Adventure Profile

How do you describe your brand of adventure?

Let's first dispense with the adventure label. Vilhjalmur Stefansson, one of the last great polar explorers, is credited with the definitive statement on this subject. To paraphrase him, adventure is what befalls explorers who fail to properly plan. Like Stefansson, I am not an "adventurer." Adventurers undertake their pursuits, in large measure, for personal gain or for an adrenaline high.

Modern, high-tech exploration, which is what I do, is quite different. The objective is to advance our knowledge of the frontiers—of which today there are few left on Earth, and they are a dwindling, finite lot—by bringing back new data in the safest possible manner. A completely successful exploratory expedition would be a boring, monotonous experience for an adventurer.

Given the danger, why explore?

We do it for the enormous satisfaction one achieves in learning firsthand something new about our planet and our universe. I have to be careful here, because there are extremely talented scientists who chart other planets and very deep places in the ocean using mechanical surrogates. Many of them, including such visionaries as robotics designer Red Whittaker, will argue forcefully that the highlight of their professional careers is when they see new data coming in on a monitor screen one line at a time from one of those impossibly remote scouts.

Exploration by remote control is no less true and valid than exploration in person. But I can tell you from profound personal experience that there is simply no comparison. The well-meaning, dedicated scientists who make those claims have never personally placed their foot where no human has ever gone. I have.

When you are physically able to touch the frontier it hits you on all levels, satisfying curiosity in a way that is indescribable and giving one a profound sense of purpose, of meaning, of connection with the universe. Adrenaline-induced thrills do not hold a candle to that experience. And so, in a way, that is what pulls me toward new frontiers.

My teams and I have focused on very deep caves and flooded tunnels over the past two decades only because that was where the final terrestrial frontier lay. Now it's becoming increasingly clear that this frontier is dwindling. We've explored most of the big, deep ones, and it's time to move out—beyond Earth. Perhaps we should start with a focus on expeditions to explore lunar lava tubes and to secure physical evidence of lunar polar ice.

In all of these environments there is real risk. You do the best you can to prepare for this. You develop new equipment, all with multiple levels of redundancy, and you train your crews years in advance. You move in a methodical, stepwise fashion into the unknown. Even then acceptance of finite risk comes with the territory. To embrace a completely risk-averse philosophy is to deny yourself a place on the frontier.

How important is technology/gear to what you do?

The word "essential" would almost be an understatement.

When I first started exploring caves, all you needed was a hard hat and a light. But when we encountered vertical shafts, we learned to rappel and ascend ropes. And when those shafts began to carry subterranean waterfalls, we developed custom exposure suits. When the caves we were exploring became so remote that we exceeded the limits of human endurance for getting to the exploration front and then back out, we developed techniques for living for weeks at a time underground. When the way onward involved reaching a gaping tunnel at the roof of a grand chamber, we adapted rock climbing techniques to allow us to scale those enormous, smooth overhung walls in the dark.

When, after all that, we finally came to places where the tunnels became flooded with water at the bottom of a very deep cave—it was then that we knew we were being taxed not just physically but mentally. Learning to dive, and using regular scuba was not sufficient. The gear was too heavy and way too inefficient. That was really the catalyst that set me off on 19 years of equipment invention, focusing early on the subject of closed-cycle life support systems.

I've been privileged, through the uncommon generosity of a few special corporations and visionary private patrons, to have the opportunity to branch out and attempt some really wild stuff. The 3-D digital autonomous wall mapper first used at Wakulla 2 was in that vein, and it was one of the most satisfying equipment-development projects I've been involved in. It is an intense mix of real-time computers, extremely sophisticated sensors, laser guidance systems, and cutting-edge computer graphics.

Like those scientists at NASA's Jet Propulsion Laboratory viewing the first images from the Sojourner rover on Mars, the crowd at Wakulla 2 Mission Control went wild when computer graphics guru Barb am Ende pulled up the first 3-D images of Wakulla's deep caves on the SGI screen.

