TROPIC

oothed monsters with glowing lamps dangling from their noses. Neon-spitting
Living kaleidoscopes. Floating Christmas trees. Maybe even a cure for cancer.
t the bottom of the ocean, a strange, new world is coming to light.

6 The Deep

By ANGELA POSADA-SWAFFORD

Descending a half-mile through pitch blackness, deep-sea explorers enter into . . . a Las Vegas light show. Cover photograph by Dr. Edie Widder shows a bioluminescent deep-sea angler fish. The glowing blue light on top of its head attracts prey into its jaws.

12 Eleven Years of Solitude

By JOSE DANTE PARRA HERRERA

An expatriate Colombian returns to a homeland where violence and beauty, reality and fantasy, are inseparable.

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If you think the bottom of the ocean is black and lifeless, open your eyes.

The Deep

BY ANGELA POSADA-SWAFFORD

How do you get to the great depths? How do you return to the surface of the ocean? And how do you maintain yourselves in the requisite medium? Am I asking too much?

— Jules Verne, *Twenty Thousand Leagues Under the Sea*

IT IS DARK AT THE BOTTOM OF THE ocean. I sit 2,300 feet beneath the surface, in the abyss, above me a void of blackness and 70 atmospheres of water, an alien, frigid, lightless place.

And then . . . all of a sudden, the void is filled with light. Illuminated from within, a host of miniature creatures glide by, their bodies pulsating in blue, green and white neons, a floating Las Vegas. Apparently bothered by our intrusion, some flare up like radiating galaxies, their luminescent tentacles undulating in spectacular choreography. Others have light organs that burst intermittently in defiance, while still others, engaged in battle, actually spew liquid light over their opponents. Then some unfortunate ones collide against the Plexiglas bubble of our submersible, and their ethereal bodies disintegrate, squirting radiance in all directions.

E. WIDDER

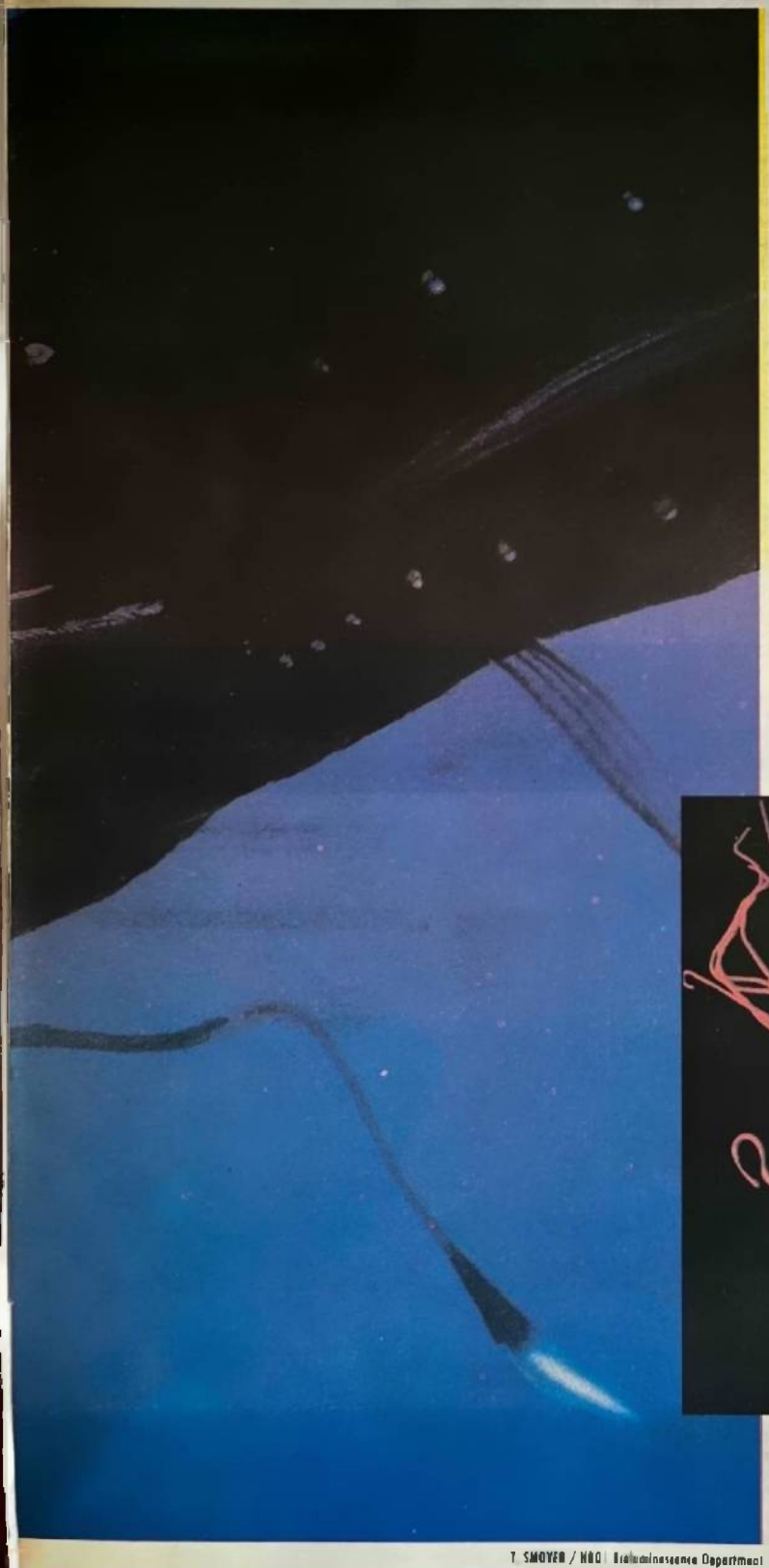
I am discovering that the deep oceans of Earth are not dark, empty places. There is life here, light and strange beauty. And just possibly, a cure for cancer.

