

The background of the cover is a deep-sea photograph. A submersible is visible in the center, illuminated by a bright light source, creating a circular glow. The surrounding environment is dark and filled with intricate, textured rock formations and silhouettes of tall, thin structures, possibly hydrothermal vents or mineral deposits. The overall color palette is dominated by deep blues and blacks, with the white text providing high contrast.

THE UNDERWORLD

JOURNEYS TO THE
DEPTHS OF THE OCEAN

SUSAN CASEY

NEW YORK TIMES bestselling author of THE WAVE

Also by Susan Casey

The Devil's Teeth
The Wave
Voices in the Ocean

THE
UNDERWORLD

*

Journeys to
the Depths of the Ocean

Susan Casey



Doubleday *New York*

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www.doubleday.com

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Cover photograph: “Lost City,” a frame from the Giant Screen Film *Volcanoes of the Deep Sea* © The Stephen Low Company

Cover design by John Fontana

Book design by Maria Carella

Endpaper map designed by Jeffrey L. Ward

Library of Congress Cataloging-in-Publication Data

Names: Casey, Susan, 1962– author.

Title: The underworld : journeys to the depths of the ocean / Susan Casey.

Description: First edition. | New York : Doubleday, 2023. | Includes bibliographical references.

Identifiers: LCCN 2023002536 (print) | LCCN 2023002537 (ebook) | ISBN 9780385545570 (hardcover) | ISBN 9780385545587 (ebook)

Subjects: LCSH: Ocean. | Oceanography—History. | Ocean—Mythology. | Submarine topography | Ocean bottom. | Deep-sea sounding. | Marine ecology. | Marine ecosystem health.

Classification: LCC GC21 .C36 2023 (print) | LCC GC21 (ebook) | DDC 551.46—dc23/eng/20230518

LC record available at <https://lcn.loc.gov/2023002536>

LC ebook record available at <https://lcn.loc.gov/2023002537>

Ebook ISBN 9780385545587

ep_prh_6.1_144556707_c0_r0

For those who love the ocean

*And in memory of
Ron Casey, John Casey, Judy Casey, and Tom Walkling*

We must go and see for ourselves.

—JACQUES-YVES COUSTEAU

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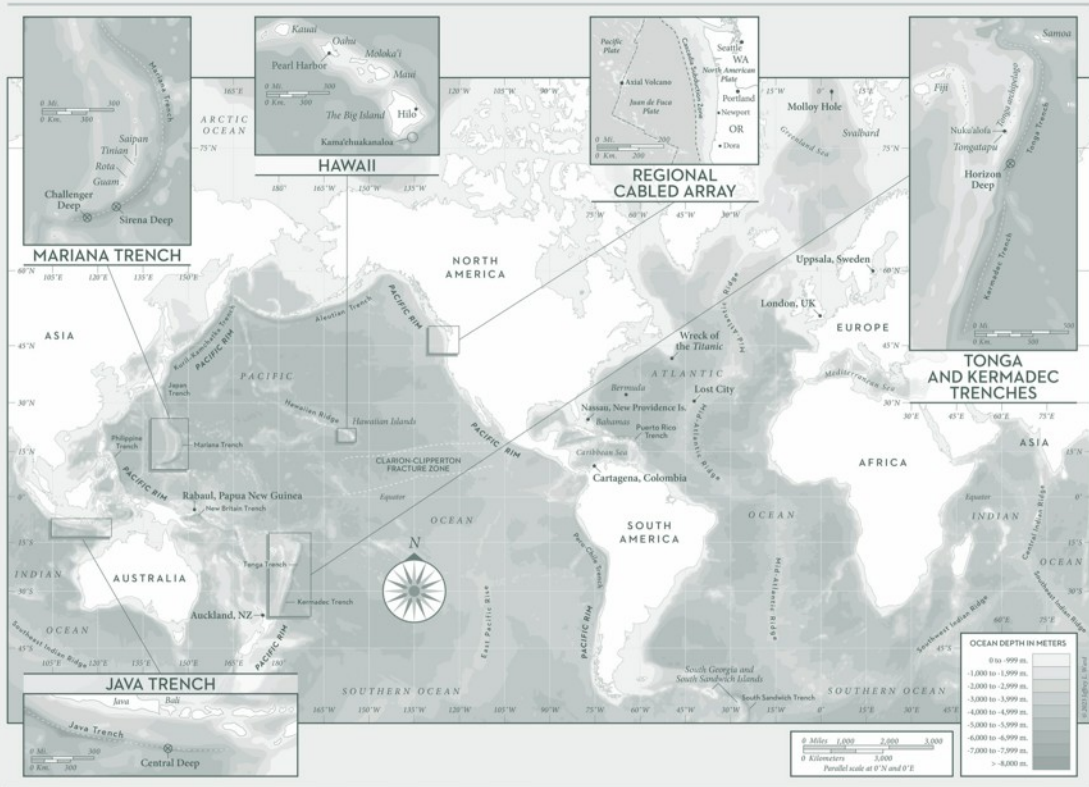
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Author's Note

