JAMES NESTOR

# DEEP

## FREEDIVING, RENEGADE SCIENCE, AND WHAT THE OCEAN TELLS US ABOUT OURSELVES

AN EAMON DOLAN BOOK
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# Table of Contents

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# 0

I'M A GUEST HERE, a journalist covering a sporting event that few people have heard of: the world freediving championship. I'm sitting at a cramped desk in a seaside hotel room that overlooks a boardwalk in the resort town of Kalamata, Greece. The hotel is old and shows it in the cobweb cracks along the walls, threadbare carpet, and dirt shadows of framed pictures that once hung in dim hallways.

I've been sent here by *Outside* magazine, because the 2011 Individual Depth World Championship is a milestone for competitive freediving—the largest gathering of athletes in the history of the little known sport. Since I've lived my whole life by the ocean, still spend much of my free time in it, and often write about it, my editor thought I'd be a good fit for the assignment. What he didn't know was that I had only a superficial understanding of freediving. I hadn't done it, didn't know anyone who had, and had never seen it before.

I spend my first day in Kalamata reading up on the competition rules and the sport's rising stars. I'm not impressed. I Google through photographs of competitive freedivers in mermaid outfits, flashing hang-loose signs while floating upside down in the water, and blowing intricate bubble rings from the bottom of a swimming pool. It seems like the kind of oddball hobby people take up, like badminton or Charleston dancing, so they can talk about it at cocktail parties and refer to it in their e mail handles.

Nonetheless, I have a job to do. At five thirty the following morning, I'm at the Kalamata marina talking my way onto a twenty-seven-foot sailboat that belongs to a scruffy Québecois expat. His is th only spectator boat allowed out at the competition, which is held in the deep open waters about ten miles from the Kalamata marina. I'm the only journalist aboard. By 8:00 a.m., we've tied up to a flotilla of motorboats, platforms, and gear that serves as the competitors' jumping-off point. The divers in the first group arrive and take positions around three yellow ropes dangling off a nearby platform. An official counts down from ten. The competition begins.

What I see next will confound and terrify me.

I watch as a pencil-thin New Zealander named William Trubridge swallows a breath, upends his body, and kicks with bare feet into the crystalline water below. Trubridge struggles through the first ten feet, heaving broad strokes. Then, at about twenty feet, his body loosens, he places his arms by hi sides in a skydiver pose, and he sinks steadily deeper until he vanishes. An official watching a sonar screen at the surface follows his descent, ticking off distances as he goes down: "Thirty meters . . . forty meters . . . fifty meters."

Trubridge reaches the end of the rope, some three hundred feet down, turns around, and swims bac toward the surface. Three agonizing minutes later, his tiny figure rematerializes in the deep water, lik a headlight cutting through fog. He pops his head up at the surface, exhales, takes a breath, flashes an okay sign to an official, then gets out of the way to make room for the next competitor. Trubridge jus dove thirty stories down and back, all on one lungful of air—no scuba gear, air tube, protective vest, or even swim fins to assist him.

The pressure at three hundred feet down is more than ten times that of the surface, strong enough t crush a Coke can. At thirty feet, the lungs collapse to half their normal size; at three hundred feet, the shrink to the size of two baseballs. And yet Trubridge and most of the other freedivers I watch on the first day resurface unscathed. The dives don't look forced either, but natural, as if they all really belong down there. As if we all do.

I'm so dazzled by what I see that I need to tell somebody immediately. I call my mother in Southern California. She doesn't believe me. "It's impossible," she says. After we talk about it, she dials some friends of hers who’ve been avid scuba divers for forty years and then calls me back. ~~“There is an oxygen tank at the seafloor or something,” she says. “And I suggest you do your researc~~ before publishing any of this.”

But there was no oxygen tank at the end of the rope, and if there had been, and if Trubridge and the other divers had actually breathed some of it before ascending, their lungs would have exploded whe the air from the tank expanded in the shallower depths, and their blood would have bubbled with nitrogen before they reached the surface. They’d die. The human body can withstand the pressures of fast three-hundred-foot underwater ascent only in its natural state.

Some humans handle it better than others.

Over the next four days, I watch several more competitors attempt dives to around three hundred feet. Many can’t make it and turn back. They resurface with blood running down their faces from the noses, unconscious, or in cardiac arrest. The competition just keeps going on. And, somehow, this sport is legal.

For most of this group, attempting to dive deeper than anyone—even scientists—ever thought possible is worth the risk of paralysis or death. But not for all of them.

I meet a number of competitors who approach freediving with a more sane outlook. They aren’t interested in the face-off with mortality. They don’t care about breaking records or beating the other guy. They freedive because it’s the most direct and intimate way to connect with the ocean. During that three minutes beneath the surface (the average time it takes to dive a few hundred feet), the body bears only a passing resemblance to its terrestrial form and function. The ocean changes us physicall and psychically.

In a world of seven billion people, where every inch of land has been mapped, much of it develope and too much of it destroyed, the sea remains the final unseen, untouched, and undiscovered wilderness, the planet’s last great frontier. There are no mobile phones down there, no e-mails, no tweeting, no twerking, no car keys to lose, no terrorist threats, no birthdays to forget, no penalties for late credit card payments, and no dog shit to step in before a job interview. All the stress, noise, and distractions of life are left at the surface. The ocean is the last truly quiet place on Earth.

These more philosophical freedivers get a glassy look in their eyes when they describe their experiences; it’s the same look one sees in the eyes of Buddhist monks or emergency room patients who have died and then been resuscitated minutes later. Those who have made it to the other side. An best of all, the divers will tell you, “It’s open to everyone.”

Literally everyone—no matter your weight, height, gender, or ethnicity. The competitors gathered in Greece aren’t all the toned, superhuman Ryan Lochte–type swimmers you might expect. There are few impressive physical specimens, like Trubridge, but also chubby American men, tiny Russian women, thick-necked Germans, and wispy Venezuelans.

Freediving flies in the face of everything I know about surviving in the ocean; you turn your back on the surface, swim away from your only source of air, and seek out the cold, pain, and danger of deep waters. Sometimes you pass out. Sometimes you bleed out of your nose and mouth. Sometimes you don’t make it back alive. Other than BASE jumping—parachuting off buildings, antennas, spans (bridges), and earth (geological formations)—freediving is the most dangerous adventure sport in the world. Dozens, perhaps hundreds, of divers are injured or die every year. It seems like a death wish.

And yet, days later, after I return home to San Francisco, I can’t stop thinking about it.

I BEGIN TO RESEARCH FREEDIVING and the claims made by competitors about the human body’s amphibious reflexes. What I find—what my mother would never believe and what most people woul doubt—is that this phenomenon is real, and it has a name. Scientists call it the mammalian dive refle or, more lyrically, the Master Switch of Life, and they’ve been researching it for the past fifty years.

The term *Master Switch of Life* was coined by physiologist Per Scholander in 1963. It refers to a variety of physiological reflexes in the brain, lungs, and heart, among other organs, that are triggered the second we put our faces in water. The deeper we dive, the more pronounced the reflexes become, eventually spurring a physical transformation that protects our organs from imploding under the immense underwater pressure and turns us into efficient deep-sea-diving animals. Freedivers can anticipate these switches and exploit them to dive deeper and longer.

Ancient cultures knew all about the Master Switch and employed it for centuries to harvest sponge pearls, coral, and food hundreds of feet below the surface of the ocean. European visitors to the Caribbean, Middle East, Indian Ocean, and South Pacific in the seventeenth century reported seeing locals dive down more than one hundred feet and stay there for up to fifteen minutes on a single breath. But most of these reports are hundreds of years old, and whatever secret knowledge of deep diving these cultures harbored has been lost to the ages.

I begin to wonder: If we've forgotten an ability as profound as deep diving, what other reflexes an skills have we lost?

I SPENT THE NEXT YEAR and a half looking for answers, traveling from Puerto Rico to Japan, Sri Lanka to Honduras. I watched people dive to one hundred feet and spear satellite transmitters onto the dorsa fins of man-eating sharks. I rode thousands of feet down in a homemade submarine to commune wit luminous jellyfish. I talked to dolphins. Whales talked to me. I swam eye-to-eye with the world's largest predator. I stood wet and half naked inside an underwater bunker with a group of researchers strung out on nitrogen. I floated in zero gravity. I got seasick. And sunburned. And a really sore back from flying tens of thousands of miles in coach. What did I find?