Adrift in a Bubble

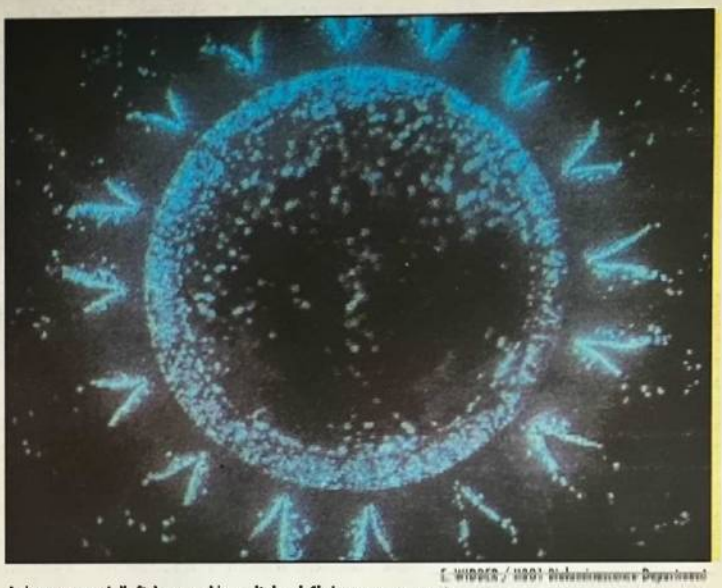
My first sight of the vessel that will take me to the bottom of the world leaves me incredulous: How could that tiny bubble of plastic survive in the crushing darkness of the deep ocean? It is the Johnson-Sea-Link I, a technologically advanced, free-floating submersible operated by the Harbor Branch Oceanographic Institution of Fort Pierce. The submersible and its crew have been ferried here — about 80 miles southeast of Nassau — and now it is time to dive.

Nervously climbing up the yellow ladder alongside the Plexiglas bubble, I notice that two of the three crew members, Dr. Edie Widder, one of the world's few experts in bioluminescence, and back-up pilot Ben Chiong, are disappearing under the vessel's aft chamber, a rectangular box for two passengers, which, unlike the forward transparent sphere, has only two small portholes. I also notice that the chambers are unconnected, and that a large

This little monster, at right, which could double for the outer-space creature in *Alien*, has no name except for its scientific designation — *Melanostomias bartonbeani*. An eerie light organ glows beneath its eye. Inset photo at left, the *Melanostomias bartonbeani* showing its bioluminescense.