When writing about the deep ocean, the first question that arises is: What is it? At what point does the ocean become the *deep* ocean? It may be surprising to learn that even deep-sea scientists don't fully agree on how to define the various depth zones. Typically, however, the deep ocean is considered to comprise the waters below two hundred meters, or approximately six hundred feet—the point at which sunlight essentially disappears. In this book, I have defined the deeper layers as the twilight zone (six hundred to thirty-three hundred feet), the midnight zone (thirty-three hundred to ten thousand feet), the abyssal zone (ten thousand to twenty thousand feet), and the hadal zone (twenty thousand to thirty-six thousand feet). These names and measurements are commonly used, although there are other ways to delineate the deep's regions, particularly within its vast mid-waters.

The abyssal zone is known in short as *the abyss*, but the word *abyss* also has a broader meaning as a deep and seemingly bottomless chasm: it's often used when referring generally to the ocean's great depths. You'll find both usages in these pages, with the distinction evident in context.

You could travel through the abyssal zone in a submersible (though few vehicles in the world can venture that deep), but if you were traveling in a submarine you wouldn't have that option. Submarines are capable of sustained, independent undersea operations, but their diving range is relatively shallow. The deep-sea vehicles I describe in these pages are all submersibles. There are two types: manned and unmanned. Manned submersibles carry passengers, who sit within a dry, pressure-controlled atmosphere equipped with life-support systems. These compact subs can descend, ascend, and fly around beneath the surface independently, but they require a support vessel and crew for transport, launch, and recovery. Their power supplies come from batteries, so they can't remain submerged for weeks the way a submarine can.

Unmanned submersibles are robots, and include remote operated vehicles (ROVs) that are tethered to a ship and driven remotely by a human pilot; and autonomous underwater vehicles (AUVs) that may also be launched from a ship, but are preprogrammed to dive, collect data, and return to their base without real-time human input.

In casual usage the words *submarine* and *submersible* are sometimes used interchangeably, referring generally to an underwater vehicle. Both submarines and submersibles share an abbreviation: subs.

The deep ocean occupies 95 percent of the ocean's volume, and you'll notice that both terms are singular. The earth possesses one ocean, though it's traditionally recognized as having five major regions: the Pacific, Atlantic, Indian, Arctic, and Southern Oceans. Whenever possible, I refer to the ocean as a single entity.

The science of measuring the seabed terrain is known as bathymetry—the submarine version of topography. Bathymetric maps chart the depths and contours of the seafloor in three-dimensional relief, revealing its mountains, valleys, canyons, plains, rifts, trenches, and other undersea features.

