If you think about the ocean and the creatures living in it, the mental picture you might get is of an undersea zoo with fish and crustaceans and squid and whales and tiny little wriggling shrimp. They're the creatures who come up close to the water's surface where sunlight can get in. But how about the animals living in the lower depths, down in the darkness? Those regions make up the vast bulk of the ocean. And because it's so dark and hard to get to, we know so very little about what's going on down there. Dr Edith Whitter says that the open ocean is a fantastically strange and wonderful place. Edith is a marine biologist. As a young woman, she experienced a spell of temporary blindness. And after she regained her sight, she was driven towards the light, to the science of bioluminescence, the spectacular light displays made by creatures in the dark regions of the oceans. Edith has visited these places in pressurized underwater suits and in submersibles, and she's seen amazing things. A jellyfish that generates spinning pinwheels of light, a fish with headlights like a car, and others that are lit up like Christmas trees. And as a scientist, she had to know, why? Why is there so much light down there in the dark? Edith's wonderful memoir is called Below the Edge of Darkness, and I'm speaking to her while she's in her home in Florida in the United States. Hi Edith. Hi. Your first experience in seeing this wonderful underwater world was when you were lowered down into the lower depths in a submersible suit called a wasp suit. Edith, what do you see when you're being lowered down into those dark waters? Well out in the open ocean environment, away from the bottom and shore, it's a very strange world. You know, the first thing you notice when you go through the interface between air and water is an abrupt change of color. Suddenly all the oranges and the reds and the yellows fade away, and pretty quickly all you're seeing is blue-green and then just blue light. And then as you continue on down, it starts becoming too dim to even see the color anymore. It becomes kind of charcoal gray, and eventually the light from sunlight disappears, but you start seeing flashes of living light from bioluminescence. And that was just the most spectacular light show I had ever seen. It was like Van Gogh's Starry Night, except you know all of these stars were swirling around me. I've had a lot of people describe the experiences being like the Fourth of July. You see fireworks all around you, but it's not the same because with a fireworks display, you're observing it from a distance. But in this case, you're part of the display. You're right in the center of it, and every movement is causing all of these flashes and glows and sparkly eruptions that are all around vou. The creatures that are giving off light down there, is that just some of them, a few of the creatures, or many of them, or most of them? Well actually it turns out it's most of them, most of the shrimp, the fish, the squid. It's the rule rather than the exception. On average about 75%, but there are places where it's as much as 90% of the animals make light. When you turn on the lights in the wasp or a submersible when you're seeing that sparkly display all around you, most of the time you don't see what's making the light because it's either too transparent or too small to be detected by eye. So there's all this other much smaller stuff that's making light as well. How strange does that feel? Like you're describing it as being like fireworks, but also it's like fireworks in space that are happening all around you. Does it feel like otherworldly? It's very otherworldly. In fact, James Cameron is drawing on that for a lot of avatar. It's that otherworld experience that we can best relate to because it is our planet, but it's one that very few people have had the opportunity to explore. And the thing that's really stunning about it is if you understand that what you're seeing is life, and it takes a lot of energy for that life to produce light. And so that was what I was struck

