

# Extreme Exploration, Ocean Edition: from Reed Rafts to the Titan Submersible

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Entertainment

## Midnight Facts for Insomniacs

Podcast Transcript

(Note: transcript consists of episode outline)

This week I had an opportunity to make another huge mistake by trying to pack a massive topic into a single episode. but I've learned my lesson insomniacs, I'm too wily for your shenanigans, so we're breaking this one up. The topic chosen by the discord poll was "extreme exploration," and that could take us in a lot of different directions. Caves, jungles, deserts, mountains, glaciers...however, any terrestrial exploring pales when compared to the true final frontiers of exploration... there are only two environments that humans don't yet have the resources and ability to map, explore, and conquer. I bet you can guess. Outer space, and aqua space. So we're going to split these into two episodes, which let's be honest still isn't enough, but we can revisit them both in the future. in honor of the fact that deep sea exploration has been very much in the news and the zeitgeist recently for tragic reasons

that we will explore in depth later, no pun intended, we're going to start with the history of ocean exploration.

Now I consider myself to be somewhat of an expert when it comes to deep sea oceanic exploration owing to the fact that I have played over 40 hours of Subnautica and at least 25 hours of the sequel, Subnautica Below Zero. I have learned all about the aliens at the bottom of the ocean, I know all of the things THEY don't want you to know. On a serious note, I was diving certified at age 14, my uncle was a diving instructor, and I've been lucky enough to scuba dive around the world. Mostly, however, in Oregon, which is some of the worst diving you can do. Do not recommend, unless you enjoy frigid water and minimal visibility. So my point is that I am basically an oceanographer. Plus, as you and the insomniacs know, we previously released an episode about oceans, and we covered the entire field of ocean research, so we're not going to repeat ourselves and talk about salinity and depth etc., if you want to know why the ocean is blue or the approximate total number of shipwrecks left to discover, scroll back to September 2020 and listen to "off the deep end: facts and mythology of the ocean."

The only fact from that episode that I DO want to bring up right off the bat is that light waves can penetrate ocean water only down to about 700 feet. And no light is going to make it past

3000 feet. The average depth of the ocean is 12,000 feet. So the vast majority of territory in the world's oceans is dark and mysterious and unexplored. As I mentioned this is truly one of the final frontiers for extreme exploration. The deepest spot in the ocean is so-called challenger deep, in the Mariana trench that runs through the Pacific Ocean. It was a major milestone when humans reached that point, and it might have felt like the seas had been tamed, but the truth is that we've explored and charted a measly 5% of total ocean territory.

It's wild to think about what the ocean must have seemed like to primitive humans before the invention of boats. For primitive humans, the sea transcribed the borders of their environment; when you reached the ocean that was literally the end of your world. I've been doing a lot of gaming lately and it's always funny when you try to venture off a path and hit an area where your character just can't continue to explore, you're just suddenly walking in place and jumping against an invisible force field. That's what the ocean must have felt like for prehistoric, pre-boat humans. Of course you could wade into the ocean, you could swim a little ways out, but ultimately the water was a barrier that harbored and obscured an unknown world. Prehistoric humans would see the distant plume of blowspouts from whales, they watched seals and turtles lumber in and out of the water, wondering what kinds of marvels

those aquatic animals could experience beyond the horizon, but they probably weren't too eager to find out because occasionally the tide would disgorge a giant from the depths, monstrous beasts that dwarfed even elephants and giraffes. And of course primitive people relied on the ocean for food. The world underneath the water was as bountiful as it was mysterious and dangerous. A need for food is what presumably would have driven much of the initial exploration of the ocean via free diving. The promise of capturing delicious fish via Spearfishing and harvesting clams and sponges from the depths were incentives for people to overcome their fear.

Of course it's impossible to know when the first boats were invented because boats pre-date written history, but the oldest boat ever discovered was a 3 foot hollowed dugout, or chunk of curved pine tree bark, found in the Netherlands, known as the Pesse canoe. It dates back to around 8200 BCE.

But of course we have evidence that boating dates back much farther. Our ancestors, *Homo erectus*, most likely used primitive boats to travel among islands and across rivers and lakes etc. The earliest depiction of a boat that we know of is a rock carving from Azerbaijan from around 10,000 BCE, and depicts a ship made of reeds carrying around 20 people. 20 very nervous people who despite being primitive humans probably understood how reeds work and the fact that they

aren't particularly sturdy and have a tendency to rot and degrade in the water. But you make do with what you had. The ancient Egyptian's constructed rafts out of papyrus reeds. Some of the first boats that could traverse long distances and carry cargo were the Uru, used by the ancient Greeks and Arabs. they could carry some 400 tonnes of cargo. these crafts would qualify as ships, because there is a difference between ships and boats as you probably know, ships are bigger. I didn't really know that in an official sense, I think I just absorbed it intuitively. I wouldn't call a cruise ship a boat. Also the words just don't feel interchangeable a lot of the time, I don't want to hear the Lonely Island song I'm on a ship. I'm on a ship motherfucker don't you ever forget, not the same bravado.

