

Opening Interview

Challenging Toward Private Deep Sea Explorations



*Patrick Lahey: President, Triton Submarines LLC (Left)
Triton Submarines LLC is a Florida-based company that designs and manufactures private submersibles for research, filming, deep-ocean exploration, and the luxury yachting and tourism sector. Mr. Lahey, president of Triton Submarines, co-founded the company in 2007.*

*Interviewers
Ken Takai: Director, Japan Agency for Marine-Earth Science and Technology (JAMSTEC)
Super-cutting-edge Grand and Advanced Research (SUGAR) Program (Right Top)
Afsushi Sunami: President, The Sasakawa Peace Foundation (Right Bottom)*

Interviewer: Afsushi Sunami

— Thank you very much for joining us, Patrick. I would like to hear how you generate excitement by exploring the deep oceans and leading that excitement to innovations, and how you encourage more young people to start their own business. In Japan, we see some startups similar to Triton Submarines in the area of space exploration. Personally, I want to see more startup activities in the area of oceans. So, I would like you to tell Japanese readers: What really motivates you, and what's so exciting about challenging the deep oceans?

Interviewer: Ken Takai

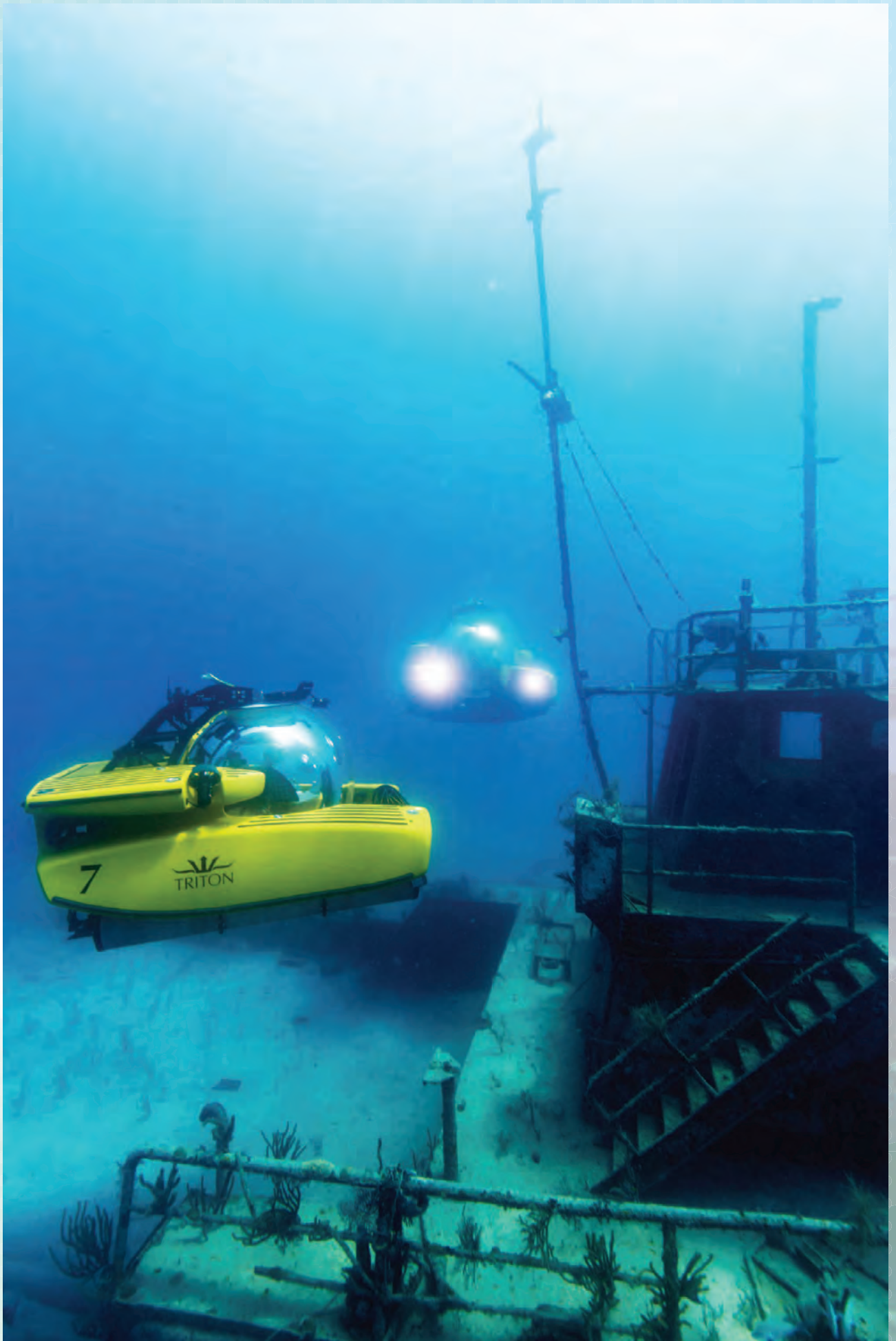
— I visited Triton Submarines two years ago. While I didn't have a chance to see Patrick at that time, I had experienced a Triton submersible in the Bahamas at the time. I am a microbiologist of microbes living in deep sea such as hydrothermal vents and trenches. So, I am impressed by the recent progress of Triton. Last year, your submersible, *Limiting Factor*, succeeded in diving 5 ocean's deepest points for the first time