by on that first dive. This much energy had to be really, really important. And I just wanted to understand more about why it was so important that so many animals in the ocean make light. I suppose that's a question of perspective, isn't it? Because it's very human to imagine that this is all for your benefit, isn't it? When you're down there and seeing all this light being given off, but of course, it's not all about you and what you want to see. There must be a real need for this because it doesn't cost them energy-wise to give off this light. It costs them a lot. Yeah, we're looking at billions of photons per second being emitted by these creatures. It's astonishing amount of energy and clearly has to be playing a critical role in their survival or they wouldn't be doing it. The light that they give off, it's blue. Is it a warm light or a cool light? Oh, it's definitely cold light. If you've ever held a firefly, that's kind of its magic. You can hold the firefly in your hand and realize that there's no heat associated with that light. Most of it in the open ocean environment is blue, but not universally. It actually comes in all colors, red, orange, yellow, green, blue, and violet. Most of it is blue because that's the color that travels furthest through water. And so animals have evolved the wavelength or the color that is the best means of communication. So most animals produce blue light and most animals only see blue light. But there are very interesting exceptions. There's a deep-sea fish called the stoplight fish that not only has blue light organs that it can use as headlights, but it's got red ones too. And it can see its own red light because it can see both blue light and red light, which is very unusual. But that means that it can use its red light like a sniper scope to be able to sneak up on other animals that are blind to that red light and it can see them, but they can't see it. How do they make the light? What do we know about the chemistry of that and how it works within their bodies, Edith? Well, that's one of the fascinating things about bioluminescence. The enzyme is called luciferase and the substrate luciferin. Those are just generic terms for any enzyme or any substrate that produces living light. And they are very different in different animals. So we've harvested these different types of chemistries and harnessed them for our own use. The most famous of all of these is from a jellyfish and it's a molecule called green fluorescent protein. And its discovery and application has been equated to the invention of the microscope in terms of the impact it's had on advancing understanding of cell biology because it turned on a light inside cells and let us know whenever DNA was being activated in a particular cell. Edith, given that it costs these creatures so much to produce this light, that seems to sit against their need to hide in the dark. I mean, they're living down there because they want to hide in the dark. So if they're hiding in the dark, why are they putting on these lights? What are the main reasons why these creatures of the dark are making their own lights? So that was obviously my guestion when I was seeing all that light being made. But part of that confusion came from the fact that I didn't realize how much of that light I was stimulating by being there. So with wasp, the suit is on an umbilical cord. So I was sort of like a tea bag on a string bouncing up and down in the ocean, you know, attached to the ship at the surface that was bouncing up and down on the waves. And the first time I dove, the single person submersible deep rover, which is untethered, I went down into the deep waters and leveled out the sub and just went dead in the water, completely neutral buoyancy. And I was intending to sit there and count the number of spontaneous flashes per second or per minute. And I sat and I waited and I waited and I waited and there was nothing. But if I bumped the thrusters or moved in the slightest bit, there was explosions of light all around me. And I suddenly realized that this is a minefield that these animals have to negotiate all the time. There's all of this light poised to go off if you bump into it. But it

doesn't get used except very conservatively, which made more sense from the energetic standpoint. So the analogy I give in the book is imagine you're in a big football stadium enclosed, and it's pitch black. And there's nice juicy apples hanging from strings that can help you survive. If you can just find them, the trouble is when you start moving around, you realize also dangling from strings everywhere are these little LED lights that light up on contact. The other problem is in that same football stadium is a panther as hungry as you are. And the first time you move and trigger one of those lights, its head is going to snap around and lock onto you and you're dead. And so these animals have to figure out how to survive under those conditions. So basically what most of them are using their light for is either to find food, to attract mates, or to ward off predators in some ways. So tell me how some of the shrimp down there use bioluminescence for defense? There's shrimp that do it, there's squid that do it, there's even a few fish that can do it, and there's jellyfish that can squirt out their luminescence. Into the water, into the face of an attacking predator, temporarily blinding it while they make an escape into the darkness. It's like ink or something, is it? It's liquid light, it's brilliant. I think one of the weirdest creatures you mentioned in your book is the cockeyed squid. Tell me what that is and how it looks at the world and how it uses its own lighting system. So it's called the cockeyed squid because its eyes are different sizes and it has one large eye that looks up and one very small eye that looks down which seems to make no sense because you need a large eye to collect more light and there's, you'd think it would be the other way around. But the large eye is looking up against a charcoal gray background trying to pick out a very small silhouette against that background that tells it that there's food up there. And the small eye is looking down into the blackness but surrounding that small eye are light organs called photophores that are like headlights that allow it to see things like prey items that come close to it. So you have to understand the visual environment that these animals are occupying to have a better understanding of how their their eyes and their light producing capabilities work to their benefit. Edith, you say that every night in the ocean, the world's biggest migration takes place. What is that migration? Well as evolution developed more and more predators that could swim fast and see at a distance, prey either had to be able to out swim than predators or find some place to hide but there's no trees or bushes to hide behind in the open ocean. So they were forced into the dark depths but there's no food down there. So they have to come up into the food rich surface waters where photosynthesis occurs but they do it under cover of darkness. So every day the most massive animal migration pattern on the planet occurs in the ocean as animals dive into the depths of the ocean at sunrise to avoid being visible in the light and then at night they come up to the surface in order to feed. They live most of their lives below the edge of darkness and they've evolved all of this light producing capability to allow them to survive in darkness. I think the lower depth fish that most of us are familiar with is the angler fish which is a particularly fabulously monstrous looking fish with that giant overhanging light bulb. Now is it just for finding food that light bulb that hangs over the front of the angler fish? Yeah it's meant to attract food but it can also be used to attract a mate. So those scary looking angler fish that you're most familiar with are females and the males in the angler fish world are what are known as dwarf males and they have no actual visible means of self support. They have no lure for attracting food, no teeth for clamping on to anything that came near them. Their only hope for existence on the planet is as a jiggaloo. They've got to find themselves a bathe and they've got a latch on for life. So what do they do? They go around looking for one of these

