Will Work for Food

BY PAIGE EATON

FOR CENTURIES, MAN HAS TRAINED ANIMALS to perform labor, be companions and entertain. Historically, large animals such as elephants, camels and horses have been used for agricultural and transport work. Smaller creatures such as canines, monkeys and homing pigeons have performed wide-ranging jobs that include home security, soaring into outer space and delivering messages. Interestingly, even insects as tiny as "trained" fleas have acted in carnival attractions. Now, thanks to modern science, one Texas company is teaching trillions of the tiniest creatures among us, microbes, to work in the oil patch.

Microbes are the oldest life-form, and without them we could not survive. They occur naturally in all environments and live on every surface and subsurface, including on and within humans. Microbes are so small that they can't be seen with the naked eye, and millions of them can fit on the head of a pin. So it's hard to believe that these microscopic creatures can be trained in the service of mankind at all—much less the extraordinary, such as unlocking trapped oil from underground. But they can.

"We like to say from brute force to biology," quips Dr. Michael Pavia, the chief technology officer of Houston-based energy company Glori Energy. By trade, Pavia is a chemist and spent most of his career in pharmaceuticals. But since 2013, he's trained his focus on the oil industry to direct Glori's laboratory efforts to employ microbes in oil fields.

Why would that even be beneficial? In the life of every oil reservoir, there comes a time when it reaches what is called the economic limit. That's when the production rate of oil can't cover the expenses, much less turn a profit. This happens over time as an oil well loses pressure, causing the oil extraction rate to slow. Pavia says that after the initial profitable extraction, over two-thirds of the oil in a typical oil reservoir becomes trapped and is unrecoverable using conventional methods. Secondary recovery methods are labor-intensive and expensive. Therefore, an enormous amount of oil is left underground because it's just not profitable to extract. A worldwide consortium of scientists, biologists and engineers have found a way to change that.

In the mid-2000s, The Energy and Resources Institute of India, known as TERI, along with India's Oil and Natural Gas Corp., demonstrated how an oil reservoir's native microbes could be used to greatly increase the yield of a slowing well. Michael Schulhof, the managing director of Global Technology Investments LLC, learned of the technology and decided to bring it to the United States. By combining parts of the Global and TERI names, Glori was formed.

TOP: Nutrients are pumped from a tank into the water supply circulating into the oil field. Only 100 nutrient parts per million water parts are needed to begin a microbe feeding frenzy to help extract oil.

BOTTOM: From left, Ken Nimitz, Glori Energy's senior vice president of operations; Johnny Ziegler, Glori's Coke field production foreman; and Dr. Michael Pavia, Glori's chief technology officer, stand in the Coke field, Glori's first acquisition where the company serves as owner-operator.

Once the company brought the technology to the U.S., the team learned that the technology needed further optimization to be most effective. So they reached out in a collaborative way to the global oil community, finding some promising technologies in Russia, Argentina and Norway. After the integration of those improvements, the results were a patented process called the AERO system, which stands for Activated Environment for Recovery of Oil. The finders say it has the potential to free billions of barrels of trapped oil.

At first, Glori used AERO in operations for other oil producers in about 15 different fields in the U.S., Canada and Brazil. Then, in March 2014, the company purchased its own oil field in the Coke community of Wood County. This summer, Glori engaged the AERO system, which is expected to produce a population explosion of microworkers to assist them in oil recovery. To accomplish this feat, they had to know a little bit about microbe behavior, and that's where Pavia and his team of microbiologists came in.

"Food, everything you eat, is made up of chemicals," Pavia says. "Your body, all of us, everything that lives, even the microbes, need certain essential nutrients. Everybody needs nitrogen, for example. Everybody needs phosphorous. Everybody needs carbon. So that is basically what we do. We test various sources of nitrogen, phosphorous and other essential nutrients in various combinations until the microbes do what we want them to do." And he says, "Microbes are really very interesting. If you tell a microbe community to do THIS or die, they will always do THIS. They are very amazing things."

In simpler terms, to get the microbes to do what scientists want, they concoct a food source that has every essential nutrient that the microbes need except carbon, which is vital to their existence. The scientists want to force the microbes to use hydrocarbons from the ground-locked oil as part of their food source. Basically, they want the microbes to eat just a little bit of the oil. "You don't give it a choice," Pavia says. "We set up a laboratory system that says to the microbe, 'You are going to use this oil as your carbon source. And we are going to give you various nutrients to allow you to use this oil as your carbon source. It's your choice. You can either eat that oil and survive or don't and die.' And they eat it, and they are happy to eat it!"

The microbes must adapt to be able to eat the oil. That's because microbes live in water, and water and oil don't mix. So the microbes form these tiny slippery appendages (like hands)

Ken Nimitz, Glori's senior vice president of operations, checks the oxygen flow to the nutrient tank to ensure adequate supplies for microbes.

that they did not ever have before, to get some oil. Then, with their new little hands, they reach through the oil-water barrier and pull some oil into their world of water. This act of pulling the oil through the oil-water barrier has an effect similar to dropping dishwashing liquid into a greasy frying pan. It loosens the oil and allows it to move. Don't worry, the microbes only eat a very small portion of the oil, so they are not gobbling up the profits. In the process of dining, they set off a reaction that frees the oil.