in the world. I'm excited to talk with you today.

Patrick Lahey

First of all, I want to thank you very much for allowing me to participate in the opening interview of your White Paper. I would like to start out by saying I am a staunch advocate and passionate lover of the ocean and I have been since I was a small kid. I happen to build these great machines that people like yourselves can use to explore our oceans. I'm a submarine builder. However, I'm not a scientist. I'm not an engineer. Yet, I believe that humanoccupied vehicles, which allow people like Dr. Sunami and Dr. Takai to explore the ocean and to see things in real time, are an important tool for creating advocacy.

One of the things you mentioned is how we create excitement and engagement in our oceans. A big part of that comes from creating documentaries, capturing video footage, and telling stories about the ocean that we can share together with those who are not fortunate enough to be able to dive in a Triton submersible. I think those stories have a great way of creating





advocacy and engagement, thereby encouraging people to take an interest in our ocean. So, if you want to create an environment where young people are going to be encouraged to consider an oceanic career, whether as an engineer or a scientist or an explorer, the best way to do that is to create compelling content about why the ocean is so important to us. We know this because we live and work in the ocean community, and understand the ocean is the life support system of our planet and we depend on it, perhaps in Japan even more so than other places because you are an island nation, surrounded by ocean.

My favorite subject in the world is the ocean, and anytime I can talk to people who share that passion and that love, I'm eager to be part of it!

Sunami

— Thank you very much. First, can you tell us about the history behind Triton Submarines?

Lahey

We started the company in 2007, and the first submersibles we built were two-person vehicles that could dive to 300 meters. We have been growing ever since and building submersibles for scientists and explorers as well as for people to use recreationally. During that time, we've really made some important improvements. We live in a very exciting time with advances in materials technology, electronics, batteries or power systems and software analytic tools. We are now able to produce submersibles that can do things that we couldn't have imagined even five years ago, let alone 10 or 20 years ago.

I started commercial diving when I was 18, then began working as a submersible pilot at the age 21. I was really disappointed to see submersibles disappear from the oil and gas industry. They were entirely replaced by remotely operated vehicles in the 1980's. As I mentioned before, I feel strongly that a human presence at the site is essential. Our ability to see things and take in information with our own senses in real time is

very powerful and an important part of any toolbox for the ocean. When we started, our intention was to build submersibles that we would put on private yachts. I used to go to yacht shows, trying to promote the idea that yachts are a great platform for submersibles. Yacht owners are people that, by and large, have an interest in the ocean. In many cases they are already divers and they have the financial wherewithal and support system for them. We felt that there was a natural fit between yachts, yacht owners, and submersibles.

