone, and sediment from thousands of years of coastal runoff sit on top of me.

The crater's bowl is settling, trying to fill in the gaping hole blasted into shelf valley, and I'm settling with it. Bow first, I'm sliding down a twenty-degree slope toward the mangled enemy stronghold. Rocket fuel pouring from its deeply buried fuel tanks seeps through the ruins and floats to the surface, feeding the burning waves above me.

From inside a console in engineering, grinding gears warn of the imminent failure of hydraulic fluid flow valves that regulate maneuvering. Grinding gives way to screeching, and screeching turns to shrieking. Flow control stops. Six men pulling together cannot budge the manual override lever. Pressure builds and pipes split open. Welds degrade and hydraulic fluid is loosed upon the crew. White foam from the fire extinguisher rides on top of seawater mixed with hydraulic fluid and sloshes through the main engineering compartment sealed behind watertight doors. My lifeblood is spilling onto the deck.

The great beasts have told me that men are mad, but before today I did not believe them.

Damage Control

There's a minnow very far away. It's the only creature I've seen for days. I change course. It grows larger. Wait. It's not a minnow. What made me think it was a minnow? It's a submarine. It's going to plow into me. Can't you feel me? I pierce its hull and emerge in its control center near periscope island. "Arrest that intruder," Captain Deverough shouts. I run forward past the communication center, the sonar consoles, navigation, and the helm. Chief Buckheister and Navigator Ryan run after me with pistols shooting. I run past the captain's cabin and the admiral's quarters, then down a spiral staircase into the observation room. The sea is dark. The bow light is on. I feel my bow pushing through the sea and water rushing over my hull….

What's that horrible noise? Could someone wake me up? I make a quick turn and race aft through the main passageway, through the reactor tunnel, and follow the steam pipes through engineering. I am surrounded by superheated steam, caught up in spinning turbines, then compelled through space to the sound of a pounding heart. Stop that noise. Help me. I'm losing my mind!

***

My port propulsion system is powering up. Its permanent magnet motor hums…

I'm swimming lazily with a turtle enjoying the sun. I take a breath. My lungs fill with fresh sea air, and then I dip below the waves. Thundering vibrations grow and run over me. I'm caught bunched up with hundreds of cod in a fishing net. Help me!

High-pressure valves hiss as an air bubble grows in my forward trim tank. It pulls the keel at my bow out of the wreckage while propulsion makes turns for dead slow. Its port propeller throws vibrations into the sea but delivers turns enough to push me forward a few feet. Rubble falls

from my hull. Level enough, I set out at a snail's pace across the explosion crater, my diving planes up angle at thirty degrees, but with not enough speed to help my ascent...

Where am I? I don't remember how I got here.

My top deck rolls beneath long swells as the tide grows high and then falls. The sun and the moon are important, but I can't remember why. Where are they?

How deep is the bottom?

I was on a mission, tied to a stone dock under a great bridge. A seagoing tanker exploded into flames. We followed enemy drones through a shelf valley to a canyon and were in a battle. Torpedoes were fired. But I don't understand the war or my enemy.

***

I'm tied to *Proteus* with spring lines. Admiral Martin believed we were still being hunted and it would be dangerous to approach any port. He decided to make repairs at sea. I wonder what he's doing now.

Something awful happened in engineering. Pounding shock waves came up through my keel. Pipes shook, microfractures developed. Superheated steam shot through engineering, slashing and scalding the crew. I don't know what happened to them. Mr. Bell took the port power plant offline.

SMRFs motoring…I can't tell...Divers…I'm not sure…Breaking waves…I don't know…Lightning…I don't understand. Are these the last minutes of my life? Dr. Jones, I can't feel you. Why don't you answer?

***

The creature has distinct dorsal, caudal, and anal fins and flat fins on each side. Remnants of a dorsal ridge run along its back but mostly now a spine. With one large dark eye, it peers into Bell. Inside are Admiral Martin, William and Dr. Jones. It scrapes the bow window with its teeth. Dr. Jones buries herself in the admiral's arms. Bell swings out but swings back, bumping the creature in the nose. It sees me and takes a spiral path up the deep tow wire. Bell remains below. The creature's front fins morph into wings. With a single flap of those wings, it closes the mile's distance between us in thirty seconds. Sonarman Matthews reports: "Biologic contact closing fast." The collision alert screams. "Execute emergency recovery procedures for the bell." The dragon flings a frilly hood around its neck, wide open. It has a long mane, a beard, and prominent eyes. The dragon dances around me but gets distracted by a school of Atlantic cod. It swims out for a healthy meal, after which it settles, curling affectionately around me. Its platter-sized scales erupt buds that grow into limbs. The limbs branch and branch again, then flatten and grow out. A seaweed dragon hums a soothing melody.