I discovered that we're more closely connected to the ocean than most people would suspect. We'r born of the ocean. Each of us begins life floating in amniotic fluid that has almost the same makeup a ocean water. Our earliest characteristics are fishlike. The month-old embryo grows fins first, not feet it is one misfiring gene away from developing fins instead of hands. At the fifth week of a fetus's development, its heart has two chambers, a characteristic shared by fish.

Human blood has a chemical composition startlingly similar to seawater. An infant will reflexivel breaststroke when placed underwater and can comfortably hold his breath for about forty seconds, longer than many adults. We lose this ability only when we learn how to walk.

As we grow older, we develop amphibious reflexes that enable us to dive to incredible depths. The stresses of these depths would injure or kill us on land. But not in the ocean. The ocean is a different world with different rules. It's a place that often requires a different mindset to comprehend.

And the deeper we go in it, the weirder it gets.

When you're in the first few hundred feet, the human connection to the ocean is physical—you ca taste it in your salty blood, see it in the gill-like slits of an eight-week-old fetus, and sense it in the amphibious reflexes humans share with marine mammals.

Past the limit where the human body can freedive and survive, about seven hundred feet, the connection to the ocean becomes sensory. You can see it reflected in deep-diving animals.

To survive in this lightless, cold, and pressurized environment, animals such as sharks, dolphins, and whales have developed extra senses to navigate, communicate, and see. We too share these extrasensory abilities; like the Master Switch, they are remnants of our collective past in the ocean. These senses and reflexes are latent and mostly unused in humans, but they have not disappeared. An they seem to revive when we desperately need them.

It's this connection—between the ocean and us, between us and the sea creatures with whom we share a great deal of DNA—that drew me deeper and deeper still.

AT SEA LEVEL, WE ARE ourselves. Blood flows from the heart to the organs and extremities. The lungs take ~~in air and expel carbon dioxide. Synapses in the brain fire at a frequency of around eight~~ cycles per second. The heart pumps between sixty and a hundred times per minute. We see, touch, feel, tast and smell. Our bodies are acclimatized to living here, at or above the water's surface.

At sixty feet down, we are not quite ourselves. The heart beats at half its normal rate. Blood starts rushing from the extremities toward the more critical areas of the body's core. The lungs shrink to a third of their usual size. The senses numb, and synapses slow. The brain enters a heavily meditative state. Most humans can make it to this depth and feel these changes within their bodies. Some choos to dive deeper.

At three hundred feet, we are profoundly changed. The pressure at these depths is ten times that of the surface. The organs collapse. The heart beats at a quarter of its normal rate, slower than the rate o a person in a coma. Senses disappear. The brain enters a dream state.

At six hundred feet down, the ocean's pressure—some twenty times that of the surface—is too extreme for most human bodies to withstand. Few freedivers have ever attempted dives to this depth fewer have survived. Where humans can't go, other animals can. Sharks, which can dive below six hundred and fifty feet, and much deeper, rely on senses beyond the ones we know. Among them is magnetoreception, an attunement to the magnetic pulses of the Earth's molten core. Research sugges that humans have this ability and likely used it to navigate across the oceans and trackless deserts fo thousands of years.

Eight hundred feet down appears to be the absolute limit of the human body. Still, an Austrian freediver is willing to risk paralysis and death to go beyond that depth.

At a thousand feet down, the waters are colder and there's almost no light. Another sense clicks on animals perceive their environment not by looking but by listening. With this extra sense, called echolocation, dolphins and other marine mammals can "see" well enough to locate a metal pellet the size of a rice grain from a distance of 230 feet, and they can distinguish between a Ping-Pong ball an a golf ball from 300 feet away. On land, a group of blind people have tapped into the ability to echolocate and use it to ride bikes through busy city streets, jog through forests, and perceive a building from a thousand feet away. This group isn't special; with the right training, we all can see without opening our eyes.

At twenty-five hundred feet below, the water is permanently black, and pressures are eighty times that of the surface. For the animals living at these depths, danger lurks in all directions. Electric rays have adapted by harnessing impulses inside their bodies to fatally shock prey and fend off predators. Scientists have discovered that every cell in the human body also contains an electrical charge. Tibetan Buddhist monks who practice the Bön tradition of Tum-mo meditation have learned to focus these cellular charges to warm their bodies during bitterly cold winters. Researchers in England have discovered that by controlling the output of cellular charges in our bodies, humans can not only creat heat but treat many chronic diseases.

At ten thousand feet below, a black and unforgiving depth, we find sperm whales—whose behavio surprisingly, more closely resembles our culture and intellect than any other creature's on the planet. Sperm whales may communicate with one another in ways that could be more complex than any form of human language.

At twenty thousand feet and below, the deepest waters harbor the world's most inhospitable environments. Pressures range from six hundred to a thousand times that of the surface; temperatures hover just above freezing. There is no light and very little food. And yet life persists there. These hellacious waters may in fact be the birthplace of all life on Earth.

TWO MILLION YEARS OF HUMAN history, two thousand years of science experiments, a few hundred year of deep-sea adventuring, one hundred thousand marine biology graduate students, countless PBS specials, Shark Week, and still, *still*, we’ve explored only a fraction of the ocean. Sure, humans have gone deep on occasion, but have they really seen anything? If you compare the ocean to a human bod the current exploration of the ocean is the equivalent of snapping a photograph of a finger to figure o how our bodies work. The liver, the stomach, the blood, the bones, the brain, the heart of the ocean— what’s in it, how it functions, how we function within it—remain a secret, much of it hidden in the dark and sunless realms.

To be clear, this book has a downward trajectory. With each passing chapter, it will descend farthe from the surface to the bottom of the blackest sea. I’ll go down as far as I physically can, then, for those depths I cannot access, I’ll use a proxy—one of the many deep-diving animals with whom humans share unexpected and startling similarities.

The research and stories that follow cover only a sliver of the current research on the ocean and pertain specifically to the human connection within this realm. The scientists, adventurers, and athletes profiled here are only a handful of thousands of people now plumbing the sea’s mysteries.

It’s no coincidence that many of the researchers are freedivers. I learned early on that freediving was more than just a sport; it was also a quick and efficient way to access and research some of the ocean’s most mysterious animals. Shark, dolphins, and whales, for instance, can dive a thousand feet or more, but there’s no way of studying them at such depths. A handful of scientists have recently discovered that by waiting for these animals to come to the surface, where they feed and breathe, and then approaching them on their own terms—by freediving—they can study them far more closely tha any scuba diver, robot, or sailor.

“Scuba diving is like driving a four-by-four through the woods with your windows up, air conditioning on, music blasting,” one freediving researcher told me. “You’re not only removed from the environment, you’re disrupting it. Animals are scared of you. You’re a menace!”

The more I immersed myself in this group, the more I wanted to share the close encounters they were having with their subjects. I began freediving on my own. I became a student of the form. I wen deep.

And so, my freediving training is also a part of this book’s downward spiral—a personal quest to overcome dry-land instincts (aka breathing), flip the Master Switch, and hone my body into a diving machine. Only by freediving could I get as close as physically possible to the animals who were teaching us so much about ourselves.

But freediving, I knew, had its limits. Even experienced divers usually can’t go below 150 feet comfortably, and even when they do, they can’t stay long. The average beginning freediver—me, for instance—isn’t able to get past a few dozen feet for several frustrating months. To get to these deepe depths and see deep-sea animals that never come near the surface, I followed a different kind of freediver—a subculture of do-it-yourself oceanographers who are revolutionizing and democratizing access to the ocean. While other scientists working in government and academic institutions were filling out grant requests and reeling from funding cuts, these DIY researchers were building their ov submarines out of plumbing parts, tracking man-eating sharks with iPhones, and cracking the secret language of cetaceans with contraptions made of pasta strainers, broomsticks, and a few off-the-shelf GoPro cameras.

To be fair, many institutions don’t carry out this kind of research because they can’t. What this group of DIY researchers was doing was dangerous—and often totally illegal. No university would ever permit its graduate students to motor miles out to sea in a beat-up boat and swim with sharks an sperm whales (which have eight-inch-long teeth and are the largest predators on Earth) or ride thousands of miles deep in an unlicensed and uninsured hand-built submarine. But these renegade researchers did it all the time, often on their own dimes. And with their slapped-together gear and shoestring budgets, they clocked more hours with the inhabitants of the ocean’s depths than anyone before them.

“Jane Goodall didn’t study apes from a plane,” said one freelance cetacean-communication researcher working out of a lab he’d set up on the top floor of his wife’s restaurant. “And so you can’t expect to study the ocean and its animals from a classroom. You’ve got to get in there. You’ve got to get wet.”