Early boats were unpowered with no system of propulsion, we're talking a piece of wood that basically drifted with the current. So you might use a chunk of bark as a raft to get down river, but getting up the river without a paddle would be tough, it probably would be easier just to swim. You don't want to be stuck up a creek without a paddle, or so I've heard. The first propulsion technologies were basically methods to make a boat swim, they were substitutes for arms: oars and paddles.

Sailing boats seem to have originated in Egypt circa 4000 BCE and would travel along the Nile, carrying obelisks and construction materials, and also

cruise around around the Mediterranean.

Around 600 BCE the first standardized sea routes were established, so that ships could traverse the sea with maps the way humans navigate the earth. Initially most vessels stayed within side of shore, but celestial navigation was the natural next step, using the position of the sun during The day and the North Star at night. The North star is the brightest star in the sky and one whose stable position in the heavens makes it extremely useful for orienting to your location. and of course the development of compasses and sextants (which can be used to calculate latitude and longitude) allowed oceanic explorers to venture further and further from the shore with confidence that they could find their way home.

Machine powered craft debuted with the invention of the steam engine; the first patent for a steamboat was registered by Englishman John Allen in 1729, but the concept was theoretical and impractical and would only be made viable with improvements by noted inventor James Watts. The first demonstration of a working steamship took place in France in 1783 when inventor Claude-François-Dorothee, marquis de Jouffroy d'Abbans sent his ship *Pyroscaphe* up the river Saone... I'm not going to try that again. Anyway this was a big deal, for a ship to travel upriver on its own power. The boat broke down immediately following the trip but was repaired and would make

a number of successful journeys. This was a paddle steamer, I love these boats because they look like tiny cars with wheels, there is a wheel on each side of the boat and it is constructed of paddles, I guess you might've guessed that, the wheels are turned by steam pressure and propel the boat forward. It's a straight up Flintstones design, or maybe Swiss family Robinson.

So the first stages of ocean exploration involved traversing the surface, basically the ocean was an obstacle to be crossed. But exploration of the depths actually started way earlier than I was aware. Significant diving begins in around 4000 BCE in Egypt and Greece, diving is used to gather food and materials and precious items like pearls and Jade, and is eventually used in warfare to sneak up on enemies etc. divers are rumored to have cut the moorings of enemy ships and even punched holes in the bottom of the hull. True deep-sea diving begins as far back as 1000 BCE, there are accounts of humans going down more than 100 feet aficionado is almost 3 atmospheres. I used to dive as I mentioned, with scuba gear and a tank, and I've never gone past 100 feet. And part of the problem for me was that you have to equalize, because as you go further down the pressure becomes intense and any air pockets in your body are going to be compressed, which means your nasal cavities, your ears. and when that happens it hurts like hell. It feels like your brain is being squeezed

into your nose. Or maybe that's just me. But it sucks. So what you typically do is stop descending, and then start working your jaw like you do when you're trying to equalize in an airplane or going over a mountain in your car. And then you often hold your nose and blow to try to push air against the pressure that's pushing in. And eventually hopefully your ears will sort of pop and then you can go down deeper. But if you're a free diver holding your breath while doing this—if you're limited by how long you can go on a single breath of air—then you can't just stop for a while and mess around with your ears and push air out your nose and then go deeper, you basically have to figure out ways to equalize super quickly, or you could come up with uncomfortable but clever strategies like putting drops of oil in your ears and holding a mouth full of oil while you dive, you're basically filling up the air pockets with liquid that can't be compressed. that wouldn't really help your nose but apparently it was a strategy that was used by ancient free divers.

So even though there are some pretty amazing free divers in the world—my cousin is one and we've discussed it before—there's a limit to how far down the unassisted human body can go, and certainly a limit to how long they can stay there. But since way back in postiquity inventors and intellectuals and adventurers have been working on ways to more thoroughly explore the scary ass ocean depths. Because no matter where you go in location or

time, people be crazy. location  
location duration,

So the next technological advance in deep sea exploration was the dive bell.

The first ever reference to a dive bell pops up in fourth century BCE credited to Aristotle, "they enable the divers to respire equally well by letting down a cauldron, for this does not fill with water, but retains the air, for it is forced straight down into the water."

Apparently you can talk like kind of an awkward weirdo and still be a genius.

Alexander the Great, a student of Aristotle's, supposedly used dive bells to explore the sea and also maybe during the siege of Tyre which we explored in our sieges episode.

