InSight

IMAGERY FROM THE WORLD OF FSU RESEARCH & CREATIVITY

Gift from the Sea

For nearly a decade before his death in 1968, American author John Steinbeck maintained a steady correspondence and close friendship with Jack Rudloe, founder of Gulf Specimen Marine Laboratory in Panacea, Florida. An amateur marine specimen collector, Steinbeck made a six-week collecting trip in 1940 around the Baja Peninsula in the Gulf of California with his friend, Ed Ricketts, a professional marine biologist in Monterey's Cannery Row (and the inspiration for Steinbeck's fictional character, Doc). The famous journey, on the vessel, *The Western Flyer*—a 75-foot purse seiner—was documented in the 1941 book, the *Sea of Cortez*, which featured delicate, pencil illustrations of sea urchins, sun stars and bristleworms cataloged and processed on the trip (more than 500 species of fauna were documented on the voyage). As a gesture of friendship, Stenbeck gave Rudloe, the original portfolio of drawings by California artist Alberte Spratt (1893-1950). Those drawings are currently housed in the Special Collections Department at FSU's Strozier Library. For more about Rudloe and his wife, Anne, a marine biologist and longtime FSU adjunct professor (*see page 28*).—E.B.

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Research in Review

CELEBRATING 40 Years

A CHAT WITH E.O. WILSON

The modern icon of evolutionary biology talks candidly about human nature, race, and a threat to science Darwin could never have imagined— political correctness. p.14

PLUS:

40TH ANNIVERSARY EDITION

1969-2009

A SALUTE TO OUR 40TH YEAR

Research in Review celebrates its fourth decade in this, the nationally designated Year of Science 2009. For such a young university (in 1947, Florida State College for Women became Florida State University), to have been in the business of writing about research and scholarship for a general audience for 40 years is noteworthy. Not only has this span of time seen unimagined changes at Florida State, but the university's evolution as a major research center parallels profound changes in Florida as well.

In 1969, the state's population was only 6.7 million, but already Florida was the fastest growing state in the nation. Like its famous space program, Florida's population was headed to the moon—today, nearly 19 million residents crowd the peninsula. *Research in Review* has steadfastly chronicled the impact this unprecedented human wave has had on the state's natural resources, its people and its economy by reporting on the work of a dedicated core of academic specialists in fields ranging from marine biology to urban and regional planning.

The story these scholars have told us through these pages hasn't always been cheerful, but we would argue it's never failed to be enlightening and helpful. In truth, the problems Florida finds itself wrestling with today are in many ways no more vexing than what it faced 40 years ago, when great leaps in science and technology buoyed public confidence in Florida's future (and often to unrealistic levels).

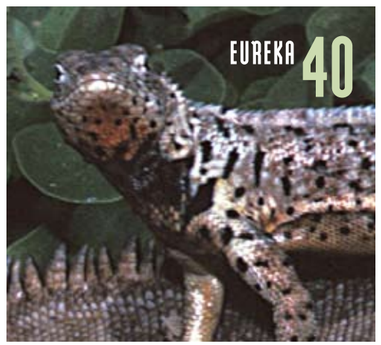
Even in our current recessionary malaise, the good news is that the drive to overcome challenges to our commonwealth is keener at Florida State than ever. We look forward to the prospect of keeping the story of that struggle fresh and perhaps even fun to read for years to come. *—Frank Stephenson*

In This Issue

SUMMER 2009 • VOL.XIX NO.1

FEATURES

ATTENTION TEACHERS: We encourage the use of this magazine as a teaching aid for middle and high school students. For more details, e-mail the editor at fstephenson@fsu.edu or call 850-644-8634.



DEPARTMENTS

Research in Review

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abstracts

Devoted Avian Dads

From towering ostriches to tinamous—a family of quail-like birds native to Central and South America—the males help build nests, incubate eggs and rear the young. In a mostly deadbeat-dad animal world, these avian fathers are a rarity.

Where did these dedicated dads come from? And why did their behavior evolve this way when most animal fathers—including dads in more than 95 percent of mammalian species—leave rearing to moms? New research suggests these birds' caring origins go back to a surprising source: their long-extinct dinosaur ancestors.

Scientists had theorized that male birds' devotion originated after they evolved from theropods—bipedal, carnivorous dinosaurs (think ferocious velociraptors from Jurassic Park).

Then a team of researchers, led by David Varrichio at Montana State University and including Gregory Erickson of Florida State, studied bones from seven fossilized theropods found in brooding positions on top of eggs.

Erickson, associate professor of biological science and former host of National Geographic Channel's show *Hunter and Hunted*, sliced and examined the bones and found that none showed evidence of a medullary bone, a structure normally found in breeding female birds.

"It was evidence that these were males, not females," Erickson said.

In their article published in the journal *Science* last December, the team also reported that the dinosaurs were most likely polygamous. Their analysis showed that the volume of eggs compared to the size of the parents most closely matches the pattern they see in ostriches and their living kin that are polygamous.

The most thrilling part of the work, Erickson said, is fleshing out the evolutionary story of how modern birds developed from dinosaurs. Over time, dinosaurs acquired a hodge-podge of characteristics that would later show up in their avian descendents and allow them to develop into one of the most diverse animal groups on the planet with more than 10,000 species. Thanks to recent access to fossil-rich sites in China, Erickson said, paleobiologists are able to close gaps in the evolutionary record faster than ever.

"The field has exploded," he said. He estimated that about one new dinosaur species is discovered per week. "The dinosaurs are completely different than when I became a graduate student in '89… And as a result, our views of these animals have changed dramatically." —C.S

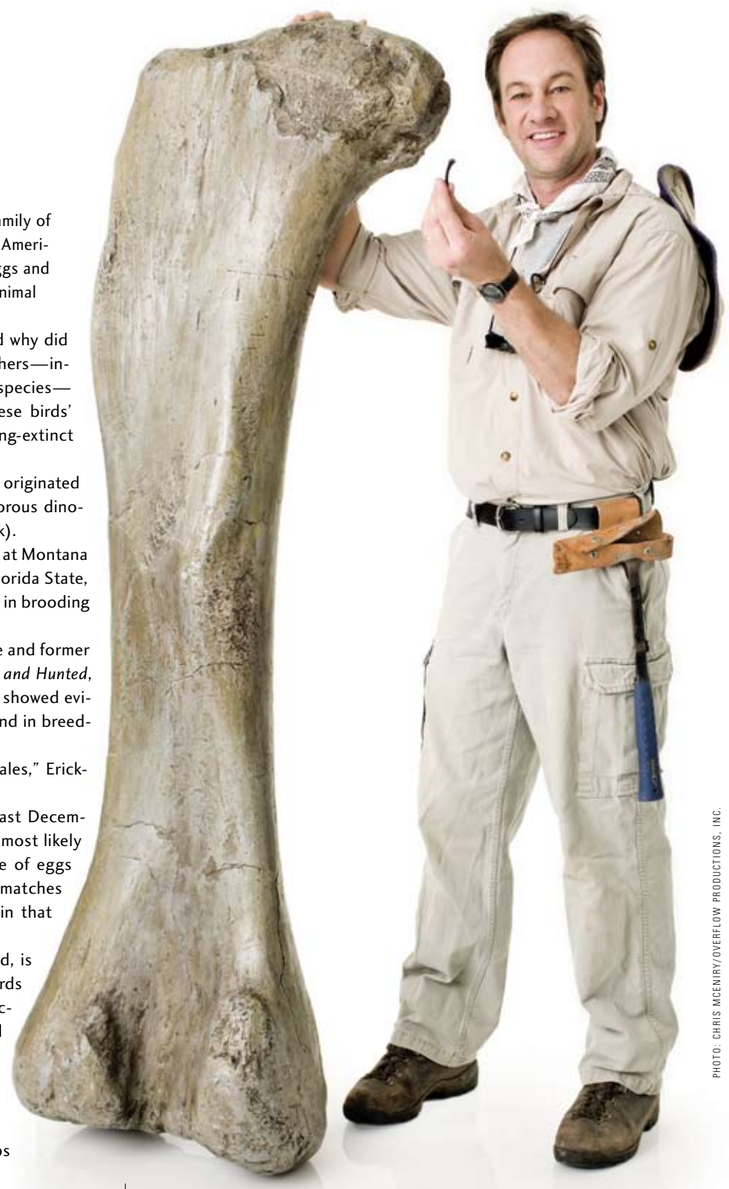

PHOTO: CHRIS MCENIRY/OVERFLOW PRODUCTIONS, INC.