And so I did.

WHAT HOUSTON IS TO SPACE stations, a turquoise two-story tract home in Key Largo is to Aquarius, the world's only underwater habitat. In front of the house, a mailbox is propped up on a cinder block and zip-tied to a pile of weathered wood. White gravel covers a driveway filled with grimy, decades-old cars. Go past a menacing chainlink fence and up a wooden staircase, and you'll find a sliding glass door that opens onto a room paneled in 1970s veneer. Mission Control is on the right.

Aquarius is run out of what's essentially a dorm room. There are oak cabinets in the hallway, threadbare sofas placed at odd angles in the living room, and sunburned guys in shorts and backward ball caps eating microwaved noodles in the kitchen.

Saul Rosser, operations director, invites me into the observation deck. Rosser, who is thirty-two ar has worked at Aquarius for two years, is wearing a black polo shirt, baggy brown pants, white socks, and black shoes—the unofficial uniform of an engineer at leisure. In front of him on a sectional desk are three computer monitors, a red telephone, and a logbook. Rosser shakes my hand and then excuse himself. He needs to take a call.

"Ointment," a female voice crackles through the speaker.

"Copy on ointment," says Rosser.

"Applying ointment," says the voice.

"Copy on applying ointment," says Rosser.

A closed-circuit video feed in front of Rosser—one of ten displays on the computer monitors—shows a grainy image of a hand applying ointment to a knee.

"Ointment applied," says the voice.

"Copy on ointment applied," says Rosser.

Rosser documents every word by hand in the logbook. The speaker goes silent. He stares at the video screen and watches as the woman caps off the tube of ointment. A moment later, another video feed from a different angle shows the back of a woman as she walks across a tiny room and puts the ointment in a small white drawer. The video is pixelated, and it looks as though the transmission is coming from outer space. Except for the fact that the woman is young, blond, and wearing a bikini bottom and a T-shirt, which, in a way, makes Mission Control seem even more like a dorm room.

"Over," the woman's voice crackles through the speaker.

"Over," says Rosser.

The woman, Lindsey Deignan, is a sponge researcher from the University of North Carolina, Wilmington. She has been living inside Aquarius for eight days and won't surface for another two. She's got a scratch on her knee that needs medical attention and some healing time in the sun, but it won't get either anytime soon. There's no sun in Aquarius, and no doctor. Opening the back hatch an swimming straight to the surface would probably kill Deignan; her blood would boil and most likely shoot out of her eyes, ears, and other orifices.

In the name of science, Deignan and five other researchers, called aquanauts, have volunteered to have their bodies supercompressed to the same pressure that's found sixty feet deep on the ocean floo—about thirty-six pounds per square inch—so they can dive for as long as they want without ever having to worry about decompression sickness. The only requirement is that once the aquanauts head down to Aquarius, which is located seven miles off the coast from where we're sitting, they'll have t stay there for a week and a half, until the mission is over. Then they'll be decompressed, a seventeen hour process that brings their bodies back to surface pressure and allows the nitrogen gas to safely diffuse.

In the name of research, I've come here to see what these scientists get out of spending ten days living in the equivalent of a submerged Winnebago. Plus, I can't freedive yet, so this is the best way for me to sample the immersive approach to underwater research.

A doctor visiting Aquarius a few years back demonstrated what would happen to Deignan and the other aquanauts should they suddenly get claustrophobic and go AWOL without decompressing. He dove down and drew blood from an aquanaut who was just finishing a long mission, placed the blood in a vial, and then headed back to the surface. By the time the doctor reached the top, the blood was bubbling so violently it blew the rubber stopper off the vial.

"Imagine what would happen to your head," says Rosser, kicking his black comfort shoes from beneath the desk. Sissy Spacek in *Carrie* comes to mind.*

The prospect of bubbling blood is only one of the inconveniences of living underwater in a steel box. Even with air conditioners running on high, nothing ever really dries down there. This is why Aquarius aquanauts are usually half naked and why Deignan applied ointment to a tiny scratch on her knee. In the pervasive humidity, which ranges between 70 and 100 percent, infections are rampant. S is mold, and so are earaches. Some divers experience constant, hacking coughs.

In 2007, Lloyd Godson, a twenty-nine-year-old from Australia, attempted to spend a month living just twelve feet underwater in a self-sustaining pod called Biosub. It wasn't the loneliness that eventually got to him—it was the wetness. Within a few days, the humidity inside Biosub was at 100 percent, water was dripping from the ceiling, and Godson's clothes were soaking wet and molding. H became dizzy, faint, panicky, and paranoid. He lasted less than two weeks. Crews in Aquarius have lived in similar conditions for up to seventeen days. Fabien Cousteau, the grandson of the famous French ocean explorer, is planning a thirty-one-day mission in Aquarius in 2014.

If the moisture in Aquarius doesn't get you, the pressure might. One hundred and twelve tons of water presses down on Aquarius at all times. To keep the water out, the habitat must be pressurized a a high level, which, at around sixty feet below the surface, works out to about two and a half times th pressure at sea level. Being inside Aquarius feels the opposite of what it would feel like to be thirteen thousand feet up. Bags of chips become pancake flat. Bread becomes dense and hard. Cooking facilities are limited to hot water and a microwave, and most food is vacuum-packed camping stuff. Years back, a surface-support-crew diver delivered a lemon meringue pie in an airtight container to the aquanauts. The pressure had flattened it into a thin sheet of white-and-yellow goo by the time it was opened.

ROSSER IS NOW WATCHING A video feed of aquanauts as they prepare for sleep. (He writes in the logboo that the aquanauts are preparing for sleep.) One checks the oxygen level on a back wall. (Rosser write in the logbook that an aquanaut checked the oxygen level on a back wall.) This goes on for the next twenty minutes.

Aquarius is under twenty-four-hour surveillance. Microphones record conversations in every room Each movement, motion, and action is logged. Air pressure, temperature, humidity, and carbon dioxide and oxygen levels are checked by a computer every few seconds. Valves are checked every hour. The smallest break in the system could have a domino effect that would lead to flooding in the living chamber, which would instantly drown the aquanauts. Rosser and the other managers are there to make sure it doesn't happen. So far, they've done a good job.

Over the past two decades, Aquarius has run more than 115 missions, and there's been only one death, and that was caused by a malfunction on a rebreather device and had nothing to do with the laboratory itself.

But the Aquarius team members have had their share of close calls. A generator caught fire during hurricane in 1994, requiring aquanauts to evacuate immediately after decompressing into fifteen-foo high waves. Four years later, in another storm with seventy-mile-an-hour winds, Aquarius was rippe from its foundation and almost destroyed. In 2005, the seas got so rough that Aquarius—which weig 600,000 pounds—was dragged a dozen feet across the seafloor.

To the aquanauts, though, danger, close quarters, sleeping on wafer-thin bunk beds, eating flattene potato chips, and sitting around wet and semi-nude are a small price to pay to have unfettered access to the first six stories of ocean, a depth researchers call the photic zone.

LIFE IN THE FIRST FEW hundred feet of the sea is much like life on land, only there's a lot more of it. Th ocean occupies 71 percent of the Earth's surface and is home to about 50 percent of its known creatures—the largest inhabited area found anywhere in the universe so far.

The depth of shallow waters, called the photic ("sunlight") zone, varies depending on conditions. I murky waters of bays near the mouths of rivers, it might extend down to only about forty feet or so; i clear, tropical waters, it can reach down to around six hundred feet.

Where there's light, there's life. The photic zone is the only place in the ocean where there's enough light to support photosynthesis. Although it makes up only 2 percent of the entire ocean, it houses around 90 percent of its known life. Fish, seals, crustaceans, and more all call the photic zone their home. Sea algae, which makes up 98 percent of the biomass in the ocean and can grow nowhere else but in the photic zone, is essential to all life on land and in the ocean. Seventy percent of the oxygen on Earth comes from ocean algae. Without it, we couldn't breathe.

How algae can generate so much oxygen and how that might be affected by climate change, nobod knows. That's part of what the aquanauts on Aquarius are trying to find out. They're also trying to crack more mystical marine riddles, like the secret behind coral's "telepathic" communication.

Every year on the same day, at the same hour, usually within the same minute, corals of the same species, although separated by thousands of miles, will suddenly spawn in perfect synchronicity. The dates and times vary from year to year for reasons that only the coral knows. Stranger still, while one species of coral spawns during one hour, another species right next to it waits for a different hour, or different day, or a different week before spawning in synchronicity with its own species. Distance seems to have no effect; if you broke off a chunk of coral and placed it in a bucket beneath a sink in London, that chunk would, in most cases, spawn at the same time as other coral of the same species around the world.

