The Perfect Fit

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A biologist who roams the world's oceans studying endangered whales. A bacteriologist leading efforts to develop a new and potentially crucial source of energy: hydrogen-creating bacteria. A dedicated surgeon who gives transplant patients new life. ¶ Profiles of these three alumni—Paul Wade '80, Caroline Harwood '73, and Patrick Wood '75—were written for *Colby* in recent months. Though they were assigned and reported independently, a common thread runs through them, and we've sewn them together as a package about scientists who have found their niche. ¶ Wade, Harwood, and Wood are passionate about their professions. They believe fervently that their knowledge and experience should be used improve the world. And they all set out on paths that began in the labs and classrooms of Mayflower Hill. ¶ So here's to success and to the mentors and the experiences that ultimately led all three to specialized areas of science where each has proven both well prepared and perfectly suited.

Paul Wade '80

The office décor reveals the man's mission. The book titles: *Marine Mammals*, *Orcas*, *The History of Modern Whaling*, and *Aquatic Toxicology*. The photos and illustrations of creatures from the sea. The small glass statue of a breaching whale. The three medals (gold, silver, and bronze) awarded by the U.S. Department of Commerce for stellar marine research.

How did Paul Wade '80, an unassuming former Colby soccer star, become an internationally renowned whale researcher? How did this self-confessed one-time ski bum rise to lead the NOAA Cetacean Assessment and Ecology Program for the National Marine Mammal Laboratory?

The seed was planted at Colby. "I took a course on ecological theory from David Firmage that delved into population modeling, and I responded to it right away. Russell Cole's course on animal behavior and Miriam Bennett's course on animal physiology also fascinated me. I knew I wanted to be a wildlife biologist of some kind."

Wade also knew he wanted to take some time off after graduation. After three years of skiing and rock-climbing at Jackson Hole, Wyoming, he moved on to Bozeman, Montana, where he earned an M.S. at Montana State University in biological sciences with a focus on population modeling. Then he went to the Scripps Institution of Oceanography at U.C. San Diego, where his dissertation ("Abundance and Population Dynamics of Two Eastern Pacific Dolphins, *Stenella attenuata* and *Stenella longirostris orientalis*") gave him early visibility in the field.

Fisheries biologist Paul Wade '80, center, and fellow scientists aboard an inflatable boat they use to approach whales.

It was a fast start, and since then Wade's career has gone swimmingly.

Douglas DeMaster, Wade's mentor at Scripps and current colleague as the Center Director for the Alaska Fisheries Science Center, NOAA Fisheries, spotted Wade's potential early on. "Paul had the gift of being able to tackle very difficult and complex quantitative modeling, as well as the passion and interest in conservation biology," Demaster said. "He loved the opportunity to go to sea, yet flourished in the enriched academic environment at Scripps." Today, Wade's knowledge of logistic constraints in doing marine mammal research is invaluable when it comes to designing experiments that are likely to produce the desired results at an affordable cost, Demaster says.

For example, Wade's team initiated a three-year study in 2001 with the aim of providing information on killer whales in the Gulf of Alaska and around the Aleutian Islands. Because resident killer whales are known to be primarily fish-eaters and transient killer whales feed primarily on marine mammals (such as sea lions), the highest priority was to estimate the abundance of transient killer whales. Differences between resident-type killer whales and transient-type killer whales can be distinguished based on examination of differences in the dorsal fin and adjacent saddle patch region. Now Wade and his colleagues are determining what transients eat and where.

In addition to taking photographs of individual whales for later identification and tracking, the researchers collected biopsy samples by using a pneumatic rifle that shoots a lightweight dart. The dart rebounds from the whale and floats, retaining a small sample of epidermal tissue and subcutaneous blubber that are used in genetic and other studies.

Over the three-year period the team sighted 5,178 individual marine mammals including 1,038 killer whales (in groups of from two to 90), 773 humpback whales, 580 fin whales, 96 minke whales, 44 sperm whales, 123 gray whales, and

2,072 Dall's porpoises, among others.

"A typical day for me at sea," Wade said, "would be to get up at six-thirty a.m. and rotate through observer watches on binoculars during the day to locate whales. When we find whales, we deploy our twenty-two-foot rigid-hulled inflatable so we can approach the whales closely for photographs and biopsy samples. I usually pilot the boat, and we can be back on the water anywhere from two to ten hours following whales. At some point during the evening back on the ship, I have to meet with the captain to check the weather and make plans for the next day. After nightfall I make sure all the data and samples get processed, catch up on things like writing reports and e-mail, and try to hit my bunk by midnight."

Wade's knowledge, savvy, and patience garner high marks from his colleagues. Phillip Clapham, a renowned large-whale biologist who used to work in Woods Hole, says of Wade, "To really make a difference as a scientist, you need three qualities: considerable intellectual ability, a deep commitment to conservation, and a drive to merge your work with the sometimes harsh realities of politics. Many scientists do their work—well or ill—in an ivory tower and don't give a damn about whether what they do contributes to the preservation of the species that they study. Others believe strongly in conservation but don't know how to make the connection between science and the real world, in which political and management decisions are made. Paul is a rarity in that he practices outstanding science—some of the best in our field—and has a bulldog-like determination in the application of that work to conservation."