The first two we delivered were intended for pure recreation but even they ended up being used for a scientific research platform. In 2011, we built our first 1,000-meter, three-person submersible with an acrylic sphere. At the time it was the largest and thickest acrylic sphere ever built. That submersible ended up in the hands of none other than Mr. Ray Dalio of Dalio



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Foundation. As those of you who have been following what's happening in the ocean may know Mr. Dalio recently started a program called OceanX as a counter to SpaceX, whose goal is to enable commercial space transportation. It's a very important and very bold initiative, and we're incredibly proud to be a part of it. Most recently in 2019, we delivered our second submersible to OceanX. They launched a new vessel called the 'OceanXplorer' in late 2020. I describe this vessel as a kind of USS Enterprise¹ for the ocean. It's the most advanced and capable ocean exploration platform that's ever been conceived and I really feel strongly that they're going to capture the kind of content that I mentioned before, which is so important to creating excitement and engagement in our oceans. Even though we started out building submersibles for recreation for use on yachts, very quickly our clientele

realized that they could be used for lots of other things, one of which was filming documentaries. In fact, our very first expedition was in Japan. We supported Mr. Dalio on a vessel called the Alucia, his first ship, where we filmed a documentary in the Sagami Bay with NHK and JAMSTEC. It was a fantastic project. We put our submersible down and filmed all kinds of deep-sea sharks. And it was followed up very quickly by another documentary with Discovery channel and NHK. We went to Chichijima, in the Bonin Islands, and we were able to not only capture footage of the giant squid in its natural habitat for the first time in history, but we filmed it for nearly 30 minutes from 680 meters to 930 meters.

Dr. Kubodera of the National Museum of Nature and Science in Tokyo, whom I'm sure many of you know, was one of the scientists on site. Dr. Kubodera has been studying the giant squid for his entire life but had never seen this magnificent creature in its natural habitat. During his dive, he came face to face with the animal that he had devoted his life to studying. It was such a powerful and emotional moment that he wept. And you can't duplicate that profound experience with an unmanned system. I'm not suggesting ROVs or AUVs are unimportant. Of course, they are critical tools in the toolbox, but human-occupied vehicles have a way of connecting us viscerally with the ocean and creating powerful emotions and memorable moments. When they are shared with the rest of the human family,



¹ The name of a fictional spacecraft in the Star Trek science fiction franchise.

they can and do create excitement and advocacy and encourage others to take an interest in and protect the most precious place on Earth. I go back to being a kid; I remember vividly watching Jacques Cousteau² on weekends and being glued to the television set. We need that kind of engagement today. Storytelling will create a generation of people who love the ocean like we do, and they may want to be part of or consider professions related to it.

As Triton grew, we started getting client requests for bigger, deeper diving and more capable submersibles. Triton spent five years developing the world's first DNV GL-certified, full-ocean-depth³ submersibles. This is a craft that makes it possible to dive every day to the deepest and the most remote parts of the ocean. It was like unlocking a door. As many of you are scientists, you understand what this means. You can get in the Triton 36000/2 or Limiting Factor, and physically go anywhere in the oceans. I'm sure most people intuitively understand the impact of studying the ocean by seeing it with your own eyes, rather than just relying on images from an AUV or an ROV.

Sunami

— I can imagine the excitement you feel when you see the real giant squid you have been studying all your life but have never seen in real time, and that kind of excitement really motivates a young scientist to get into the ocean field. Triton keeps challenging the impossible. What really makes your



company different from others?

Lahey

I would say the thing that makes Triton different is the remarkable people who work at the company and the experience they have. Many of the people at Triton are like me. Many of us have worked our whole lives in the ocean for example. I started working as a commercial diver and then progressed into working with subs. These projects have allowed me to learn quite a bit. Many of our employees have had similar experiences. Triton is fortunate to have a group of fantastically interesting people working at the company. We have very experienced hands-on people, who have been building and working with equipment that goes into the ocean for many decades, and we also have young brilliant engineers and designers who are creative, technically savvy, and made it possible for a Triton to incorporate the latest in technology and the most advanced ideas into our products. When you start infusing these elements together, you get something magical, that's Triton.