American and British readers are accustomed to thinking in miles, feet, tons, degrees Fahrenheit, pounds per square inch. Science uses metric measurements. Mariners use nautical miles and fathoms. Here, I'm defaulting to the imperial system of measurement, but when it is helpful for clarity I've cited metric figures. Metric usage in quotes is verbatim.

Prologue

My dear child, how did you come to this land of darkness
while still alive? It is hard for the living to get here.

—HOMER, *THE ODYSSEY*

18.70° N, 155.17° W

THE PACIFIC OCEAN

JANUARY 31, 2021

I stood on the ship's deck in my long underwear and my fireproof jumpsuit, watching a pale silver sunrise and gauging the wind. It was blowing twenty knots, gusting to thirty, and it had been blowing this hard all night, churning the ocean into a disorderly mess. What I wanted to know—and had come outside to check—was *how* disorderly. I could see that the waves were trouble: ten-foot swells galloping from two directions, surging with whitecaps. They'd run halfway across the Pacific, gaining strength along the way. Out here, there was no land to stop them. Bracing myself against a railing, I took out my phone to check the marine forecast. Again.

Today, to me, every knot of wind speed and every inch of wave height mattered. Two hours from now, at 0800, conditions permitting, a team of engineers, technicians, and mariners would attempt to launch an eleven-ton deep-sea submersible with two people in it—and I would be one of them. If the launch was successful, the sub would bob at the surface briefly, the pilot would pump seawater into the ballast tanks, and then we would sink beneath the waves and free-fall for two and a half hours, plunging for miles and touching down in a place that human eyes had never seen. That was the plan. But right now the conditions didn't seem very permissive.

In order for the dive to go forward, the weather would have to lie down. If we didn't dive today, it was unclear if I'd get another chance—and I had been waiting for this one my entire life. In all of history, few had ventured as deep as we were going. There was a long list of reasons why, a roster of difficulties and risks, the most obvious being that at the bottom we would encounter eight thousand pounds of pressure per square inch. For oxygen, communications, navigation, shelter—survival—we'd be utterly reliant on the sub. It was a singular machine, the first submersible that could dive repeatedly with a pilot and passenger to full ocean depth (thirty-six thousand feet), so new and innovative that its creators still referred to it as a prototype. To put the deep's engineering challenges into perspective, consider that there are three Mars Rovers, while this sub was one of a kind.

But the inaccessibility of the deep, I thought, made it even more alluring. Others wanted to visit Paris, Bora Bora, the Serengeti: I wanted to go into the ocean's abyss. The idea of an unknown aquatic realm, ever present below us but invisible unless we look for it—an

underworld, within our world—had always worked a sort of spell on me, an alchemical mix of wonder and fear.

It may seem as if those emotions would cancel each other out, but the opposite is true. When you add them together you get the sublime, which transcends both. “The passion caused by the great and sublime in nature...is Astonishment,” wrote the eighteenth-century philosopher Edmund Burke, “and astonishment is the state of the soul, in which all its motions are suspended, with some degree of horror.” But, he added, it was “a sort of delightful horror.” The abyss might be terrifying, but you wouldn’t notice because you’d be too busy gaping in awe. At least that’s how I imagined it, and I wanted to see if I was right.

*

To tell you the story of how I landed on this ship, ready to climb into the world’s most extreme submersible, I have to go back to the beginning. My obsession with the deep started early. In childhood, I had a recurring dream in which I floated on a moonlit sea in a small boat, while below me big fish circled ominously, or swept by like phantoms. The dream was haunting, but I never thought of it as a nightmare. Beneath the one-way mirror of the surface anything might be lurking, but even if it scared me I was determined to check it out.