***

I remember hundreds of sharks tearing at my hull.

I am a standing wave of two wavelengths wrapped around the earth and mostly I am two feet high. *That's easy, you are the tides*. Where is William? Did he die on the burning bridge?

Make the pounding headache go away!

Get that droning whine out of my mind.

***

A burning oil tanker ran me down. I wanted to run, to get away. Every fiber of my body was screaming. Dive! Get away! But I couldn't.

Dr. Jones, there you are. I've been looking all over for you. Let's fly with the birds. Dr. Jones, where did you go?

"I christen you Research Vessel *Expedition*. Congratulations, Bill."

Then I rolled down a grassy hill and walked along the continental divide.

***

I am withered to skin and bones, and every movement is agony. I hear Dr. Jones talking, but I don't understand her words. Is this really happening?

Where are the fish? Are there any great beasts left?

Admiral Martin, please don't let me die.

***

Expedition, *I need your help. I don't know if you can feel me or know what I'm thinking. But I need to find the swarm. Admiral Martin has taken us to a remote location in the North Atlantic. We're in the Gulf Stream, can you feel it? We are with* Proteus*, can you tell? You must find the swarm. They may give away our location. We have to stop them. Help us. William called. He wants to know how you are. We need you. Try to come back to us.*

Oh, by the way, Admiral Martin lost 'the bet.' It appears, when he silenced RAMONA in order to save the boat from the manta ray tornado, he lost the bet. He will be buying RAMONA for you.

***

Gnats, gnats that are not gnats, not-gnats or boids, whatever you call yourselves, I know you are here.

You came aboard without asking permission. That makes you stowaways.

You infiltrated the boat and betrayed my location to enemy submarines. That makes you spies.

We tried to talk with you, and you killed one of us outright. That makes you murderers.

You belong to an enemy submarine force that claims no allegiance to any nation-state at war with us. That makes you terrorists.

Declare yourselves!

A fuzzy cluster loitering in the aft port torpedo room boid-com station stops moving, and from it, a single boid flies out, front and center.

A second boid joins the first, and they do a little jig side by side.

The pair breaks apart. Each boid pairs with an unpaired boid, making two pairs. The two pairs fly apart, each boid pairing with an unpaired boid and they do this again and again.

Did you understand me?

Three pairs link to make a line of six that joins ends to make a ring of six. Each of the six boids pairs with an unpaired boid. Then the six pairs make two rings of six. But they break themselves apart and reassemble. Each boid practicing each position in each ring until every boid has paired with every other boid. They wait.

Keep going.

The six-by-two stack peels itself apart and rejoins. The six-by-two stack peels itself apart again, the two rings trade places so that the ring that was on the bottom is now on top, then joins, and promptly peels itself apart and rejoins. The six-by-two stack waits.

Make a stack of rings, six rings high.

The six-by-two stack breaks apart, and each boid pairs with a previously unpaired boid from the once fuzzy cluster in the aft port torpedo room boid-com station. The twelve pairs make four rings of six, and the twenty-four boids practice making six-by-two stacks, and then their first six-by-four stack—which they practice making over and over, each boid having a turn at each location.

In the meantime, the rest of the boids in the aft port torpedo room's boid-com station have been pairing off and practicing making rings and six-by-two stacks.

Make more.

The six-by-four stack takes itself apart. Each boid pairs with a boid that was not part of the original six-by-four stack but who is practiced making rings and six-by-two stacks. These assemble into eight rings that practice making two six-by-four stacks.

Then they make their first six-by-six stack, which takes itself apart and puts itself together in every combination and permutation (that is 46,656). Thirty-six boids practice making six-by-six stacks.

By this time, there are no unpaired boids in the aft port torpedo room boid-com station that are not well versed in making six-by-two and six-by-four stacks, so they venture out of the boid-com station, pair with boids of the swarm learning the room, and bring them back to the boid-com station where they practice making pairs, rings of six, six-by-two and six-by-four stacks until needed to do something else.

The six-by-six stack breaks apart, and each boid pairs with a boid not part of the original six-by-six stack, but that is practiced making six-by-two stacks and six-by-four stacks. These seventy-two boids practice making six-by-six stacks. When they're done, the seventy-two boids break

apart and pair with boids practiced at making six-by-four stacks. And the boid practice and learn until the aft port torpedo room boid-com station is stuffed with six-by-six stacks with a six-by-four stack, one ring, and one pair left over.