Our products are capable. You want to get into a craft that's safe, and you can dive in with confidence, and know is going to be simple to operate, easy to maintain and reliable. But you also want to be in the submersible that is fun and exciting and features capabilities that allow you to do things that we couldn't even imagine 20 or 30 years ago: the sonar systems that we have available to us, camera systems, lighting systems, battery systems, and our ability to produce acrylic spheres, for example. Virtually all our subs, except the Limiting Factor, which has a titanium hull with acrylic windows, use transparent pressure hulls. And there's something incredible about being in a submersible with a completely transparent pressure hull. You're not looking out through a little window. You're sitting inside of a completely transparent sphere, which is made of material that has the same refractive index as water. When you submerge it feels as though the hull vanishes. You suddenly feel immersed in this environment. You could reach out and touch the

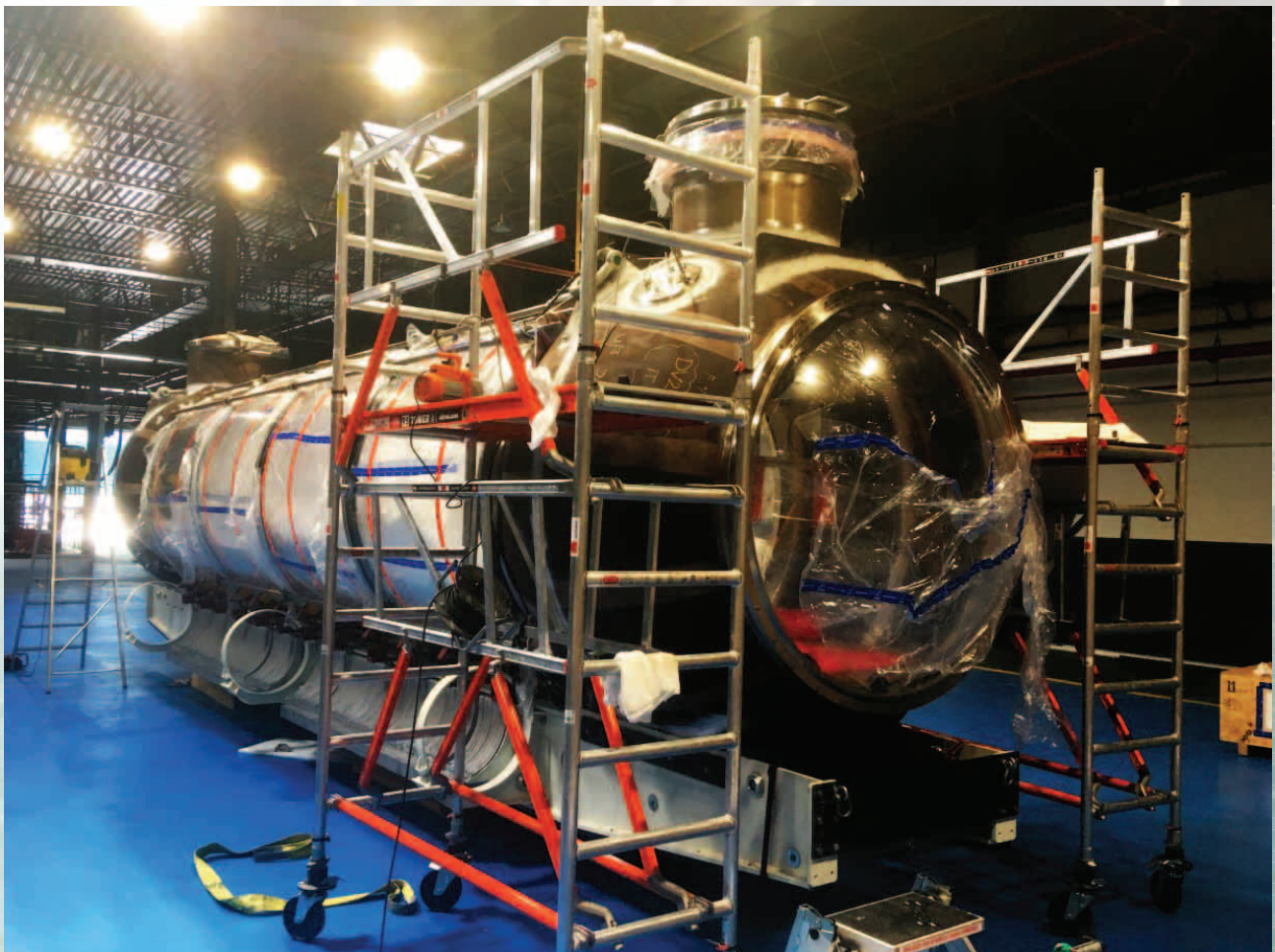
² A French oceanographer, author, and filmmaker, who studied marine life. He directed a documentary film about the deep ocean, *The Silent World*.