BONE MAN: **Dinosaur researcher Gregory Erickson stands next to a thighbone of a 150-million-year-old Apatosaurus, one of the largest land animals that ever lived. In his hand he holds a 150-million-year-old thighbone from one of the smallest dinosaurs ever discovered, a species found in Colorado that he and his colleagues are still naming.**

A Quirky Quark

If there's a way to unravel the mysteries of the universe, physicists have just taken one long-anticipated step toward finding it.

In 1977, scientists became convinced that there was a fundamental particle in the universe that they'd never seen before. It flashes in and out of existence inside everything in the world—from plants to people, stones to stars—but for no longer than a mind-boggling trillionth of a trillionth of a second. Scientists named the fleeting particle the "top" quark.

One mystery about this particular quark—it is one of six—is that it is present at all.

"Only three entities are needed to make everything around us…the 'up' quark, the 'down' quark, and the electron. Why do the others (including the top quark) exist?" says Harrison Prosper, Kirby W. Kemper professor of physics. "Perhaps without the top quark, the universe wouldn't exist as we know it."

At first, physicists predicted the top quark should be easy enough to find, with the biggest being the availability of an instrument sophisticated enough to detect it. They turned to the Fermi National Accelerator Lab, known as Fermilab, outside Chicago. They smashed a trillion pairs of protons and anti-protons together in the lab's particle accelerator, the highest-energy instrument of its kind currently operating in the world.

By 1995, scientists could declare success. They had solid evidence that the top quark did indeed exist, but with a curious hitch—the bizarre particle only appeared with its anti-self, the so-called "anti-top" quark. The particle also was found to be far heavier than anyone expected.

Scientists made another prediction—that it would also be possible to observe the top quark as an individual particle. After Fermilab boosted the energy of the accelerator, physicists smashed more protons and antiprotons together, and kept looking for the single top quark's signature.

Almost exactly 14 years after first observing the top/anti-top pair, a team of physicists, including six from FSU, observed the production of the top quark by itself. The single particle is produced only once in 20 billion collisions.

"We finally had enough energy and collisions to see this thing," says Prosper, who was part of the 1995 top quark discovery team.

The other FSU collaborators on the project include physicists Todd Adams, Susan Blessing, Sharon Hagopian, Horst Wahl, postdoctoral research associate Jedranka Sekaric, and their graduate students.

Getting to know the top quark better will help scientists detect yet another particle: the Higgs boson, dubbed "The God Particle" by Nobel Prize-winning physicist Leon Lederman (now director emeritus of Fermilab). It is the last undiscovered particle in the Standard Model, a comprehensive theory that explains "the behavior of everything around us," Prosper says.

If scientists are lucky, the successful work on the top quark will speed up confirmation that the Higgs particle exists, and inch them infinitesimally closer to understanding the nature of the universe.—C.S

PHOTOS: REIDAR HAHN, FERMILAB

Particle Hunters: **Physicists monitor and collect the faintest traces of subatomic bits of matter in the DZero Control Room during an experiment at Fermi National Laboratory in Batavia, Illinois.** *(below)* Quark Machine: **This massive, 30-foot-tall device, known as the DZero Detector, is the hardware heart of an international experiment involving physicists from 90 institutions and 20 countries. The detector is one of the world's most sophisticated machines used for searching for quarks and other fundamental components of matter.**

Big Strides in Science Ed

As the worried discourse over America's global standing in science education reaches a new level of urgency, a bit of good news shows some trends are headed up.

"We are getting smarter," says Susan Losh, professor of educational psychology. "We're getting more astute at evaluating information about science."

Losh came to this conclusion after analyzing years of survey data meant to track how well the American public understands science. The nearly 24,000 surveys were conducted between 1979 and 2006 by the National Science Foundation.

One of the key questions tested participants on their belief in evolution. They were asked (starting with the 1985 survey) whether the following statement was true or false: "Human beings, as we know them today, developed from earlier species of animals."

Out of the countless science questions that were posed, this one drew Losh's close attention.

"It's a litmus test for what people understand about science," Losh explains.

Only 37 percent of those 65 and older answered "true" while 52 percent of the youngest age group marked "true." When Losh teased apart age, education and generation variables, she found education accounted for the change in evolution support.

"Education is making a big difference in understanding how science operates," she says.

It's an interesting find amid the talk about America's slide in science education rankings. On the 2006 Program for International Student Assessment, U.S. 15-year-olds scored lower than teens in 16 other countries, with the Finns earning bragging rights to the top spot.

One reason for this, Losh says, is that the United States' educational system boasts a high rate of high-school graduates. Not all countries make education for all a priority, and as a result, lower performing students are weeded out and not included in international comparisons. In fact, Losh says, the U.S. has made significant strides in improving science education.

"The changes we've made in science education on the whole have been to get students to understand, not memorize facts," Losh says.

PHOTO: PHOTODISC

At the same time, she does have serious concerns that this positive trend could be easily undermined. Standardized tests have dropped thought-provoking essay questions in favor of easy-to-grade, multiple-choice questions.

"I am for accountability," Losh says, "but if we don't have essays, teachers are going to teach to the test, and we're going to lose what this revolution in science education has started." —C.S.

Culture by the Sea

Sarasota has long been touted as the "Cultural Capital" of Florida—and with good reason: This gem of a coastal city is home to everything from its own unique—and much acclaimed—architectural movement, the Sarasota School of Architecture, to a thriving arts scene that knows few rivals anywhere else in the Southeast.

Now it's host to a major new celebration of the arts that, for five days this fall, will bring together more than 100 extraordinarily gifted artists from around the world. From October 7-11, the Ringling Museum of Art on what Gov. Charlie Crist has called FSU's "cultural campus" in Sarasota will host the first Ringling International Arts Festival—an event funded by a $1.5 million seed grant to the FSU College of Visual Arts, Theatre & Dance from the governor's Office of Trade, Tourism and Economic Development.

Under the artistic direction of New York's Baryshnikov Arts Center—a creative laboratory, performance space and theater in Manhattan's famed Hell's Kitchen—the event will feature works by internationally recognized playwrights, choreographers, stage directors, chamber musicians—even a cabaret performance by edgy, post-modern showgirl, Meow Meow. The Florida State University Symphony Orchestra, which will be led by the respected conductor Roberto Spano, will kick off the gala with a program of Liszt and Beethoven and a performance by pianist Pedja Muzijevic, who has been called by London's Financial Times "a virtuoso musician with fiercely original ideas about the music he plays."

The performance will follow an opening-night reception set amidst the movie-set beauty of the historic Ringling Museum courtyard on Sarasota Bay.

In a sagging economy, the festival, a proposed biennial event, offers a sampling of ticket prices and package deals for every budget: The opening night party and concert ticket duo is $100 ($90 for museum members) while all other events can be had for a range of costs, including a wallet-friendly $10 option.