T. SMOYER / HBOI Bioluminescence Department



E. WIDDER / HBOI Bioluminescence Department

A deep-water jellyfish resembles a lighted Christmas ornament.

Graceful deep-water jellyfish, *Periphylla periphylla.*

E. WIDDER / HBOI Bioluminescence Department

THE DEEP

battery box sits behind the spotless bubble, while an array of oxygen and ballast tanks sits alongside and underneath it. For a submersible that is capable of diving to 3,000 feet, the whole rig —including its two hydraulically operated arms — seems surprisingly small.

As I reach the top of the bubble, I am told where to step and how to slide through the tight opening. Pilot Dominic Liberatore (Dustin Hoffman sans the large nose) is already in his seat. He shows me how to sit down in the comfortable chair to his right without stepping on the instruments that cover the back and sides of the sphere. I find myself in a tight space, my right shoulder touching the gauges that measure the oxygen and carbon dioxide levels within the sub, my left side against a narrow panel that contains the sonar and a monitor screen for the video camera mounted outside.

As the hatch is being sealed over us, Liberatore, a veteran with more than 1,200 dives, including the recovery operations for the space shuttle Challenger and the USS Monitor, gives me a four-minute submersible course.

"Should I be unable to bring the sub back to the surface, the first thing you need to do is take my headset off, put this little earpiece in your ear and press this button right here. That's our underwater telephone. Should we be stuck on the bottom for a while, the life support in this vehicle is good for five days. We have enough oxygen on board, enough water-making capabilities, warm clothes and food to keep us alive for five days on the bottom."

Of course he doesn't mention that there is no bathroom. I have been "dehydrating" myself on purpose all morning — plus, I made sure coffee was not on the menu — hoping to prevent any problems during the three-hour dive.

As Liberatore speaks, a huge trapeze-shaped crane mounted on the stern of the mother ship gently picks us up and moves us over the water. Then it lowers us with a soft hum until the sub touches the sea and we float free, rocking with the surface waves.

And then the dive begins.

My vague sense of claustrophobia disappears as Liberatore fills the ballast tanks with water and we sink, leaving behind a trail of minuscule bubbles shining under the early afternoon.

I've gone scuba diving before, but it was always diving to a reef of some kind. A place where you expect to find *something*. But this descent is diving into blue emptiness. Monochromatic, endless, electric blue. A blue that seems to hide more than it reveals. There is nothing whatsoever to give us a sense of orientation — except our own bubbles, which grow larger as they expand on their journey upward.

Two hundred fifty feet. All reds, oranges and yellows have been filtered out. As the blue absorbs us like one more drop of water, we continue to fall slowly into a cobalt embrace.

I am in charge of two things today: handling the video camera mounted on the frame of the JSL through a remote-control box, in such a way that Widder and Chiong back in the chamber can see what's going on up front, and reading our depth out loud at 50-foot intervals so that Widder can enter the data in her computerized spectrometer. The spectrometer will measure the quantities of light penetrating the water.