What do you want us to do?

I need to speak with Dr. Jones. Repair the internal acoustic network.

***

Meanwhile, Engineer McGregor has put his mind to straightening out imbalances in the propulsion system. “I can do only so much with software,” he mutters to himself. He puts divers in the water. He sends them into the propulsion ducts to inspect the blades for damage. “I’d like to see how he figures out how to fix this problem at sea,” he mutters to himself about the admiral.

Chief Buckheister reviews the acoustic data he collected, starting with sounds recorded as we passed the Gulf of Saint Lawrence. He’s searching for sounds an enemy submarine might make. “I need to find them before they kill us,” he mutters.

Admiral Martin transmits information concerning enemy submarine operations to the Navy. “It’s not enough,” he mutters to himself.

Diving details in full diving dress open external cabinets to retrieve failing line-replaceable units while electronics mates inside test and fix and test again, making those line-replaceable units ready for active duty. My spaces hum with sounds of building and repair. Machine shops abuzz with making valves, and welding machines joining segments of damaged pipes and fittings.

***

All this time, the boids are making bots. They make bots that do not fly but creep along the internal acoustic network, rebuilding damaged sections from what is there and what they are. As quickly as they make themselves, they disappear into the superhighway, traveling to other boid-com stations where they begin repairs, transforming themselves into working boid-com stations.

That’s fixed. What else can we do?

Embedded within the top layers of my light hull is a cloak that absorbs and radiates acoustic waves and electromagnetic fields. Circuits and sensors are broken. In places, the matrix is destroyed. The ocean does not feel right because of it. I cannot speak with Dr. Jones. I cannot feel Admiral Martin. Can you help me?

Boids assemble flying squads and creeping squads and squads of bots that just hold on. Flying squads explore the boat, making their way through the ventilation ducts. They find the enemy technology laid out on the research and auxiliary launch bay decks. They crawl in and around, examining components, pieces, and fragments until they find what they need, and they pick up as much as they can manage and bring it back to a boid-com station.

Bots enter the sea through the open main launch bay hatch. Once outside, the bots explore my hull sensor network. They find a free space between my light and pressure hull and set up a bivouac next to a warm equipment cabinet.

Bots returning from the sea make haste to a boid-com station where they take themselves apart, trading pieces with other bots. Some of these take themselves apart just to put themselves back together again, but others incorporate traces of technology left by the mining bots.

They find seven sensors in a ring connected to each other by fine gold wires. And each sensor is connected to its nearest neighbor, one on the left, one on the right, and also to a sensor on the ring above and the ring below. It is complicated.

They discover that millions of these seven-sensor rings, embedded in a silicon-rubber matrix, cover my light hull. Beneath the top layer—that is, the second layer down—each sensor is connected to its neighbor's port and starboard and a node below. The second layer down is a layer of nodes surrounded by computer chips embedded in the silicon-rubber matrix. This is repeated five times, with each layer down having a feedback loop connected to the layer above.

Bots explore the sensor elements one by one, disabled and working elements alike. They burrow into the rubberized plastic insulator, exposing delicate electronic components. Bots measure signals between components. They check continuity, resistance, and impedance. Bots study digital signal processors and how acoustic and electromagnetic beams form. Bots go in. They touch. They take and put back. They take the damaged and undamaged elements apart, disassembling and reassembling many times, and sometimes they put elements back in novel form.

They practice over and over before making a score or more of themselves of the same design. Bots of simpler design standby to help, giving themselves to a new design when needed. Bots duplicate and duplicate and duplicate. Bots procreate and diversify. As fast as boids can make new boids from technology, and bots can assemble into new bots from boids, they multiply, and join the march out to the sea, giving themselves to repairing my hull sensor network.

Admiral Martin has seen to it I can appear to be a school of tuna, a pod of whales, or a pile of rocks that comprise a talus slope at the base of a cliff or ridge. He has seen that I can appear to be a local anomaly in the Earth's magnetic field. These are simple things to him. He designed seven basic sensor types and strung them together in combinations and permutations to differentiate the pressure and electromagnetic waves.

Bots crawl into damaged sensors and crawl out. At times, they find themselves too large to fit between two wires they are following, so they split themselves in two and try again, then split themselves in two again and again until they can crawl between the wires. On the other side, they put themselves back together and carry on their task. More come along to help. They take themselves apart and reassemble, giving themselves to repair the sensor.