Alexander supposedly wanted to make sure that the Tyrians weren't building any underwater defenses, so he supposedly was lowered in a diving bell to make sure that the coast was clear and that his soldiers could take care of any sneaky submerged traps that might have been laid, I guess by people who had a diving bell of their own, seems unlikely. I don't really buy this story at all but it did show up in ancient accounts of Alexander's life, many of which were considered romances and no doubt exaggerated. But who knows. It's possible that he was the James Cameron of his day. Now with the ability to stay under water at previously unreachable depths for extended stretches of time came a new challenge: decompression sickness, also known as the bends. You don't feel it right now but the air

around us is pressing against our bodies at a pressure of about 14.7 pounds per square inch. So even if you're relaxed right now, you're always under pressure; just ask David Bowie.

And water is significantly heavier than air. The deeper you descend into the ocean, the more water is pressing down on you, and the pressure increases rapidly. Every thirty-three feet is considered an additional atmosphere; so at 33 feet you're experiencing twice the normal pressure, and at 66 you add yet another atmosphere and so on. Now this pressure doesn't just affect your ears and nasal passages, it also affects the gasses in your body...and specifically nitrogen and oxygen.

Oxygen just dissolves harmlessly into your bloodstream, but if you rise suddenly to the surface, the nitrogen solution expands into bubbles. And those bubbles cause problems. All kinds of problems. For one thing, that can form pretty much anywhere in your body...about 80% of people will experience them in the joints, which causes the sufferer to bend and contort from pain, thus "the bends". However, the bubbles can be cutaneous leading to intense itching or the sensation of insects crawling on the skin (also known as formication. That's really close to another word but very different sensations. I hope). So the bends is not fun and can be deadly. The way to avoid the bends is to ascend gradually, allowing the nitrogen to dissolve, and that means stopping at specific depths for

specific lengths of time. So-called decompression stops are a pain in the ass, I've done them, you have to achieve neutral buoyancy so that you float in place just suspended in water and then you just hang out there awkwardly watching a timepiece until you can continue rising upwards.

So the divebell is often shaped like, you guessed it, a trapezoid. No, pretty much like a bell. when you're lowering a divebell into the water, the air inside the bell is being compressed as the depth and pressure increases. So let's say you had ten cubic feet of air inside a diving bell, and it went down three hundred feet, the water would push its way up into the bell and the air would now be compressed into  $\frac{1}{4}$  of the space; you would now have only 2.5 cubic feet of air. Of course there's actually the same amount of air...the same number of oxygen molecules, but the volume has decreased as the pressure increased. The air basically gets squeezed into the top of the bell.

Now the bell was useful for getting to the bottom of a body of water and staying there for a while, but you couldn't travel very far from your little pocket of air and so they had a limited range of usefulness. To expand that range would require some kind of air pocket that followed or was attached to the diver.

Diving suits wouldn't make an appearance until the early 1700s,

when Frenchman Charles C-J Le Roux created a waterproof fabric that allowed two British inventors to produce the first functional dive suits. At that point the race was on to improve and perfect the designs, because you have to remember that this was the middle of the seafaring colonial era and pirates were rampant; ships laden with valuables were sinking left and right and often being sunk, and most of the wrecks were too deep to access. So the oceans were rife with plunder to be had...there was a massive incentive to get to the bottom of the sea. The first completely enclosed suit capable of performing salvage work was built by English wool merchant named John Lethbridge. This thing is amazing. I'm not convinced that it qualifies as a suit. It looked like a giant whiskey barrel with two armholes. Here's a description of the "suit" in his own words. "It is made of wainscot perfectly round, about 6 feet in length, about 2 feet and a half diameter at the head, and about 18 inches diameter at the foot, and contains about 30 gallons; it is hooped with iron hoops without and within to guard against pressure. There are two holes for the arms, and a glass about 4 inches diameter, and an inch and a quarter thick to look through, which is fixed in the bottom part, so as to be in a direct line with the eye, two airholes upon the upper part, into one of which air is conveyed by a pair of bellows, both which are stopt with plugs immediately before going down to the

bottom. At the foot part there's a hole to let out water. Sometimes there's a large rope fixed to the back or upper part, by which it's let down, and there's a little line called the signal line, by which the people above are directed what to do, and under is fix'd a piece of timber as a guard for the glass. I go in with my feet foremost, and when my arms are got through the holes, then the head is put on, which is fastened with screws. It requires 500 weight to sink it, and take but 15 pound weight from it and it will buoy upon the surface of the water. I lie straight upon my breast all the time I am in the engine, which hath many times been more than 6 hours, being frequently refreshed upon the surface by a pair of bellows. I can move it about 12 foot square at the bottom, where I have stayed many times 34 minutes. I have been 10 fathoms deep many a hundred times, and have been 12 fathom, but with great difficulty."

One fathom is 6 feet so this insane Brit was being lowered 72 feet under water—more than 2 atmospheres of depth and pressure—in a barrel. That's deep enough to have to worry about the bends.