The Wakulla 2 mapper was piloted on each mission. We felt it important to have a human at the stick. Even though we had the computational horsepower of five desktop workstations inside that machine, we were not about to risk a million-dollar investment to any possible bug in the artificial-intelligence code. Not then, anyway. We spent an enormous amount of effort building a floating decompression habitat and deep crew recovery system that would allow those mapping teams to routinely conduct five-hour missions inside the cave at 100 meters (328 feet) underwater. (Total mission times, including decompression, were closer to 24 hours.) We showed that humans and machines could complement each other in an extraordinarily hostile environment.

At Wakulla 2 someone made the observation that onboard computers controlled every single piece of equipment we used, from life support to mapmaking systems. A lot of our time was spent training human explorers to program the machines they would be using on the frontier. That method, I believe, will be the exploration paradigm for centuries to come. We will now turn the lessons from the subterranean world to the purpose of establishing orbiting facilities and, we hope, to fielding a privately financed expedition to the moon.

How did you get started?

I was 15 years old in 1968 and attending North Allegheny High School, north of Pittsburgh, Pennsylvania. A flyer came around at the beginning of the fall semester announcing clubs. One was entitled "Spelunking." Not really understanding what that word meant, I attended the first meeting.

The trigonometry teacher, a fellow by the name of Ron Bergman, had overheard a few of his senior students talking about how they had gone into a cave over the weekend. This teacher felt it was important that some form of professional guidance be made available, so he contacted the local group affiliated with the National Speleological Society, and they came to that first meeting and gave a slide presentation.

Seeing people rappelling into deep, dark shafts in the Earth was incredibly thrilling, so I signed on. It was probably the most pivotal day of my life—saved me from being a terminal nerd.

What was your happiest moment?

I've been blessed with many. But if I were to pick one that stood out above all others, and that was related to expeditionary work, it would most certainly be the evening of May 6, 1994, toward the end of the four-and-a-half-month San Agustin Expedition. That was when, after 11 days underground in the Sistema Huautla caves in Mexico, my colleague Barb am Ende and I managed to make it back to Camp 3.

We were still 710 meters (2,330 feet) beneath the surface, but it felt like home to us. We had just returned from an electrifying six-day reconnaissance-and-mapping trip beyond the 600-meter-long (1,967-foot-long) San Agustin sump, a flooded tunnel at the minus-1,323-meter (minus-4,341-foot) level). We had explored 3.3 kilometers (2.1 miles) of virgin territory leading to a depth of minus 1,475 meters (4,840 feet). It was something we had predicted for 15 years, and it finally happened.

When we met team physician Noel Sloan and veteran Huautla explorer Don Broussard at Camp 3, it was a celebration that will live with me forever. The emotional high from that reunion carried us through another seven days of intense derigging efforts as we retreated higher into the cave, pulling our equipment with us. Breaking out to the surface, on a high plateau, on the 18th day of being underground on that push with those well-worn teammates was a religious experience.

What was your most frightening moment?

I've had many over the course of 30 years of exploring. But fear is something you are forced to learn to confront and control very early on. If you are well prepared, frightening moments are rare.

My most memorable bout with fear and panic came long ago, when I was training to become a cave diver. In the fall of 1980 I traveled to Florida as an apprentice to Sheck Exley, arguably the world's finest cave diver. Back then we didn't know about helium, advanced decompression theory, or rebreathers. So if you were going to dive deep into a cave (which we anticipated having to do in the San Agustin sump), you had to learn to deal with nitrogen narcosis (a euphoria that clouds judgment at great depths), because you would be breathing with compressed air. (The nitrogen component in air, at great pressure, acts very much like the nitrous oxide some dentists use in anesthesia. The deeper you go, the stronger becomes the anesthesia. No one is immune.)

Most people draw the line on nitrogen narcosis at around 50 meters (164 feet). It turns out that this narcosis is about 50 percent physiological and 50 percent psychological. That is, you can learn, to a certain degree, to control yourself and go deeper. Learning that discipline is tricky, because if you are very deep and lose focus there is a high likelihood of narcosis blackout. It's a very insidious thing. Furthermore, that is not the only effect. There is delayed psychomotor response: Your mind sees things happening, but your body does not react in sync.