Assessing the future, Wade says we're fortunate to be witnessing the strong recovery of many species of large whales, such as humpbacks, following the cessation of uncontrolled commercial whaling. In contrast, the fate of several other severely depleted whale species, such as North Atlantic right whales, remains uncertain because their populations are small and they are killed from collisions with ships and entanglements with fishing gear.

While his prognosis is mixed, Wade's passion remains pure. "I love learning about science and wildlife, which I get to do on a continuing basis," he said. "I have friends in the scientific community throughout the world and I get to go to beautiful parts of the world. And, of course, it's always wonderful seeing whales."
—David Treadwell

Caroline Harwood '73

In a small office at the bottom of a science building in the middle of a mammoth campus at the center of Seattle, one of the nation's leading microbiologists heads a team charged with developing a new way to produce a biofuel that may one day help ease the world's dependence on petroleum. The scientist is Carrie Harwood '73, professor of microbiology at the University of Washington, and her no-longer-so-secret weapon is the metabolically versatile phototrophic bacterium *Rhodopseudomonas palustris*, a potential catalyst for the production of hydrogen, a biofuel.

The plan is this: genetically engineer *Rhodopseudomonas palustris* so that in order to live it has to produce hydrogen—and a lot of it. Eventually the bacteria would be embedded in a sort of solar panel to maximize the photosynthetic process that is essential to the bacterium's hydrogen production. Some far-fetched futuristic scheme?

Not at all.

"The process of getting this all [genetically] engineered—we can make a lot of progress in five years," Harwood said. "Clean up all the details in the next five years. I'm really excited."

Her team's largely federally funded research has the potential to change the way we live. They have published several papers, with more in the works, that they hope will establish *Rhodopseudomonas palustris* as a model for studies of bio-hydrogen production.

"I love my work," Harwood said.

And she has ever since she was a biology major (one of only seven in her graduating class). With the enthusiastic support from the Colby faculty of the time, she decided to pursue a career in science, settling on microbiology.

"When I was at Colby, I had no idea that I'd end up as a professor at a major research university," Harwood said.

The path was this. After earning a master's degree in biology at Boston University, Harwood spent a career-shaping summer working at the Marine Biological Laboratory at the Woods Hole Institute. "While studying microbial diversity, I learned that you can grow bacteria, which has the most breadth of all forms of life, in a test tube and study any properties you want to study. I knew that that's what I wanted to do."

Then Harwood moved on to the University of Massachusetts at Amherst to pursue her doctorate and commence her study of bacterial physiology. "I loved graduate school. When you know something that no one else knows, that for me is a 'Wow!'" After completing postdoctoral studies at Yale and Cornell, she spent eight years at the University of Iowa, where she developed her main focus of research, bacterial physiology.

While at Iowa she developed a new area of research interest related to her daughter's condition: cystic fibrosis. Harwood is interested in the pathogen *Pseudomonas aeruginosa*, the bacteria that infect and damage the lungs of most cystic fibrosis patients.

Harwood moved to Seattle in 2005 to join the faculty at the University of Washington. She continues to lead studies of the cystic-fibrosis bacterium, attempting to determine how it grows in high densities in low-oxygen environments, like the mucous in a person's lungs.

She also is principal investigator for the team working to

PHOTO BY YULIA IVASHCHENKO, NOAA/NATIONAL MARINE MAMMAL LABORATORY

define the metabolic networks that lead to hydrogen generation. The team, made up of postdoctoral fellows and graduate students, is working to define the essential components in each network and how they are regulated in order to effectively predict and maximize hydrogen production by *Rhodopseudomonas palustris*.

"This is a whole new way of thinking in biology, sometimes called systems biology," Harwood explained. "We're not just analyzing one gene or enzyme at a time; we're studying everything at once. And this bacteria contains about five-thousand genes. We have to be patient; most days we make no progress at all. But the process of discovery is exciting, no matter how long it takes."

Harwood acknowledges that her pioneering roles have extended beyond her work itself. "There were very few women professors when I was at Colby, and there still aren't enough women nationwide in the sciences. I'm incredibly fortunate to be living at this time, to ride at the front of the wave."

This, she said, is "the golden age of biology." —*David Treadwell*

Caroline Harwood '73 at work in her lab at the University of Washington. Harwood and her team of researchers are developing ways to use bacteria to produce hydrogen for use as an energy source.

Patrick Wood '75, M.D.

Soft classical music calms Patrick Wood '75, M.D., while he pores over paperwork in his office. But in the operating room, it's all rock 'n' roll.