So Lethbridge tested his nautical barrel in the garden pond behind his house, probably scared the crap out of some turtles, and then quickly began using it as a crude method of salvaging treasure and booty from shipwrecks. One particular ship, the Dutch vessel called *Slot ter Hooge* had gone down with 3 tons of silver.

Lethbridge and his stupid ass barrel

became extremely wealthy. This is definitely one of those "scoff now, but I'll have the last laugh" scenarios, because I would have mocked this guy relentlessly after watching him trundling around looking like a barrel-shaped robot, but that's probably why I'm not a silver doubloon millionaire. The next innovation was a very similar concept but scaled down, I don't know how to really describe German mechanic Karl Heinrich Klingert's diving suit. You kind of have to see it, I'll post it in Discord. It's sort of looks like if you cut R2 D2 in half and then shoved a guy up in his hollowed out upper body and then attached some breathing hoses and a metal tubelike girdle that covered the body all the way down to the waist, and then some kind of burlap trousers that stopped at the knee, like the most surreal pair of capris, below which sprouted a pair of awkwardly naked calves and bare feet. It is bizarre and awesome, and Klingert proved that it worked by submerging himself in a local river and sawing through a tree trunk. This was a huge breakthrough for aquatic lumberjacks everywhere, a major advance in the field of river logging. The suit was attached by hoses to a portable air supply, it was clumsy and bulky and maybe the dumbest looking thing I've ever seen, but extremely innovative in the ugliest possible way. A real triumph of function over form.

Around 1837 we finally get the "heavy footers," designs very similar to what we all picture as the classic metal

helmeted diving suit. I think of it as the Big Daddy, which I'm realizing sounds weirdly homoerotic, but is actually a character from the game BioShock, a brilliant first-person-shooter experience and my mental reference point for all things vintage oceanic. These are the suits with weighted boots, giant bulbous metal helmets featuring multiple thick glass viewing ports like brass portholes locked behind crisscrossed iron bars. They look like medieval torture devices, or extremely hard-core BDSM gear... these things are steampunk as fuck. The real innovation here was the use of leather and rubber to create durable and flexible watertight seals. I watched a video of a guy being outfitted in one of these things, it takes a team of basically two pit bosses to strap him in and apply each of the layers and then lace him up, attach metal wing nuts and bolts, sealing this guy in the suit like the man in the iron mask. This is the ultimate claustrophobic gimp outfit, watching this video gave me legit anxiety. Once you're in that suit you can't get out without help, and if any of those bolts or wingnuts get stuck, they'd have to basically jackhammer the helmet off of your head. It's intense. But these suits would be used for over a century, well into the 1900s.

The next technological innovation was an atmospheric diving suit, or ADS, a rigid articulated anthropomorphic suit in the shape of a human. It works like a personal submersible, and a big benefit here is that it is completely

insulated and protected against the elements and thus maintains one atmosphere of pressure inside the suit. Unless this thing sprouts a leak and goes full titan submersible, being inside it should feel utterly normal. somehow the first one of these things was built back in 1878 by a pair of French brothers, Alphonse and Theodore Carmagnolle. The helmet featured 20 portholes... I do not recommend googling this if like I do you suffer from trypophobia, the fear of densely packed holes... this thing made my skin crawl.

The suit itself looks like a brass suit of armor with articulated limbs featuring giant metal bulbs at all of the joints, it weighed close to 1000 pounds and being inside it was basically like being sealed and locked into a hideous, chitinous, underwater insect. I feel very similarly about this suit as I did last episode about Kok Boru, thanks I hate it. And I feel justified in hating it because the damn thing never worked. The concept was sound and it's a marvel of engineering and also it leaked and was an utter debacle, I don't know if anyone perished inside it but it was a giant fail, even though it did provide inspiration for more successful versions down the road. Later versions like 1929's Neufeldt-Kuhnke suit would look like big plastic Michelin men, sort of like the stay-pufft marshmallow man with a helmet on. This is another suit you just have to see you to believe. it has a giant fat plastic belly and arms like thick white

caterpillars and the hands are pinchers, it's all kinds of wrong and disturbing. In the 1930s American inventor H.L. Bowdoin would integrate a telephone into his dopey looking boxy atmospheric diving suit; it very much resembled a robot made out of trash cans. Seriously, all of these suits are incredibly entertaining and hilariously awkward.

These days atmospheric dive suit technology has advanced to crazy levels; before researching this episode I don't think I really knew that this stuff actually existed outside of science fiction. In 1985 an inventor named Phil Nuytten developed the Newtsuit, and they've been iterating this thing ever since, It's this huge bulbous suit with a clear fronted helmet, and it is straight up Iron Man stuff, in fact you'll hear that in the clip I'm going to play, but if you want to picture the suit it looks less like Iron Man and more like the roided out suit that Iron Man fought against at the end of the first movie, the giant one piloted by the bad guy Obadiah Stane. I had to look it up to remember and Jesus, that fucking name. These things have taken people down over 3000 feet. Nuytten passed two months ago, RIP, but I'm going to play an extended clip of him explaining the technology, mostly because I think he's a great speaker, I really love this guy's voice and his speaking style. I'll have you watch the video and everyone listening I encourage you to look this thing up.