In the seventies, when *The Undersea World of Jacques Cousteau* was at its zenith, I would sit in front of the TV and watch, riveted, as Cousteau and his jaunty band of aquanauts descended into coral forests and grottoes filled with hungry sharks. During the episode where the *Calypso* sailed to the South Pacific so the crew could explore sunken World War II wrecks in a lagoon, you couldn’t have pried me away from the screen if the house were on fire. To roam around the globe in your own ship, diving into one mystery after another, represented a kind of idealized existence that not only seemed unattainable; it hardly seemed real. That didn’t make the show any less fabulous, though: it allowed me to join the expeditions vicariously, from the safety of land. This was important because for all my desire to visit the undersea world myself, I didn’t learn how to swim until I was almost ten—and even then, I was shaky about it.

I grew up in a suburb of Toronto, far from the ocean but close to hundreds of Canadian Shield lakes, gouged from Precambrian granite by lumbering glaciers. These northern lakes appear brooding, even somber. Their waters are an inky green-black, shadowed by the craggy bluffs and boreal forests that surround them. Rock shoals rise to form islands offshore, attended by lichens and pines, and serenaded by loons.

My family spent summers at a place called Port Severn, two hours north of the city. It is tucked along the southeastern shore of Georgian Bay in Lake Huron, the second largest of the Great Lakes. To my ten-year-old mind, Port Severn was a place full of dark intrigue. I would stand at the end of the dock and look down into the water and see no sign of the bottom, and envision the animals that lived in its depths. There were northern pikes with beady eyes and torpedo bodies, their jaws lined with needle teeth; and muskies, pikes on steroids that had been known to attack children. Sturgeons, with their bony armor, looked like the offspring of a catfish and a crocodile: they could grow as big as a canoe.

Within walking distance of our cottage there was an old boathouse, unused and derelict, with a wooden door that groaned when you opened it. Inside, it was gloomy and cobwebby with a rickety U-shaped dock and a musty smell of mildew. The whole structure listed to starboard. In its cave-like, half-sunk end life, the boathouse was an ideal lair for reclusive giant fish. At dusk, I would sneak in with a flashlight and drop bits of food in the water, hoping to coax them to the surface. Most of the time there were no takers. Then one day I tossed in a scrap of hot dog and a great beast of a fish—it had to be four feet long—emerged from under the dock, raised its head, and lunged at the meat before quickly retreating. In the dim beam of the flashlight I could make out only the fish’s silhouette, but that was enough. It was the coolest thing I’d ever seen, and proof of concept: the underworld was alive with surprises.

*

It was about the water, always the water. Nothing else had the same magnetism; nothing else even came close. I was irresistibly drawn to it, and I developed the skills I needed to immerse myself in the aquatic world. I became a serious competitive swimmer, then an open-water swimmer, free diver, scuba diver. The Pacific Ocean became my favorite playground, the largest waters on earth. I moved to Hawaii to be closer to my muse, and she rewarded me by letting me swim with her residents: sharks, whales, dolphins, sea turtles, eels, fish—marine creatures I’d never encountered before, each possessed of a presence that mesmerized me like nothing found on land.

The sheer *unearthliness* of everything that was happening beneath the waves rocked my world. It was plainly an empire that only the ocean could rule—an ungovernable territory that begins where the sunlight stops. It’s out of sight, but once it allows you a peek at its majesty, it’s never out of mind. I wanted to know more, I wanted to see more: I wanted to dive into the darkness. Somewhere in those waters I’d crossed a threshold, stepped through the doorway of the craziest boathouse of all, and now I wanted to go deeper.

When you’re compelled by something I think you owe it to yourself to go out and investigate it, but my desire for deep-sea submergence came with some technical obstacles. Musing about the abyss felt like falling in love with a mirage: an image flickers into mind, then dissolves, as ungraspable as water itself. “Who has known the ocean? Neither you nor I, with our earth-bound senses,” the marine biologist and author Rachel Carson lamented.