In addition to loosening the oil, Glori wants the microbes to move the oil, or change the path of the water that forces oil from the reservoir. They do this because as the microbes eat the nutrients, they begin to multiply. As the colony of microbes grows and expands, they begin to block fissures and cracks in the sandstone, forcing water into new areas, which allows new oil to be released for production.

With the AERO system, unlike some others, all of the microbes that are "put to work" are subterranean in nature, and native and natural to the sandstone water-flooded reservoir where the technology is implemented. There are no new "bugs" introduced. When Glori first starts a job, a technician will take some water samples to Glori's Houston lab, where a biologist will determine what those particular microbes like to eat. The biologist can perform 96 different experiments of combinations of nutrients at a time. They continue these tests until they discover the combination of food that causes the microbes to perform as needed at a reservoir site. Once they have the secret sauce, they mix up a batch and send it to the field to feed the hungry native microbes.

In the Coke field, Ken Nimitz, Glori's senior vice president of operations, says that they injected the first well with nutrients in July. The Coke field is about 9 square miles and has 31 wellheads. Glori plans to use six of those as nutrient injection sites and the remaining 25 as extraction sites.

"We are in the first inning," Nimitz says. "You have to build up the biology. It takes time for [the microbes] to multiply to a degree that they will have the effect we need. That can take anywhere from two to six months."

As the process moves along, Glori also systematically tests the sites where the nutrients are going in and the oil is coming out to ensure there is no environmental impact.

"We analyze going in and going out," Pavia says. "Nothing has changed. The only thing that has changed is there is more oil."

That is the plan. Just as important to that plan is the vital requirement that the operations be performed inexpensively.

"Our cost to extract the oil is way under the current cost of oil," Nimitz says.

In a downturned oil market, this can be extremely attractive. Another main selling point of the AERO system is its environmental angle. Extracting more oil from the thousands of wells that have already been drilled and abandoned or that have slowed puts those wells into useful service without any additional drilling.

"More oil. More benefit," Pavia says. "This activity is protecting jobs and revenues. Everybody wins."

Glori leaders believe their AERO system will be the solution to recovering billions of barrels of oil from existing infrastructure. They like to say they are securing tomorrow's oil from yesterday's wells. Although the Coke field is the first major acquisition by Glori as an owner-operator, the company is actively negotiating to acquire more reservoirs throughout North America that fit the criteria for implementation of the AERO system. Those properties can be producing or inactive, but they must be sandstone reservoirs that have responded well to water flood operations.

Right now, the company has about 50 active employees. Eight of those are mechanics, pumpers, oil field technicians and production foremen who are based in Wood County to support the Coke field. Those workers are supplemented with four to five contract workers, as needed. And then, of course, let's not forget the trillion or so of the smallest roustabouts, the microbes, who are simply working for their dinner.

To learn more about Glori, its operations and the AERO system, visit glorienergy.com.

Encouraging your children to turn off the lights when they leave a room will help build energy-saving habits that last a lifetime.

Electrical Tips for Children

AT WOOD COUNTY ELECTRIC COOPERATIVE, we understand that your children's health and well-being are top priority. With thousands of electrical fires and electrical shocks occurring in American homes each year, knowledge of electrical safety is necessary to ensure that your loved ones stay safe. A few tips can help teach good habits to keep your little ones safe:

Electrical fires are caused when a wire or electrical device overheats. Make sure your children understand that water cannot extinguish this type of fire. Only fire extinguishers can be used to put out an electrical fire.

Electrical shocks are also a common safety hazard. Remind your kids that it is never a good idea to mix water with electricity. Keep blow dryers, radios and any other electrical devices away from all water, especially in a bathroom. Make sure ground-fault circuit interrupters are installed in all outlets in areas that might come into contact with water, such as bathrooms, laundry rooms, kitchens and outdoors.

Keep metal objects out of appliances and plugs. If a piece of toast gets stuck in the toaster, never use a metal knife to retrieve it. Unplug the toaster, allow it to cool, and use a different tool or utensil to remove the toast.

Remember, only plugs should go into outlets. Sticking fingers or other objects in outlets may result in an electrical shock and possibly a fire.

It's always a good idea to turn off lights when they are not in use. You may feel like you tell your kids hundreds of times a day to turn off lights when they're not using them, but it's worth the effort. Not only will this save your family money on your electric bill; it could also prevent electrical fires from overheated bulbs.

For outside play, remind children to avoid overhead power lines. Whether they are climbing trees, flying kites or playing with remote-controlled toys, they should always be mindful of what is above.

Talk to your children about the importance of electrical safety, and more important, lead by example—because you never know when little ones might be watching.

For more information about electrical safety, visit wcec.org.