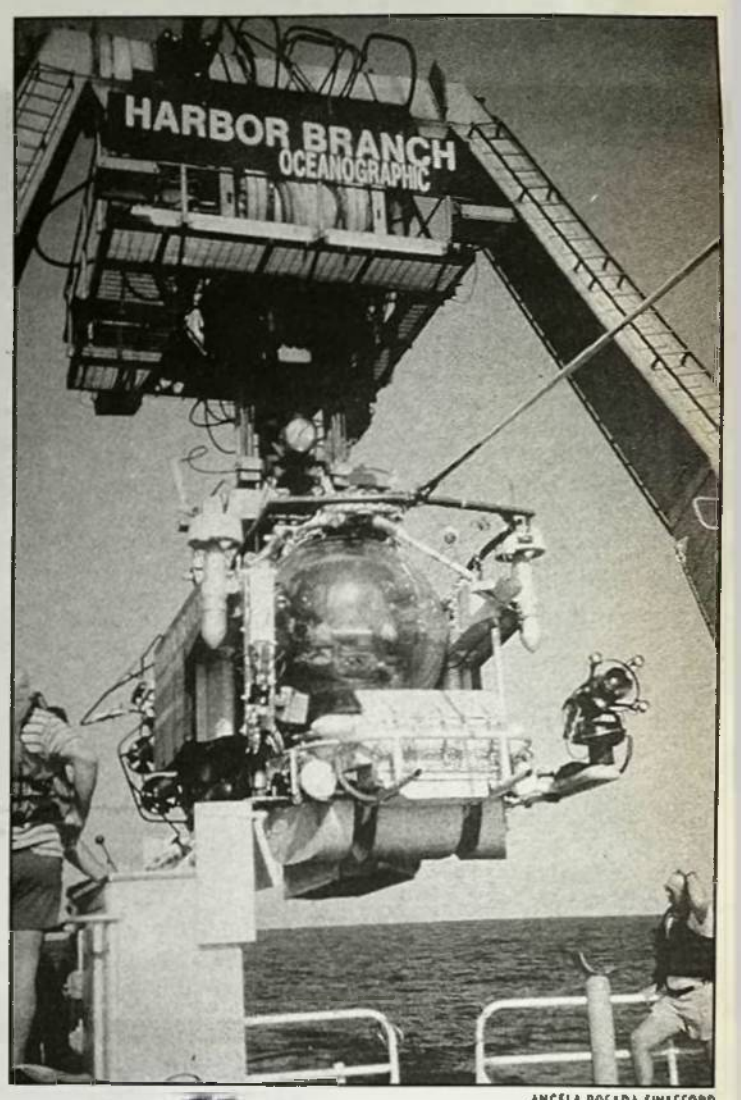
Four hundred fifty feet. The interior of the sphere, which is maintained at one atmosphere of pressure, is glowing with the soft red light of the instruments above our heads, the only comfort in this place. Liberatore reports back to the surface: ops normal.

Seven hundred feet. The sub's external spotlights are still off as the blue is transformed into a clear gray, then a darker gray, then a diluted black. In these tropical waters light dies hard. Still, Widder's spectrometer keeps on receiving light where our eyes cannot. "These are the clearest waters in the world," Widder says through the radio.

Eight hundred and ten feet. The lights switch on. Beyond them, only blackness. Incredibly, I feel as though I am sitting in the cab of a high-tech truck on the Interstate at night. The only thing that reminds me where I am is the cold radiating from the Plexiglas.

Eleven hundred feet. I try playing with the video camera and manage to jam the lens against the collection traps. Better leave that alone for a while.

Fifteen hundred feet. I feel chilled. Reflecting the glare of our lights is a shower of falling particles. Like a curtain of marine snowflakes, tiny fecal pellets and bits of plant and animal lifeforms descend before us. This detritus eventually will come to rest at the bottom of the ocean, to form, under pressure for hundreds of thousands of years, layer upon layer of sedimentary rock, like the ancient sea bottom that now forms the peaks of the American Rockies.



ANGELA POSADA-SWAFFORD

The Johnson-Sea-Link I, an untethered submersible that can take ocean scientists to depths of 3,000 feet, is one of two belonging to the Harbor Branch Oceanographic Institution in Fort Pierce.

Liberatore turns the sonar on, and it echoes musically as it searches for the rapidly approaching bottom, its amber light drawing a map on the screen: We are almost there.

Twenty-three hundred feet. After 60 minutes of falling we settle on the slightly muddy bottom, near a huge rock wall. In the sub's light, the naked wall breaks out in patches of feathery plant-like animals, some looking like miniature Christmas trees. Overwhelmed by the desolate terrain of the abyss, I can't contain a gasp of excitement. Even my three submates, who have done this sort of dive hundreds of times, don't hide their enthusiasm. They chatter excitedly, not scientifically. The pilot exclaims, "Wow!"

And then we shut off the light. Our eyes adjust. The darkness fills with a constellation, a galaxy of light.

I remember Charles Lindbergh's words: "What kind of man would live where there is no daring? I don't believe in taking foolish chances, but nothing can be accomplished without taking any chance at all."

The external temperature is 12 degrees C — about 54 degrees Fahrenheit. It can get much colder, depending on the currents.

Minutes before we boarded the sub, I was handed an eight-ounce Styrofoam cup. "Write a message to yourself on the cup," Liberatore said, handing me a green felt-tip pen, "and you'll see what happens."