I understood that frustration—yet still I felt the deep’s pull. Limited to the ocean’s top hundred feet, as I was, the real abyss eluded me, as if it were an abstraction rather than a destination. It glittered in my imagination like a distant galaxy, about as tangible as a blast of radio waves. What kind of a place was it? What was it like to be there? *What would you see if you went?*

Even now, when every last crater on the moon has been named and interactive three-dimensional maps of Mars can be viewed on an iPhone, 80 percent of the seafloor has never been charted in any kind of sharp detail. Yet the deep ocean—defined as the waters below six hundred feet—covers 65 percent of the earth’s surface and occupies 95 percent of its living space. (The Pacific alone could swallow every landmass, every continent and island, and still

have room for another South America.) The deep isn't merely a part of our planet—it *is* our planet. You'd think we would want to be more familiar with it.

*

Our awareness of the ocean typically stops at its uppermost layer, known as the epipelagic (or sunlight) zone. If you see marine life and you can name it, odds are it swims in these shallows. But the epipelagic occupies only 5 percent of the ocean's volume. For all its loveliness, it's merely a ceiling. The real action takes place below.

That's where you'll find the twilight zone (from six hundred to thirty-three hundred feet), with its menagerie of creatures that twinkle and glow with bioluminescence; followed by the midnight zone (from thirty-three hundred to ten thousand feet) and the abyssal zone (ten thousand to twenty thousand feet), wraparound layers of eternal night, populated by marvelous weirdos. The intersection where these waters meet the seafloor is known as the abyssal plain, a sediment-cloaked flatland that hosts extraordinary and subtle life. Although these plains may seem quiet, they're often interrupted by outbursts of geological drama.

This is the bottom of the world, but the descent isn't over yet. Beneath the abyss lies the hadal zone, named after Hades, the Greek god of the underworld (and brother of Poseidon), and his mystical realm of the dead. Hadal waters start at twenty thousand feet and pitch down into dozens of ultradeep trenches and troughs—the vast majority of which are located in the Pacific—shaped like the inverted summits of Himalayan peaks. The deepest of them is the Mariana Trench, a fifteen-hundred-mile-long, forty-four-mile-wide gash in the seabed, near Guam. It's home to the 35,876-foot Challenger Deep, the ocean's absolute nadir. By comparison, Mount Everest is 29,029 feet high.

These great depths are a shadow kingdom. In the past, they were the blank spots on the map that carried the old warning: *Here Be Dragons*. Although now we're quite sure the abyss is dragon-free, it still has a mythical aura. Even the slightest glimpse of it is fascinating, because it doesn't reveal itself easily. Actually it doesn't reveal itself at all, unless we approach it with serious technology.

The only way to get a clear picture through thousands of feet of liquid darkness is with sound, which travels faster and farther through water than it does through air. This technology is known as acoustic imaging, or sonar: bouncing sound waves off the bottom and measuring the speed of their return. By processing these data, we can build a refined three-dimensional model of the seafloor. This can't be done from afar: to map an area the sonar array must pass directly over it. Making precise bathymetric maps is a highly technical affair, and in most places in the ocean no one has even tried.

Our lack of a seafloor atlas lends itself to some startling discoveries, and in 2017, one of them ignited my curiosity. In my efforts to learn more about the abyss, I had been tracking the science, reading books, watching documentaries. I pored over any deep-sea news, so I was primed to notice when this headline came along: "Search for MH370 Unveils a Lost World Deep Beneath the Ocean."

*

Like millions of others, I'd followed the story of Malaysia Airlines Flight 370's disappearance with a sinking heart and a long list of questions, and I believed that, eventually, those questions would be answered. How could they not be? To simply *lose* a jumbo jet and its 239 passengers was inconceivable. But as the years ticked by without a resolution, and pieces of MH370's torn wings washed up on East African beaches, it was evident that the Indian Ocean had claimed it—and she doesn't answer to us.