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MOBILE CONVENIENCE CENTER

Monday, First Methodist Church, *Van*
Tuesday, Family Dollar, *Mount Vernon*
Wednesday, City National Bank, *Hawkins*
Thursday, Brookshire's, *Winnsboro*
Friday, Economy Drug, *Grand Saline*

Wood County EC recognizes its employees who have served in the military, including, from left, Daniel Williams, journeyman lineman; Daniel Miller, dispatcher; Chris Garrigus, apprentice 2 lineman; Daren Turner, right-of-way assistant; and David Spindle, journeyman lineman.

Veterans Among Us

AT ITS CORE, WOOD COUNTY ELECTRIC COOPERATIVE is a service organization, and our employees must have servants' hearts. There are a few who served in extraordinary ways before coming to work for the cooperative. We are proud of the co-op men who have served in various branches of the U.S. military, and we wanted to tell you a little bit about them.

Daniel Miller served in the U.S. Marines for four years. He was a 0331 machine gunner with the 1st Marine Division, 2nd Battalion, 5th Marines, and was stationed at Camp Pendleton, California. Miller was deployed in 2001 with the 31st Marine Expeditionary Unit during 9/11 and was sent in 2003 to Kuwait to begin the efforts of Operation Iraqi Freedom. He now lives in Mineola with his wife and two daughters. At WCEC, Miller is a dispatcher, fielding calls and dispatching WCEC servicemen and linemen to member locations.

Daniel Williams served in the U.S. Marines for four years. He was a 0311 infantryman with the 3rd Battalion, 3rd Marine Division and was stationed in Kaneohe, Hawaii. Williams now lives in Pickton with his wife and three children. At WCEC, where we all call him "Boone" for his love of the outdoors, Williams is a journeyman lineman on a construction crew that builds and maintains lines on our system.

Chris Garrigus is an apprentice 2 lineman at WCEC. Before joining the co-op, Garrigus was a U.S. paratrooper who served in the 4th Brigade, 25th Infantry Division of the U.S. Army for eight years. Spending most of his days stationed in Anchorage, Alaska, Garrigus was later deployed to help in the efforts of Operation Iraqi Freedom. He now lives in Mineola with his wife and three children.

David Spindle served in the U.S. Army for five years as an artillery cannon crewmember of the 3rd Calvary Division. Spending most of his time in Fort Carson, Colorado, and Fort Sill, Oklahoma, Spindle was later deployed to Iraq to help in the efforts of Operation Iraqi Freedom. Spindle lives in Alba with his wife and two children. At WCEC, he is a journeyman lineman and spends his time building and maintaining lines.

Daren Turner served in the U.S. Marines for three years with the ORD Maintenance Company of the 4th Maintenance Battalion. Stationed mostly at Camp Pendleton in San Diego, California, Turner finished his time in Waco as an amphibious assault vehicle driver. Turner lives in Van with his wife and three children. At WCEC, he is the right-of-way assistant and meets with members regarding tree trimming and removal and supervises crews in the field.

Letter From the CEO

DEAR MEMBERS,

This month is a time of reflection as we gather with friends and family for Thanksgiving. At Wood County Electric Cooperative, among our many blessings, we are especially thankful for our members who support our mission to provide reliable electricity at a reasonable rate, as well as our strong presence in sustaining the communities we serve.

This month, in addition to Thanksgiving, we also observe Veterans Day. How appropriate that these two holidays are both in November—because one of our greatest blessings as citizens of these United States is our freedom. We also are thankful and pay tribute to all of the U.S. military members, past and present, who have served. We are grateful to them beyond measure.

I'm also personally thankful for all of the dedicated WCEC employees, and our board, who daily demonstrate a level of professionalism and duty that I find inspiring. I'm proud to be among them.

May you and your loved ones have a happy and healthy holiday.

With Thanksgiving,
Debbie L. Robinson
CEO/General Manager
Wood County Electric Cooperative

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Veterans Day November 11

Wood County EC thanks all veterans for their service.

LISA F. YOUNG | DOLLAR PHOTO CLUB

Prepare Now for Winter Storms

IT'S HARD TO PREDICT THE WEATHER, but it's easy to prepare for it. Here's how to plan ahead for unavoidable power outages that can accompany winter storms.

Listen to weather forecasts often so you'll know when high winds, heavy rains or ice are on their way.

Prepare an outage kit that contains: a battery-powered radio, fresh batteries, a flashlight, candles, matches, a wind-up clock, bottled water, and paper plates and plastic utensils.

Teach children to stay away from fallen or sagging power lines. They could be energized and dangerous, even if the power is out.

Keep a stock of canned food and a manual can opener. Consider buying a camp stove and fuel that you can use (outdoors only, please) if you can't cook on your electric stove.

Tape outage reporting phone numbers for Wood County Electric Cooperative on your refrigerator so they will be handy if you must report an outage: To report an outage, call (903) 763-2203.

Pile a few extra blankets and sweaters together so you can find them easily if the heat goes off.

We all hope that the weather will spare us, and we won't have any outages this winter. If we do, however, you can count on Wood County EC to restore power as quickly as possible.