I wrote my message, and Liberatore placed the cup in the external collection basket. From time to time on the descent, I glanced at it through the window as the water pressure steadily increased. Was it shrinking? It was hard to know. But now, at the bottom, I take another look. Still a perfect cup-shape, it is now the size of a thimble — talk about an indestructible material! Even our 5⅛-inch-thick Plexiglas bubble is compressed by as much as one-quarter inch. Don't try that with a human body. Even though we would not be crushed by the pressure — saved by the high water content of our cells — the very act of breathing oxygen from a tank could kill us.

"Under pressure, nitrogen, which accounts for around 70 percent of the air we breathe, is dissolved into the blood stream," says

Dr. Ivan Montoya, an expert on the medical effects of diving at the South Florida Hyperbaric Medical Center. "It saturates the blood to the point that as you ascend you need to decompress for hours until the gas is reabsorbed into the tissues." After a few minutes at that depth without the protection of a pressurized submersible, you would need to decompress for days.

Depth for Versatility

Limited by design to depths no greater than 3,000 feet in an ocean that can sink to 40,000 feet, the JSL trades depth for versatility, and a panoramic view that is critical for many oceanographic studies. Other submersibles, such as the Alvin, operated by Woods Hole Oceanographic Institution in Massachusetts, have titanium hulls with tiny windows that allow them to reach depths of 15,000 feet. But how can you look for that rare deep-sea sponge or study an elusive creature through a small porthole?

As we hover near the bottom, we encounter a current, so Liberatore approaches the wall carefully, using the eight switches that control the sub's engines. By quickly turning each one on and off, he maneuvers the vessel with incredible accuracy. His dexterity, I tell him, would make him the best Nintendo player in the world.

Liberatore tells me his skill comes from knowing the sub inside out. "In order to drive this sub," he says, "we pilots must first be able to take it apart and then assemble it from scratch."

Despite the dangers of the deep and a record of 7,000 dives, neither this sub, nor its twin, the Johnson-Sea-Link II, has had a close call in 20 years. But soon after an early version of the sub was developed in 1973, a tragedy claimed lives. It happened off Key West, when the Johnson-Sea-Link I, designed by oceanographer Edwin Link in cooperation with millionaire J. Seward Johnson, son of the founding family of Johnson & Johnson, got entangled in debris at the bottom. As the sub occupants waited to be rescued, the air scrubber ceased to absorb CO_2 because of the low temperature. Two of the four people on board died, including Link's son.

A few months later, Link and Johnson, the latter of whom had founded Harbor Branch Oceanographic Institution in 1971, pro-

Dr. Shirley Pomponi, a biologist with Harbor Branch Oceanographic Institution, is looking for compounds in sponges and other marine invertebrates that can be used for making drugs to treat cancer, among other illnesses.

duced today's improved version of the Johnson-Sea-Link. Since then, scientists on board the JSLs have pioneered in many fields of oceanographic research. One of them is Widder, who was the first person to videotape the living light of the oceans.

"It's been estimated that there are bioluminescent animals in every cubic meter of the ocean," she says. "I have made over 100 dives in various submersibles, and I have never made a dive where I haven't seen some sort of bioluminescence."

Though the phenomenon has been known for years, Widder is among a handful of scientists beginning to systematically study and identify the thousands of luminous animals in the deep ocean.

In the dark we watch in amazement the radiant signatures of these creatures, most of them not even two inches long, as they orbit inner space in search of prey. The bursts of fire, intermittent signals and steady glow of organs that look like miniature light bulbs are fueled by chemical reactions within the animals. The bioluminescence serves several purposes. Some of the animals use light as a diversionary tactic, to confuse a predator or prey. "Since down here there are no bushes or trees to hide behind, camouflage becomes key to survival," says Widder. Others use it to attract a mate, frighten a potential enemy or, at higher depths where light from the surface can make them a tasty silhouette, to make them merge with the backlighting.

Many of these creatures participate in the largest animal migration in the world: a nightly vertical journey from the deep to higher depths, where more food is available. At dawn, vampire-like, they flee the sunlight into the dark below.

Very little is known about this massive movement, or anything else about this strange world. For instance, why do some abyssal creatures have such large eyes if there is no light to see?

"It was assumed that deep animals could only see blue light, the light that penetrates the deepest," says Tammy Frank, Widder's colleague. "But I found that a certain species of shrimp is also sensitive to ultraviolet light. So we've been trying to determine why a deep-sea shrimp should be able to see UV light in an environment where the dogma says there is no UV light."