To make matters more complicated, the plane was thought to have gone down in the Indian Ocean's remote southern reaches, where gale winds rake across waters up to twenty-three thousand feet deep. On March 8, 2014, the night MH370 vanished, nobody knew much about that area—except that it wasn't friendly. The only hints of what the seafloor might look like were models derived from satellite altimetry: by measuring gravity's effects on the sea surface, you can infer the depth and contours of the underlying terrain. (Above a large seamount, for instance, the surface bulges perceptibly; above a trench or other depression, it's subtly lower.) Blurry and low-resolution, the gravity models were more like estimates than facts. To have any hope of pinpointing the jet's wreckage, better information was needed.

What followed was the biggest, deepest, hardest, longest, most technically ambitious and expensive deep-sea search ever conducted. For 1,046 days the searchers scoured the abyss with robots and high-resolution sonar, creating crisply detailed three-dimensional maps of the deep across an area the size of New Zealand. They found four shipwrecks, and identified one as the *West Ridge*, a 250-foot British barque that was lost with all hands in 1883. Now it lay thirteen thousand feet down.

Although they didn't locate the plane, the search had been a true *katabasis*—a recovery mission into the underworld. Like the Greek hero Orpheus, the searchers had descended far to retrieve what they sought, and then had to return to the surface without it. But a *katabasis* is never a wasted journey: it always offers a dose of the phenomenal. According to the news article that caught my eye, this one was no exception.

The maps revealed that the Southern Indian Ocean seafloor was spectacularly, eerily beautiful. It was a symphony of extremes, a playlist of geology's greatest hits. It was as if we had discovered Tolkien's Middle-earth, four miles underwater. There were mountains taller than Swiss Alps, valleys that dwarfed Yosemite, yawning crevasses, vertical cliffs that plunged into chasms. The seabed was slashed with scars left by the supercontinent Gondwana when it broke into pieces, creating Australia, India, and Antarctica.

A hundred million years ago during Gondwana's long crackup, a gargantuan volcanic rift in the seafloor opened up like a zipper. Fiery magma from the earth's mantle poured into it, swelling into a huge mass of igneous rock that morphed and changed shape over time, rising and falling and twisting and tearing as two tectonic plates pulled apart. This split resulted in a 750-mile-long fracture zone flanked by a serrated escarpment that plunges seventeen thousand feet—passing six canyons on the way down—bottoming out in one of the Indian Ocean's deepest spots, the Diamantina Trench.

If you were to walk across the Diamantina Trench your feet would sink into soft sediment, the accumulation of millions of years of marine snow—bits and flecks of dead sea

creatures, tiny skeletons and tinier shells, plankton, bacteria, organic waste, silt, and these days, microplastics—that slowly wafts down from above. Not all of the bottom is oozy, however.

In one adjacent area geologists counted 154 volcanoes, and 17 of them topped thirty-three hundred feet, which qualifies them as seamounts: full-fledged, freestanding mountains. Many were encircled by moats that had been dug by surprisingly strong currents—and as currents sweep by, they circulate food. In the deep, hunting for something to eat is a full-time job, and the seamounts serve as oases that attract a riot of unique species. Creatures would be everywhere in this terrain: wedged into crevices, blossoming on the rocks, swimming around, burrowed into sediment. And south of these peaks was another epic feature: the Geelvinck Fracture Zone, a three-thousand-foot-deep cleft in the seabed that runs so straight for so long, it looks like someone drew it with a ruler.

*

It was an undersea network of national parks for giants and until now, no one had known it existed. Reading about this fantastical seafloor, I found it impossible not to wonder: *What else are we missing?* What else is stashed in the abyss—and why aren't we dropping everything to find out? How much lost history is down there? How much knowledge? How many geological marvels? How many undescribed species? What kind of wild rumpus goes on below while we're preoccupied topside with our leveraged buyouts and political bickering and selfie apps?

Nothing would be too unbelievable. In the deep, there are creatures that breathe iron and creatures with glass skeletons and creatures that communicate through their skin. Some of its creatures can turn themselves inside out. They might have two mouths or three hearts or eight legs. Or their bodies might consist of a thousand little bodies, a coordinated army. At least one deep-sea creature squirts yellow light. Some have see-through heads. Even the most ethereal among them can handle pressures that would crush a Mack truck.

