

Sawbones 237: The Bends

Published July 13^h, 2018

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Intro (Clint McElroy): *Sawbones* is a show about medical history, and nothing the hosts say should be taken as medical advice or opinion. It's for fun. Can't you just have fun for an hour and not try to diagnose your mystery boil? We think you've earned it. Just sit back, relax, and enjoy a moment of distraction from that weird growth. You're worth it.

[theme music plays]

Justin: Hello everybody, and welcome to *Sawbones*—[inhales]—a marital tour of misguided medicine. I'm your cohost, Justin McElroy.

Sydnee: And I'm Sydnee McElroy.

Justin: I had to get a breath in between the middle of the intro. That's never happened before.

Sydnee: Are you okay over there?

Justin: I—I am okay. I'm having—it's—the anxiety is bad today. I'm about to leave town for, like, two weeks. I'm feeling very, like, stressed out right now. Havin' a hard time with it.

Sydnee: Well, the second week is for our beach week.

Justin: I know. That will be nice, but I'm still feeling kind of stressed out about it.

Sydnee: I'm sorry.

Justin: It's just bein' away from home. This is where I thrive. This is where I grow. This is where the deals get done. Here, in—in the house.

Sydnee: I meant to ask you before—

Justin: *Inside* the house.

Sydnee: Right. I meant to ask you before we started recording, but did you pull up the Nest Cam of our daughter?

Justin: Yes. I got her—I got the Charlie show—or, sorry, the Cooper show is pulled up here.

Sydnee: Okay.

Justin: Uh, I'm enjoying it immensely. It's kind of a slow episode. She's... *just* sleeping, so.

Sydnee: Good.

Justin: And it's in black and white, which I—stylistically is not my favorite.

Sydnee: That's what we'd like her to do, at least for the duration of this episode.

Justin: Well, what is this episode about, Sydster?

Sydnee: Well, Justin, maybe this—maybe this will be good for your anxiety right now. Uh, usually when we cover—I feel like when we cover current events or topics that are, um, relative that are things that are happening today, it's usually bad.

Justin: Mm-hmm?

Sydnee: I don't know if that says a lot about a lot of the current events that are happening these days. [laughs quietly]

Justin: Little bit of everything, yeah.

Sydnee: But since we're talking—

Justin: Kind of a potpourri out there.

Sydnee: —since we cover a lot of misguided medicine, if we're talking about current events, then naturally it would be somewhat dis—disconcerting.

Justin: Right.

Sydnee: Well, this is a current event that I thought would lend itself to kind of a—a more positive story, a more—a more—a happier story.

Justin: Okay.

Sydnee: Um, have—did you hear about the, uh—the soccer team in Thailand that got stuck in the cave?

Justin: Well, Syd, that's—I'm assuming you're speaking rhetorically. That was a very difficult story to miss. Lotta chatter about that on the—on the web.

Sydnee: I never know. Sometimes you go Twitter dark for a while and I don't know what—

Justin: Indeed!

Sydnee: —and you don't know what's happening.

Justin: Indeed!

Sydnee: At all.

Justin: Yes, correct.

Sydnee: That is true about you periodically.

Justin: Yes, periodically yes.

Sydnee: So, as many people have heard, there was a group of 12 kids in Thailand who were—they were out with their coach exploring, like, some caves, and then the flooding happened and they got trapped in these caves. And as you already know, they're already—they're out. They've been rescued.

Justin: They're out! Yeah.

Sydnee: Yay! That's why this is a good story!

Justin: That's good.

Sydnee: But a lot of—a lot of what people started talking about as they were trying to figure out how to rescue this team was, uh, the logistics of diving and the dangers of cave diving. one of the people who went in and actually helped assist with the rescue was a doctor. Um, who happened to be—

Justin: You—are you friend?

Sydnee: No.

Justin: One of yours?

Sydnee: All doctors don't know each other.

Justin: Oh, sorry.

Sydnee: Uh, an Australian doctor who happened to be there on vacation, Dr. Richard Harris.

Justin: Oh, wow.

Sydnee: And was—and came 'cause he was also a diving expert. So—an anesthesiologist diving expert. And he went and assisted, and so—

Justin: I feel like this Australian anesthesiologist diving expert—I know everything I need to know about him. I feel like I've written his entire biography in my head. I bet he looks great. Really super handsome. Right?

Sydnee: Ye—yeah. [laughs]

Justin: Of course. I hate thi—I hate this guy! I don't care how many kids he rescued. [through laughter] I hate this guy!

Sydnee: Don't. He's a good guy.

Justin: No way! [wheezes]

Sydnee: A lot of—a lot of people worked really hard to, um, use their particular skills to get these kids out, and the coach, and it's really kind of—I mean, it's—it's a wonderful story, because, um... do you know how hard that is? I mean, I think—

I took a course in diving when I was in college, and the most diving I did was in the swimming pool. [laughs quietly] In the gym, at our college.

Justin: Yeah.

Sydnee: And—

Justin: I do remember you taking that.

Sydnee: Yes. And I found it very scary at the bottom of the pool. Uh, the—the physics and the medicine and the science that goes into this, it's really incredible. And so I thought a little bit about where diving and medicine intersect, and the history of hyperbaric medicine I thought would be a good topic for a show. Um, and relates to this—this amazing story.