But playing ophthalmologist to these creatures can be quite difficult. One mistake researchers studying the vision of these animals frequently make, says Widder, is to expose them to light as they are brought to the surface in deep-water nets.

"It just blinds them," she says. "They never recover. Even moonlight blinds the most delicate of them. This is why you have to bring them up in complete darkness and transport them to the lab also in the dark."

So far, the longest she has managed to keep the animals

alive in a lab is one day. She is hoping to learn how to do better than that.

Widder feels like Aladdin in the cave of treasure. She is surrounded by an untold, untouched wealth of things to learn.

"Every fourth or fifth time we go down on the submersible, we see something that nobody's ever seen before," she says.

As the JSL moves through the water, the animals luminesce as they bump against a screen mounted on the ship's hull. And as they cry light, an intensified camera records their neon tears, each pattern unique

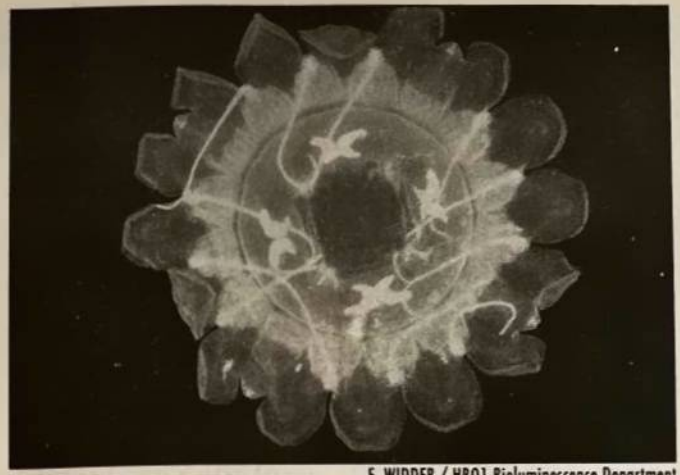
Alien

These creatures shed new light on our concept of life on Earth. Take the siphonophore. At first sight it looks like a twisted red party streamer. But a closer look reveals that part of its body is made up of an ethereal embroidery of transparent sacs. Along the body, hundreds of tentacles probe the water for prey. Then there is *Phronima*, a miniature monster with a protruding head and scary-looking jaws, a semi-transparent cross between a flea and the monster in

A spiraling siphonophore, twisting through the depths, can grow to several feet in length and use its feathery tentacles to search for prey.

Alien. This delightful character's specialty is to eat its prey from the inside out, in order to lay its own eggs in the victim's gelatinous shell. Parading before our acrylic window in an aquarium where the animals are outside, the shapes get stranger by the minute: an iridescent zeppelin, a Chinese lantern.

And of course there are fish — small, because food down here is scarce — but fabulously bizarre. Their light organs adorn their bellies and sides in elegant patterns. Some have strange biological contraptions attached, such as the angler fish, which has a blue light organ perched on top of its head. To humans, it looks like a Christmas



E. WIDDER / HBOI Bioluminescence Department

A rare deep-water jellyfish caught at 2,000 feet deep during the dive off the Bahamas described by the author. Back at the lab it glowed green for hours until it was exhausted. Scientific name: *Periphylline intermedia*.

light. To other fish, it looks like food, and it draws them straight into the predator's jaws, which are lined with razor-like transparent teeth. Who needs UFO stories when we have these incredibly weird creatures right here in Earth's inner space?

Despite all there is to learn, money for oceanographic research is literally flying into outer space

Ever since she lost her funding from the Office of Naval Research in 1993, Widder has been hard-pressed to maintain her research in bioluminescence, and has had to redirect her efforts into areas of more interest to funding agencies. She is now trying to support her research with funds from less traditional sources, including the proceeds of a coloring book for children with glow-in-the-dark paintings. She spends much of her time writing grant proposals.