big scary female angler fish with the light bulbs, these little dwarf males. What do they do when they find one? Well they're very cautious about the way they approach her and if they make a mistake

it could end badly but they usually attach themselves to her flank and his flesh fuses with her flesh. Her bloodstream goes into his body and he becomes nothing more than a little sperm sack. Wow dear, dear. That's a very very strange example of gender relations I think. I'm not sure how much we want to learn from that as an example Edith. So all that's all he brings to the party here is his little tiny deposit of sperm as he latches on to the female in this case. It's sperm on demand, that's it. You said that it's not just a way of looking for food though, that lamp light. It's also a lure. How does that work? Well that particular lure is unusual in that the fish doesn't produce its own luminescence, it uses bioluminescent bacteria and so the end of the lure has a specially designed or evolved compartment that the bacteria grow in so it's a symbiotic relationship and the interesting thing about bacteria is they glow instead of flash and glowing things tend to be attractive in the ocean. Most of the food that makes its way into the deep sea is stuff that falls down from above and a lot of that stuff is fecal pellets, fish poop. That's a major major form of sustenance for many animals in the deep sea and interestingly a lot of fecal pellets glow because they have bioluminescent bacteria on them and that has a selective advantage for the bacteria because if they get pooped out and just fall to the bottom of the ocean there's not much food down there but if they glow then they get consumed by another fish and are reintroduced into the food-rich environment of that fish's gut and then get pooped out and consumed again and again and again and it keeps the bacteria up in the water column so the lure of the anglerfish looks like a very common source of food in the deep sea which is glowing fish poop. So the use of light is really complicated then. Light is used for all kinds of different things. It's almost like an economy of light that operates down there. Yeah it's enormously complicated and I don't think we've even begun to tap into the level of complexity that's possible. Tell me about a fish called the Viperfish that you've encountered, Edith. I love Viperfish. They're just such cool-looking animals and they're kind of the Christmas tree of fish because they've got light organs all over them so it's called a Viperfish because it's got these super long fangs that if they actually closed inside the mouth of the fish it would impale its own brain and instead they slide in grooves on the outside of the head and if it closes its mouth the ends of the teeth would actually extend above the eye and it's got a modified fin ray that comes out of its back and arches in front of the toothy jaw and at the end of that is a light organ this one not with bacteria it produces its own bioluminescent chemicals so that's used as a lure then it's got these beautiful jewel like light organs that adorn its belly

and that's actually a pretty common trick amongst fish and squid and shrimp. They produce light from

their bellies that exactly matches the color and the intensity of downwelling sunlight in the ocean and it allows them to just eliminate their shadow that silhouette that is the most common search image of most predators that are generally swimming around looking up for any kind of shadow

that would indicate there's food up there they just eliminate their shadow completely.

Are you saying Edith that these fish these Viperfish are able to generate

just the perfect amount of light very just like the tiniest glow if need be

to counteract the effect of their black shadow against a very dark gray background

for predators that are looking from the bottom up towards the surface is that what you're saying they're able to calibrate it to that degree. Exactly right and if a cloud goes over the sun and dims the sunlight then they dim their bioluminescence it's an amazing trick. Is this why fish are thin rather than fat most of the time?

That is exactly right that shape is not for hydrodynamic reasons if you want to be fast swimmer you're big and round like a shark or a tuna that flat form is meant to make you harder for to see from below and the silver sides achieve the same thing but a lot a lot of animals take it one step further and produce light from their bellies that is a perfect color match a perfect intensity match it's a perfect match for the angular distribution of the light so a lot of these light organs have lenses over them that make sure that the light kind of splays out and just the right pattern it's a perfect perfect match it's the ultimate cloaking device.

Good God that's the genius of natural selection for you that's amazing. It is and the Viperfish has even more light organs it's got a flashlight under each eye it's got a mucous layer that covers the back and the belly and it can flash an outline of its body for reasons unknown.