Justin: Now, as much as we love science, I know that this topic, you were mentioning frustratedly last night, does cross over into... a different class of science, of physics, and you weren't necessarily thrilled about it.

Sydnee: I am a biologist. And a minor chemist. [laughs quietly] Because I have a minor in chemistry. Uh—

Justin: [laughs] [holding back laughter] She's—I mean, she's a very notable chemist. [crosstalk]—

Sydnee: I'm a major biologist and a minor chemist.

Justin: Okay.

Sydnee: Uh, I am—physics was something I took, and I did fine in, and then forgot about, because it was not my strong suit. I don't have good spatial reasoning, honey. It's just not—it's just not the way my brain works.

Justin: Okay.

Sydnee: Okay. So stuff like—

Justin: So if Sydnee gets the physics wrong, just keep your tweets to your—in your pocket.

Sydnee: —stuff like gas, like the physics of gas and stuff. The—like, the... principles of... anyway. So let's talk about diving medicine. [laughs quietly]

Justin: Yes.

Sydnee: This could also be called undersea and hyperbaric medicine, and it's basically the study of humans underwater, right?

Justin: Right.

Sydnee: All the things that happen to your body under pressure, and trying to pressurize gases to, you know, put them in your lungs so you can breathe underwater, what risks there are, how do you prevent and diagnose and treat illnesses that can occur while diving, and how your own fitness—how you can do different things to your body to try to make you a better diver. That's the whole study, and it's its own thing altogether, because it's—I mean, everything changes once you put the human body underwater.

Justin: [snorts]

Sydnee: Kind of like we talked about with space medicine. Everything changes when you put the human body in space.

Justin: Right. We weren't designed to be there, folks.

Sydnee: Well, but that—I—that's what the amazing thing—

Justin: We are—we *are* in space, we were in the ocean for long periods of time, [holding back laughter] in defiance of God the Father—

Sydnee: [laughs]

Justin: —and we all need to accept that it's a sin. There, I said it! If y'all won't! I'm in the house! I'm staying here! I'm not gonna go in space, I'm not gonna go to Barboursville, I'm not gonna go to the ocean, okay? I'm fine here!

Sydnee: Why did Barboursville get to be in the list of—

Justin: I'm just listing—

Sydnee: "—Space, the ocean, and Barboursville?"

Justin: There's many places that I cannot go right now—

Sydnee: [laughs]

Justin: —and they are all—that's all of them that are outside of the walls of this—this domicile!

Sydnee: We're gonna go to my parents and have a chill time in the pool in a little bit here.

Justin: I'm gonna—I need it.

Sydnee: Alright. A lot of—a lot of this has to do with the effects of gases under pressure, and then as they are no longer under pressure, as you leave the underwater environment. Does that make sense?

Justin: Yeah, yeah, yeah.

Sydnee: 'Cause you're under pressure, and then you have to go back up to the surface and you're not under pressure. And you have to also understand the various mixtures of gases that you could put in a tank to breathe.

Justin: Oxygen. Done. Next.

Sydnee: Not a—not pure oxygen.

Justin: [simultaneously] Got it.

Sydnee: There are problems with that that we'll get into.

Justin: Nitrogen. 80% nitrogen, 20% oxygen.

Sydnee: Sort of. 21% oxygen.

Justin: 1%—1% helium. Because once you get to the rescue, you can crack everybody up with this great voice you could do.

Sydnee: Helium's actually a really great choice. We'll talk about why.

Justin: [quietly] Yes!

Sydnee: Uh, but the mixes of gases in the tank actually are a little different than the mixture of gases in the air we breathe on the surface.

Justin: 'Cause we need—'cause we need different stuff? 'Cause we're not absorbing it through our skin.

Sydnee: Let me get—let me get through it.

Justin: [snorts]

Sydnee: Let me get there. No, but—well, no, no, that's not a—hmm, okay. [laughs] Uh, all this changes as you go up and down through the water, and especially to different depths, and—and not to belabor the point, but... do you know, with cave diving, how much more dangerous that is than open water diving?

Justin: Um... I mean, I know that cave *being* is a lot more dangerous than non-cave being? So I can kind of just, like—yeah, I can extrapolate.

Sydnee: 'Cause a lot of—with cave diving, there's no surface to go to, right?

Justin: Right, it's—yes.

Sydnee: Like, it's not like—you imagine, like, you pop up out of the water and there's the cave ceiling up above you. Like, the ceiling is in the water.

Justin: This comes up—this comes up in *Tomb Raider* a lot. You are swimming down through a chasm. You know that there's something else on the other end, because the game was made by people.

And you think, like, "Should I pop up and get some air?" But you can't, 'cause you're kind of, like, in a tunnel. So maybe you need to go—

Sydnee: Only, people do this in real life.

Justin: [clears throat] Yeah, I'm just... my experience is with *Tomb Raider*—you don't need to be crappy about it. I'm just saying that my—

Sydnee: No! I'm just saying, like, as wild as that sounds in a game, like, people do this in real life! So, like, I read you have to—if you're going cave diving, you have to conserve two thirds of your air to get back.