The deep's tiniest residents are the earth's mightiest biological force. These are microbes—bacteria, archaea, protists, and viruses—the single-celled organisms that power life's laboratory. They convert chemicals into energy, recycle carbon, supply oxygen, turn waste into nutrients, and chew up toxins, among countless other feats. We wouldn't be here without them. In the ocean, their numbers are so astronomical that we need to borrow a word from cosmology to estimate them: nonillion, or 10^{30} . If all 3.6 nonillion marine microbes were gathered up and put on a scale, they would account for 90 percent of the ocean's biomass. (Scientists don't know how many species they represent—possibly as many as a billion.) There were microbes gusting from seafloor vents back when multicellular life was only a glimmer in the primordial eye. They've managed to thrive in brutally harsh conditions for eons. By studying their resilience, we've discovered new antibiotic and antiviral medicines, new biomaterials, new compounds for treating cancer, and new diagnostic tests, including the one used for COVID-19.

There's nothing anthropocentric about any of this; it's a full cast of aliens. But the deep's *otherness* is the essence of its enchantment, and it deserves to be appreciated on its

own terms. “To sense this world of water known to the creatures of the sea we must shed our human perceptions of length and breadth and time and place,” Rachel Carson wrote, with her usual poetic clarity. It would also be helpful if we could set aside our terrestrial bias, the mistaken belief that everything important happens aboveground, because that’s where we live.

In fact, our survival depends on the ocean. The more we’ve delved downward, the more we’ve had to revise our ideas about how the earth operates, how the climate behaves, what we can learn from the distant past, our place in the overall scheme of life—even our definition of life. Now it’s apparent that nature runs as a massively interconnected system, with the deep sea as its motherboard. Yet even as we tinker with the machinery in potentially irreversible ways, we have only the foggiest notion of how it all works. The deep buffers our excess carbon (at least so far), drives the ocean’s circulation (and thus, climate), regulates the earth’s geochemistry (important, to put it mildly), and absorbs surplus heat (ditto)—to cite just a few of its services. Humming away in obscurity, it’s the foundation of the planet.

This underworld is a thrilling mystery, but you’d never know it. In general, our culture is far more interested in space. For every dollar the National Oceanic and Atmospheric Administration spends on ocean exploration and research, NASA gets a hundred and fifty. We lavish billions on the prospect of colonizing Mars, a barren dust ball. The ocean’s inner space is a harder sell, because humanity has the unfortunate habit of ignoring and fearing what it can’t see. The solar system is directly overhead, visible through our eyes and telescopes, but the seafloor is beyond our immediate perception. To many, it’s the earth’s haunted basement—sinister, shrouded in blackness, spewing molten rock and poisonous gases, a den of freaky beings and hoary specters—and they would rather stay upstairs.

The idea of a descent into anything unnerves us. We descend into madness, into grief, into chaos. We fall into disrepute, fall from grace, and even worse, fall into oblivion. We’re hardwired to look upward, to head toward the light. Heaven is up there, in our opinion. “If the stars should appear one night in a thousand years, how would men believe and adore; and preserve for many generations the remembrance of the city of God which had been shown!” Ralph Waldo Emerson rhapsodized about the night sky, adding that the heavens “awaken certain reverence, because though always present, they are inaccessible.”

So is the abyss, on both counts, but it doesn’t get the same adoration. Mountains, forests, rivers, ponds, trees, flowers, birds, clouds, stars: they’ve all been exalted in literature and poetry, in art, in music, in minds, in hearts. When the ocean makes an appearance, it’s usually as a soothing backdrop or a stormy surface or a medium that reflects sunlight or moonlight in beguiling ways. On the rare occasion when the abyss is considered, it looms as a threat or a cautionary tale. In a word, it’s abysmal. It’s as if the deep were too remote, too frightening—too ugly to be lovable.