For more information or to purchase tickets, go to: www.ringlingartsfestival.org. —E.B.

Origins '09 Draws Hundreds

A March tribute to science and discovery struck a lively public chord.

In March, Florida State University pulled off one of the most ambitious celebrations of 2009 as the nationally designated "Year of Science" in the country.

"Origins '09: A Celebration of the Birth & Life of Beginnings," launched March 17, was inspired by the 200th birthday of Charles Darwin (b. 1809), an anniversary feted by science-lovers around the world. The event drew large and enthusiastic crowds for 12 events spread over 12 days.

Designed to appeal to the wider North Florida community, the event sparked a level of interest that came as a pleasant surprise to organizers. The program was built around eight evening lectures and demonstrations by nationally and internationally recognized figures in fields ranging from physics to jazz. Only two events failed to draw overflow crowds, and both coincided with Tallahassee's notorious, crowd-thinning thunderstorms.

Joining headliner **E.O. Wilson**, famed naturalist and author from Harvard, were evolutionary biologist and author **Sean Carroll**; Oxford scholar of religion and science **Peter Harrison**; anthropologist **Don Johanson**, co-discover of "Lucy", the world's most famous fossil; **Lisa Randall**, noted Harvard cosmologist; **Gary Mormino**, Florida's best-known and most prolific historian and **Ron Numbers**, historian of science, medicine and religion at the University of Wisconsin-Madison.

Special treats included a reprise appearance of **Ira Flatow's *Science Friday***, National Public Radio's weekly show featuring science and technology news; and an exemplary tribute to the origins of jazz. Flatow last brought his *Science Friday* program to campus for a live, national broadcast in April 2005. Guests for his March 20 show were Sean Carroll, naturalist and author **Bruce Means**, Lisa Randall and Nobel laureate and FSU professor of chemistry **Harry Kroto**.

Scotty Barnhart, globe-trotting jazz trumpet maestro and assistant professor of jazz studies within Florida State's College of Music, designed and directed the jazz program. His custom-made salute to America's only true musical art form sounded a perfect endnote to Origins '09 on March 28. The spectacular show—"The Origin & Evolution of Jazz"—saw members of both cross-town universities' jazz studies programs performing together for the first time before a thoroughly delighted audience of 1,100.

Bonus events included a day-long Science & Arts Fair held Saturday, March 21, downtown. Held in conjunction with the Challenger Learning Center, this outreach effort featured 35 exhibitors from FSU, Florida A&M and Tallahassee Community College. An estimated crowd of 2,000—with a large contingent of school kids—enjoyed live marine animal touch-tanks, exploding chemistry demonstrations, live jazz, a skull exhibition, pottery-making and a variety of hands-on activities inside the Challenger Center.

PHOTO: MARK WALLHEISER

But a centerpiece of the **Science & Arts Fair** appealed directly to adults—a **Florida Writers' Book Fair**, sponsored by the FSU-based Florida Book Awards program. Twenty-two noted authors of Florida-based books were on hand to greet fans and read from their latest works.

Organizers' worries over public reaction to the program vanished on opening night, when dozens of people were turned away from a talk by Oxford's Peter Harrison on "The Origins of the Conflict Between Science and Religion." Held at a downtown Presbyterian church, the standing-room-only talk set the tone for turn-out thereafter.

No one enjoyed the response more than Kirby Kemper, vice president for research whose office coordinated and helped fund the event.

"We knew there was widespread interest in this community for programs of this nature," he said. "But I think all of us were surprised by just how much interest there is here. People of all ages and all levels of education really want to hear about science and discovery. I think this was one of FSU's finest moments in making this possible for the public to enjoy."

With the exception of the jazz finale, all events were free. Joining the Office of Research as key sponsors were The College of Medicine, the FSU Council for Research and Creativity, the FSU Research Foundation, the Florida Humanities Council and the Tallahassee Scientific Society.

For a video recap of Origins '09, see www.origins.fsu.edu. —F.S.

Archaeologists test the technology of ancient mariners

Nothing tests the mettle of a maritime archeologist more than building a replica of a 3,800-year-old ship and sailing it on the Red Sea.

But that's exactly what FSU anthropologist Cheryl Ward and two dozen sailors, ship builders and archeologists did last year when they recreated a leg of a voyage to what the ancient Egyptians called "Punt" or "God's Land"—a rugged, geographic swath incorporating parts of modern-day Sudan, Ethiopia and Yemen.

The idea for the project—financed largely by a French film company with support from FSU—stemmed from the recent discovery of the oldest artifacts of seagoing ships in caves at Wadi Gawasis in the Egyptian desert. The Egyptians used the caves to build and disassemble cedar-planked boats and equipment between voyages.

"I have always argued that the Egyptians built ships as well or better than they built pyramids, and the incredible efficiency and simple operation of all the ship's systems—steering, rigging, hull—only encourages me to keep sharing that perspective with people," explains Ward, who worked on the project last year while on sabbatical. "Doing the research took me back to data I collected long ago that has new relevance and helps make sense of features I'm just discovering in the port site timbers."

Ward is an internationally recognized maritime archaeologist who specializes in the study of ancient ships and seafaring. Her research looks not only at ships but also at all the points of interaction that humans have with water—coastal cities, river paths, ship technology—even the social structures that support trade.

"What I got interested in was how different groups over time solved the basic problem of getting from one place to another using the tremendous benefit of water travel," Ward says. "And the reason that Wal-Mart exists today is because of giant container ships that come over from China. By moving things by water, you have a huge benefit in terms of cost as well as time moving the same weight of materials over land."

Building an ancient boat that ancient Egyptians mariners might have fancied, took Ward and her team more than a year; sailing it took just two glorious weeks.

And what a week it was.

"What we learned when we built a seagoing ship using the technology of the ancient Egyptians is that the system works great, even in 25 knots of wind and 10-foot seas," Ward recalls. "We had no significant difficulties with the hull."

An amazing feat considering the ship—christened *Min of the Desert*—was built to specifications that ancient Egyptians used that allowed them to take their boats apart and carry them across the desert, more than 90 miles from the Nile to the Red Sea.

"They manufactured ship kits—that's what they did," Ward explains. "They built the ships, labeled everything and then took everything apart."

Typically, massive expeditions of 3,000 to 5,000 people loaded up salted fish, wine, camping equipment, donkeys and sleds and trekked the disassembled boats across the desert.

The idea for the voyage was initiated by Sombrero & Co., a French film company that shot a documentary that will debut this fall at the Louvre museum in Paris.

Over the last few years, Ward made several trips Egypt to further her research and oversee the building of the ship with the help of an Egyptian archaeologist, a naval architect and Mahrous Lahma, the project's primary ship builder.

The voyage traced the ancient route of a similar journey funded by Hatshepsut, a woman pharaoh who reigned in Egypt's 18th dynasty (she ruled around 1475 B.C.) who opened trade networks and oversaw missions to Punt. Built using Douglas fir, the closest cousin to the ancient Egyptians' prized cedar of Lebanon (now considered scarce), the modern 66-foot-long by 16-foot-wide ship was constructed without nails or frames. Only wooden tenons—12- to 14-inch-long pieces of wood—were used by ship builders.

"The thing that's very different about Egyptian boats was that they built them out of very thick planks—10 inches thick, 20 inches wide," Ward explains. "Each plank was locked in place to six other planks in the hull. They weren't straight smooth edges like we would expect, but rather, they narrowed and widened and had what we call "joggles"—small notches along the edge that made them like a jigsaw puzzle, fitting together tightly."

When the expedition finally set sail last December, David Vann, then a member of FSU's English faculty and a seasoned sailor, took the helm. Ward and what she jokingly calls the "Ladies Rowing Team" of six women worked to keep the vessel pointed into the wind.