Exley had planned a graded series of exposures, taking me a little deeper each day, all in flooded subterranean tunnels. On the final dive we reached 75 meters (246 feet) depth. Exley, who was in the lead, turned and gave the thumbs-up—the signal for us to turn back.

As I turned to head out with him it never occurred to me that I was still descending. Suddenly, before I could force my hand to add gas to the buoyancy control system, I landed in the deep silt on the floor. The tan mushroom cloud that boiled up enveloped me instantly, obscuring the guideline—the only sure route out of this maze and back to air.

I lost focus and the narcosis smashed in, producing tunnel vision and creating thunderous echoes with every exhalation of bubbles from my regulator. My breathing rate skyrocketed. I could see the gas going down on my pressure gauge with each breath. I went around in this vicious little circle until I came to realize that this was it: I was going to die.

Quite fortunately for me, Exley, who had worked at much greater depths and was in complete control, reached down, took my hand, and towed me up to a depth of 60 meters (197 feet). There I suddenly snapped out of the stupor and, quite chastised, completed the dive. That dive had been planned to determine my personal limits.

Over the coming years many people would die in that same tunnel, lacking the benefit of Exley's watch. We all learned from this, and in 1987 the original Wakulla expedition changed technical and scientific diving forever by developing and publishing procedures for the safe use of heliox and trimix.

Heliox contains no nitrogen. It is a synthetic mixture of oxygen and helium—one not found in nature. Helium, until you go very, very deep, does not have any narcotic effects. Trimix is "poor man's heliox." In trimix only part of the nitrogen in air is replaced with helium. Thus some residual narcosis at depth remains, but much reduced from that of air.

Equally important to adopting these unusual gas mixtures is the requirement to develop knowledge of how to decompress from great depths after you have breathed them. That was why there was such a formidable barrier to adopting their use and why people continued to try to find ways to push the compressed-air envelope.

Ultimately, fear can be a very powerful means to force innovation. Today few people dive deep on air.

How do you make a living?

I lead the Construction Metrology and Automation Group at the National Institute of Standards and Technology in Gaithersburg, Maryland. We're a ragtag group of engineers, computer geeks, and robotics designers who develop systems to bring automation to the average construction site.

Specifically, we integrate fast sensors, distributed real-time computers, wireless communication links, fiber optics, dynamic databases, actuators, and 3-D computer graphics. Our work helps contractors, owners, and building designers construct buildings faster, cheaper, and better.

What, for you, would be the ultimate accomplishment?

Being the first to explore Peary Crater at the lunar south pole and scoop up with my own space-suit-covered hands a handful of ice crystals mixed in with pulverized lunar regolith. The discovery of water on the moon would be more significant than the discovery of gold or uranium on Earth. It would change the course of human exploration in the inner solar system.

The main factor keeping humans from exploring farther out in space is the sheer weight and expense of the fuel needed. Water can be used as both a means of life support and—after being split and cooled into liquid oxygen and liquid hydrogen—a fuel. So if you have water on the moon, you don't need to transport water or fuel from Earth—you've got a fueling station in space.

In addition, it takes about 20 times more propellant to blast off from Earth than it would to blast off from the moon, due to the difference in gravity and average density. So if you could start off from the moon, you'd save massive amounts of fuel—and thus have space for much more cargo.

How do you respond to being labeled “controversial” in “The Battle for the Black Lagoon” in the Summer 1999 ADVENTURE?

The thing a potential expedition leader has to realize in the 1990s is that the media seeks, and even fabricates, controversy to sell papers. It implies conflict, which-for some reason that has always mystified me-people pay to read about. The truth is, being “controversial” detracts from your effectiveness as a leader.

Often controversy is spurred by a teammate who has left an expedition. Why do they leave? It varies from individual to individual, but here are some typical reasons: inability to work as a member of a team (too volatile and self-centered), physical and mental fatigue, the realization of being in over one’s head, disputes with other team members, love triangles, bad food, and harsh living conditions.