Moving away from Atmospheric dive suits and back to what we would think of as standard diving gear today, it was back in 1878, the same year that the first trypanophobia-nightmare bug-faced atmospheric hell suit was self-destructing in France, that in London an inventor named Henry Fleuss debuted his self-contained underwater breathing apparatus. If you've ever wondered about the acronym behind scuba, now you know. This thing was pretty amazing for the time, right out the gate it offered three hours of drive time and was a closed circuit system. Unlike the standard dive gear we use to today, in which carbon dioxide is released into the water and bubbles to the surface, this was a closed circuit and all of the air was recirculated. So pure, compressed oxygen was fed to the diver and the carbon dioxide that was exhaled was "scrubbed" which is a term used to describe trapping the harmful CO<sub>2</sub> and recycling the oxygen. The way this suit worked was that a rubber mask was attached to a hose which was attached to a breathing bag, which was attached to a copper tank that supplied oxygen, and carbon dioxide was scrubbed via an incredibly high tech system: the exhaled gas was drawn through a bundle of rope yarn soaked in caustic potash. Technology! The future! This was not going to last, long-term.

However the design wouldn't improve significantly until 1945 when two Frenchmen, one of whom you will definitely recognize, modified the

original design sufficiently to make SCUBA practical for regular people. This new version was called the aqualung, looked very similar to dive suits you would see today, and was designed by Emile Gagnan and an obscure young ocean enthusiast named Jacques-Yves Cousteau. No idea what happened to that guy, a real nobody.

Sidenote, I love the internet because in my searches about diving suits I stumbled upon a site that offered a useful Q&A, the answers seemed very professional and reputable, and included this useful exchange:

“Question: Can you fart while diving?

Answer: Farting is possible while scuba diving but not advisable because: Diving wetsuits are very expensive and the explosive force of an underwater fart will rip a hole in your wetsuit. An underwater fart will shoot you up to the surface like a missile which can cause decompression sickness.”

Be careful on the Internet, kiddos.  
Check your sources.

Now obviously we need to cover submarines and submersibles, especially considering recent events, and we should probably start by explaining the difference between the two. Do you know, Duncan? A submarine is an independently operated underwater craft, it can navigate and operate independently, on the other hand a submersible has

to be tethered electronically or physically to a mothership of some type, and transported to its dive destination. For instance, as mentioned the Newtsuit or EXO suit is technically a single-occupant submersible; it is carried to its location by a vessel and maintains a connection during deployment.

So to talk about the beginning of submarines and submersibles we are going to be jumping back in the timeline, because many of these technologies were being developed simultaneously. And submersibles actually pre-date submarines, which makes sense but I hadn't really thought about it. That stupid barrel diving suit was basically an early submersible. Even a diving bell is kind of a primitive submersible.

And submersibles are vital to the story of ocean exploration; in fact, the deepest dives ever recorded— which are the deepest dives possible—have all been achieved by submersibles. That's primarily because submersibles can be an extremely simple in design; in comparison to a submarine that has to maneuver and navigate and potentially fire torpedoes and accomplish all kinds of other complex maneuvers, a submersible really only has one job: to successfully be submerged. And then I guess it has one other really important job, which is to reemerge. If not for that part, anything could be a submersible. You can submerge a cow, it is submersible,

but it's not "A" submersible, because it's not coming back up. and unfortunately some submersibles that we will discuss have been about as buoyant as cows. We mentioned challenger deep, the deepest spot in the ocean located in the Mariana trench, some 35,000 feet down; well the first vessel to reach it was a submersible called the Trieste, very similar in design to a previous Greek submersible called the Bathyscaphe which itself had set depth records. In many ways these submersibles are a contradiction; they are extremely simple—basically just thick, fully enclosed diving bells—but they are also are marvels of structural engineering with an emphasis on the structure...structural integrity to be exact. At the bottom of the Mariana trench, the pressure per square inch is almost 16,000 pounds, or 8000 tons. If you were to suddenly appear at the bottom of the trench it would be like having 50 jumbo jets stacked on your body, you would immediately jellify. Liquidate but not in a cha-ching fiscal sense. It takes about five hours to get to the bottom of the trench descending at a rate of about 3 feet per second. The floor of challenger deep consists of diatomaceous ooze, basically sludge composed primarily of microalgae. Fish can't survive at those depths, they typically can't venture below around 25,000 feet, so there's a 10,000 foot gap which is just empty nothing as far as we know, but again we've done such little exploration and been down there so

infrequently that I wouldn't be surprised if some giant neon sand worm like something from the abyss were to slither by. we just don't really know.