Justin: Oh, 'cause you use—

Sydnee: Because you'll probably breathe a little faster.

Justin: Yeah.

Sydnee: And you would use up your air faster, and you don't ever want to—if you—they say if you use up half your air on the way into the cave, then you're already dead and you don't know it.

Justin: Mm-hmm.

Sydnee: It's terrifying! Cave diving is incredibly dangerous!

Justin: Which is—which is hilarious, because it's like—

Sydnee: Is it?

Justin: —if you—no. I mean, it's—I'm saying it's hilarious because it's like, "Save two thirds of your oxygen, because you're gonna be real freaked out comin' out. And if you *don't* save two thirds, of your oxygen, you're dead." And it's like, "Well, is there anything we could do to maybe... *not* make me just burn through all the oxygen instantly? Is there anything you're gonna say that's not gonna trip me out more than I already am tripped out?"

Sydnee: I mean, don't cave dive. [laughs]

Justin: I guess, yeah.

Sydnee: It's—it's ve—I will not be doing it, and for those of you who do it, I salute you, 'cause it... would scare me. The *pool* scared me! Um, so some common illnesses with diving. Uh, just to kind of get into these before we go into the history.

The most common that most people have heard of...

[pauses]

Justin: The bends.

Sydnee: There you go, the bends. Decompression sickness. Uh, do you know what it's named for?

Justin: Uh, you asked me this while you were researching, and I said... from bending over. And you looked somewhat deflated, as though that was... the—the last thing I would've guessed.

Sydnee: Well—okay, you didn't know that—

Justin: And not, in fact, the first.

Sydnee: —[laughs quietly] you didn't know the whole thing. So, the bends—okay. This is—this is what the bends are. So, you're inhaling a mixture of gases, compressed gases, right? In the tank. Um, nitrogen is in there, and you're inhaling more of it because it's under pressure. And this is because of Boyle's law—and we'll get into who Robert Boyle was and how he came up with this, but basically, uh, the volume of gas is inversely proportional to the pressure that it's under. So more pressure, lower volume; less pressure, higher volume.

So there's nitrogen that you're inhaling, it's dissolved in your tissues, until you start coming up for air. So you start rising through the water up to less pressure, that volume of gas starts to expand, and it bubbles back into your circulation.

Justin: Okay.

Sydnee: Okay? And you can get air bubbles different places. Um, in the, I guess, best case scenario, you'd just get air bubbles in your tissues and joints and things that cause a lot of, like, pain in your knees and your hips and your shoulders, and that kind of thing.

Justin: Mm-hmm.

Sydnee: And that pain will cause you to kind of stoop over, and that's where the name "the bends" comes from, 'cause you're bent over. And it's actually named for the Grecian bend. Do you know what the Grecian bend is?

Justin: No.

Sydnee: It was a, uh—a silhouette of the female body that was popularized around 1820. You'll know what I'm talking about. It's, like, the—the female figure that's, like, kind of stooped over, and she's got the big bustle in the back so the back of, like—like her butt area—

Justin: Yeah, yeah.

Sydnee: —is kind of poked out, and she's usually carrying a teeny little umbrella or parasol in the front.

Justin: Yeah, yeah, I think—

Sydnee: And that—that curvature of the body.

Justin: Okay.

Sydnee: It was greatly exaggerated in art. Um, that is the Grecian bend, and it was named for stooped Grecian figures that were found that were beautiful for that reason.

So, most people have heard of that part of the bends, where you feel really sick and you hurt all over. You can also actually get those little bubbles of gas that can embolize or break off and kind of go in your blood vessels, and can block blood flow to different places.

Justin: Okay.

Sydnee: So this can be very serious. This can result it—

Justin: It sounds—it sounds very bad—in my layman's, uh, brain, that sounds very bad!

Sydnee: It can result in paralysis. It can result in death. It's a—it's a big deal.

Justin: Those are two of the worst things.

Sydnee: There's a wide range of—of presentations, and it can be very bad. There's also a couple other things that can happen when you're diving. You said

"Inhale all oxygen." No, you don't wanna do that. Um, it's not good to inhale too much oxygen. I mean, our air is, like, 21% oxygen. Not, like—not, like, a lot.
[laughs]

Justin: Why do we call it oxygen?

Sydnee: Well—honey, we call oxygen oxygen. We don't call air oxygen. Air is air.
[pauses]

Justin: Okay. Well, that's fine.

Sydnee: [laughs] It's mostly nitrogen.

Justin: I just feel like oxygen gets a lot of the... glory.

Sydnee: You *have* to have oxygen, 'cause if you don't have it you'll die. But if you have too much of it, you could also die.

Justin: So you want, uh, two O's and not, like, 3 O's, 'cause 3 O's might be too many.

Sydnee: Well, that was ozone. We did that last week.

Justin: Right. You don't want 3 O's, 'cause that's too many O's. You want just the right amount of O's, O₂.

Sydnee: Too much oxygen can result in—it can damage cells. You can have vision problems, lung problems—seizures are the biggest, worst presentation. Oxygen toxicity, again, could be fatal. So you have to have just the right—the inhaled gases in, like, a—in a diving tank sometimes have more oxygen in them, but you don't want too much.