It's got light in every single one of its scales that it can flash and it's got light organs even in its mouth and I've seen those flash and they can make the teeth look like they're flashing sometimes

it's it's just incredible and we you know we can guess at some of it but but most of it we have no clue what it's using all these different light organs for. It has all these adaptable lights correct let it live in the dark it's fascinating paradox I suppose that's the heart of what you do Edith is trying to figure that out. It is and I love it it's a fabulous mystery. Jellyfish you mentioned jellyfish there tell me how they use their lights for defense. Well that's the intriguing thing about jellyfish because they have some very elaborate flash patterns and they you know they don't have eyes so it's clearly directed probably at predators jellyfish even one jellyfish can have multiple different types of displays depending on the type of stimulus it receives so one of my favorite jellyfish is the Etola which looks like a bright red flower with tentacles streaming out of it and if you just touch it gently it can squirt luminescence off one of the flaps that that are called lapids. If you poke the bell it'll just give you kind of a localized flash but if you grab it like a fish was grabbing it and it was at risk of being consumed it produces a pinwheel of light that swirls around and around and is bright and can be seen from a very long distance off and that's what's known as a bioluminescent burglar alarm it's just like on your car with the blinking lights and flashing I mean flashing lights and beeping horn are meant to attract attention so a lot of animals that have bioluminescence will use every light organ they've got to attract attention if they're caught by a predator in the hopes that they'll attract a bigger predator that may attack their attacker and afford them an opportunity for escape but it has to be at the point where a much larger predator has got a jellyfish in its mouth and at that point this is like a a last ditch defense a last scream if you like of terrible for its consume it is exactly a scream for help yep but with light I wonder if such a thing could ever work for a jellyfish it must work I suppose otherwise there'd be no evolutionary advantage in having it well that was my question

was I you know okay that's the idea but how could we ever know for sure and the problem was that anything I could think of doing to be able to observe was going to disturb the animal life down there in such a way that I could never be sure what I was seeing was natural and I every time I went down in a submersible I would imagine you know how many animals are there just outside the

range of my lights they can see me but I can't see them how am I ever going to learn about them and so I wanted to develop a camera system that I could leave on the bottom of the ocean that could see without being seen it needed to be unobtrusive we do that all the time on land if we want to observe nocturnal animals we use infrared lights and infrared cameras but you can't do that in the ocean because infrared light is absorbed so thoroughly by water that it's essentially useless and so I wanted to see if I could figure out a combination using red light in combination with a super intensified camera to compensate for the fact that red light is absorbed so thoroughly by seawater and I call this camera system the eye in the sea because I would it was hoping that I could get it developed and leave it on the bottom of the ocean but I had a terrible time getting funding for it because every funding agency would always ask the same thing well what will you discover with this thing and I kept saying but I don't know that's the point I think we've been scaring stuff away finally I got an undergraduate college harby mud college to do it as a engineering student project and they got something that kind of worked on the bench and then I got the national oceanic and atmospheric administration to pay for putting it all in an underwater housing and a frame and I got the Monterey Bay Aquarium Research Institute where I was

I still am an adjunct and they paid for the batteries to run the thing and then the early tests of the system where I was trying to figure out how to get just the right illumination so I could see without being seen and in the early days when I was using red light and red LEDs I could still tell that the fish were seeing light and I finally got inspiration for how to solve the problem from the stoplight fish because when I was studying the stoplight fish I was measuring the emission specter from its light organ and I discovered it had this really really sharp cut-off filter over its light organ that was shutting out all of the shorter wavelengths the oranges and the yellows and I remember when I measured that I thought wow it's giving up a lot of energy to do that it's got to be really important so I imitated that for the eye in the sea and that turned out to be the key to being able to see without being seen podcast broadcast this is conversations with Richard Fidler hear more conversations anytime on the ABC listen app

or go to abc.net.au slash conversations like I said earlier Edith this came in some to some degree out of an experience you had that arose from complications during surgery tell me how all this began for you when you realised that you might need surgery in the first place well I just went in for my college physical and the classic question was do you have any persistent pain and I was having a pain down my back of my left leg but I was a water skier in the summer and a snow skier in the winter and I figured oh I just pulled something but the doctor wanted an x-ray and I got kind of an alarmed call telling me I needed to go see an orthopedic surgeon immediately who proceeded to explain that my back was broken which he illustrated by putting one fist on top of the other and pulling them halfway apart and saying I had a 50% slippage that was cutting off the nerve down my left leg anytime I was sitting and when I was standing you know I had I'd always had low back pain I couldn't remember a time when I hadn't do you have any idea when you broke it well it was probably when I was about eight or nine I used to spend a lot of my youth climbing into and jumping out of trees and I remember one instant where the jump didn't go very well and I think that's probably when I broke it so you've been living with a broken back since since your childhood then yeah I was having a pretty good childhood though I just you know I thought I called it being tired I didn't know