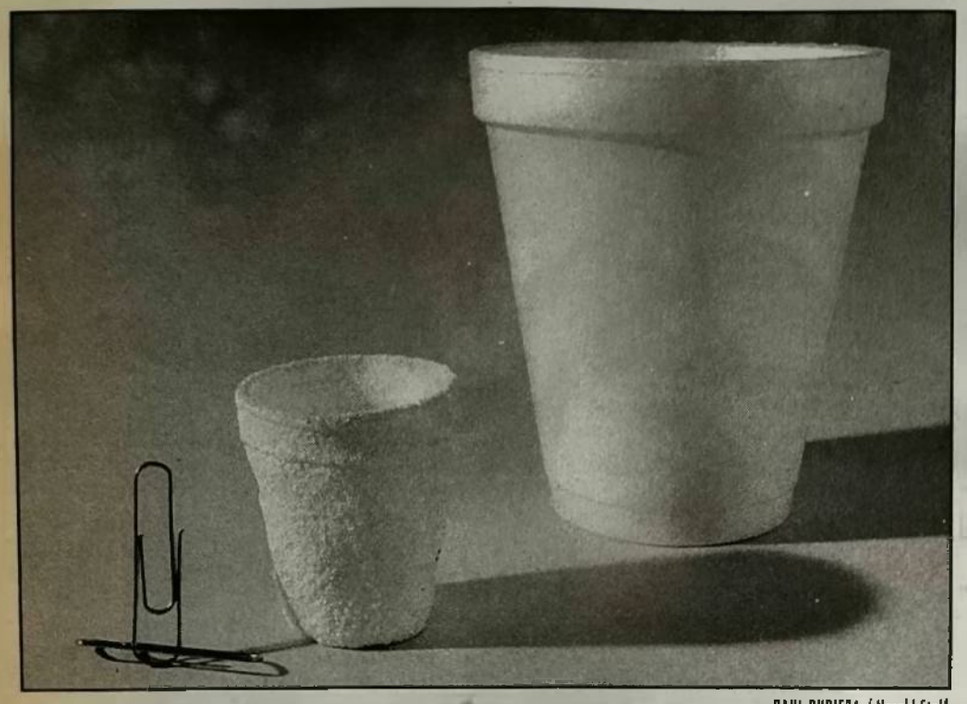
"Because of the loss of the Soviet threat, the Navy lost interest in bioluminescence, which was used for nonacoustic antisubmarine warfare, since you could detect submarines by the trails of luminescence," she says. The amount of money now available for undersea research is dwarfed by what goes into space exploration

Her research doesn't come cheap: The use of the 204-foot RV Seward Johnson vessel costs $9,000 a day, and the submersible time costs $5,000 — for a total of $14,000 a day.

"Compared to what the Defense Department spends in maintenance of nuclear warheads, it's very small. And Congress is pumping money into NASA for the potential life on Mars, while we have all this lovely life in the oceans, which supports life, mostly unexplored," she says.

"We haven't pushed the product," says Dr. Richard Spinrad, a Washington advocate for oceanography. "We need to convey to the people that our quality of life depends on the health of the oceans."

One of Widder's problems is that bioluminescence, for all its compelling curiosity, is still not seen as something that can be directly applied to any human need. At least one aspect of deep-sea



RAUL RUBIERA / Herald Staff

The tiny Styrofoam cup, hardly bigger than a paper clip, was the size of the eight-ounce cup at right before it was exposed to the crushing pressure of 2,300 feet of ocean depth.

oceanography has an obvious connection, however: Scientists have discovered compounds in ocean life that can be used as drugs to treat illnesses from cancer to arthritis.

Drugs From the Sea

Among the scientists looking to the ocean for new drugs is Dr. Shirley Pomponi, a colleague of Widder's at Ocean Branch. Upon returning from a recent night dive on board the Johnson-Sea-Link, Pomponi and her colleague, Dr. Amy Wright, rushed to take their precious sponge samples into the lab. The new arrivals needed to be preserved for later study and identification, in hopes that they will reveal a chemistry that proves to be helpful for human diseases.

As she put small pieces of a yellow rubbery sponge into glass vials with ethanol, Pomponi, a University of Miami graduate in marine biology, pointed out that at least 75 percent of the top 20 hospital drugs are derived from organisms that live on land. Since the oceans cover approximately 70 percent of the world's surface, she added, they may turn out to be the source of more therapeutic agents than dry land.

Research over the past 25 years has supported that hope. "More than 5,000 natural products have been reported from marine organisms over the past 10 years," Wright said.