Justin: Okay.

Sydnee: A little more, but not too much more.

Justin: Nice blend.

Sydnee: Um, also, the reason you don't want as much nitrogen in part is the bends that we just talked about. That's largely from nitrogen. But it's also nitrogen narcosis.

So pretty much all inert gases, all gases except for helium and possibly neon, but helium is the important one here, can make you drunk at high enough doses.

Justin: Okay?

Sydnee: Like, if you inhale them, narcosis for the narcotic effect, it makes you loopy and... you know, out of your mind?

Justin: Why am I spending all these calories on old fashions, then?

Sydnee: Yeah, you just inhale some nitrogen.

Justin: There you have it, folks.

Sydnee: There you go. Inhale enough nitrogen—

Justin: From your favorite medical podcast—

Sydnee: I mean, don't! Don't do it! [laughs]

Justin: —from podcasting's favorite doctor, Sydnee McElroy says—

Sydnee: But—but basically you inhale too much nitrogen, and you feel out of it, and that's not good, 'cause you're diving. You're underwater, and you're doing something dangerous, and—especially cave diving. You really can't be suffering from that. So that's actually why you'll see—there are different diving mixtures that have more helium in them to prevent this, because helium doesn't do this.

Justin: Okay.

Sydnee: But again, you've—you've gotta get just that right mixture of everything. There's also barotrauma, just pressure from the pressurized gases that—we know—this can happen outside of diving, too. This can happen in, like, people who are on a ventilator and that kind of thing, where you can damage lung tissue that way, either from, like, pressure, or from a vacuum applied to the lung tissue that can cause bleeding.

So there are lots of things that can happen to the human body while diving.

Justin: It sounds terrible.

Sydnee: Yes. But—but, that's why there's this whole field of science and medicine where they have sought to find ways around all these issues.

Justin: Okay.

Sydnee: Now, all of this kind of goes back—as I mentioned, I was gonna tell you a little bit about Robert Boyle. Robert Boyle was an Irish chemist, and a physicist and an inventor, and he did a lot of different experiments on gases in the 1650's and 1660's, along with Robert Hook. And a lot of what he was interested in was how gases behaved in a vacuum. This would all become very important as we sought to understand diving medicine and everything down the road.

Um, he was also—I just think this is an interesting side note. This was part of the time when—and Justin, I think you were recently reading about this—around the new philosophy of science?

Justin: Yes. Yes!

Sydnee: He was part of the new philosophy.

Justin: Okay.

Sydnee: He formed what was originally called the The Invisible College but later became known as The Royal Society. Uh, scientists who believed instead of just, um, kind of in, like, the—the tradition of Aristotle, you would argue your scientific point. Like, how does something work? You argue it, and whoever comes up with the best argument for it is right.

Justin: Right. You're really talking about this sort of transitional phase between science being an accurate recounting of the phenomenon that we can perceive in the world, and an accurate recounting of why that phenomena actually occurs.

Sydnee: And he was interested in experimenting, testing. Observing things, testing those things, and then figuring it out based on that, as opposed to just

"This sounds logical, I'll argue it. My argument makes more sense than yours. I win."

Justin: Yeah.

Sydnee: So anyway, he was part of that. And a lot of the experimentation he did was on gases, and he came out with Boyle's law, which is that the volume is inversely proportional to the pressure of a gas, and this is how you figure out how to pressurize gas in a tank and give it to divers, and all that.

Anyway, he also once threw a viper into a compression chamber and then decompressed it?

Justin: Um... why?

Sydnee: [hesitantly] I'm not sure?

Justin: [laughs]

Sydnee: But—

Justin: [coughs]

Sydnee: —he did—he did note that he saw a bubble form in the eye of the viper as he decompressed it.

Justin: [shudders]

Sydnee: It was nitrogen. It was decompression. He was witnessing decompression illness.

Justin: Yeah.

Sydnee: Don't—don't do this, please. I'm not a snake fan, but do not do this to snakes.

Justin: Yeah.

Sydnee: Um, in 1662—so this is recently after we're starting to understand compression and decompression of gases, right? Boyle has just done all these

experiments and published all this stuff. A British physician, Henshaw, tried to treat people with compressed air.

Like, "Hmm, this is interesting. Let's compress some air and put it around people." So he built something called—

Justin: That's great for getting the dust out of people, actually. [steadily getting quieter] It is fine, but just don't, uh, turn the canister upside down, because it becomes very cold. And it's very unpleasant.

[pauses]

Sydnee: [holding back laughter] What are you talking about?

Justin: Compressed air? Like, the can of—

Sydnee: Ah, ah, okay. [laughs]

Justin: —uh, compressed air.

Sydnee: Ah.

Justin: Because it's, like, in the can—

Sydnee: Yes, I gotcha.

Justin: —to use as you clean of your—your—

Sydnee: He wasn't doing that. He built the domicilium, which was a big, sealed room that was attached to some hand operated bellows.

Justin: [holding back laughter] Okay?

Sydnee: So you put people in the room and then just kind of, like, put—like, used the bellows, and either compressed the air or decompressed the air, and you would want the air pressure in the room to be higher for acute stuff and lower for chronic stuff. Then you could also just spend some time in there for your general... wellness.