everybody didn't have low back pain but by the time I got through my first semester at Tufts University I realized I really couldn't go on like this because the pain had gotten much much worse so at the beginning of my second semester as they scheduled a spinal fusion which in those days involved taking bone chips out of my hip and putting them between those two vertebrae and then I was supposed to be in a full body cast for quite a few months to make it heal and it didn't go well the surgery went fine but it was the recovery room they said I was flipping around the table like fish out of water and I had what is known as DIC disseminated intravascular coagulation and all your clotting factors go out into your capillaries and usually a doctor sees his patient is hemorrhaging because those clotting factors aren't available where they're needed so you're hemorrhaging into your surgical site and then they'll treat you with an coagulant but that's what ends up killing you and leading to organ failure so my doctor had actually just been to a conference and knew what it was that was happening to me and he treated it with an anticoagulant heparin but that made the bleeding that much worse and so I actually bled into

my lungs and I bled into my eyes so when I came to eventually I was blind Edith how close to death did you get it during that period well they had to resuscitate me three times three resuscitations but only one near-death experience what do you remember of that it was the classic NDE where I was above my body looking down and there was actually another entity there with me and we were making a decision about what was going on under beneath us were you feeling frantic in that time in that moment or serene no no no very serene very calm that's that's one of the universals of NDE's is this sense of calm which I wonder might even be some kind of evolutionary adaptation to keep you from hurting yourself when you're in extreme extremists like that I mean I don't draw any conclusions from this I prefer to keep an open mind but I certainly understand why people that have experienced it feel like it it felt spiritual it certainly felt real did it feel profound oh veah it felt pretty profound as I said I was very calm when I came to which is in retrospect surprising since I was blind I had a tube down I'd been intubated you know so I couldn't speak I had tubes running everywhere um and I remember my parents trying to explain to me what had happened and being sounding like oh yeah okay that's fine no problem what had happened to blind you what why were you blind I had hemorrhaged into both eyes I'd hemorrhage into my lungs hemorrhage because you know the loss of the clotting flak factors on top of

having to use heparin just meant um the blood was leaching out of my my capillaries did that bother you when you woke up no not at all I was fine with it um and I was fine for about a week in the ICU and for a few days afterwards when they put me on the ward but once I was on the ward I got to have visitors and some friends had brought roses and everybody who walked into my room

commented on these beautiful roses everybody made a fuss over the roses and then somebody came in $% \left({{{\left[{{{\left[{{\left[{{\left[{{\left[{{{\left[{{{\left[{{{\left[{{{\left[{{{\left[{{{\left[{{{\left[{{{\left[{{{}}}} \right]}}}} \right.}$

and mentioned the beautiful yellow roses and it was like somebody slapped me awake because I went

what yellow I had been picturing those roses as red and I it was just like being slapped awake and I started trying to analyze what I could see and I realized I couldn't see anything I didn't know where the door was I kind of guessed where it was based on sounds I hadn't been seeing people's

faces I'd kind of been filling them in I tried to see my own hand and I couldn't see it you know I was profoundly blind um I started to get vision back in one eye over time but it was very slow and when I finally got out of the hospital four months later I could see out of my right eye but my left eye I remained blind in for almost a year what about your spine Edith what had happened to that after the operation well the doctor told me that the spinal fusion had been ruined because of all my flipping around all the bone chips had gone flying but I got a lucky break if you'll excuse the expression I actually got a massive infection which was a huge problem that was your lucky break

that was my lucky break that because it led to increased calcification so I'd ended up I ended up with a strong fusion which was very unexpected do you remember your sight returning to you and

how it felt did it feel like a gift to get it back again well it's it I think it's been it felt like a gift ever since um there was no one moment when I knew I was going to get my vision back in fact the