Among them were a substance that prompted the synthesis of a drug to treat herpes infections and another used to treat leukemia, which Pomponi studied in sponges found in South Florida waters.

"It is thought that this diversity of compounds is due to the extreme competition between organisms for space and resources in most marine habitats," Wright said, blender in hand, as she prepared a sponge shake that would go under the microscope back on dry land.

Since many invertebrates live fixed to a rock or a piece of coral, they must defend themselves against both predators and rivals for a firm foothold. So they produce potent toxins. One predator's poison, however, can be a treasure to humans. Such is the case of *Ecteinascidia turbinata*, a humble little sea squirt, whose sacs of jelly proved to contain compounds that can kill human cancer cells.

Each squirt has such a minute quantity of the chemical, however, that one ton of animals is needed to isolate one gram of the compound. Five grams are needed for clinical testing.

But harvesting directly from the ocean is probably not the answer. Colonies of these animals live attached to mangrove roots and other similar surfaces, and each colony is a bouquet of only 50 to 100 creatures.

But the compound is hot among drug prospectors. According to a biologist in the field, divers have bagged several tons of the squirts from around the Florida Keys and the Caribbean.

Something similar has happened to *Discodermia dissoluta*, a deep-water sponge that grows in the Caribbean, whose remarkable antitumor activity was discovered a few years ago by Dr. Ross Longley, also at Harbor Branch. Its compound, called discodermolide, aggressively freezes breast cancer and leukemia cells as they divide, killing them in 24 hours. According to Pomponi, this compound is at least as potent as Taxol, the compound currently used to treat breast and ovarian cancer, extracted from the bark and needles of the Pacific yew tree.

But this sponge grows at 600-foot depths, and only scientists in submersibles with robotic arms can pick it up. As Wright put it, "People can't ride around in a sub all the time collecting stuff."

To ease collection difficulties and to avoid overexploitation, researchers such as Pomponi are actively seeking alternatives to the wild population of these organisms.

The first choice is to synthesize the stuff — produce it artificially at the lab by copying its molecular structure. "But some substances are so complex that, industrially speaking, it's impossible to synthesize them," says Pomponi.

Another possibility is aquaculture, the growing and harvesting of undersea animals. This approach has proved successful with some species, such as *Bugula neritina*, a brown invertebrate found stuck to piers that is being ranched successfully in California. This animal produces a substance called bryostatin-1, toxic to cancer cells. It is currently undergoing clinical trials in human patients, and has the potential of making hundreds of millions of dollars if it makes it into the market.

Most of today's anticancer drugs are toxic; that is, they work on the principle that they will kill the fast-growing tumor cells before doing too much damage to the healthy ones. But drug researchers, says Pomponi, are always looking for compounds that kill only the cancer cells so chemotherapy patients have fewer side effects.

Creative Chemistry

Even better than culturing the whole animal is culturing only those cells that make the desired chemical. It is at this sophisticated level that Pomponi is putting most of her effort, identifying which sponge or sea-squirt cells make the interesting chemicals and then reproducing just these cells. She has managed to make sponge cells divide several times. However, "after a certain number of divisions they stop," she says.

So far, none of the possible solutions has proved it can produce the quantity the pharmaceutical industry requires.

In the meantime, entire colonies of sea squirts are being collected in the Caribbean, and no one knows how long the population can sustain the assault. Nor can anyone predict the effects of pollution or global warming on these mysterious creatures.

And so goes the riddle for oceanographers: so much to learn, so little time, so little money.

A MESSAGE FROM THE SURFACE indicates that our deep flight is coming to an end. I am shocked: 2½ hours have passed as if they were 15 minutes. We delay long enough to take one last look at a pair of shrimp flashing neon blue as they battle. Then we turn our lights on and the subtle universe of darkness disappears.

Liberatore empties the water in the ballast tanks and the JSL ascends. The layers of colors reverse themselves: dark gray, light gray, dark green and the impossible blues, until we are again rocking in the surface, waiting to be picked up as the sun begins to set behind the horizon.

Today's dive is over. But the adventure of exploring the ocean floor is just beginning. ❦

ANGELA POSADA-SWAFFORD is a Miami-based freelance writer who specializes in marine and environmental sciences.