³ Standard for diving to the Challenger Deep in the Mariana Trench, the deepest spot in the ocean.

animals or they could swim into the cabin with you. You're able to see it with a clarity and an openness that wouldn't be possible through traditionally configured submersibles.

I would point to advances in materials technology, manufacturing techniques that allow us to produce these big transparent acrylic spheres that can go deeper and carry more people. We just launched a submersible that will carry six people to 1,000 meters while they enjoy the view from inside a sphere that is 205 millimeters thick, 2.55 meters in diameter. We couldn't have even done that three years ago. So that's exciting and is at least partially what's driving the innovation.

Of course, these achievements or innovations by Triton are funded by our clients and their insatiable appetite for ever more interesting products. We love the challenge. Because at the end of the day, Triton is a design and engineering company. If you come to us and say you want a submersible that can carry this many people and go to a particular depth, we come back to you with an idea and present a design. The Triton 36000/2, our Full Ocean Depth submersible is an excellent, recent example of this relationship. The client wanted to make these dives to the deepest point of each of the five oceans. He came to us. We created a design, built the vehicle, which allowed him to prosecute his wildly ambitious and unprecedented global expedition⁴. We



⁴ The Five Deeps Expedition, <https://fivedeeps.com/>

were so fortunate to find an individual who was willing to fund such an audacious program, because that gave Triton the opportunity to pioneer a revolutionary new craft. It came from our client's willingness to fund and our desire to create something remarkable, new, something which had never been done before.

Takai

— We, JAMSTEC, have been interested in Triton. We could be one of your customers. I think a transparent cockpit, which enable observers inside the submersible to secure full vision, is a transformative concept. The traditional submersibles, such as Japan's Shinkai and US's Alvin, have just a small window for scientists to look out of to observe the ocean, and we have been always frustrated. Triton's full vision submersibles has opened a new world for ocean observation. I see Triton builds submersibles for recreation. I think recreational submersibles are an audacious concept and I like it very much. If I were a rich man, I would want to buy one of your submersibles. You said Triton started as a company to build recreational submersibles. I think just 500 to 600 meters diving depth is enough for recreational submersibles. But Triton tries to build submersibles capable of diving deeper and deeper. What motivates you to develop such submersibles with deeper diving capability?

Lahey

First of all, let me just say that I have visited the JAMSTEC facility. It is one of the most impressive ocean facilities in the world. I was blown away by the capability of ships and submersibles of JAMSTEC and their obvious passion for the ocean. I had many fantastically interesting exchanges with the people at JAMSTEC. We have wanted to build a submersible for you for many years. I hope one day we will get that opportunity.