Justin: Sure!

Sydnee: This is not compressed oxygen, by the way. This is, like, a precursor to hyperbaric oxygen, we'll get into.

Justin: Okay.

Sydnee: 'Cause this was just high pressure air.

Justin: Okay. Not oxygen.

Sydnee: Just oxygen.

Justin: Okay.

Sydnee: It was all air. Um, this probably was not very effective either way. It probably wasn't very dangerous either, just because—how much compression were you getting with a sealed room that had a hand operated bellows attached to it? [laughs] That you're—that you're pumping on your own. Um—

Justin: This is—basically what you're describing is the machine from the Pit of Despair, right?

Sydnee: Yeah, it kind of is.

Justin: [snorts]

Sydnee: He was—he was sucking away... one year of your life. [laughs] Uh, but no—but there wasn't really—other than this, this one physician who was like, "Huh, I wonder if all this compression stuff could be good for medicine." There wasn't really much interest in it until the 1800's.

Justin: Okay. [pauses] What happened then?

Sydnee: Well, I'm gonna tell you, Justin.

Justin: Aww, you—I walked right into that one!

Sydnee: But first, let's go to the billing department.

Justin: Let's go!

[ad break]

Justin: So, it was the 1800's and people were getting really into compressed air for some reason, Sydnee.

Sydnee: That's right. And—

Justin: I'm assuming it was for the Phantom of the Opera.

Sydnee: [laughs] No.

Justin: [wheezes] No, okay.

Sydnee: But the—and—and please know, I'm trying to cover kind of like two things at once here. I'm talking about the history of how we figured out a lot of diving medicine, and also—like, in order to figure out how to diagnose and prevent the bends and decompression sickness was the biggest thing people were trying to understand. Um, you also were trying to figure out how to treat that, and all this kind of goes hand and hand.

So I'm telling you the history of, like, this—how we figured out how gases work, and then also hyperbaric oxygen treatment for decompression sickness. It's all tied in there together. Um, if it seems wandering, that's why.

So in the 1830's, a French physician, Emil Tabouris, began treating patients using a—a hyperbaric chamber of his own device. So he made this compressed air chamber.

Justin: I'm assuming he had a big house.

Sydnee: [laughs quietly] Mainly to treat respiratory illness. That was the big use for it at the time. Like any kind of asthma, or tuberculosis, or pneumonia, or anything that's wrong with your lungs. This led to interest in France, and other French physicians building their own chambers, especially Junod who built this big, round, copper chamber that could reach much higher pressures.

Justin: Okay.

Sydnee: So he was actually, like—these early attempts maybe weren't doing too much. This was probably the first time that, like, we were probably doing something. And he noted that people who spent time in there—he thought he was increasing their well being; like, their general wellness. This is the time of, like, "I don't know, can we do something just to make us feel better all the time?" And people who spent time in this chamber would feel better, which may have actually been a little bit of that nitrogen narcosis we talked about.

Justin: They got a little bit high!

Sydnee: Yeah, they're getting a little bit high.

Justin: Alright.

Sydnee: This is also—by the way, have you heard of the rapture of the deep?

Justin: No.

Sydnee: It's what Jacques Cousteau called it.

Justin: No. I mean, I—the Bio—

Sydnee: You've heard of Jacques Cousteau.

Justin: —I—I played *Bioshock*. Which is set in Rapture, underneath the water. Is that—is that something?

Sydnee: The rapture of the deep is what Jacques Cousteau called that feeling you get when you're breathing too much nitrogen and you're underwater.

Justin: "[bad French accent] When I need to get baked..."

Sydnee: [laughs] Um... that's the same thing. Uh, in 1837, there—the contemporary of these other sci—of these other doctors, Pravas built a giant air bath that could accommodate 12 people at once, in Lyon.

Justin: Hmm!

Sydnee: So you could get 12 people compressed [through laughter] all at the same time.

Justin: Just squish 'em all together.

Sydnee: Um, and like—like a lot of new treatments that we cover, it became a cure-all for a while.

Justin: Okay, of course, yes.

Sydnee: Yes, of course. Everybody wanted to try it for everything, and—and use of these chambers were spreading all throughout Europe. So everybody was wanting to go spend time—especially for things like tuberculosis, which nobody was sure what to do with yet—spend time in one of these compressed air chambers for that, or just to make you feel better in general.

Um, there was a Dr. Fontaine who built a mobile one in 1879, that you could just, you know, take around.

Justin: I'm assuming he had a big car.

Sydnee: [laughs] To county fairs or whatever. Spend some time in the—in the compressed air chamber.

Justin: Sounds kind of like how escape rooms just started poppin' up everywhere?

Sydnee: [through laughter] Exactly! Same idea.

Justin: Just prescribin' 'em for everything.

Sydnee: Um, it could hold more people, and they even started to do surgeries inside this. Uh, they thought that the pressurized air helped, um, reduce hernias better. And—

Justin: Nope! Just got the doctors baked. Good job, everybody!

Sydnee: Um, there was even—Fontaine had plans for a 300 seat, hyperbaric surgical theater. So, like, a big, giant—like, the whole room would be... pressurized.