But what if we have it upside down? What if the deeper you go, the more astonishing everything becomes? To me that seemed like a compelling possibility, but there was only one way to know. I would need to make my own *katabasis*—to descend into the depths myself, and return with the stories I found there. I knew this was easier said than done, but I also knew that technology was moving fast, enhancing our ability to study the abyss, and even to view it in person. Autonomous deep-sea robots with artificial intelligence, manned submersibles like zippy little spacecraft, seafloor observatories wired to the Internet, scanners

that sequence DNA in the water, new sonars, new sensors, new science: they're all here, at last. And more breakthroughs are coming.

As with any trip to an offbeat place, you can learn from those who've gone there before you. Certainly, I wasn't the only one drawn to the deep. A formidable group of explorers and scientists had left their own aquatic trails. Over the course of five years I would seek them out—and ultimately, the journeys I took with them would lead me to the day when I would be poised to dive into the heart of the Pacific abyss.

Some of these people were famous; others were quietly knowledgeable. All of them were intrepid. And they knew firsthand that to take such a plunge is to grapple with one of humanity's most intimidating and well-ingrained beliefs: *If you dare to go down there, you may not come back.* On that January day in 2021, as I stood on deck in the blustering wind, I was worried, but not about being lost in the deep. Despite the surly ocean conditions, despite the fact that the sub had experienced its share of mechanical problems, despite my awareness that we would be diving deeper than I'd ever dreamed of—I intended to come back. I had faith in the whole operation. At that moment, my only concern was whether I would get to go.

Magnus's Monsters

Indeed, I should also add that monsters, some long-familiar, some unprecedented, are sighted off Norway, and this is due particularly to the unfathomable depth of the waters...

—OLAUS MAGNUS

UPPSALA, SWEDEN

If you were searching for world-famous deep-sea monsters, a stately building at the top of a hill in Uppsala, Sweden, is not the first place you'd look. But the monsters are here, behind the butter-colored façade and tall windows of Uppsala University's oldest library, an institution known as Carolina Rediviva. The university was established in 1477. Uppsala, a charming city about an hour north of Stockholm, has been around for even longer. It was a Viking stomping ground in the first millennium, a hub of feisty Norse pagans who worshipped the gods of thunder and wind and war, while enjoying the odd human sacrifice, before Christianity moved in. There's a lot of history in Uppsala, but I had come to see one particular relic: the *Carta Marina*, a sixteenth-century illustrated map that depicts the North Atlantic, North Sea, and Norwegian Sea regions—and the fiendish creatures that, according to the map's author, lived in those waters.

For as long as people have gazed out at the ocean, they've shivered at the thought of its silent inhabitants. The word *abyss*, translated from its Greek roots, means "without bottom." What kind of ungodly beast would find such a place hospitable? It was hard to imagine what such a thing might look like, though religion and mythology offered chilling descriptions and comparisons to Satan. So when someone created a map of the sea that featured portraits of these residents, it was sure to attract attention.

The *Carta Marina* was printed in 1539, and at a glance it was no boring document. Every inch of its twenty-three-square-foot surface was covered with intricate drawings, landmarks, labels, directions, and notes written in a cramped Latin script. The map was packed with its era's latest intelligence about natural history, geography, marine life, ocean conditions, navigation, shipping routes, and local customs. It charted Scandinavia—an isolated part of the world at that time—with unprecedented accuracy. But the reason I flew to Sweden to see the *Carta Marina* is because it's a 480-year-old snapshot of the prevailing fears and beliefs about the deep ocean. Beyond its cartography, it's a map of perceptions.

In an age before science, before deep-sea exploration, before high-definition underwater cameras, what people overwhelmingly believed about the deep was that it was filled with monsters—and the *Carta Marina* made their presence official. It portrayed their malice in striking detail. From Greenland all the way to Norway, menacing creatures are shown lolling