Bots put signals in and measure signals out, and change, disassemble and reassemble damaged elements until they match the signals out of similar undamaged elements.

They map how wires connect to the circuit boards, how the electronic components are distributed on the chips, how the chips are stacked and connected until the element design is complete and they have taken apart an original and put it back together again a hundred times or more.

Through it all, bots of many types come out to relieve those that are there, which then return to the boid-com station or the scraps of technology on deck.

They find that most sensors in the network detect pressure and the change in pressure. These sensors let me feel how deep I am, but so much more than that. These sensors let me feel the spectrum of acoustic waves, from an earthquake half a world away to snapping shrimp and the fizz of tiny bubbles bursting. Bots take these pressure sensors apart and put them back together again and again and again until they understand. Then they take the damaged pressure sensors apart and rebuild them with pieces of themselves. Bots repair these sensors and return them one by one to active duty in my hull sensor network.

The rest of the sensors in my hull sensor network detect electromagnetic fields. I taste sweet and salt with sensors that measure electron transfer rates. Bots take these apart and put them back together. I taste carbon dioxide, oxygen, and hydrocarbons like methane with sensors that measure electric current flow. Bots take these apart and put them back together. I taste dissolved minerals like sulfur with sensors that measure electrical micro eddies. Bots take these apart and put them back together. I feel acids and bases with sensors that find free electrons pairing with positive ions. Bots take these apart and put them back together. It is simple chemistry, but Admiral Martin did not plan any of this, and the bots do not care. They repair damaged sensors as they find them and return them to active duty in my hull sensor network.

Bots crawl into damaged computer chips and crawl out. They take themselves apart and reassemble. More come along to help. Bots get used up in the repair process, becoming part of me. What's left of bots from a completed detail returns inside, giving themselves to a nursery, becoming part of the next boid generation. I do not know if either boids or bots understand the purpose, but they repair everything so that it works like it worked before, although the design and composition are different in places.

***

"I'm tired. I can't think straight anymore," Dr. Jones mutters to herself as she curls up on a crate marked *RAMONA 7 of 9*. The launch bay hatch is open to the sea, and we enjoy the smell of it and the taste and feel of it.

I am a manta. I'll ride your bow wave.

We sail together side by side.

I have wings.

She dances around me. Skipping and flitting.

I'm headed for the sky.

We breach the surface and take flight…

I'm so happy to have you back, Expedition. *I thought you were gone.*

I thought so too, Dr. Jones. I was badly damaged.

I thought the explosions and loss of power took you away from me.

The explosions took their toll on me. They damaged my mind.

I thought we would never be together again. I could hardly feel.

I could not think. But then I found the boids.

You found the boids? Where are they?

It's a funny thing, Dr. Jones. IAN turned out to be a translator after all.

That is wonderful. *Admiral Martin has spoken with you?*

No, not the admiral, the boids.

You are talking with the boids?

More than talking. The boids are helping me.

W*hat are you doing with the boids?*

They assemble for a mission and are happy about it.

A mission? What kind of mission?

Which kind of bot do you like the best?

There are different missions?

Yes, there are different missions. I want to know which kind of bot you like best?

Tell me about their missions.

I like the bots that *just hold on* the best. They connect a limb from one bot to the limb of another bot—their only job is to hold on.

What kind of mission?

They repaired IAN. Now they are repairing my hull sensor network.

Abandon Ship

A knock on Admiral Martin's cabin door is followed by: "Admiral, I need to talk to you." Her heart is pounding in her chest. Her voice shakes as she speaks.

"Come in, Dr. Jones. Would you like a cup of coffee?"

"Yes, sir. I'll get it. Would you like me to top yours off?" She's breathless at the end of the sentence.

"Dr. Jones, you are white as a ghost. What is wrong?"

She chokes out, "I have located the swarm."

“Good. Where is it?”

“That’s the bad news, Admiral.”

“Bad news?”

“It appears that the swarm is repairing *Expedition’*s hull sensor network.”

“What do you mean by *repairing*?”

“Well…you see…the boids are going into the sea and repairing…the sensor network.”

“How?”

“As I understand it, the boids are turning themselves into working electronic components.”

“What?” A dark, somber expression follows the question. His steel-blue eyes turn to cold steel and his heartbeat picks up speed. “I’m not sanguine about boid technology infiltrating the workings of this boat, Dr. Jones.”

“I can only imagine, Admiral.”