Justin: Yeah.

Sydnee: In addition to the operating area. Like, you could sit in your pressurized comfort.

Justin: I wanna see, uh—uh, *Wizard of Oz* in there with *Dark Side of the Moon* synced up to it—

Sydnee: [laughs]

Justin: —and then fire up the hyperbaric chamber.

Sydnee: This was—there was actually, like, some kind of injury that occurred that he—that Fontaine sustained while building this thing, which is why it was never realized, because he died before he got to see its creation, and then it never happened.

Justin: Aww.

Sydnee: Yeah. Um, but, uh—but—so they never built that, but, um, they were using these all over Europe. Now, of course in the US, we had to get in on that, right?

Justin: We need it!

Sydnee: We need it. So a Dr. Cunningham was one of the biggest, um, proponents of this kind of therapy, because he observed during the Spanish Flu epidemic that patients in higher elevations he thought fared better. And so based on that idea, he thought that hyperbaric therapy would be helpful for the Spanish Flu. So he treated all his patients with it, despite the fact that one night he—he had a bunch of patients, and he would put them in these, um, compression chambers for a long time. And one night, he had them all in a chamber, and they lost power.

[pauses]

And, uh, everybody died.

Justin: [quietly] Oh...

Sydnee: Everybody decompressed instantly.

Justin: Aww, Sydnee!

Sydnee: Yeah. But he only saw this—instead of seeing it as, like, a—a danger of this therapy—because nobody understood why this was problematic yet. But instead of seeing it as a—

Justin: Mm-hmm. They didn't understand why 12—a bunch of people died, it wasn't problematic?

Sydnee: Well, what he thought was, "Ah, my therapy was the only thing keeping them alive."

Justin: God, people... [wheeze-laughs]

Sydnee: So he went on to expand, especially once the Spanish Flu epidemic waned, he went on the treat every—I mean, like, he had to find another reason to do this. So syphilis, hypertension, diabetes, cancer, everything. In Cleveland in 1928, he built a five story, 64 foot diameter chamber. It was basically like a nice hotel.

Justin: That's so radical.

Sydnee: That was all, like, a—like, a compression chamber. Like, a compression, decompression—'cause you could do both. I'm calling it compression, but you could do both to people, depending on—there was some belief that pressurizing the air was helpful for some conditions, and then what they call rarified air or the decompressed air, lower pressures, were helpful for other illnesses.

So you could do either. But he built—it was like a giant hotel that he built!

Justin: That's awesome.

Sydnee: To just put a bunch of people in, and they could sleep there and stay there and be under pressurized air.

Justin: It might be slightly more exciting if it weren't for your previous anecdote. Like, that this—

Sydnee: Well, that is true.

Justin: —hotel had the possibility of just becoming a huge coffin at any second!

Sydnee: I guess that's fair.

Justin: [scoffs] Undeterred! This cat, huh? Just like, "One mo' 'gain! Maybe the problem was I didn't get enough people in there!"

What if this is what H. H. Holmes—what if that was his big plan—he—why did he waste so much time building a whole hotel and then serial killing a bunch of people in there? He could've wiped them all out with just one—

Sydnee: With just this—

Justin: —just pull the plug and then everybody beefs it!

Sydnee: I was reading—as I was reading this story I was like, "Please tell me this place still exists. I have to go visit this place. It's in Cleveland, we could get there—"

Justin: [strained] No, no you can't go! What?!

Sydnee: No, it's not. They tore it down. The—the AMA was always on this guy's case. They kept saying, like, "If this works, where's the evidence? Present us with the evidence. Surely you have evidence that this works."

And, I mean, he didn't. So, he was discredited in 1937. It was converted to, like, a regular hospital briefly, and then just torn down.

Justin: Oh, alright.

Sydnee: Anyway, you can't visit the Cunningham Chamber, as much as I would... very much enjoy that.

All of this comes together—not with diving, actually, but with coal mining, okay?

Justin: Okay?

Sydnee: So, uh, the Industrial Revolution brought along the demand for coal, right? 'Cause we're building a bunch of things. We need coal. We need energy. And in France, coal was found beneath a river, the Loire River. Okay?

And, uh, flooding left it hard to mine all of this coal.

Justin: Okay.

Sydnee: So we had to get people down to where this coal was, so that we could use it for energy.

So, a mining engineer, Jean Triger, developed a system of caissons.

Justin: Caisson. [quietly] What's a caisson?

Sydnee: Well, okay. I had heard of these, but I had to look at a lot of diagrams to really understand what was happening.

So, if you're going to build something, if you're gonna mine coal underwater or—this is the same thing if you're gonna build a bridge. If you're gonna build something underwater, you have to get people down under the water. You have to displace water with pressure.

Justin: Okay, right.

Sydnee: And then get people down there, right?

Justin: Right.

Sydnee: So you would lower these pressurized chambers underwater and then— or lower these chambers, and then pressurize them, and force out all the water and mud and everything, and then put people in. Look at diagrams, they're, like, big boxes.

Justin: Okay.

Sydnee: Underwater, that are pressurized.

Justin: Okay.