The synchronous spawn is essential for corals' survival. Coral colonies must continuously expand outward to thrive. To remain healthy and strong, they must breed outside of their gene pool with neighboring colonies. Once released to the surface, the coral sperm and eggs have only about thirty minutes to fuse. Any longer, and the coral eggs and sperm will either dissipate or die off. Researcher have found that if the spawning is just fifteen minutes out of sync, coral colonies' chances of surviva are greatly reduced.

Coral is the largest biological structure on the planet and covers some 175,000 square miles of the seafloor, and it can communicate in a way far more sophisticated than anyone ever thought. And yet, coral is one of the most primitive animals on Earth. Coral has no eyes, no ears, and no brain.

There soon won't be much of it left. All over the world, coral colonies have been dying off at recor rates. Fifty percent of the corals along Australia's Great Barrier Reef have died. In some areas of the Caribbean, such as Jamaica, coral populations have shrunk by over 95 percent. Colonies off the coast of Florida died off by 90 percent over the past decade. The causes are unclear but scientists believe pollution and global warming are to blame. In fifty years, coral may be completely gone, and disappearing with it will be one of the stranger unsolved mysteries in the natural world.

For the Aquarius aquanauts who were researching coral, their work is a race against time—one of many such races I'll encounter in the months ahead.

EVER SINCE ARISTOTLE PROPOSED turning a giant jar upside down, putting a man inside it, and sinking it ~~humans have devised all sorts of grand schemes to explore the shallow waters of the photic zone~~. Mo of these either killed or maimed their occupants. The history of underwater exploration is paved with the bones of those who tried to go deep.

In the 1500s, Leonardo da Vinci drew up a sketch for a diving suit: it was made of pig leather, had pouch at the chest to hold air, and a bottle at the waist to catch urine. (It was never built.) Years later another Italian suggested putting a bucket with glass cutouts over his head and diving down twenty feet. (It failed in trials.) In the 1690s, an English astronomer named Edmond Halley, who would later have a comet named after him, proposed dropping a man inside an enormous wooden bucket and delivering air to him through wine barrels. (He never tried it.)

The first diving contraption capable of making it down to Aquarius's depth was invented around 1715 by John Lethbridge, a wool merchant who lived in Devon, England, with his seventeen children The craft was constructed using a six-foot-long oak cylinder that had a glass porthole at its head and an armhole with a leather sleeve at each side. Air was fed through a hose at top. The whole thing looked extremely primitive and fragile but Lethbridge managed to take it down to around seventy fee for a half hour at a time—although, Lethbridge wrote, it was done "with great difficulty."

A half a century later, a Brooklyn machinist named Charles Condert debuted a more agile and "safe" means to explore the seafloor—the world's first self-contained underwater breathing apparatu or scuba. The device consisted of four feet of copper tube, which was mounted onto Condert's back, and a pump made from a shotgun barrel, which pulled air into a rubber mask that covered Condert's face. Anytime Condert wanted to breathe, he'd just pump the gun-barrel contraption and receive a blast of fresh air. In 1832, Condert debuted the device in New York City's East River and became the world's first successful scuba diver. Later that day, when the copper tube broke off at twenty feet down, Condert became the world's first scuba fatality.

Other inventions soon followed. In England, John Deane attached a fireman's helmet to a rubber suit to create the first production dive suit. A pump on deck delivered air through a hose that was connected to the back of the helmet, allowing a diver, for the first time, to stay at depths of around eighty feet for about an hour. The Deane helmet was a great success, but it was dangerous. The compressed air pumped into the suit made it susceptible to sudden and extreme shifts of pressure during dives. If the helmet or air tube ruptured, the reversed pressure created a vacuum in the suit tha "squeezed" the diver's body from inside out, forcing blood out of the nose, eyes, and ears. Squeezes became semiregular events. Some were so powerful that a diver's flesh would be ripped from his body. In one case, so much of a diver's body was torn away that there was nothing to bury but the helmet clogged with his bloody remains.

The deeper humans plunged into the ocean, the more grotesque and violent the consequences. In th 1840s, construction workers were using watertight structures called caissons to build underwater foundations for bridges and piers. To keep water out, the structures were filled with pressurized air from the surface. After being in them for just a few days, caisson workers usually reported maladies like rashes, mottled skin, difficulty breathing, seizures, and extreme joint pain. Then they began dying.

The condition became known as caisson disease or, more commonly, the bends, named for the excruciating pain that the afflicted workers felt in their knees and elbows. Scientists later discovered that the shift from pressurized air in the caissons to normal air at the surface was causing nitrogen ga to bubble in the workers' bodies and collect in their joints.

It would take another forty years for engineers to understand that it wasn't the deep water that was harming the ocean explorers—it was the deep-diving machines. Ironically, while Western divers in carefully constructed suits or caissons were drowning or getting their faces sucked off or suffering th bends at depths above sixty feet, two thousand miles to the south, Persian pearl divers were regularly ~~plummeting to twice that depth and doing it with nothing more than a knife and a single breath~~ of air. They suffered none of these maladies, and they had been diving to these depths for thousands of year

Eventually, Western engineers developed elaborate systems to protect the body from underwater forces. They figured out how pressures change at depth and how oxygen can become toxic. Lethbridge's and Deane's primitive inventions eventually led to armored suits with compressed air, submarines, and scuba-diving decompression tables.

In 1960, Don Walsh, a U.S. Navy lieutenant, and Jacques Piccard, a Swiss engineer, took a steel chamber called *Trieste* down to 35,797 feet in the Pacific Ocean's Marianas Trench—the bottom of the deepest sea. Two years later, humans were living underwater.

The first underwater habitat, built by Jacques Cousteau, was set up thirty-three feet below the ocean's surface in an area off the coast of Marseilles. Called Conshelf, it was about as big as the cabi of a Volkswagen bus, and just as cold and wet. "The hazards are great and exceed the challenges," sai Cousteau of Conshelf. In fact, the hazards were so great that Cousteau sent two underlings in his plac They lasted a week.

A year later Cousteau planted a more deluxe five-room model—with living room, shower, and sleeping quarters—on the seafloor off the coast of Sudan. Footage from the expedition, later featured in Cousteau's Oscar-winning documentary *A World Without Sun*, shows a kind of futuristic/French paradise where by day, aquanauts spent their time floating through Technicolor sea gardens, and by night, they smoked, drank wine, ate perfectly prepared French meals, and watched television. The aquanauts lasted a month. Their only complaint was the lack of women down there to "keep us company."*

By the late 1960s, more than fifty undersea habitats around the world were being built, and many more were planned. Australia, Japan, Germany, Canada, and Italy were all going deep. Cousteau predicted that future generations of humans would be born in underwater villages and "[adapt] to the environment so that no surgery will be necessary to permit them to live and breathe in water. It is the that we will have created the man-fish." The race for inner space, it appeared, was on.

And then it was off. After just a few years, all but a handful of the habitats were scrapped. Living underwater proved to be much more of a challenge, and far more expensive, than anyone had thought Salt water ate away at metal structures; storms ripped foundations from the seafloor; aquanauts lived in constant fear of decompression sickness and infections.

This was the space age, after all; men were landing on the moon and building houses in orbit, so spending weeks underwater in a cold, wet box—in an environment you couldn't even see in, let alone *be* seen in—seemed pointless. And few land dwellers could relate to the research on microbiology an oxygen toxicity that was being conducted down there. Scientists had proved that humans could dive down to the deepest ocean floors and live underwater, but so what?

TODAY, ALMOST ALL OCEAN research is done topside via robots dropped from the decks of boats. Humans know more about the ocean's chemical composition, temperatures, and topography, but they have also grown more physically and spiritually distanced from it.

Most marine researchers (at least, the ones I interviewed early on) never even get wet. Aquarius, one of the last oceanic institutions where researchers got wet and stayed wet for ten days at a time, was slated for closure.

I wanted to see it, this last piece of the institutional legacy of ocean exploration, before it joined th trash heap of inventions rusting away on the ocean floor. I wanted to see how the sanctioned experts researched the ocean before I headed out to spend a year with the renegades.