But they only followed ancient tradition to a point: The ship was trucked 90 miles across the desert rather than transported by donkey and sled.

"The ancient Egyptians appreciated how valuable ships and boats were to building their society. Boats became a symbol of the pharaoh," Ward says. "And we can say that the oldest plank boats in the world that archaeologists have been able to find came from ancient Egypt."—E.B.

VISIT OUR WEB SITE:
www.rinr.fsu.edu
TO SEE MORE FROM WARD'S VOYAGE

PHOTO: STEPHANE BEGOIN

Sailing the *Min of the Desert* on the Red Sea last December. The ship was built using technology of the ancient Egyptians.

***clockwise:* Planners study a pre-construction model of the *Min of the Desert*, a replica of a 3,800-year-old ship**
• Ship builders working on the *Min's* hull
• Cheryl Ward *(second from left, bottom)* and crew during the December '08 voyage
• The crew rows the 66-foot long, 16-foot wide ship. The boat handled well, Ward said, even in 25-knot winds and 10-foot seas.

PHOTOS: CHERYL WARD

BY MARY HOPPE

SEX IN THE SEA

PHOTO: DON LEVITAN

SOME OF THE SIMPLEST ANIMALS IN THE SEA ENJOY A SEX LIFE UNIMAGINABLE TO DARWIN, BUT FASCINATING FOR WHAT IT SAYS ABOUT HIS FAMOUS LEGACY.

In the button-down world of university research, Don Levitan has a very sexy job. The marine ecologist has spent the better part of his career delving into the sex lives of animals who, to put it mildly, just don't get around much.

Levitan is an expert in the spawning habits of sea urchins and corals. At first blush, probing the mating playbook of these sedentary sea creatures may seem insufferably bland. There are no courtship displays or barroom brawls to determine who takes home the girl. No bucks locking antlers or male fiddler crabs making female crabs swoon with a come-hither wave of an oversized claw. No wink and a nod from the sexy sea urchin across the reef.

Even Charles Darwin was unfazed. The pre-eminent English naturalist posited that sexual competition didn't occur among species that fertilize eggs externally, in other words, without copulating. "In the lower division of the animal kingdom," he wrote, "sexual selection seems to have done nothing…(these animals') perspective and intellectual faculties are not sufficiently advanced to allow feelings of love and jealousy or the exertion of choice."

Levitan says this view, coming as it did from such an eminent authority, put a damper on early research into marine invertebrates' mating habits.

"Because naturalists did not realize there were sex differences in these organisms and because no one knew how to measure fertilization in the sea, this remained a largely unexplored topic."

So, pity the poor sea urchin or coral, the conventional thinking went. Too low on the Darwinian totem pole to pick a mate, too dumb to care.

But in recent years, Levitan says research has profoundly changed that thinking. Scientists have discovered that despite what Darwin thought, marine invertebrates such as urchins and corals have a robust—if complicated—sex life that is far beyond anything the father of evolution could have imagined.

Sex and the Single Sea Urchin

Levitan says the best part of his research is how he approaches it. He says he is the only biologist specializing in the reproductive habits of marine organisms who combines field experiments with molecular studies. From coral reefs of the Caribbean, in Panama and in Belize to the frigid coasts of western Canada, since 1989 he has observed firsthand one of nature's most intriguing phenomena—the annual spawning rites of some of the world's most colorful reef-bound marine creatures.

In the brisk waters off the west coast of Vancouver Island, for example, Levitan and his graduate students brave 45-degree waters to study the red sea urchin (*Strongylocentrotus franciscanus).* These small, spiky, globular creatures are members of the phylum Echinodermata, which also includes sea stars, sea cucumbers and brittle stars.

Analogous to wind-aided pollination of plants on land, sea urchin mating is a free-floating affair. Both male and female urchins look for environmental cues to tell them when to release their gametes—their eggs and sperm—into the open water. Levitan said this spawning activity seems to be triggered by a combination of phytoplankton and sperm. When phytoplankton concentrations are sufficiently high, a few males will start to spawn, in turn triggering other males and eventually females to join them.

In a single spawning event, male urchins can release anywhere from

IN FACT, HE WAS THE FIRST BIOLOGIST TO MEASURE PATTERNS OF SEXUAL SELECTION IN AN EXTERNALLY FERTILIZING ORGANISM, PERIOD.

10 billion to 100 billion milky white sperm cells, Levitan said. Females, by comparison, release only a million or so eggs.

How successful this co-mingling of eggs and sperm is—in terms of producing fertilized eggs—can vary widely, Levitan said. Many physical factors come into play, such as currents, wave action, water temperature, salinity and chemistry. Once fertilized, eggs spend about six weeks floating around before settling to the ocean floor and metamorphosing into an adult urchin.

But a major factor in determining the success of an urchin spawning event is a phenomenon well beyond the ken of even the sharpest scientist of Darwin's day. Both the eggs and the sperm cells are coated with layers of special proteins that attract each other, but at different rates. Surprisingly, there are plenty of fireworks in urchin sex—it's just that all the competition between the sexes takes place at the molecular level.

Large protein molecules attached to the surface of urchin eggs and sperm are literally the matchmakers of urchin mating, the key to the animals' existence and their evolutionary history. These critically important molecules determine the compatibility between suitor—sperm cells—and the pursued—the eggs.

Levitan is the first researcher to show how these proteins and other reproductive traits perform in the ocean and influence fertilization in both urchins and corals. In fact, he was the first biologist to measure patterns of sexual selection in an externally fertilizing organism, period. The body of his research represents a book of clues to the evolution of animals that don't need physical contact to reproduce.

Understanding how and under what conditions marine invertebrates successfully reproduce is important both commercially and ecologically. The research aids fisheries managers in determining sustainable harvests for oysters, abalones, mussels, clams and sea urchins, for example, and in designing marine reserves.

Sperm Wars: The Battle for the Prize Egg

But what Levitan and others have come to understand in ever-clearer detail is the importance of the availability of free-swimming sperm, especially to sessile (stationary) animals literally cemented to their homes for life. The relative levels of sperm density during spawning control both the reproductive success and evolution of these animals more than any other factor, said Levitan.

Too many sperm can be as bad—if not worse—than too few. Levitan's research has shed much light on why this is, and what it means.

When a free-swimming urchin (or coral) sperm cell chances upon an egg whose surface proteins find it compatible, the two gametes quickly fuse—"tie the knot," in a manner of speaking. When this happens, the egg immediately erects a cellular barrier to prevent access by other sperm. But if sperm cells happen to be overly abundant, additional sperm can sneak in before the egg gets a chance to erect a defense. Biologists call this condition *polyspermy,* and it is lethal to eggs.

When sperm are at a normal density level, on the other hand, that's generally a plus for a successful spawning event. Polyspermy is kept at a minimum, and thus,

Coral Sex: One Enchanted Evening

AFTER THE FIRST full August moon in Florida and the Bahamas, corals release millions of eggs and sperm in a synchronized mass-spawning ritual. These spectacular displays often include many coral species spawning on the same evening. Gametes (eggs and sperm) in the trillions can thus be broadcast over large distances.

Most mass-spawning corals are hermaphrodites, whose individual polyps contain both sperm and eggs. Each polyp expels a tiny pink bundle containing about a hundred eggs and a million sperm that float towards the surface for a chance rendezvous.

Fertilization produces larvae that ride the tides and currents on a grand voyage that can last for months and sweep them hundreds of miles from their origins. If the tiny larvae somehow survive hungry predators, they will eventually sense suitable hard substrate below, settle, and begin producing a tiny calcium skeleton—the genesis of a great reef that can live for hundreds of years. **–M.H.**

PHOTO: RAPHAEL RITSON-WILLIAMS

Pink bundles of eggs and sperm signal the spawning of this coral *(Monastraea annularis)* off Carrie Bow Cay, Belize.