doctors were extremely unhelpful in that regard because they couldn't see my retinas so they didn't know if they detached so when I asked if I was going to be able to see again they didn't know but little by little I started to see flashes of light through swirling darkness which I think probably helped me think a little bit more about what it was like for these animals in the deep sea and later because they it's flashes of light in swirling darkness and you know you have to try to make sense of it somehow how long did it take before you could get out of hospital and and start to see the world again well it's four months before they they let me out but then you know once I got home I started healing pretty fast um I could walk I had to wear a back brace for more than a year but I within a year I was I was scuba diving again how lovely was it to be weightless in the water again suspended like that oh yeah scuba diving was just wonderful because it is it is just being suspended weightless I remember one dive um in the Bahamas where I just suddenly had this

sense of total glee and freedom and I just started laughing so hard I filled my mask several times with water I had to keep clearing it because I got the giggles so bad but it was it was just this amazing sense of freedom does that sense of wonder and gratitude go away after a while what does it

stay with you well it's definitely stayed with me I I felt very blessed um and fortunate and you know every time I get to go down in a submersible and have the opportunity to just see something that possibly nobody's ever seen before I just can't believe my good fortune you mentioned there the camera system I in the sea that you developed or helped develop or initiated in order to have a sort of an unobtrusive camera system that could sit right down the bottom of the ocean depths to observe animals going about their business without feeling that there was some great big bit of technology or human trading around the place near them how well did it work once you actually got it down there when did you start to actually see things you hadn't seen before with that device so the very first expedition I took it on was to the Gulf of Mexico to this absolutely amazing place called the brine pool which is an underwater lake it is literally a lake on the bottom of the ocean yeah

then you have to keep asking yourself as you're looking at it how how the heck is this happening but the brine is you know just super salty water that settles in these pools and it actually has a

shoreline and a lot of these brine pools have methane that bubble up through them and there's bacteria that support an ecosystem around them so that you can have a shoreline that's got all of these huge muscles and clams and crustaceans roaming around it and you come up on it with the submersible and if you try to go through that water that brine it's too dense for the submersible to go through it but it you'll create waves slow motion waves that actually lap against the shore and it's so otherworldly you are blowing my mind right now this is really blowing my mind well you should google but brine pool because you gotta see some of the video of it because it's just astonishing it's absolutely astonishing and it is kind of an oasis on the bottom of the ocean where a lot of i've assumed a lot of predators might patrol so that was the first place i put the eye in the sea and i left it down overnight and i had programmed it so that for the first four hours it was just the red lights on and i was ecstatic when we got it back and i was reviewing the video because i could tell the fish weren't seeing the lights the lights came on and they didn't respond in any way they just kept swimming around and i i had my window into the deep

sea and just thought i couldn't possibly be happier and then four hours into the deployment i had programmed the electronic jellyfish that imitated the display of that atola jellyfish that i told you about the pinwheel of light that i always wanted to know how animals responded to it and so i had programmed that to come on four hours into the deployment 86 seconds after it came on

for the first time we recorded a squid over six feet long that was completely new to science they could not even be placed in any known scientific family i could not have asked for a better proof of concept and i went back to the funding agencies and said this is what we will discover and they gave me a half a million dollars to do it right that that squid was worth half a million dollars to you was it was it capering around or what was it doing as it came up to you came no it was attacking the electronic jellyfish trying to find the thing next to it that was causing it to light up did you feel guilty about that i mean you got half a million dollars but the squid didn't even get a meal out of it i don't feel guilty at all so that's wonderful so this this device caught the attention of other people who have been looking for the legendary giant squid the kraken of the oceans that was rumored to exist it's part of old sailors tails tell me how you were brought into that the hunt for the giant squid with this wonderful technology edith so i had given a ted talk a gathering of people to share ideas and i talked about bioluminescence mostly but i showed some of the video that i'd recorded of squid attacking the electronic jellyfish and one of the other speakers at that particular event was a giant squid hunter named mike degree and he just got super excited when he saw my video and he said

do you think that might work to attract a giant squid and i hadn't actually thought about it but i said yeah i think it actually should work because you know i think they've got to be visual predators they got the largest eyes of any animal that we know of and so mike got me invited to speak

before a bunch of television people at the discovery channel and the japan broadcasting corporation nhk that we're thinking of funding this giant squid expedition off japan so i you know i put forth my idea of using red light being unobtrusive and using an optical lure and i think it was mike's energy more than anything that got me invited on an expedition there originally the expedition was supposed to occur in 2011 but that was when the tsunami hit in japan and fukushima