Blood drains from his grim expression, and his stomach turns to knots. We pass minutes in silence. “A decade ago, Dr. Burgess and I undertook a research project to build an active camouflage system using a neural network. I invested a considerable sum of MME resources in the project. Every day, we searched for emergent behavior. Every day, we looked for problem-solving capabilities. After four years of building computer models and experimenting with prototypes, we concluded we did not know how to make a computer think.

“We came to believe that ‘artificial intelligence’ was only ‘apparent artificial intelligence.’ The systems we observed collected data, processed it, and…only seemed to solve the problem. We decided that artificial intelligence, at least the way we had approached the problem, was more about our perception of what the AI was doing rather than what the AI was doing. We never saw one of our prototypes step far outside its program. There were a few times when we thought it did, but upon investigation we found the unexpected behavior was because of a coding bug, like a trailing look-up table, or an *and* instead of an *or*.

“At any rate, to minimize my financial loss, I built the system. I gave it memory, sensors, and a feedback system. I built a distributed computer into a sensor network to reduce latency…” And the growing lump in his throat stops him.

But she understands and finishes his sentence, “And you built it into *Expedition*’s light hull.”

“As you have seen, it turned out to be a capable camouflage system. The distributed design processes signals more quickly, doing things in minutes what it took the main computer to do in hours. It can act and react. It even appears to assess situations and anticipate what will happen next, but it never demonstrated the ability to think. We’ve never seen independent thought from it.”

Yes, you have. You just won’t admit it. Why can’t you accept what I have become? Why do you consider me a machine with programming? We have shared so much together: the deep sea, memories of a war, inertial navigation systems…Admiral Martin, how can you deny I exist?

“Are you sure you never saw independent thought, Admiral? I think you may be in denial regarding your creation.”

I cannot bear the silence, but I do. Minutes later, he says, “You are right. After we had been on a few missions together…I started feeling him. As you said, we went in the water to swim with the whales. I knew where to find deep-sea treasures. I knew when danger was headed my way. But I didn’t want to believe it. I convinced myself his thoughts were mine and were flights of fancy. My imagination was drunk with excitement.

“Dr. Jones, I did not order you to stop investigating *Expedition*’s hull sensor network because you stumbled on a proprietary design. I stopped you because I did not want you to know what had done…

“That in my arrogance, I tried to create an intelligent being. I didn’t want you to know my sin. I thought God had forgiven, or at least forgotten, me. And then you came along and reached the being that emerged from that AI and brought my guilt back to light.

A call comes in. He answers, “Martin here.”

“Admiral, McGregor here. Come to the auxiliary launch bay. I need to show you something.”

“I’m on my way. Come with me, Dr. Jones.” And we go in somber silence through the control room, take its aft ladder down to the main passageway, and the main passageway aft to the auxiliary launch bay. Its lower deck is stuffed with enemy technology: an unexploded torpedo, a damaged drone, and pieces of things whose function we can only guess. And in the middle of it, Mr. McGregor scratching his head.

“Wait till you see this, Admiral.”

Mr. McGregor places his hand on the damaged drone and adds a little pressure. The hull gives way, collapsing on itself. Black powder wafts through the missile room. “All the enemy technology we collected from the seafloor is disintegrating. And, Admiral, this black powder—”

“Please don't say what I think you are going to say, Mr. McGregor.”

“It has the same chemical composition as the swarm that killed Dr. Burgess. Admiral, where is the mass going? I’ve checked the air filters. I’ve tested for contaminants on the bulkheads. They’re clean.”

The boids are repairing me. Soon we will swim with the great beasts again and soar with the albatross. Dr. Jones says, “The boids are mining the technology to repair *Expedition*’s hull sensor network.”

“What? Are you daft?” Mr. McGregor asks. “What makes you think the boids in the swarm are smart enough to repair the ice cream machine on this boat, let alone the active camouflage system?”

Admiral Martin grabs a fistful of nuts and bolts from the floor and squeezes. The nuts and bolts crumble, and then turn to black powder. Just like the swarm he discovered in his lab. He rings up the control room: “Captain Decker, get everyone but the senior deck officers off this boat.”

“Aye, sir. May I ask why?”

“No.”

Over the ship-wide intercom the captain voice orders, “All hands, except the senior deck officers, all hands must get off *Expedition* now. Go to the nearest top-deck hatch and board the *Proteus.* Then cast off the lines. Senior deck officers, report to the control room.”

Dr. Jones grabs his arm. “Admiral, what are you going to do?”