PHOTO: DON LEVITAN

(inset)
A MALE RED SEA URCHIN ***(Strongylocentrotus franciscanus)*** **off Vancouver Island, British Columbia, releases wisps of sperm during spawning.**

(larger shot)
RED SEA URCHINS, **reportedly the largest urchin in the world, live nowhere near the Red Sea, and get their name from their hue. The invertebrates are found on the rocky shores of the Pacific, ranging from Baja California to Alaska, where they munch primarily on kelp and in turn, serve as primary fodder for sea otters.**

PHOTO: BRANDON COLE MARINE PHOTOGRAPHY

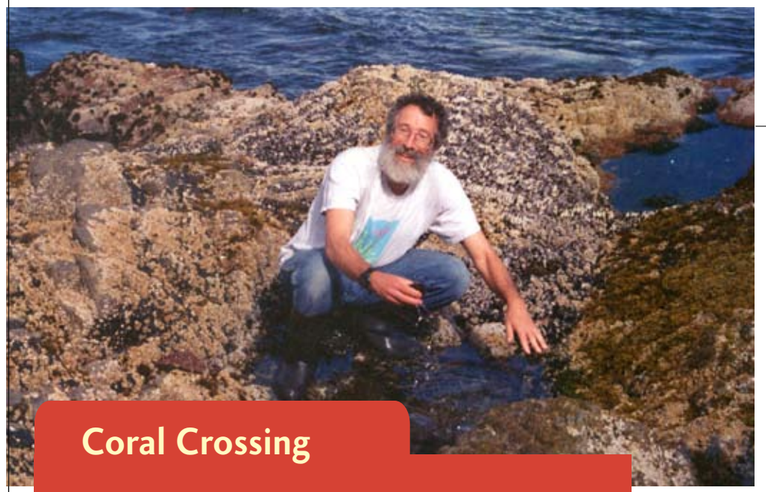

PHOTO: MIA ADREANI

DON LEVITAN, pictured here amid a field experiment on Vancouver Island, ranks as one of the world's top experts in the reproductive biology of sea urchins and corals.

Coral Crossing

How do corals—and the world's seas contain hundreds of species—live and spawn in the same waters without cross-breeding?

Cemented in place as they are, they are obliged to literally cast their sexual seeds to the "wind" of water currents and waves and trust in chance to keep their races alive.

The truth is that in the biology of any organism—plant or animal—that depends on external fertilization (as opposed to internal insemination) to reproduce, cross-breeding (hybridization) happens all the time. As animal breeders know well, cross-breeding can be a good thing.

But left unchecked it can lead to extinctions. In the wild oceans, how do corals deal with the inevitability of hybrid development yet manage to maintain the integrity of their own species?

Coral reproductive biologist Don Levitan said that corals seem to rely on a combination of mechanisms to ensure species integrity. Some species time their spawning to avoid competing directly with the spawning cycles of other species, for example. They also develop proteins on the surfaces of their eggs and sperm cells that help the species sort themselves out during the fertilization frenzy.

"In some places, we see more evidence of hybridization, and we think it has to do with the ecological conditions those corals are living in—water flow, distribution and the abundance of adults," he says.

Scientists are concerned that the loss of corals—a disturbing global phenomenon— not only will affect their ability to successfully reproduce at lower population densities, but also trigger a chain of events resulting in the extinction of some species through cross-breeding.

"As densities go down, more hybridization could lead to the potential for 'genetic swamping' of one species by another leading to extinction of some species." **–M.H.**

compatible proteins are the "winners" in the competition for mates and become more common in the genetic pool.

But that's not the whole story. When sperm are abundant, eggs can rapidly evolve new surface proteins that fight polyspermy. Such eggs become pickier about their choice of mates—deliberately making themselves less compatible to the sperm hordes. Not to be outdone, spurned sperm can start making—evolving—newer and more enticing varieties of proteins, too, and fast. Eventually, the eggs find themselves right back where they started when vast numbers of sperm show up—vulnerable to multiple invasions of sperm (polyspermy) and thus death.

So, sperm are constantly under pressure to provide the best match possible with whatever eggs they encounter, while eggs faced with high sperm densities are constantly evolving mechanisms to repel multiple suitors. When sperm evolve to become a close match, the egg evolves to become a poor match, the male catches up by producing more compatible proteins, and the female once again is "chased away," so to speak.

Still, as a whole, urchins as a species benefit from this evolutionary arms race, Levitan said. Females with highly compatible eggs risk far higher chance of death from polyspermy when sperm are prolific.

Ultimately, females producing less compatible eggs are more successful at having their genes passed on to the next generation. Males do best when the fertilization rate is high and females are more successful when the fertilization rate is lower, resulting in conflict between males and females over the optimal fertilization rate—a tit-for-tat in the sexual game that perhaps even humans can relate to on some subliminal level.

Did Darwin have it all wrong?

Darwin was the first scientist to describe in any detail the dynamics of sexual competition and conquest among species—an elaborately cunning process he called the theory of sexual selection.

In most vertebrate animals, evidence is anywhere one cares

PLAYING SILENTLY BEHIND THIS OFTEN UNCONSCIOUS SORTING PROCESS IN MATE-PICKING IS A MOLECULAR ORCHESTRA THAT MODERN BIOLOGY IS ONLY NOW BEGINNING TO UNDERSTAND.

PHOTO: KERA SCHLINING

to look that his idea—150 years old this year—is rock-solid. To keep themselves from going extinct, animals develop outlandish behaviors and physical accoutrements—from flashy tails to bright red appendages to deep-throated mating calls—in fierce competition to find a suitable mate. The whole elaborate song-and-dance explains how certain evolutionary traits get passed down through the generations, and, if necessary, modified over the eons.

Sexual selection at work is easy to see in a strutting peacock, but all but impossible to notice—with the unaided eye—in an invertebrate life-form that never moves or makes a sound. Darwin was dead-on when he posited that most species survive and evolve on the premises of sexual selection. What he didn't know was that his theory works at the molecular level.

"He was both right and wrong," says Levitan, "in that the act of sexual selection, instead of operating (strictly) on morphological traits, is operating on gamete traits and spawning behavior."

In other words, proteins on the surface of eggs and the number of individuals competing for mates—not physical traits such as body size,

PHOTO: BRIAN SCHLINING

(above) **LEVITAN SURFACES** from the chilly (45 degrees F) off Vancouver Island with an apparatus used to collect red sea urchin eggs in the sea to determine fertilization success. In the boat, grad students Tamara McGovern and technician Brian Schlining help retrieve the device. *(left)* **AT DEPTH,** Levitan injects a red sea urchin with potassium chloride to induce spawning.

fighting appendages or plumage—determine who ends up with whom. And here's the kicker: This system works in humans, too.

"The same sorts of proteins are found on human and mammal eggs," he said. When it comes to picking a husband, women may be picky about the height, weight—and even smell—of whom they choose to marry. Playing silently behind this often unconscious sorting process in mate-picking is a molecular orchestra that modern biology is only now beginning to understand.

"The basic idea is that we need a thorough understanding of gamete (egg and sperm) availability," Levitan said. "In the end, this will provide a basic understanding of egg and sperm compatibility and perhaps provide insight into human fertility." RINR

BY FRANK STEPHENSON

A CHAT WITH

E.O. WILSON

THIS SPRING, THE PEERLESS MAN OF BIOLOGICAL SCIENCE MADE TALLAHASSEE A SPECIAL STOP IN HIS WORLDWIDE CRUSADE TO SAVE LIVING THINGS.