KEY LARGO, SEVEN MILES OUT, in hissing and storming seas. I am about to attempt my first scuba dive ~~down sixty feet to Aquarius. I flash the captain of the motorboat that shuttled me here a thumbs-~~up, adjust the mouthpiece, and head down. I descend twenty, thirty, forty feet and notice a stream of bubbles belching from the seafloor, like an upside-down waterfall. An Aquarius safety diver stands wreathed in the bubbles, beckoning me closer. I kick toward him, duck my head, and, a few seconds later, reemerge in the air of the wet deck at the back of Aquarius.

"Please take off your wetsuit," says a man at the top of the metal staircase. He hands me a towel t put around my waist. "And welcome to Aquarius."

His name is Brad Peadro and he'll be leading my tour. Because even the tiniest puddle can take da or weeks to dry in Aquarius, all visitors are required to leave their scuba gear and wet clothes at the door. Clad in my towel, I follow Peadro through the deck and into a control room. The squawk of amplified voices from the PA and blasts of pressurized air echo against the steel walls. A few paces i I see two men and two women sitting arm to arm around a kitchen table. They are marine biology graduate students from the University of North Carolina, Wilmington, and they're just finishing up a ten-day mission researching sponges and coral. Between them lies a flattened, half-empty bag of Oreos. "The long days do wear on you," says a pallid man named Stephen McMurray who is researching the population dynamics of sponges. He dips a spoon into a Styrofoam cup of instant noodles and looks through a window to the seafloor below.

"Nothing is ever dry down here," says John Hanmer, sitting across from him. "Ever." Hanmer, wh is studying parrotfish, laughs and looks at his hands. Another aquanaut, Inga Conti-Jerpe, sits beside him. Her matted, frizzy hair clings to her scalp like wet plaster. "The pressure does interesting thing to your skin," she says with a chuckle.

The aquanauts all laugh, then fall silent. They laugh again, then go silent again. I can't help but fee that everyone down here is a little off. Not in the cabin-fever kind of way that I expected; they are fa too jolly for that. They seem, basically, drunk.

I learn that having your body pressurized to 36 psi for extended lengths of time can produce mild delirium. At higher pressures, more nitrogen dissolves in the bloodstream, eventually producing the same effect as nitrous oxide, or laughing gas. The more nitrogen in the bloodstream, the more whacked out the aquanauts feel. By the end of a ten-day mission, the whole group is on the equivalen of a Whip-It bender.

Lindsey Deignan, the aquanaut I watched apply ointment to her knee from Mission Control the night before, looks especially dazed. "The longer we're down here, the larger the space seems," she says, smiling broadly. "It's now like triple the size. It's as big as a school bus! But it seems bigger than that!"

To me, the aquanauts' euphoric haze feels like an essential coping strategy in this dank, cramped, dangerous place. Moldy towels, rusting metal, and suffocating humidity are the main facts of life her And you can't just get up and go home without having blood squirt out your eyes. To make matters worse, every thirty seconds or so, the crests and troughs of the waves at the surface shift the pressure inside Aquarius, requiring all of us to equalize our sinus cavities by popping our ears.

The tour continues. Peadro leads me three paces east, into the sleeping quarters—two rows of bun beds stacked three high—and then back into the kitchen. The tour is over, he says. There's nothing else to see on Aquarius.

I noticed that we haven't seen a bathroom, and I ask Brad if we've passed it.

"We usually just go out the back there," he says, pointing to the wet deck entrance I just swam through. The front door of Aquarius doubles as its outhouse.

Toilets are notoriously difficult to manage in underwater habitats, mostly due to the constant shift in air pressure, which can create vacuums inside the plumbing lines. In early underwater habitats, toilets would explode and splatter waste throughout the compartment. Aquarius's commode is an ~~improvement, but it is so small and offers so little privacy that aquanauts prefer to do their busi~~ness in the water out back. Even that has its problems. Sea life fights for the human "food." On one occasion a male aquanaut who was submerged in the wet deck from the waist down had his ass bloodied by a hungry fish.

Peadro tells me to head back to the wet deck. At 36 psi, nitrogen usually takes ninety minutes to reach dangerous levels, but it can sometimes happen sooner; to be safe, Aquarius allows visitors a maximum of a half hour onboard. My time here is up.

I put on my wetsuit, splash through the door, and kick into the smoky blue water. The constant gurgle from my scuba regulator scares off everything around me; it's like I've gone bird watching with a leaf blower strapped to my back. And the wetsuit, tank, and knot of tubes around my body prevent me from even *feeling* the seawater.

Being inside Aquarius was the same way. Even though the habitat allows the aquanauts to do invaluable long-term research, sitting in that steel tube and looking at the ocean through windows and video screens was, to me, hopelessly isolating. I've felt far more connected to the ocean and its inhabitants surfing on its surface than sitting in a rubber-and-steel tube six stories beneath it.

BACK ON THE MOTORBOAT, I strip off my scuba gear and sit in the captain's cabin. Before I can leave, members of the Aquarius support crew need to dive down some canisters of food and supplies for the aquanauts.

The captain, an intense, sunburned man named Otto Rutten who has been working at Aquarius for more than twenty years, hands me a bottle of water. He tells me about some close calls he's had in the job—rescues in the high seas, explosions, emergency ascents.

"It was really the Wild West out here," he says. "I mean, we weren't even using scuba for a lot of the deliveries." He explains that scuba took too long and enabled him to make only a few dives at a time before the nitrogen gas in his bloodstream built up to dangerous levels. So instead, Rutten and the other crew members would just jump into bathing suits, put on fins and masks, and freedive the supplies down.

Swimming down there while carrying a bulky, airtight container and then coming back would take well over a minute. I mention to Rutten that he and the other divers must have stopped down at Aquarius to take a breath before returning to the surface. Rutten laughs and says that if he had, the high-pressure air would have probably killed him.

It was by stripping off all the gear—the tanks, weights, regulators, and buoyancy-control devices—that Rutten and his coworkers could dive deeper, more often, and four times as fast as someone wrapped in the most technologically advanced equipment.

I ask Rutten if he had any kind of special training to freedive to such depths.

"No, not really," he says. "It's easy. You just take a breath and go."

IN 1949, A STOCKY ITALIAN air force lieutenant named Raimondo Bucher decided to try a potentially deadly stunt in a lake on the island of Capri. Bucher would sail out to the center of the lake, take a breath, and go down one hundred feet to the bottom. Waiting there would be a man in a diving suit. Bucher would hand the diver a package, then kick back up to the surface. If he completed the dive, he’d win a fifty-thousand-lira bet; if he didn’t, he would drown.

Scientists warned Bucher that, according to Boyle’s law, the dive would kill him. Formulated in th 1660s by the Anglo-Irish physicist Robert Boyle, this equation predicted the behavior of gases at various pressures, and it indicated that the pressure at a hundred feet would shrink Bucher’s lungs to the point of collapse. He dove anyway, delivered the package, and returned to the surface smiling, with his lungs perfectly intact. He won the bet, but more important, he proved all the experts wrong. Boyle’s law, which science had taken as gospel for three centuries, appeared to fall apart underwater.

Bucher’s dive resonated with a long line of experiments—most of them very cruel and even monstrous by modern standards—that seemed to indicate that water might have life-lengthening effects on humans and other animals.

This line of inquiry arguably began in 1894, when Charles Richet rounded up several ducks and tie strings around their necks. He took half the group, tightened the strings until the birds couldn’t breathe, then timed how long it took them to die. He then repeated the process with the other half, bu these he strangled underwater. The ducks left in the open air lived only seven minutes, while the duck kept underwater survived up to twenty-three. This was very odd. Both groups were deprived of oxyge in the same way, but the ducks put underwater lived three times longer.

Richet, who would eventually win a Nobel Prize for his work on the causes of allergic reactions, thought water might be affecting the ducks’ vagus nerve. In both humans and ducks, this nerve extends from the brain stem to the chest and can slow the heart rate. Richet theorized that a slower heart rate would result in decreased use of oxygen and thus longer survival times.

He tested this theory by injecting one group of ducks with the drug atropine, which keeps the vagu nerve from slowing the heart rate. He left the second group untouched and atropine-free. He strangle both groups and timed how long it took them to die. They all died in about six minutes.

Then, with another group of ducks, he injected atropine and repeated his experiment, this time wit the ducks underwater. The atropine-dosed ducks took more than twelve minutes to die underwater— twice as long as the ducks in open air. Even though the vagus nerve had been blocked with atropine and could not slow the heart rate, the water *still* had some inexplicable life-lengthening effect on the ducks. Richet took one atropine-drugged duck out of the water after twelve minutes, untied its neck, and resuscitated it. It lived.