Now I explained the difference between a submarine and a submersible, but some of these craft that we're discussing are sort of weird hybrids and it can occasionally hard to draw a distinct line between the two. The delineation here seems to be whether the craft was primarily operated independently or whether it had to be carried by a larger mothership to its destination, but again, the lines get a little bit blurry. You might be able to make a case for this next one being a submarine, but we're going to say that the first navigable submersible was built in 1620 by Dutch Engineer Cornelius Drebbel...sounds like one of the kids from Charlie and the chocolate factory. Is that the one that got sucked up the tube or the one who watched too much TV? "Cornelius Drebbel, you come back here this instant. stop fondling the Oompa-Loompas." The submarine was steerable, made of wood covered with leather, so clearly it was a timeless design intended to last generations. No, it was rickety, but Drebbel kept improving on the design. His final version could carry 16 people and stay submerged for three hours. The Drebbel submarine would be demonstrated in front of king James and thousands of onlookers and

eventually carried the king himself under the Thames River. Gutsy king. Or maybe he bought into his own hype and believed he was divine and unsinkable. The Titanic would like a word.

The first *armed* submersible built to be used in war was the so-called turtle developed by American David Bushnell in 1775 for use in the revolutionary war against England. It should probably have been called the chestnut, it doesn't really look like a turtle at all but the hull was constructed of treated oak and the craft looks exactly like a floating chestnut if a chestnut could carry bombs and was large enough to accommodate one cramped, crouched, unhappy passenger. The turtle was 10 feet long, 6 feet tall, and 3 feet wide. It could rise and sink and move forward and backward by use of propellers operated with hand crank and pedals. This would have been a full body workout. SoulCycle eat your heart out, this thing is raw cardio. It moved very slowly and laboriously, but in an emergency the operator could dump up to 200 pounds of lead instantaneously to shoot to the surface if extra buoyancy was needed. It even had a primitive glowing dashboard; the instrument panel and all of the instruments were adorned with bioluminescent Foxfire—a glowing fungus—for a cyberpunk blacklight vibe. The turtle was surprisingly advanced for its time, implementing rudders, snorkel attachments, plus the first known use of an aquatic propeller,

and the idea was that it would approach enemy ships from below and affix mines to their hulls and then scurry away while they exploded. This never worked. I mean the turtle worked in the sense that it floated underwater and didn't sink on its own but it failed every mission. Its most notable failure was the attempted attack on the HMS eagle. "Attack" would be a charitable term. The pilot, Ezra Lee, set out with 25 minutes of air and managed to reach the ship in just under two hours, I'm assuming there were some quick trips to the surface along the way. He finally reached the Eagle and, "Once surfaced, Lee lit the fuse on the explosive and tried multiple times to stab the device into the underside of the ship. Unfortunately, after several attempts Lee was not able to pierce *Eagle's* hull and abandoned the operation as the timer on the explosive was due to go off and he feared getting caught at dawn." Experts have theorized that Lee was unable to successfully affix the bomb due to confusion as a result of carbon dioxide inhalation and fatigue. Eventually some British soldiers spotted him and rowed in his direction, and at that point Lee got frustrated enough to just release the bomb, "expecting that they would seize [it] likewise, and thus all would be blown to atoms." But the approaching soldiers surprisingly did not choose to approach and investigate the large bomb-like object floating toward them, *they* had not been inhaling carbon dioxide for the

last two hours and thus soberly and warily retreated, and the explosion only took out any unlucky fish that happened to be in the vicinity. "Lee reported that the charge drifted into the East River, where it exploded "with tremendous violence, throwing large columns of water and pieces of wood that composed it high into the air." [40] It was the first recorded use of a submarine or submersible to attack a ship; [33] however, the only records documenting it are American. British records contain no accounts of an attack by a submarine or any reports of explosions on the night of the supposed attack on *Eagle*." Some experts have questioned Lee's account and accused him of making it up, but we do know that the turtle could maneuver underwater and carry bombs, so who knows. What we know for sure is that, while the turtle never managed to blow up any ships, it did itself get blowed up while *on* a ship, in 1776 the sloop that was carrying the turtle to its dive point was sunk by gunfire in the Hudson River.

Turning to indisputable submarines, as opposed to submersible Frankenstein hybrids, well submarines had been conceptualized for generations before any were actually built. Leonardo da Vinci sketched a cigar shaped design for an underwater craft way back in 1515. Which is true for pretty much every piece of technology ever. I'm pretty sure there's an iPhone somewhere in that sketchpad. but the

first truly modern submarine was American Robert Fulton's Nautilus, built in 1800 and constructed of iron ribs sheathed in copper. No idea why he didn't go with wood and leather. Propulsion was achieved via a hand cranked screw propeller, so once again this was basically the submarine version of crossfit, but in most other ways it looked and functioned similarly to submarines you would see you today. It was over 20 feet long, and cigar shaped, although it did have one unique feature: a collapsible fan that could be raised when the Nautilus was surfaced to act as a sail. So you could sail your submarine around the ocean, seems kind of like the opposite of what a submarine is supposed to do but I guess it's nice to have the option. Feels more like a backup plan that maybe wouldn't make me feel super comfortable getting in this contraption. "This is a stealthy underwater craft that also includes a large prominent sail in case it breaks."