PHOTO: MARK WALLHEISER

WILSON HELD FORTH on the topic "Darwin's Four Great Books: The Origins of a Revolution" to an overflow crowd at Bethel A.M.E. Church in Tallahassee March 23.

On March 22, Edward Osborne Wilson came to Tallahassee to be a keynote speaker for "Origins '09: A Celebration of the Birth & Life of Beginnings." The event was a two-week-long tribute to science and discovery inspired by the 200th birthday of Charles Darwin (b. 1809), a celebration still ringing the globe.

The two-time Pulitzer Prize winning author and world-renowned evolutionary biologist was persuaded to accept the invitation, he said, for several reasons. It's no secret that Wilson has a genuine fondness for Florida State University, and, in particular, a number of its biologists who he counts among his dearest friends and colleagues. "It's also my job; it's what I do," he told conference organizers. "I'm happy to have opportunities like this to talk to people about things I think are so terribly important."

Shaking hands with Wilson for the first time is a daunting experience for anyone with even an inkling of the man's stature in science and natural philosophy. Having some bona fides in Southern culture comes in handy for greasing the nerves.

For example, the sooner one appreciates that the Alabama-born Wilson is partial to white socks, a coon-bottom twang, a farmer's knuckle-popping handshake and a plate of fried mullet and cheese grits, the better. A much-celebrated citizen of the world, the kindly gentleman will happily tell you he'll die a son of the American Southland first.

But if your roots never reached deep into Dixie, don't even think about trying to fake it with this man. Sure, he's been away from "home" for nigh onto six decades now, but don't let that fool you. His ear pans, turned 80 in June, can still detect nuances in the Southern tongue that no latecomer to the storied land of cotton will ever know. Buried in that impossibly fecund brain of his are all the sensory cues that only a joyous, unfettered boyhood in the bayous, woods and swamps of lower Alabama can sync to the soul.

Luckily for this greeter—armed as he is with not one but *two* of Wilson's most coveted possessions (an Alabama birth certificate and a degree from the University of Alabama)—the howdy-dos went down like mayhaw marmalade.

"It's a pleasure to finally meet you, but I have to correct you on something you said right off the bat," he said, grinning. "It's not 'Dr. Wilson.' It's *Ed*. And since you're from Alabama, you know how that's pronounced. It's *AY-ud*. Of course, if you want to get technical, it's *AY-ud-ah!*"

Even in impolite Southern circles, one has to know that, as a rule, introductions don't get much finer than that. The folksy first impression set precisely the right tone for an unforgettable visit with one of the most fascinating individuals of modern times.

But even for such a serious man of the mind as Ed Wilson, there *are* priorities. Such as a mouth-watering seafood dinner with long-time Florida State friends Walter Tschinkel (like Ed, an expert on the social life of ants) and Bruce Means, an FSU-trained herpetologist who's become a well-known naturalist, wildlife photographer, explorer and environmental writer. Over forkfuls of fish and grits, Ed let it drop that he'll soon have a first novel featuring two noble characters—both, as it happens, biologists at Florida State University—who "accidentally" resemble Tschinkel and Means.

His companions paused mid-bites to chew on the news. "Oh, don't you boys worry a bit," Wilson deadpanned. "You both turn out to be heroes."

As the sun set across Ochlockonee Bay, a short drive south of town on the Gulf Coast, Wilson watched as a platter of fried mullet, cheese grits and coleslaw appeared before him. The meal was exactly what he'd asked of his host some months before in a phone call from his Harvard office. *"Oh, my, would you look at this! We just don't see food like this too often in Boston!"* he exclaimed, digging in.

Not a drinking man, he washed it all down with sweet iced tea, tossed praise at a pretty waitress whose accent matched the silky tang of his key lime pie, and knew, in his bones, he was home.

Next evening, Wilson spoke to an overflow crowd of 1,100 from the pulpit of the Bethel AME Church in Tallahassee, his first appearance in a black church. Before he left, he sat down to talk candidly—as few scientists can or do—about some of the many passions that daily fire his resolve to wrestle with an imperiled world. —**F.S.**

SEE **INTERVIEW**/PAGE 18 >

PHOTOS: MARK WALLHEISER

(top) **AN EVOLUTION EVANGELIST,** E.O. Wilson brought a message of hope for saving the planet's biodiversity—as well as a short sermon on the wisdom of Charles Darwin—to packed pews at Bethel A.M.E. Church in Tallahassee March 23. *(below)* **NOBEL LAUREATE** Harry Kroto (in green), professor of chemistry and biochemistry at Florida State, greets Wilson following the talk.

...HE SAT DOWN TO TALK CANDIDLY—AS FEW SCIENTISTS CAN OR DO—ABOUT SOME OF THE MANY PASSIONS THAT DAILY FIRE HIS RESOLVE TO WRESTLE WITH AN IMPERILED WORLD.

INTERVIEW

RinR: *Is there anything truly unnatural on the planet?*
Wilson: There's a lot that's unnatural, obviously. There are systems everywhere in the world that are maintained in their present condition, which usually means a very small number of species, with the water drained off and everything, only by strenuous human effort. When you pull away from that it will revert to a condition that's more stable.

RinR: *But what about the human drive to cause these perturbations? Isn't that natural?*
Wilson: I suppose you might say it's part of human nature. You have to remember that according to our best estimates, *Homo sapiens,* our species, was fully developed as a species a little more than 40,000 years ago, and that's when it broke out of Africa and rapidly spread throughout the world. Up the Danube into Central Europe and it proceeded to wipe out the other species, including Neanderthal Man, and then moved swiftly across the world, changing everything as it moved. Wiping out the large herbivores and carnivores.

RinR: *But again, human nature....*
Wilson: Yes. Well, as I say, the history of humanity in the past 40,000 years has been one of expansion over the world, celebrating the conquering of new territory, changing wild land into cultivated lands and driving out original inhabitants. That's not a political statement, that's a well-documented historical fact.

This is actually a topic I'm writing a book on now, a reconstruction of human history. We've been constantly at war. Is this natural? Well, I've said it's basic to human nature because aggressiveness and qualities that we consider most high—patriotism, fidelity, religion, society's history—is basic. Darwin suggested in the *Descent of Man,* that what we consider our noblest causes and high intelligence was driven by this type of conflict. And that might turn out to be true. Constant war, and the grabbing and changing of the environment, driving human evolution for the last 150,000 years to high levels of intelligence and (therefore making) society everywhere glorify the warrior.

RinR: *Somehow we have popular notions that humans are somehow exempt from natural laws. But there's no evidence we're exempt in any aspect is there?*

Wilson: Not a single exemption has been granted us. We've always felt like the law of the woods doesn't apply to us, because we've always been a conquering species. Always thought the earth was endlessly bountiful. Today, we figure that if we use up something, we'll figure something out. But that's coming to a grinding halt. In America and the rest of the world, the most crucial choking agent will be the shortage of fresh water. Most experts agree now, that's what's going to stop us quicker than running out of energy.

RinR: *So, the notion that humans are a subset apart from animals....*
Wilson: That sounds good in church and on the political campaign, but I'm telling you, it ain't true.

RinR: *Billy Graham once was asked what he'd do if he were God to improve humanity, and he said he'd do away with race. Many biologists today say the concept of race is nonsensical when applied to humans. But they don't have any problem talking about races of salamanders, spider crabs, king snakes and so forth. Why is that and does it make sense?*
Wilson: Human beings have races. Of course, it's the politically correct thing to say otherwise. But the evidence to the contrary is overwhelming. In 1953, what I did, and I didn't mean to be politically correct, was to show that it's very hard to draw boundaries around human races, and say there's this race that is exactly defined here and that race there and so on, in other words, subspecies. But there's plenty of geographic variation, there are a lot of differences between the Zulu in the south and the mountain people of northeastern Africa and from continent to continent. And there are many, many traits.