The liver-transplant specialist prefers Jimi Hendrix or The Doors while performing surgeries at his private practice in downtown Houston. "In the OR there's a lot of activity going on. So I'm big on old-time rock 'n' roll," said Wood. Then he joked, "I'm not too much on rap or the new stuff, being an old man."

Though his taste in music may be stuck in '70s, his work in the medical field is cutting edge.

Wood founded three liver-transplant centers in Houston during the last 15 years and has since become one of the region's premier surgeons. As the chief of liver transplantation at St. Luke's Episcopal Hospital, he is well respected for his work with livers—considered the most difficult organ to transplant—but over the last few years has transitioned more into general surgery.

He has also performed or been involved in hundreds of transplant surgeries as a medical director with the Texas nonprofit organ agency LifeGift.

Despite a demanding schedule that often requires 12-hour workdays and middle-of-the-night surgeries, "I love what I do," Wood said. "Somebody's putting their life in your hands."

Being a transplant surgeon has always appealed to him, he said, because of the relationships he develops with his patients. Unlike general surgery patients, who have relatively little face time with their doctor before and after the procedure, organ recipients require long-term care. Wood still checks up on patients he operated on a decade ago, and, since many of those patients were children, he has watched them grow into adults.

"You have a long relationship with the patient prior to the transplant because sometimes they can be on the waiting list for a couple of years," Wood said. "So you're seeing them through that whole process and then you do an operation that's probably the most intense operation that's done, then you get to follow them long term."

After graduating from Colby, Wood went to medical school at New York University and completed a fellowship at the University of Pittsburgh School of Medicine.

His career got off to an impressive start in 1984, when he was part of a University of Pittsburgh team that successfully completed a liver-kidney transplant in a young girl—the first such dual transplant in the world.

That patient, he later learned, was his wife's cousin.

Back then, the science of transplants was very different, and

most patients did not survive. Today the chance of survival for a liver-transplant patient during the first year after surgery is in the high 80-percent range, according to the United Network for Organ Sharing; after five years the survival rate drops to a percent in the low 70s.

But with medical advances has come a new obstacle: the demand for liver donors far exceeds the supply. About 17 people die in the United States each day waiting for a transplant, according to LifeGift. "It's hard on the patients because we know if we can get them transplanted successfully they'll do very well," Wood said. "The problem is getting them a donor."

The desire to help close that gap led Wood to volunteer with LifeGift. As a regional medical director, Wood must approve and coordinate every transplant case in several Texas cities. That often means phone calls and surgeries in the middle of the night.

"There are hundreds of people alive today because of Pat Wood and his skills as a surgeon and as a physician," said Sam Holtzman, president of LifeGift.

It's not only what Wood does for his patients physically, Holtzman said. He also fosters emotional healing using humor. Wood's jokes are notoriously irreverent, patients and co-workers say. "It's that kind of humor that sort of relieves the tension and keeps everybody on an even keel while you're rushing around trying to save lives," Holtzman said.

One such saved life was that of Bill Malmquist, a Houstonian who was listed for a liver transplant in 1994.

Malmquist's first interaction with Wood was an incredible disappointment: he was told to prepare for a transplant, only to be informed by Wood that the organ was not good enough quality. But several months later, he successfully received a donor liver, and Wood performed the surgery. Though Malmquist will be on medication for the rest of his life, the 59-year-old is now healthy.

"We have such faith in [Wood]," Malmquist said. "He gives you the confidence that he's going to do everything in the world to make your life as comfortable as possible for as long as it can be."

Perhaps that knack comes from his background. The son of two nurses, Wood knew since age 10 that he wanted to be a doctor. He used to spend hours in the emergency room at the hospital in his hometown of Newport, Rhode Island, where his mother worked the night shift.

But it was during his time at Colby that the biology major honed his interest in medicine. After a football knee injury, he worked in the sports training room with then-trainer Carl Nelson, who Wood still refers to as his mentor.

He moved to Houston, which boasts one of the world's largest medical centers, in 1991 to work at the University of Texas Health Science Center Medical School, and he later formed his private practice, Transplantation and General Surgery Associates, with another surgeon.

With a busy and unpredictable schedule, even finding the time to interview for this story was difficult (the meeting was cancelled twice because of emergency surgeries). But Wood manages to find time for his hobby, fishing, and to spend with his family; he remarried seven years ago and has a son and three stepchildren. A framed family photo is displayed prominently on his desk, surrounded by otter collectibles.

But the desk also holds several photos of a different type of family: his patients. Their success stories, he said, could not exist without the organ donations made by grieving families.

"Whether you want to be a donor or don't want to be a donor, either way, it's important to make sure your family knows," Wood said. "If there's one message in this, it's 'think about organ donation.'"

—By Alexis Grant '03

PHOTOS BY MARY LEVIN, LEFT, AND JOHNNY HANSEN, BELOW

Patrick Wood '75 in surgery at St. Luke's Episcopal Hospital in Houston, Texas, where he is chief of liver transplantation. Wood says, "I love what I do."