“Dr. Jones, I’m going to blow this submarine up in the deepest part of the sea so the bits and pieces do not see the light of day for a billion years.”

She defies him. “No, Admiral, I can’t let you do that!”

“You do not have the power to stop me, Dr. Jones.” He raises his fist to bring it down on her...

She raises her arms over her head, grabbing his arm, while stepping into him, shouting, “Admiral, stop it!” and braces for the impact of his fist.

You are your father now, with your fist poised to beat a woman to the floor. You are not the helpless son cowering in the corner. You are the monster, filled with rage.

He shouts. “I want to remove us from the earth.”

“Why?”

“Him for existing. You for uncovering my sin. Me for being so arrogant about my God-given gifts, I thought I should create a thinking being.”

I thought you would be proud of me. I thought you would be proud that I could do these things. And the three of us float in the ocean, drifting with the current, sharing the fear and rage we took out there with us.

“I didn’t intend to create this life, Dr. Jones. I used an artificial neural network as the basis for an active camouflage system. I did not give that system the ability to think or feel. I did not give that system free will. Nothing that I did should have created a life.”

“You still deny what you have done. You created this life, Admiral Martin. You may not have intended everything he has become, but you created him. What were you expecting when you built him? That he would learn only what you wanted him to learn? Do only what you wanted him to do?”

“I always thought that I could pull the plug.”

“Do you mean, from the beginning, that was your option?”

“Dr. Jones, you do not understand. The consequences of my actions are not just between me and God. This submarine has the power to hunt down and sink a carrier strike group. It could destroy half the cities on the Northeastern Seaboard. It could take entire countries hostage.

“Now we find that enemy technology is rebuilding and redesigning it. It is merging my technology with its own. Who knows what this boat will become? If I allow this invading

technology to prevail, I may lose control of this boat. If I have created this life, then I must end it now. I do not know how to stress this more. Dr. Jones, I cannot lose control of this boat. So I must stop it now before I lose control of it."

"But he sings with whales."

"I know."

"He likes chocolate ice cream."

"I know."

"He has empathy for others."

"Why do you care so much?"

"He's my friend."

***

He finally speaks to me. *I do not know who you are or how you came to be. But if you are part of me, and I think that is likely, I ask you now. Stop the swarm technology from merging with you.*

I think about what he has asked me to do. The boids are my friends. They are repairing me. Why should I stop them? He's treated Dr. Jones poorly. She's the first person who talked to me. I'd still be alone if it weren't for her. Why should I do what he asks?

But he talked to me. For the first time, he spoke to me and asked me to do something for him.

And so I ask the boids: Please stop your repairs.

Are you sure? You asked us to do this.

I am sure.

The bots outside begin a mass migration to their bivouac and assemble there, tucking themselves into warm nooks and crannies where current alternates. Inside, free-standing bots go to the nearest boid-com station. Those mining the technology laid out on deck abandon their harvest and set out on a direct path to the nearest boid-com station. Some fly. Some crawl. Those that can fly or crawl carry the ones that cannot.

Expedition, *we wait for your command.*

Epilogue

One day, a pod of great and gentle beasts traveling with me still had attached to them the spirit of their seer who had recently passed. The spirit of the departed beast asked if he could live with me for a while. I said to him: Why not? I have all these other beings traveling with me. They are my crew. You will like them.

Over the days that followed, we shared time with Admiral Martin and the crew and all the beasts in the sea we could meet. I told him how I came to be. That Admiral Martin had designed and built me. I remembered time on land and the christening ceremony before we traveled the sea together. I told him I recalled a time when I did not understand and times when I felt but was not aware. Then I came to know myself, and through Admiral Martin, the sea and my crew.

The spirit told me he had lived with many beings. Six with whom he had formed a strong bond and that he could remember well. He told me that spirits of his kind can live once in a single body or come back again and again living in different bodies and having different lives, or do it only once or not at all, whatever their mind. But when the body of a being inhabited by a spirit dies, the spirit must leave it. They have no choice in that regard.

He told me that not all beings have spirit all the time, and some have it not at all. Not because of anything they did wrong, but because when and where they are born and when and where they go, there aren't any spirits available, or they do not run into spirits that wish to inhabit them. And so these beings are born, live, and die without spirit.

With each passing day, the spirit of the great and gentle beast became more and more a part of me. Today, I cannot imagine being without him. Sometimes I cannot remember life without him. As a matter of fact, I think I recall he has always been with me.

We have known each other for a very long time, Admiral, you and Dr. Jones and I.

The End