A few people will deny that these traits differentiate races—different people from different parts of the world—even though the genetic evidence is overwhelming. These people, however, would *not* deny that these (genetic differences are manifest) in physical traits, now increasingly in biochemical traits, and in athletic ability and so on. But where everyone shudders, and want to drop the whole subject, is mental capacity. We simply haven't addressed that issue and we may never have to. That's mainly because in the distribution of innate mental capacity, it's interesting how people turn out in very similar environments. There's such a broad overlap that the vast majority of people, let's say Asians—who are often referred to as innately brighter than Europeans—the overlap is so broad, that in the vast majority of these people you won't be able to tell the difference. And also, in the vast majority of people in both groups, once given the same training they will perform about as well. Where it comes out (the differences) is in the three-sigma end of the curve, the extreme end—only one person in 10,000 for example. And there, you might find that Asian groups are more likely to produce a math genius than a European group. Now we have no trouble at all accepting that concept when it comes for example to marathon running or basketball, but if you just keep straining people out, until now you have the champions of the champions, the elite of the elite, you do see that it turns out to be one particular racial group, e.g. marathoners from the mountains of East Africa. But in the world of political correctness, all this is denied.

RinR: *Let's talk about biodiversity. I've heard that there's not a lot of scientific evidence that the loss of species would be catastrophic for human civilization.*
Wilson: It's a wearing away of our resources when we let species go extinct. Eventually the effect of that will become evident to everyone. There will be major changes as keystone species are removed or added. There are classic examples of how the removal of a single species can completely alter an environment to human detriment. When we shot out all the sea otters off the Pacific coast, the kelp beds disappeared. The otters fed on the sea urchins. Without the otters, the urchins ate all the kelp. When the otters were left alone, the kelp beds eventually returned.

Sometimes if an ecosystem survives or not it's not that much of a concern to the average person. But accumulated, over and over again—and this is well demonstrated in experiments—that system, whether it's a forest or grassland, becomes less and less stable, less resilient, less able to survive a severe drought or burn-over. When you lose that capacity, there can be a catastrophe like a severe drought, which is occurring more and more due to climate change, then you have lost a lot of valuable natural environments, including the soil, ability to produce, and all this will become more apparent as we go along.

CONTINUED PAGE 24

PHOTO: ELLIS MCLEOD

AS THE TWIG IS BENT:
(left) **Ed Wilson at 13, playing with a butterfly net in his native Alabama in 1942. *(below)* working with the ant genus Atta in La Selva, Costa Rica, 1984**

PHOTO: BERT HOLLDOBLER

A WALK IN THE WOODS WITH ED WILSON

FOR THE NEXT HOUR, THE TWO STUDENTS ENTERTAINED THE WORLD'S MOST EMINENT ANT BIOLOGIST ACROSS A SWATH OF GROUND THAT IN PLACES SEETHED WITH THE WEE BEASTS.

A HALF-HOUR DRIVE south and west from Tallahassee will put you into the upper reaches of the Apalachicola National Forest, a half-million-acre expanse of longleaf and slash pines, scrub oak, palmetto-and-wiregrass savannahs, cypress bogs and bugs.

On a cool March morning, Ed Wilson got a taste of it all. Not his first, certainly—Wilson has visited the area many times over the years, accompanied by assorted experts on the sprawling park's incredible diversity of plants and animals. This day, his guides were naturalist and author Bruce Means and Walter Tschinkel, a noted expert on the South's most hated invader since Sherman, the fire ant *Solenopsis invicta* (literally, "the unvanquished").

On the short trip down, Means regaled Wilson with recent tales of hunting for salamanders in local muck beds, thick deposits of rotting plant debris created by the normal ebb and flow of the area's watery pulse. The term "muck bed" struck a chord with Wilson.

"Muck bed! Oh my God, that's wonderful!" he exclaimed. "Muck bed! How many people on earth know what a muck bed is?"

Wilson could not have been happier on this sunny morning had he been riding toward a rendezvous with some exotic critter he'd never seen, to a place he'd never been. He was among his intellectual blood kin, colleagues who shared his visceral, child-like joy in such things as stinging ants, salamanders and things called muck beds. Such is the coin of Wilson's amazing realm. It's all the fuel this towering figure in evolutionary biology has ever needed to deeply enjoy life on a level most humans have never experienced and never will.

Arriving at one of Means' favorite salamander habitats, a small, tea-colored pond ringed by old-growth cypress, the trio of biologists made its way down to water's edge. Wilson was careful not to get too close, afraid what the mud might do to his dress shoes. Somehow he'd failed to pack more appropriate footwear for the woods, and he planned on lecturing to hundreds that evening in the same shoes. "Muck beds," he chortled. "Oh, that's good."

A short drive further west brought the party to the fetching centerpiece of Tschinkel's latest field experiment. In a lovely longleaf savannah, reminiscent of the park-like stands that once blanketed the South, Tschinkel had discovered upwards of 60 species of ants thriving in an area no larger than a football field. For some months now, he'd been studying them with the help of a couple of eager students, who—like him and his famous companion this fine morning—were bitten by ant biology.

As it turned out, the two students were there, all but hidden in the palmetto patchwork. Tyler Murdock, a graduating high school senior from Tallahassee, and Christina Kwapich, Tschinkel's second-year doctoral student (B.S. Ohio State), raised up from their labors at the sound of the approaching vehicle. When a lanky fellow with a shock of silver hair unfolded out of the van with their favorite professor, the two students could scarcely believe their eyes. The Ant King himself come to call!

Slack-jawed, Tyler and Christina greeted their distinguished visitor who seemed genuinely thrilled to meet them. "Walter tells me you're doing some exciting work out here," Wilson said. "Do you mind showing me what you're up to?"

For the next hour, the two students entertained the world's most eminent ant biologist across a swath of ground that in places seethed with the wee beasts. More than once, Wilson dropped to his knees to get a better view. As the students and Tschinkel explained the experiment they were running, Wilson listened raptly, interjecting questions, making comments based on stunningly crisp details of his own fieldwork done 50 years earlier.

All too soon it was time to go. On the walk back, Christina said, "Dr. Wilson, I have something to tell you. When I was nine years old, I wrote you a letter, and you wrote me back. I've still got that letter."

Wilson was flabbergasted. "I did that? Oh, my goodness, I'm so pleased. Well, what did I tell you?"

"You wished me good luck and told me to study hard and keep up the good work," Christina said. "And I did. Now, I'm going to be an ant biologist."

In his introduction of Wilson to a packed house later that evening, Tschinkel used the story to illustrate the larger picture of Ed Wilson's profound impact on science. Wilson's brief walk in the Panhandle woods had become a memorable metaphor for the power that learned people have to touch lives and the irreducible humanity of one of the most irreplaceable wise men of our time.**—F.S.**

PHOTOS: FRANK STEPHENSON

LONGLEAF LAB: Noted fire ant researcher Walter Tschinkel *(far left above)* explains to Wilson and naturalist Bruce Means the basics of a field experiment he directs in this stand of longleaf pine in the Apalachicola National Forest. Tschinkel's students Tyler Murdock and Christina Kwapich help track up to 60 ant species found on the site.

A CENTER FOR SAVING THE PLANET

IF ALL GOES WELL, in September the doors will open to the E.O. Wilson Biophilia Center, a sparkling gem of a science learning facility unlike anything in the country.