Lung size, blood volume, and even the vagus nerve couldn’t explain Richet’s results. Water alone was extending their lives. He wondered if it had the same effect on humans.

In 1962, Per Scholander, a Swedish-born researcher working in the United States, confirmed that i did. He gathered a team of volunteers, covered them with electrodes to measure their heart rates, and poked them with needles to draw blood. Scholander had seen the biological functions of Weddell sea reverse in deep water; the seals, he wrote, actually seemed to *gain* oxygen the longer and deeper they dove. Scholander wondered if water could trigger this effect in humans.

He started the experiment by leading volunteers into an enormous water tank and monitoring their heart rates as they dove down to the bottom of the tank. Just as it had done with ducks, water triggere an immediate decrease in heart rate.

Next, Scholander told the volunteers to hold their breath, dive down, strap themselves into an array of fitness equipment submerged at the bottom of the tank, and do a short, vigorous workout. In all cases, no matter how hard the volunteers exercised, their heart rates *still* plummeted.

This discovery was as important as it was surprising. On land, exercise greatly increases heart rate The volunteers’ slower heart rates meant that they used less oxygen and therefore could stay underwater longer. This also explained, to some degree, why Bucher and those ill-fated ducks could survive up to three times longer in water than they could in open air: water had some powerful capacity to slow animals’ hearts.

Scholander noticed something else: Once his volunteers were underwater, the blood in their bodies began flooding away from their limbs and toward their vital organs. He’d seen the same thing happen in deep-diving seals decades earlier; by shunting blood away from less important areas of the body, the seals were able to keep organs like the brain and heart oxygenated longer, extending the amount o time they could stay submerged. Immersion in water triggered the same mechanism in humans.

This shunting is called peripheral vasoconstriction, and it explains how Bucher could dive to belov one hundred feet without suffering the lung-crushing effects that Boyle’s law had predicted. At such depths, blood actually penetrated the cell walls of the organs to counteract the external pressure. Whe a diver descends to three hundred feet—a depth frequently reached by modern freedivers—vessels in the lungs engorge with blood, preventing them from collapse. And the deeper we dive, the stronger th peripheral vasoconstriction becomes.

Boyle’s law seemed not merely bent in the face of this physiological conversion; it was nullified.

Scholander found that a person need submerge only his face in water to activate these life-lengthening (and lifesaving) reflexes. Other researchers tried sticking a hand or a leg in the water in a attempt to trigger the reflex, but to no avail. One researcher even put volunteers into a compression chamber to see if pressure alone would trigger a similar diving reflex. No dice. Only water could trigger these reflexes, and the water had to be cooler than the surrounding air.

As it turns out, the tradition of splashing cold water on your face to refresh yourself isn’t just an empty ritual; it provokes a *physical* change within us.

Scholander had documented one of the most extreme transformations ever discovered in the huma body, a change that occurred only in water. He called it the Master Switch of Life.

Today, competitive freedivers are using the Master Switch to dive deeper and stay underwater longer than even modern scientists believe is possible.

On September 17, 2011, I traveled to Kalamata, Greece, to watch the modern-day masters of the Master Switch—one hundred of the world’s best freedivers—test the absolute limits of our amphibious nature.

AT 7:00 P.M., THE OPENING ceremony of the Individual Depth World Championship is in full swing. Hundreds of competitors, coaches, and crew members from thirty-one countries are waving national flags and screaming their countries’ anthems from an enormous stage built on a crowded boardwalk overlooking Kalamata Harbor. Behind them, a forty-piece marching band plays a ragged version of th *Rocky* theme as video highlights of freedivers plummeting three hundred feet are projected onto a thirty-foot screen. The whole scene looks like a low-rent Olympics.

Competitive freediving is a relatively new sport, and almost every year since Raimondo Bucher’s hundred-foot dive in Capri—considered the first official competitive freedive—freedivers have been breaking records. The current world record for breath-holding underwater, held by Frenchman Stéphane Mifsud, is eleven minutes, thirty-five seconds. In 2007, Herbert Nitsch, an Austrian freediver, dove down seven hundred feet on a weighted sled to claim a world record in absolute depth

While nobody has ever drowned at an organized freediving competition, enough freedivers have died outside of competition that it ranks as the second most dangerous adventure sport. The numbers are a bit murky; some deaths go unreported, and the statistics don’t distinguish between deaths due to ~~freediving alone and deaths due to freediving as part of other activities, like spearfishing. But one~~ estimate of worldwide freediving-related fatalities over a three-year span revealed a nearly threefold increase: from 21 deaths in 2005 to 60 in 2008. Of the 10,000 active freedivers in the United States, about 20 will die every year, which works out to about 1 in 500. (In comparison, the fatality rate for BASE jumpers is 1 in 60; firefighters, about 1 in 45,000; and mountain climbers about 1 in 1,000,000.)

Just three months before the 2011 world championship, two deaths drew attention to the sport’s dangers. Adel Abu Haliqa, a forty-year-old founding member of a freediving club in the United Arab Emirates, drowned in Santorini, Greece, during a 230-foot dive attempt. His body was never found. A month later, Patrick Musimu, a former world-record holder from Belgium, drowned while training alone in a pool in Brussels.

Competitive freedivers blame such deaths on carelessness, arguing that the fatalities are often associated with the divers going it alone or relying on machines for assistance—both very risky practices. “Competitive freediving is a safe sport. It’s all very regulated, very controlled,” said William Trubridge, the world-record freediver, when I talked to him before the opening ceremonies. “I would never do it if it wasn’t.” He pointed out that, during some 39,000 freedives over the previous twelve years, there had never been a fatality. Through events like the world championship, Trubridge and others hope to change freediving’s dangerous image and bring it closer to the mainstream. Trubridge said he’d like to see it as an Olympic sport someday. The 2011 opening ceremony here in Greece, with all its blaring music and fast-edit videos, is meant to spread the word.

Onstage, the lights suddenly darken, the video screen dims, and the PA system goes silent. Moments later, strobe lights flash. The metronomic thump of an electronic bass drum pumps out of the speakers, joined soon after by canned handclaps and a bass riff that borrows heavily from “Another One Bites the Dust.” Fireworks explode overhead. The freedivers cheer and dance around, waving national flags.

The freediving world championship is on.

FOR ALL ITS MAINSTREAM HOPES, competitive freediving has one glaring problem: It’s almost impossible to watch. The playing field is underwater, there are no video feeds beamed back to land, and it’s a logistical challenge to even get near the action. Today’s staging area is a ragged twenty-foot-by-twenty-foot flotilla of boats, platforms, and air tanks; it looks like it was swiped from the set of *Waterworld.* To get there, I walk to the Kalamata marina and board a sailboat owned by a Québecois expat named Yanis Georgoulis. His is the only boat going to the competitions. Georgoulis tells me it will take about an hour to reach the flotilla. I use the time to further brush up on the complicated rules of today’s competition.

The contest officially starts the night before a dive, when each competitor secretly submits the proposed depth of the next day’s attempt to a panel of judges. It’s basically a bid, and there’s gamesmanship involved as each diver tries to guess what the other divers will do. “It’s like playing poker,” said Trubridge. “You are playing the other divers as much as you are playing yourself.” The hope is that your foes will choose to do shallower dives than you can do or that they’ll choose deeper dives than they can do and end up busting.

In freediving, you bust if you flub any one of dozens of technical requirements during and after the dive, or if you black out before you reach the surface, grounds for immediate disqualification. While not common in competitions (I’m told), blackouts happen often enough that layers of safety precautions are in place, including rescue divers who monitor each dive, sonar tracking from the flotilla, and a lanyard guide attached to each diver’s ankle that keeps him or her from drifting off course—a potentially fatal hazard.

A few minutes before each dive, a metal plate covered in white Velcro is attached to a rope and sunk ~~to the depth the competitor submitted the night before. An official counts down, and then~~ the diver submerges and follows the rope to the plate, grabs one of the many tags affixed to it, and follov the rope back to the surface. About sixty feet under, the competitor is met by rescue divers who will assist him if he blacks out. If this blackout occurs so far down that the safety divers can't see him, th sonar will detect his lack of movement. The rope will then be hauled to the surface, dragging the freediver's body like a rag doll.

Divers who successfully resurface are put through a battery of tests known as the surface protocol. This regimen gauges the diver's coherence and motor skills by requiring him to, among other things, remove his facemask, quickly flash an okay sign to a judge, and say, "I'm okay." If you pass, you get white card, validating the dive.