In most cases a team member’s departure causes the remaining core to bond closer together—almost a catharsis that makes the team stronger. For the person who jumped, however, it’s quite a different story. If it is a serious expedition, one costing millions and one that is known to the public—well, when the press gets wind that a member has jumped, now we have...controversy!

The jumper can’t state the real reason he jumped ship. Self-esteem prevents saying, “Well, I was afraid of the diving, climbing, rope work, dark etc.” In most cases, unfortunately, what happens is that these people seek to avoid probing themselves. They select a safe target for criticism, someone who is conveniently unavailable to offer rebuttal. That target invariably is the expedition leader.

The easiest and most damaging claim the jumper can make is that the expedition was unsafe or that the leader was mad, regardless of the fact that in 99.9 percent of the cases where this smoke screen is employed those claims will be completely baseless. But it is just this type of criticism that reporters salivate over.

There is, unfortunately, another path to controversy, and that is through old-fashioned jealousy on the part of individuals not even involved in the mission. Exploration history is replete with examples of different teams trying to reach a common objective.

Until quite recently subterranean exploration remained a game ruled by gentleman’s ethics, in which civility reigned and grievances between different exploration teams, if there really were any, were kept private. The Internet appears to have changed all that. A single, disenfranchised individual, using the “dark side” of the Internet, can now rapidly poison the spirit of a project, and even an entire discipline. Such individuals can now broadcast their angst to thousands.

If you’ve run enough large expeditions, which I have, then a certain amount of controversy is inevitable. The key is to carry on in spite of the press, the naysayers, and the detractors and do the job you need to do.

Any advice for potential expedition leaders?

First, lead by example, not by decree. In short, work your butt off for the cause, doing menial jobs, doing big jobs, but always for the benefit of the team. Second, never complain—it’s always been a privilege for me to work with some of the truly talented and driven individuals I’ve met through the course of 30 years of expeditions. Third, always allow those with the drive and desire (particularly younger members of the team, who will one day become leaders themselves) to be out front, exploring new territory—within the limits of reason and safety. Allowing others to partake in pioneering exploration is a steadfast method for producing results. Fourth, be prepared, as a last resort, to step up to the plate and do the job yourself if it looks like the expedition needs jump-starting.

I have found these simple rules to yield far greater results than any expedition I have heard of that was based on a pyramidal architecture in which an egotistical “leader” had to always be the one out front. A rigidly hierarchical expedition is a house of cards. The real players eventually see through the charade and move on, like free agents in the NFL.

How do you prepare your teams?

On any serious expedition—and I’m not referring to those four-color-brochure, pay-for-a-trip-to-Everest-or-the-Poles deals—there will be real danger that, if everyone is not completely prepared, can and often does claim lives. That fact forces you to train extensively.

You need to know your teammates, how they think, how they act, their strengths and weaknesses. Training takes time and commitment. Many people don’t have the patience for it and leave even before the expedition has begun.

A serious expedition typically involves three or four months—sometimes longer—of working with a very small group of often eccentric people in remote places. In my experience, veterans, hardened individuals who

have several large-scale expeditions under their belt, know what they are in for and have a long fuse. It takes something truly momentous to rattle them—more, even, than the death of a teammate.

What do you do for fun?

Between planning for and carrying out expeditions, designing and manufacturing equipment, and working a "day" job, there really isn't time for much else. I do, however, relish a challenging rock climb with good friends on a sublime, sunny day. And it's great fun to get my kids into the outdoors and teach them the tools of the trade.

Finally, in my copious free time (or CFT, as my colleagues and I refer to it), I study quantum gravity theory. I'm hoping that maybe, just maybe, I'll stumble over a few crumbs of knowledge that others have somehow missed and figure out a way to circumvent the limitations of Newtonian spacecraft propulsion.

Any advice for armchair adventurers?

If I had only one piece of advice to offer people who might be reading this, it would be this: Get involved in any outdoor pursuit, be it rock climbing, caving, mountaineering, kayaking, diving, backpacking. All of them are good for the same reason: They build self-confidence and the ability to work as a member of a team—both of which will serve you well throughout the rest of your life.