Sydnee: Okay? And so that's what they started using to—to mine the coal. Um, but in order to do—like, the chambers are pressurized to keep water and mud and everything out of them, and you're putting humans in them. So you're making them inhale pressurized gases, much like a diver would. Does this make sense?

Justin: Ohhh. Yes.

Sydnee: This is why all this ties together, because people would work there, and they'd be fine while they were down there working in these pressurized environments, but then when they would come back up to the surface at the end of the day of work, about 12 hours later they would all get really sick.

Justin: The bends.

Sydnee: Because they were getting the bends. And some of them even suffered from paralysis and death, and, I mean, obviously there were major problems with this. So, because so many people were getting ill, they started bringing in doctors to try to study, like, "What—what is happening here? Why—" you know, they're not—they pretty quickly realized, it's not being in the caissons. That's not the problem. It's when you come out. Something is happening to your body when you come out.

And so this physician, Paul Bert, began to study this issue, and he would eventually become—he would eventually come to be able to describe decompression sickness, what was happening in the body, and—and, you know, why this was the problem, but not quite how to fix it yet, but starting to understand what they may be able to do to fix it.

But because word spread pretty slowly back then, we didn't have the internet yet to tell us everything right away, um, we were still seeing—one of the most famous cases of this was actually the building of the Brooklyn Bridge. While the Brooklyn Bridge was under construction, uh, a lot of workers were claimed by what they began to call caissons disease.

Justin: Oh, named after—okay.

Sydnee: Yeah, because people were working down in these pressurized areas, and then—and then getting decompression sickness and dying. Um, before word spread, like, "Hey, we figured this out." And by the time it actually—the Holland Tunnel was finished, it had been started and then there was a funding problem and it was put on pause for a long time, and that was probably good, because then by the time it was restarted, uh, we understood this, and there was actually a decompression chamber on site to slowly decompress workers—

Justin: Huh, okay.

Sydnee: —so that people weren't dying from this. Um, they still had problems with it, but they were beginning to understand how to do this. Um, and as we did more projects in the future, like things where people had to be deeper and we had to have higher pressures, and we started to see that, like, "Eh, we're gonna need to—" there's not a one size fits all solution to this. That's where we see the British physician Haldane come up with tables of how—if you are under this much pressure for this much time, here's how long takes you to decompress.

These are diving tables. These are the precursors to diving tables, which is what a diver would use today. If you're going to go this deep in the water for this much time, here's how long and how slowly you need to ascend to the surface, or how long it would take you to decompress.

Justin: Okay.

Sydnee: So that you don't get decompression sickness.

Justin: Huh.

Sydnee: Because it—does—did you know that about diving? That one way you can avoid the bends is by slowly coming back to the surface?

Justin: I did actually know that.

Sydnee: Yes.

Justin: I did know that.

Sydnee: And that's how di—that's what diving tables help you to do, figure that out.

Justin: I did not know *that*, the second half of the sentence about diving tables. I always wondered about that.

Sydnee: Yeah, that's what they're all about. And these were the first ones that were made. There are different ones now that we use, and they've gotten more precise over time.

Justin: There are probably apps. I mean—

Sydnee: Oh, I'm sure there's an app—there has to be an app.

Justin: There's probably apps.

Sydnee: I'm certain there's an app. Um, so, all of this was understood for all of these—by the way, how—humans are wild. Here we are, underwater, building bridges... isn't it crazy? Let's drop these tanks and pressurize them and force all the water out and then put humans in 'em.

Justin: "We want a bridge here."

Sydnee: "We want a bridge here. We're gonna build a tunnel here. We're gonna do this."

Justin: "We're not goin' around!"

Sydnee: [laughs]

Justin: Aw, humans rule. Uh, yeah, we're awesome. Quick question about this, because I don't know that we're necessarily, um—you—what do you do—okay. So you can go up slowly, right? But, like, what if, like, there's a shark or something, whatever?

Sydnee: And you go up too fast?

Justin: Yeah.

Sydnee: So, that's where all this—this is where it all comes together. That's where hyperbaric oxygen comes in.

Justin: Okay.

Sydnee: So we had been—we had been toying around with ways to pressurize air, and could it make humans healthier, right? Well, eventually people realized that pressurizing the air wasn't as important as pressurizing the oxygen.

Applying high pressures of oxygen to humans—was there some advantage to that? And as we talked about, you had to be careful with this because of oxygen toxicity, but applying high pressured, hyperbaric oxygen to people after they—if they've come up too quickly or if they've been under great enough depths where they just—they just couldn't, um, that can actually treat decompression sickness and prevent—well, treat the bends at that point. You've already got the problem, so you're treating it.

So hyperbaric oxygen chambers are now standard at a lot of diving facilities, where if you've come up too quickly, you can go spend some time in the hyperbaric oxygen chamber—

Justin: And it'll just slowly... repressurize you, pretty much?

Sydnee: Yes. And—and prevent the nitrogen from bubbling up into your circulation.

Justin: They give you magazines?

[pauses]

Sydnee: You know what? I don't know. Probably. 'Cause you spend a while that way.

Justin: How long we talkin'? Days, minutes?

Sydnee: Not minutes, but hours.

Justin: Okay.