"The rules are there to make freediving safe, measurable, and comparable," said Carla Sue Hanson the media spokesperson for the Association Internationale pour le Développement de l'Apnée (AIDA or, as it's known in English, the International Association for the Development of Apnea, the freediving federation that has overseen the world championship since 1996. (*Apnea* is Greek for "without breathing.") "They are set up to ensure that, through the whole dive, the diver is in full control. That's what competitive freediving is all about: control."

As long as you're in control, it's all right if blood vessels burst in your nose and you come out looking like an Ultimate Fighter who took a beating. "The judges don't care how someone looks," Hanson said. "Blood? That's nothing. As far as the rules go, blood is okay."

After an hour, Georgoulis ties up to the flotilla. In the distance, a motorboat cuts a white line from the shore to deliver the first competitors to the site. Because of the extremely limited room on the flotilla and an adjacent motorboat, only judges, competitors, coaches, and a handful of staff are allowed at the event. There are no fans present. Luckily, I was able to talk my way onto Georgoulis's sailboat, which will be used as a makeshift locker room for contestants.

The first divers show up wearing hooded wetsuits and insectoid goggles, each moving with syrupy slow steps as they warm up on the sailboat, staring with wide, lucid eyes. One, two, three—they slide into the sea like otters, then lie back looking semi-comatose as their coaches slowly float them over t one of three lines dangling from the flotilla. A judge issues a one-minute warning, and the first competitor begins his descent.

Freediving is broken down into multiple disciplines. Today's is called constant weight without fins or CNF. In CNF, a diver goes down using his lungs, body, and an optional weight that, if employed, must be brought back to the surface. Of the six categories in competitive freediving—from depth disciplines like free immersion (the diver can use the guide rope to propel himself up and down) to pool disciplines like static apnea (simple breath-holding)—CNF is considered the purest. Its reigning champion is Trubridge, who broke the world record in December 2010 with a 331-foot dive. Today he's trying for 305 feet, a conservative figure for him but the deepest attempt on the schedule. Before he arrives, a dozen other divers get things started.

An official on line one counts down from ten, announces, "Official top," and begins counting up: "One, two, three, four, five . . ." The countdowns let the divers know when to start gulping their last breaths of air and prepare to go deep. A female diver on line three, Junko Kitahama of Japan, has unt thirty to go. She inhales a few final lungfuls, ducks her head beneath the water, and descends. As her body sinks, the monitoring official announces her depth every few seconds.

Two minutes later, a judge on the surface yells, "Blackout." Safety divers kick down along the rop and reemerge a half a minute later with Kitahama's body between them. Her face is pale blue, her mouth agape, her head craned back like a dead bird's. Through her swim mask, her wide eyes stare into the sun. She isn't breathing.

“Blow on her face!” yells a man swimming next to her. Another man grabs her head from behind and ~~raises her chin out of the water. “Breathe!” he yells. Someone from the deck of a boat yells~~ for oxygen. “Breathe!” the man repeats. But Kitahama doesn’t breathe. She doesn’t move.

A few agonizing seconds later, she coughs, jerks, twitches her shoulders, and flutters her lips. Her face softens as she comes to. “I was swimming and . . .” She laughs and continues. “Then I just starte dreaming!” Two men slowly float her over to an oxygen tank sitting on a raft. While she recovers, another freediver takes her place and prepares to plunge even deeper.

Meanwhile, a diver on a different line takes one last breath, descends two hundred feet, touches down, and then, after three minutes, resurfaces. “Breathe!” his coach yells. He smiles, gulps, then breathes. His face is white. He tries to take off his goggles, but his hands are cramped and shaking. Lack of oxygen has sapped his muscle strength, and he just floats there, with blank eyes and a clownish grin.

Behind him another competitor resurfaces. “Breathe! Breathe!” a safety diver yells. The man’s fac is blue, and he isn’t breathing. “Breathe!” another yells. Finally he coughs, jiggles his head, and mak a tiny squeaking sound like a dolphin.

For the next half an hour, divers come and go, and similar scenes play out. I stand in the sailboat with my stomach tightening, wondering if this is normal. All the competitors sign waivers acknowledging that heart attacks, blackouts, or drowning may be the price they pay to compete. But I have a feeling that competitive freediving’s continued existence has a lot to do with the fact that the local authorities don’t know what really goes on out here.

Trubridge arrives, wearing sunglasses and headphones, his arms appearing spidery next to his oversize torso. I can see his gargantuan lungs heaving even though I’m thirty feet away. He’s so lost a meditative haze that he looks half asleep as he enters the water, latches his ankle to the lanyard, and gets set to go.

A judge announces, “Official top,” and a few seconds later Trubridge dives, kicking with bare feet, descending rapidly. The official announces, “Twenty meters,” and I watch through the clear blue wat as Trubridge places his arms at his sides and sinks effortlessly, drifting into the deep, and then is gon The image is both beautiful and spooky. I try to hold my breath along with him and give up after thir seconds.

Trubridge passes a hundred feet, a hundred and fifty feet, two hundred feet. Almost two minutes into the dive, the sonar-monitoring official announces, “Touchdown”—at 305 feet—and begins monitoring Trubridge’s progress upward. After an agonizing three and a half minutes, Trubridge rematerializes. A few more strokes and he surfaces, exhales, removes his goggles, gives the okay sig and says in his crisp New Zealand accent, “I’m okay.” He looks slightly bored.

THE NEXT TWO DAYS ARE rest days. The courtyard at the Akti Taygetos Hotel buzzes with a dozen languages as teams gather around patio tables to sip bottled water, talk strategy, and e-mail worried relatives. The group here is largely male, mostly over thirty, and generally skinny. Some are short, a few are pudgy, and many have shaved heads and wear sleeveless T-shirts, action-strap Teva sandals, and baggy shorts. They hardly look like extreme athletes.

I find an empty table in the shade. I’ve scheduled an interview and a freediving lesson with Hanli Prinsloo, a national record holder from South Africa whom I met the previous day on Georgoulis’s boat. She told me that for the past three months, she had been in Egypt training to break a world record, but she had come down with a sinus infection the previous week and had to pull out. She was now coaching friends, spreading good cheer, and patiently answering my many questions about the sport. She had also been urging me to try freediving myself.

So far, the mere thought of freediving made me claustrophobic. Aside from a few graceful and awe inspiring dives from champions like Trubridge, most attempts looked awkward and dangerous. On th first ~~day, seven competitors blacked out before reaching the surface; if they hadn’t been rescued~~ by the safety divers, they’d now be dead on the seafloor. The human body was no doubt uniquely equipped to dive deeper than I had ever imagined, but it still wasn’t meant to descend to the depths these divers were attempting. It was just a matter of time before someone got hurt, or worse.

Prinsloo insisted that there was more to freediving than descending along ropes and trying to beat your opponents. “It offers a stillness,” she told me on the boat, a kind of full-body meditation that could be found nowhere else. And there was no need to force yourself down to three hundred feet to find it. The most incredible transformation, she said, happened at around forty feet down. There, the force of gravity seemed to reverse; the water stopped buoying your body toward the surface and instead started pulling you deeper.

This was the “doorway to the deep,” where everything changed, and anyone could pass through it— even me. To prove it, Prinsloo offered me an introductory, out-of-water session where we’d work on increasing my breath-holding capacity, the first step in learning to freedive. My personal breath-hold best was around fifty seconds; she promised that within two hours of training, I’d double it.

“WELL, HELLO!” PRINSLOO EXCLAIMS AS she approaches my poolside table. At thirty-four, she’s tanned and fit, with long, dark brown hair; she actually looks like a natural athlete, unlike most of the freedivers I’ve seen. She grew up on a farm in Pretoria, South Africa, and spent her summers with he sister swimming in rivers and, she joked, speaking “a secret mermaid language.” After discovering freediving in her twenties while living in Sweden, she moved back to South Africa. She now lives in Cape Town, where she runs the nonprofit conservation program I Am Water and works part-time as a motivational speaker and a yoga and freediving instructor.

We walk to a covered patio overlooking Messinian Bay and roll out yoga mats. The lesson begins with some basic poses to loosen the muscles around our chests. “If you could take your lungs out of your chest, they are completely flexible and you could blow them to whatever size,” she says, then sh puffs up her chest and exhales. What stops the lungs from expanding is the musculature around the ribs, chest, and back. Through stretching and breathing exercises, freedivers develop up to 75 percent more lung capacity than the average person. Nobody actually needs this extra capacity to start freediving, but, like a larger tank of gas, it can help you go deeper and stay under longer. Stéphane Mifsud, who set the world breath-hold record in 2009, boasts a 10.5-liter lung capacity; the average adult male’s is 6 liters. Prinsloo can hold up to 6 liters of air in her lungs, compared to the average female, who can hold about 4.2.