So we're going to end this episode by discussing the current state of affairs in ocean-exploration technology, and because humans have to ruin everything, of course I need to introduce the idea of deep-sea tourism. Although I don't really have to introduce anyone to this concept because it's been in the news nonstop ever since a five-person submersible called the Titan went boom on the 18th of June. Or sort of went boom in reverse, maybe they should have a

word for the sound of an implosion, like the opposite of boom, a moob. Boom is an onomatopoeia by the way, a word that is intended to sound like what it describes, so I don't think that works. I don't think it implosion sounds like moob.

Now I love the beginning of this New Yorker article that I linked in the transcripts. "The primary task of a submersible is to not implode." Mission not accomplished. So let's start this segment with some quick facts: the titanic sank in the north Atlantic on April 15th 1912, and rests on the ocean floor some 12,000 feet below the surface. Almost 4000 meters. The wreck was located in 1985 and is by far the most popular deep-sea shipwreck destination in the world, it spawned an entire tourist diving industry similar to what we'll discuss next time with space tourism. One of the companies built to capitalize on Titanic fever was ocean gate, founded by Stockton Rush, a very smart guy and also a massive douchebag and profiteer whose only interest in the titanic was Dollar Signs. he once told a BBC news crew "I read an article that said there are three words in the English language that are known throughout the planet. And that's 'Coca-Cola,' 'God,' and 'Titanic.' " So he was a pioneer in tragedy tourism. I struggle with this idea, that we're turning a shipwreck—a watery tomb—into a tourist destination. Hey let's go gawk at the bones of people's relatives. It's like

dachau.

Anyway, Rush cofounded ocean gate in 2009, bought a retrofitted submersible that had been built in 1973, and initially began using it to ferry tourists around mostly shallow depths.

Now submersible design is tricky. According to the New Yorker article, "Every aspect of submersible design and construction is a trade-off between strength and weight. In order for the craft to remain suspended underwater, without rising or falling, the buoyancy of each component must be offset against the others. Most deep-ocean submersibles use spherical titanium hulls and are counterbalanced in water by syntactic foam, a buoyant material made up of millions of hollow glass balls, which is attached to the external frame. But this adds bulk to the submersible. And the weight of titanium limits the practical size of the pressure hull, so that it can accommodate no more than two or three people."

Rush wanted to be able to pack the maximum number of paying passengers into the craft, and so had instead settled on a carbon fiber hull, which—for reasons that now seem obvious—had never been tried before. Now I didn't know how any of this worked but there are marine certification organizations that will classify a vessel, in other words they will inspect the vessel and determine its specific depth rating. A submersible might be classified for

only 10,000 feet, in which case it would not be able to reach the Titanic safely. Rush was reckless but he wasn't completely stupid, and he knew that his "innovative" design was not going to pass any inspections.

"Rush eventually decided that he would not attempt to have the Titanic-bound vehicle classed by a marine-certification agency such as DNV. He had no interest in welcoming into the project an external evaluator who would, as he saw it, "need to first be educated before being qualified to 'validate' any innovations."

Because of course the inspectors would simply be too stupid to understand such an ingenious design.

And he wasn't receptive to feedback even from his own colleagues and employees. When one of the safety officers working for Ocean Gate submitted a report critical of the Titan, he was promptly fired. At the time he wrote to a colleague, "I would consider myself pretty ballsy when it comes to doing things that are dangerous, but that sub is an accident waiting to happen...There's no way on earth you could have paid me to dive the thing." Of Rush, he added, "I don't want to be seen as a Tattle tale but I'm so worried he kills himself and others in the quest to boost his ego."

Yet another colleague wrote directly to Rush saying, "You are wanting to use a prototype un-classed technology in a very hostile place...As much as I

appreciate entrepreneurship and innovation, you are potentially putting an entire industry at risk."

Rush's reply? "grown tired of industry players who try to use a safety argument to stop innovation and new entrants from entering their small existing market." He understood that his approach "flies in the face of the submersible orthodoxy, but that is the nature of innovation....We have heard the baseless cries of 'you are going to kill someone' way too often. I take this as a serious personal insult."

I too hate it when people point out the literally fatal flaws in my idiotic schemes. It's very inconvenient. I wish people would stop nitpicking while I'm trying to imperil innocent passengers.