Sydnee: Yeah. Usually not days.

Justin: [exhales] I hope you get *some*—a TV? A Game Boy? Somethin'.

Sydnee: The tab—it used to be days that you would spend in decompression chambers and things, slowly rising your pressure. Um, and that was part of why the diving tables and all these pressurized tables changed over time was to shorten the length of time that you needed.

Justin: Mm-hmm.

Sydnee: And hyperbaric oxygen helps with that, too. But that is one of the uses of—the main use, probably, of hyperbaric oxygen today is to treat the bends, and help with that problem. And then all these other issues that we've come up with, like the nitrogen narcosis and the oxygen toxicity—a lot of this has to do with using the right blend of gases in your tank, which we are better and better at. Not that it can't still happen, but, you know, we're much better at it than we used to be.

Um, and so we've—from the 1930's on, we've found ways to address all these issues with divers, and we've just really advanced since then.

Now, in addition to using hyperbaric oxygen to treat decompression sickness, which is probably the main thing that it's used for, we can also use it for some other—like, actually we use it at our wound care center here.

Justin: Oh, really?

Sydnee: It helps with some wound healing; specifically, like, wounds from radiation or wounds from lack of blood flow or, like, diabetic foot ulcers, gangrene, for skin grafts or a skin flap. It can help with healing. Um, brain abscesses, like, different infections.

Justin: [simultaneously] And you—so you're, like, putting somebody in a chamber?

Sydnee: Mm-hmm.

Justin: Hm.

Sydnee: Carbon monoxide poisoning.

Justin: So you have one?

Sydnee: [pauses] Like, personally?

Justin: [quietly] Not *on* you.

Sydnee: Not on me. Yeah, at—at work.

Justin: [simultaneously] At the hospital?

Sydnee: Yeah.

Justin: Do they ever let doctors, like, go in there and get, like... chill?

Sydnee: No.

Justin: Just to relax a little bit?

Sydnee: No.

Justin: No?

Sydnee: No. The patients that I've had that have used it don't—they say it makes them feel very claustrophobic. They feel very trapped. They don't particularly enjoy it.

Justin: [holding back laughter] Y'all should get a bigger—[wheezes]

Sydnee: [laughs quietly] We should get a 300 seat—

Justin: Yes! Theater—

Sydnee: —or a five story high—

Justin: —and then we'll book—

Sydnee: —Cunningham chamber—

Justin: —then we'll book some shows at it.

Sydnee: So I say all this, again, to just underline that all of the Thai Navy Seals and this Dr. Harris and all the different—the—the diving instructors—all the

different people who went in to help rescue this team, I mean, are heroes! Because not only did they do it, which is incredibly dangerous—people die cave diving all the time. It's incredibly dangerous. But they also got these boys to do it!

Justin: Yeah.

Sydnee: That's ama—those—they are kids who have never—they never dove before!

Justin: And another hero is, I would say, science.

Sydnee: Well, yes.

Justin: Thanks again, science! You've saved the day once more. Thank you for always being there for us, even when... we're not there for you.

Sydnee: [laughs]

Justin: Uh, well, thank you to you, Sydnee, for that, uh, delightful discussion.

Sydnee: Well, you're welcome.

Justin: And thank you to you, the listener at home, for, uh, hanging out with us for another program. I—and as long as we've got gratitude here—

Sydnee: Wait. Can I thank all those amazing rescuers?

Justin: I thought you did!

Sydnee: Oh. Well, I didn't know if I actually said "Thank you."

Justin: Alright, Sydnee. Thank them.

Sydnee: Thank you. And I didn't name—and Saman Gunan was the Thai Navy Seal who died while he was helping to rescue the boys.

Justin: Oh.

Sydnee: We should remember our heroes, both living and passed.

Justin: Absolutely, Sydnee. Uh, I want to say, while we're saying thank you to folks, uh—and this is not as kind as it was for people to send things to our PO Box. Not quite on the level with, uh, giving your life to rescue Thai children, but still, very nice.

Brook sent us a purse, Sarah a blanket. Amy sent a lovely cross stitch, and Brad sent a big 20 dice roller, so thank you to all of you for those kind gifts.

That was an awkward transition but, uh, there was nothing to be done for it, I think.

Sydnee: [laughs quietly]

Justin: Uh, thank you to The Taxpayers for the use of their song "medicines" as the intro and outro of our program, and thank you to you at home for, uh, listening, of course. Uh, we sure appreciate it.

Hey, if you got a second... uh, do two things. One: go to bit.ly/thesawbonesbook and check out art from our forthcoming book that comes out October 9th from Weldon Owen. Uh, we wrote a whole book, and you can preorder it there, see some art that Teylor Smirl, Sydnee's sister and the illustrator of the book did, and preorder it, and we really appreciate you doin' that.

Um, and if you could also go to the iTunes store and give us a review, we would very much appreciate that, too. So we know that's two favors, but if you could do one or both, uh, it would just—it would just be the tops.

[theme music begins in the background]

So thank you so much. And, uh, that's gonna do it for us for this week, so—I am Justin McElroy.

Sydnee: I'm Sydnee McElroy.

Justin: And, as always, don't drill a hole in your head!

[theme music plays]

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