Next, Prinsloo takes me through a few human-pretzel poses designed to help open up my lungs. While we’re stretching, she explains how pressure works in water, and how it affects our lungs and bodies.

In the water, the deeper we go, the more the pressure increases and the more the air contracts. Seawater is eight hundred times denser than air, so diving down just ten feet causes the same change in air pressure as descending from an altitude of ten thousand feet to sea level. Anything with a flexible surface and air inside it—a basketball, a plastic soda bottle, human lungs—will be at half its original volume 33 feet underwater, a third of its original volume at 66 feet, a quarter at 99 feet, and so on.

When the basketball, plastic soda bottle, or pair of lungs returns to the surface, the air inside will quickly reinflate to its original volume. For freedivers, this plays hell on the body, especially the che area. The breathing exercises and stretches Prinsloo is leading me through are meant to keep the ches muscles flexible so that if I start freediving, I’ll be better able to handle these dramatic changes in volume and not black out or die.

We are now sitting cross-legged and facing each other, breathing into the three chambers of our lungs: ~~the belly area, the sternum, and the top of the chest, just beneath the collarbones. Prinsloo~~ says that most of us spend our lives breathing only at the very tops of our chests, meaning that we’re accessing only part of our lungs. To store more oxygen for longer dives, I’ll need to learn to breathe into the total volume of my lungs.

She directs me to draw a twenty-second breath into the belly area, sternum, and top of the chest. Doing this makes me feel nauseated, but I acclimate after a few minutes. Then Prinsloo pulls out her stopwatch and gets ready to time my first breath-hold attempt. I lie down on my mat, take one more enormous three-chambered breath and hold it. She starts the clock.

What feels like thirty seconds pass. I’m extremely nauseated. My head throbs. I imagine for a moment what it must be like to be a hundred feet underwater and feeling this awful. This thought triggers panic. A few seconds later, my body starts convulsing. I try to keep still but can’t. Prinsloo stops the watch and tells me to exhale, then inhale. I sit up, shaking my head, feeling like a failure.

“Not bad,” she says. “You’ve more than doubled your breath-holding on the first try.” She shows me the stopwatch. I’ve just held my breath one minute and forty-five seconds.

I ask about the convulsions. She explains that the body responds to extreme breath-holding in three stages. Convulsions are the first-stage response. “You start reacting not from the lack of oxygen, but from the buildup of carbon dioxide,” she says. “When that starts, it’s just a caution that you’ve only got a few minutes to go before you *really* need to breathe.” The second-stage response occurs when the spleen releases up to 15 percent more fresh, oxygen-rich blood into the bloodstream. This usually occurs only when the body goes into shock, an extreme state whose symptoms include low blood pressure, rapid heartbeat, and organ shutdown. But it also happens during extreme breath-holding. A freediver anticipates the spleen’s delivery of fresh blood, feels it happen, and uses it as a turbo-charge to dive even deeper.

The third-stage response is the blackout, which happens when the brain senses that there’s not enough oxygen for it to support itself and so shuts off, like a light switch, to conserve energy. Though the brain represents only about 2 percent of the body’s weight, it uses 20 percent of the body’s oxygen. The presence of liquid in the mouth or throat triggers another reflexive line of defense: the larynx automatically closes, stopping water from entering the lungs. Freedivers learn to sense the arrival of convulsions and spleen release, and they know exactly when to head back to the surface so the third-stage blackout won’t occur. A freediver survives by understanding and respecting these mechanisms.

“There’s a reason we’re built with all these amazing rows of defense,” Prinsloo says. “It’s that we are meant to be underwater!” She shifts me into yet another yoga pose. “You are born to do this!”

I lie on my back for my final breath-holding attempt of the day. *Inhale, exhale, big inhale, hold.* Prinsloo starts the stopwatch. I close my eyes.

After what feels like about twenty seconds, I start gently convulsing again. I tell myself this is natural, to concentrate, keep relaxed, wait for the spleen to kick in. It’s hard to wait. My chest feels pressurized and my heart pounds so forcibly that I can sense it in my hands, legs, crotch. I feel miserable.

“Stick with it, you can do this for so much longer. You’re just at the first stage,” Prinsloo reassures me. I stick with it. After what feels like ten more seconds, my stomach begins constricting, and my throat tenses. I feel claustrophobic. “Just a little longer . . . a little longer,” she says gently. Soon my body feels electrified. I noticed I’m wriggling on the mat like a fish out of water. “Right now, your spleen is filling your body with fresh, oxygen-rich blood,” she says. Moments later, I think I can sense what she’s talking about. My body calms. The darkness of my closed eyes grows somehow darker; the ambient noise of the pool area fades; and I feel like I’m drifting off to . . .

“Breathe!” she says. I exhale, inhale, exhale. I’m dizzy, have trouble focusing through fluttering eyes, but I feel good. “How long do you think that was?” she asks me. I shrug and guess about a ~~minute or so. She smiles. I didn’t just double my breath-holding record during this lesson; I tripl~~ed it The stopwatch reads three minutes, ten seconds.

HUMANS MAY WELL BE BORN to freedive, as Prinsloo insisted, but that doesn’t mean it’s easy. You still have to hold your breath a long time, exert yourself to your breaking point, and not freak out. I could now hold my breath for more than three minutes, but I hadn’t tried diving any deeper than ten feet or so. And after what I’d seen, diving to even a few dozen feet was out of the question.

And yet, I was still determined to find out what it was like down there.

Three hundred feet is the halfway point to the photic zone. Even in the clearest oceans, with blazin sunlight overhead, visibility at this depth is about .5 percent of what it is at the surface, so the water i perpetually gray and hazy. Without artificial lighting, you can see maybe fifty feet in any direction. Because the light is so diffuse, all directions at –300 feet look the same.

With less light, there is less life than at shallower, brighter depths. The creatures who do live here must adapt to the twilight: fish have evolved large eyes to see better; sharks use electromagnetic senses to seek out prey; squids, microorganisms, and bacteria use a chemical process called bioluminescence to light their own way.

Getting down to this depth is arduous and often dangerous. Scuba divers can make it to three hundred feet breathing mixed gases, but it takes years of training and is a logistical nightmare. The danger isn’t going down—although that certainly is dangerous—it’s coming back up. For a scuba diver, a one-hour descent to two hundred feet breathing regular compressed air would require a ten-hour ascent to purge the deadly levels of nitrogen gas in the blood that accumulate on the way down. three-hundred-foot ascent on compressed air would most likely kill you.

My best bet in the short term was to talk to William Trubridge. He dives to three hundred feet all the time. Trubridge and other freedivers who use nothing but their bodies to reach this depth have a physical advantage over scuba divers: decompression sickness doesn’t affect them. There simply isn enough nitrogen in a single breath to bubble the blood. At the surface, this nitrogen is quickly purged from the system in a matter of seconds—another function of the Master Switch.

Between 2007 and 2010, Trubridge broke fourteen world records (mostly his own) in the discipline of constant weight without fins and free immersion. Today he is considered the world’s top no-fins and fins-assisted freediver, so he knows as much about the experience of diving down to three hundre feet as anyone who’s ever lived.

“FREEDIVING IS AS MUCH a mental game as a physical one,” says Trubridge. We are sitting poolside at the Messinian Bay Hotel the day after my freediving lesson with Prinsloo. Trubridge, with his croppe hair, wraparound dark glasses, and a worn T-shirt, fits right in with the rest of the freedivers gathered here. He’s got the quiet, nerdy energy of a software engineer.

Like almost all competitive divers, Trubridge says he dives with his eyes closed. He’ll open them for a moment when he reaches the plate at the bottom of the rope, but that’s it. By diving blind, he prevents his brain from using up the energy—and oxygen—it would take to process visual information.

So, Trubridge can’t tell me what it *looks* like at three hundred feet down, but he can certainly describe how it *feels*. He leans back in his chair and takes a deep breath. And as he starts talking, my stomach starts tightening once again . . .

In the first thirty or so feet underwater, the lungs, full of air, buoy your body toward the surface, forcing you to paddle as you go down. As you blow air into your middle-ear canals to equalize the pressure, you’ll feel a much more intense version of the discomfort you would feel in an airplane as i