Rush continued making up excuses and spinning potential negative publicity into either a witchhunt or, bizarrely, points of pride. The fact that the second version of his submersible required a system to monitor the hull and sound an alarm in the event of danger became a boast on his website; Rush pretended that his submersible contained advanced safety features missing on other submersibles while neglecting to point out that other similar craft didn't require such an alarm because they had been extensively tested and there was practically no chance they were going to spontaneously self-destruct. It would be like if Ford started

advertising an alarm that warned you if the gas tank were about to spontaneously explode. I didn't even know this was a possibility but now it seems like something to be worried about. "Sure, other car companies have crumple zones and seat belts, but how many of our competitors will blare a siren right before the seat's eject function is triggered and the driver is hurled fifty feet into the air." Wait what?

So the Titan submersible was strategically registered and operated out of the Bahamas to avoid US regulations requiring crafts to be certified and safety tested. US law is also extremely protective of passengers on any commercial vessel, but less protective of crew, so there were technically no passengers on the titan. no one actually bought a ticket for their ride, they simply contributed money to the cause of ocean gate exploration. The ride was just a bonus. That's a hell of a bonus.

Before the Titan's maiden voyage to the titanic, more than three dozen industry experts sent a letter warning of the dangers and expressing "unanimous concern" about the safety of the vessel itself. After some disastrous trial runs full of technical difficulties, the initial launch with scrapped and it would be three years before the Titan would make the journey. When it finally started operating in 2021, passengers had to sign extensive waivers stipulating that

the craft was experimental and unclassified, and that the voyage could end in death.

However, Rush continued bragging about cutting corners and "innovating" in ways that could easily be interpreted as downgrading and flouting safety regulations.

For instance, the Titan's viewport was a 7 inch thick slab of acrylic, and did not meet suggested standards. but again Rush tried to frame this as rebellion against stodgy old losers who weren't changing with the times.

"That's another thing where I broke the rules," Rush told CBS News journalist. "According to the rules...his viewport was "not allowed."

Rush literally bragged to journalists about defying safety standards, constantly crowing about his willingness to break rules, as if the rules had been made specifically to stifle innovation and trample the little guy rather than to keep people from turning into paste. He said, "The carbon fibre and titanium? There's a rule you don't do that. Well, I did."

Perhaps Rush's most prescient quote: "[I'd] like to be remembered as an innovator. I think it was General MacArthur who said, 'You're remembered for the rules you break.'" True that. The number one rule btw, don't kill everyone on board. He definitely broke that rule.

Up until the Titan, no manned submersible had ever imploded. On the 18th of June, the Titan had been descending for an hour and 45 minutes and was approaching 3500 meters when communication abruptly ceased. Importantly, the initial reports included this little tidbit: "an implosion was heard." That's a quote. This to me is the travesty of what happened and we'll get into it, but suffice to say it was 100% known among the crew of the mothership that the submersible had imploded.

The media was transfixed, and everyone's Facebook wall immediately turned into a weird mashup of jokes, scheudensfrage, and occasional scolding. Incidentally, being a comedian is the absolute worst whenever there's some type of tragedy, because every single comic jumps in with their first knee-jerk thigh-slapper in a sad attempt to go viral and it's fucking awful. Some of these people are my friends and sometimes I hate my friends. Everyone felt justified because there were billionaires on board and I get that, but one of the people who died was a 19-year-old kid who said he was terrified to go but would do it because it was Father's Day. He brought a Rubik's cube with him, he was a nerd. I'm a comedian of course nothing is off-limits, but some jokes just don't deserve to exist. And I haven't heard a funny joke about this shit yet. I don't feel bad for the CEO. I don't

necessarily feel bad for some of the billionaires and the experts who should've known better. But for me personally, I wasn't laughing. And again, no judgment, we don't think shame, but to my comic friends, work harder, be better, all of your jokes sucked.

The real tragedy to me is that we ended up searching for this vessel for days when everyone who is intimately involved knew damn well that it had imploded. There was a media narrative that was crafted in order to result in maximum attention, one news channel had an actual countdown on screen for the nine hours of oxygen that the occupants supposedly had left. It was ghoulish.

So in the wake of the titan submersible disaster the deep sea industry is in limbo...tourism has mostly ground to a halt, maybe for the best, but this is a sad example of how one man's hubris can stifle true innovation and blow up an entire industry. Implode? Sorry, I'm terrible. Proof that I'm a hypocrite and no better than my awful friends, though I did not post a single Titan joke.

I think we might've mentioned this a while back, but if you were listening to the podcast on Spotify, you can leave a star review and you can also now leave an episode comment, so for each individual episode you can drop

us a note about what you liked or didn't like about that episode and we can publish them on the spotify episode page. Though if you write a critique we will probably not publish it not gonna lie, but we will take it to heart. We've received a bunch of these comments I think we've only read one or two so let's do a quick run through of the ones we haven't gotten to and going forward I'll try to stay up on these and acknowledge them because we do always appreciate feedback.

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