To your question: "Why go deeper?" I will simply say: curiosity. As a diver you always want to go deeper. You



want to see what's beyond your physical reach. So, to us, 1,000 meters seems like a good starting point. 1,000 meters is a deep dive, but it's not deep by comparison to the ocean, which has an average depth of 4,000 meters. With a 1,000 meters diving depth submersible, you're really limited to just exploring near coastal areas only, which are fantastically interesting. But I think what drives us to want to build deeper diving subs can be summed up by one thing, curiosity, and interest in seeing what's beyond where we could traditionally reach as a normally equipped diver. We started at 300 meters and went to 1,000 meters. We then built a full-oceandepth- capable sub, and now we're building a transparent pressure hull that can dive 2,300 meters. Better than that, we now have a design called Triton 13000/2 Titanic Explorer. It'll dive to around 4,000 meters in a transparent pressure hull for two people. That idea originated from a dive I made with James Cameron back in 2003 in the Bahamas. I took Jim on a dive, and we were in one of the deep submersibles, which were limited to 1,000 meters. I remember James Cameron saying to me, "Can you imagine if we could dive to the Titanic in this thing?" Here it is. 17 years later, Triton can build you a submersible that will allow people to visit as deep sites as 4,000 meters in a completely transparent pressure hull that is going to be over 400 millimeters in thickness. We're so excited that these advances in materials technology allow us to continue to push the envelope. We're not stopping there.



Toward Private Deep Sea Explorations *challenging*

You happened to meet a wealthy customer and that kick-started your company. I can imagine that finding such a customer who was willing to go with it was the toughest thing.

Lahey

It was absolutely the difficult part. I will tell you, for more than 10 years, we lived on a steady diet of disappointment because we could never get anybody to take us seriously. We would be dismissed at boat shows as lunatics. I think people would walk by and sort of chuckle under their breath thinking, “Look at these guys. They want to build a submarine and put it on a yacht. What a dumb idea.” But it wasn't a dumb idea, it was an inspired idea. But you hit on exactly the challenge, which is one of perception. It took a very special client willing to take a chance on us not being crazy and gave us an opportunity to build very first Triton in 2006. The gentleman's name was Mr. Chris Cline⁶. Mr. Cline, who I will always feel a deep debt of gratitude toward, was the one who gave us a chance to demonstrate that a submersible on a yacht was a brilliant idea. This really started the conversation and made people look at it differently and take it more seriously. It was thanks to Mr. Cline. It required a person with a pioneering spirit, who was willing to break with the pack and try something different. That's how innovation happens. A client's willingness to fund an audacious project allowed Triton to develop and innovate a submersible that allows us now to visit the deepest and most remote parts of our ocean. It originates from clients' request because they are prepared to take a chance and do things differently. It was very difficult to endure those 10 or 12 years of not being able to get people to take us seriously. What's interesting is, in the last five years, the conversation has changed, and people started to be very excited about it. Largely this is due to the experiences people are having in the projects like the giant squid, deep-sea sharks, and the Blue Planet series. When people start seeing submersibles with people in them enjoying these rich and fascinating experiences and having

We have plans to build this transparent pressure hull that will dive to 6,000 meters and eventually to full ocean depth. However, but we won't be able to use acrylic anymore. We're going to use glass. Now when we first presented this to the people in JAMSTEC, I know they probably thought we were crazy. When people think about glass, you tend to think about glass shattering on the kitchen floor, but glass is a remarkable material. I remember in your warehouse at JAMSTEC, looking in and seeing all those glass instrument housings. The floats rated “Full Ocean Depth” were made of glass. Glass is a material with strength characteristics to take us to any depth in the ocean. We're working together with a partner that specializes in high pressure glass. We've developed batteries connectors, lighting and camera systems, communication systems, and navigation systems, and all we need now is a transparent pressure hull. And then our goal will be fulfilled.

Sunami

— I would like you to talk about Triton from a perspective of an entrepreneur. I really want to see many startup companies in the field of oceans. I hope your story will encourage young scientists and make them think it could be possible for them to do the same. You said that at first, you went to yacht events to promote your ideas and tried to find the first customer who would fund your projects.

⁶ Chris Cline: an American billionaire and philanthropist. He died in a helicopter crash in Bahamas on July 4, 2019.