had three meltdowns nuclear meltdowns so everything was put on hold until 2012 and sadly mike was killed in a helicopter accident just before the expedition was supposed to happen so i ended up going on this expedition that he got me invited on without him which was very painful but it turned out to be a huge success i had a new version of the eye in the sea called the medusa that i had kind of designed in collaboration with uh justin marshall who's um an ex pat brit living in australia and sanca johnson we tried to figure out a way to condense the eye in the sea into something

that didn't need to be deployed with a submersible or remote operated vehicle we could just throw it off a ship and so that's what i was testing off japan the first time we deployed it was without the electronic jellyfish and we saw almost nothing on the video when we got it back and the second time we deployed it was with the electronic jellyfish and we got the first video ever recorded of a giant squid how did it come into view the first time it it just waved its enormous arms in front of the camera lens and we didn't get to see the whole body it was just like it was teasing us but after we saw how huge it was we extended the bar with the electronic jellyfish out in front of it further so that we have a better chance of seeing the whole thing when it came into view and we did eventually get the whole thing coming in for an attack so we record we filmed it four times with the the camera system the medusa it it was just so thrilling to be able to capture that creature of legend for the first time the kraken is real the kraken is real headed had its tentacles fully extended it would have been as tall as a two-story building wow i don't know why it pleases me so much

to know that such things are real edith i don't know why but it really does it really does please me to know that the giant squid it's as big as a two-story house is real and there must be more than a few of them down there oh yeah and actually they can get as big as a four-story house oh my god

and based on the number of giant squid beaks found in sperm whale stomachs there's probably millions

of them down there but what about the stuff we don't know about because we've been scaring it away

the reason we know that that the kraken exists is because it happens to float when it dies because it's got ammonia in its tissue that's actually pretty unusual what about the stuff that doesn't float how much is there down there that we don't know about just because our typical means of exploration

either dragging nets behind ships or going down with submersibles or remote operated vehicles with loud thrusters and you know just brilliant brilliant lights are scaring animals away

for the last i don't know 50 years or so space exploration seems to have been getting i don't know for me increasingly disappointing i mean i now realize how big the space is between stars and planets the planets we've been able to send probes to so far have shown no signs of life whatsoever they seem to be completely barren of life and here's you and other scientists getting into a submersible going into another frontier and finding it's full of life what do you think about all that edith yeah i i think that the space race in the 60s

caused nasa to be written a blank check and they did some great things with that money including develop an enormous public relations machine that made people fall in love with space exploration and space cowboys but it's not really logical when you realize how little of our own planet we've actually explored sometimes the excuse for space exploration is we've explored

our whole planet we haven't even come close the number you hear most often is that we've explored only five percent of our ocean it's actually way less than that that number was originally just from remote mapping of the bottom of the ocean not actually visiting it if you're talking about actually visiting it we've only visited about point oh five percent of the bottom of the ocean so the weird thing is that historically our pattern has been to explore and then exploit but with the ocean we've done it in reverse we're actually exploiting the ocean before we have figured out what's in it by dragging just enormous nets behind ships to pull up every last fish dragging them across the bottoms of the ocean to just completely destroy undersea gardens for one haul of shrimp or bottom-dwelling fish now we're about to go into a deep-sea mining mode that's going to destroy more bottom habitat we're doing deep-sea drilling and at the same time that we're pulling out every last shrimp and fish we're filling the ocean with our plastics and our pollutants do you think if we knew more about what was in the deep ocean we'd care about it more i think we have to know more about the ocean because it's part of the life support machinery of the planet and it's astonishing that we are messing with that machinery without really understanding it we don't even have a user's manual for our planet let alone a repair manual and exploration is the first step to doing that we have to explore and better understand how life works on this planet if we're going to sustain life how much pleasure have you been able to take out of life by keeping that childlike sense of curiosity and wonder about the world i think exploration is key to so much happiness we know it as children we're we're just all born explorers but unfortunately i think it gets kind of beaten out of you over time but some of your greatest joys are exploration you know our our favorite stories are of discovering an ancient tomb or a secret garden these are all you know the things that intrigue us and i can't imagine a more joyous experience than discovering something about our planet that nobody ever knew before i mean it is just such an astonishing thrill and it's there for so many to enjoy and they don't even know it edith it's been a joy to speak with you thank you so much oh thank you for having me edith widow's book is called below the edge of darkness the sea

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