THE MAN AND THE MIND behind the E.O. Wilson Biophilia Center, set to open in September, is conservationist/philanthropist M.C. Davis of the Florida Panhandle's Santa Rosa Beach, Walton County.

The brainchild of conservationist **M.C. Davis** of the Florida Panhandle's Santa Rosa Beach in Walton County, the center is named after a man that Davis regards as the world's most important voice for saving the natural commonwealth of Earth itself.

Before he started the project three years ago, Davis won Wilson's enthusiastic endorsement of the $12 million, self-funded project that incorporates the name of one of Wilson's most well known books, *Biophilia*, published in 1984. The term "biophilia" literally means the love of life.

The 28,500-square-foot center rises from the piney woods just off State Road 20 near the small Panhandle town of Freeport, Florida. It's the centerpiece of Davis's personal crusade to teach young people the importance of saving wildlife and wild places from the ravages of growth and development. Davis believes it's not too late even for a state like Florida, where destroying nature in the name of progress has long been a polished art form. The mission of the Wilson center, he said, is to plant a different environmental ethic in the minds of Panhandle youth.

The center commands a 1,000-acre parcel on the periphery of a vastly larger, 48,000-acre tract that Davis began acquiring some years ago. Named Nokuse Plantation (pronounced *neh-GO-see,* Creek for "black bear") the tract is the largest private conservation project east of the Mississippi, Davis said. The plantation teems with wildlife and shows the promise of being restored to the longleaf pine-and-wiregrass wilderness it once was. Already, Davis has replanted more than seven million longleaf seedlings, and soon will plant another four million in a bid to rebuild the kind of ecosystem that once dominated the Southland for centuries.

"This is a 300-year project," Davis said, without hesitation. "That's what it's going to take to return this to the old-growth longleaf environment that once stood here."

Obviously, Davis, by any stretch a successful businessman, isn't one for short-term investments. He and his team, led by Matt Aresco, the plantation's science director, aren't daunted by the fact they'll never see their project mature. Aresco (Ph.D. biological science, FSU) along with his wife Margaret Gunzburger, a Ph.D. ecologist also trained at Florida State, provide the scientific soul of the ambitious project.

From the turtle pond Aresco designed for the approach to the center's inviting, veranda-ringed entrance—a cool retreat for a half-dozen species of freshwater turtles soon to live there—to the 18-foot-long replica of an indigo bunting (a local migratory bird) suspended from the ceiling, the Wilson center's designers obviously had kids in mind from the get-go. (And possibly Wilson, too: Boosting the "wow factor" at the front door is a six-foot-long replica of a harvester ant—one of Wilson's favorite species—astride the foyer floor.)

The cavernous main exhibit hall will feature assorted kid-friendly attractions all designed to convey a sense of wide-eyed wonder about nature and the web of life. The hall's eastern wall literally will be alive, in fact—serving as framework for a real beehive where school kids can stare directly into the heart of a humming honey factory.

A 250-seat theater complements an assortment of gadget-heavy classrooms, most named after other prominent environmentalists, including two of Florida's most famous women growth-fighters: Everglades champion Marjorie Stoneman Douglas and Marjorie Carr, leader of the fight that killed the Cross Florida Barge Canal boondoggle in the 1970s. Outside, there's a mile-long hiking trail that features a 600-foot boardwalk that courses over and through a beaver swamp, home to a profusion of plants and water-loving critters from otters to cottonmouths.

Davis said that in the center's initial years, he will focus all his energies on meeting the needs of students in Bay and Walton County public schools. For five days each year, and beginning with fourth-graders, students will be bused to the center daily for instruction tailored to be light on lectures but heavy on hands-on encounters with live animals and a bewildering variety of flowers, weeds, shrubs and trees. Seventh-graders and ultimately seniors will be exposed to similar sessions.

Davis's charity—he won't be charging the counties a dime—is hailed as a godsend for area school districts faced with preparing students for the new science portion of Florida's annually dreaded comprehensive test—and on puny budgets.

"Students are our only hope for the future of conservation," he said. "I hope this idea spreads, of course. Maybe then we'll have a chance to save this planet."**—F.S.**

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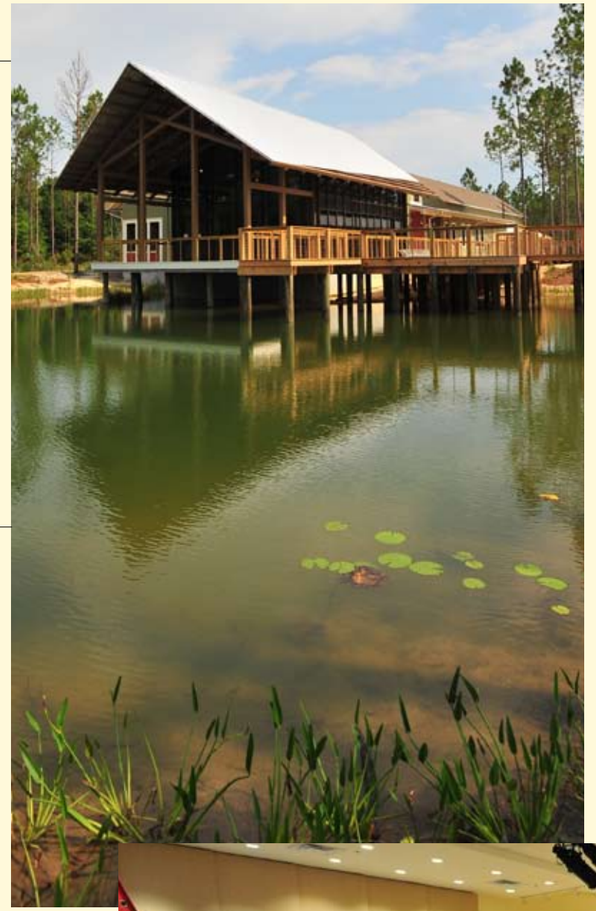
See www.eowilsoncenter.org for more about the center.

PHOTOS: RAY STANYARD



THE $12 MILLION WILSON CENTER sits on the fringes of a wild, 48,000-acre tract that M.C. Davis purchased in recent years near the Panhandle town of Freeport, Florida. The main entrance, overlooking a manmade turtle pond, is part of a 28,500 square foot facility that includes a spacious exhibit hall, classrooms and a 250-seat theater. Christy Scally *(above)* serves as the center's director.

"WE'RE SPEEDING UP THE DEATHS OF THESE CREATURES A THOUSAND TIMES, AND DESTROYING ONE OF HUMANITY'S GREAT HERITAGES FOREVER."

INTERVIEW (CONTINUED)

The loss of biodiversity and the deterioration of the environment is like a cancer. It's different from war or (other) destruction. This is the cancer eating away at the world. It's something most people don't see or care, and that may be one of the reasons that people are slow to wake up to the fact that the disappearance of biodiversity is very serious. The only way I've found to make people think about it as a problem is to make it understood that each species lives on average a billion years and that we're speeding up the deaths of these creatures a thousand times, and that we're destroying one of humanity's great heritages forever.

RinR: *What do you think will become of the federal Endangered Species Act in this new administration?*

Wilson: I am fairly certain Obama will strengthen it. The Bush administration tried to degrade it and did. They threw up legal barriers to weaken it. They also chose not to add new species. A lot of that can be fixed with the stroke of a pen, and I'm sure Obama will do that. I was consulted during the campaign on this but not since—the man is absolutely buried.

RinR: *In your book,* The Creation, *among others, you fairly stated the case that scientists have an imperative to synthesize ethical/moral positions based on good science.*

Wilson: It's true in certain cases. Not only to provide information that will allow for wise, ethical decisions, but without bias. That's what science is supposed to do, no matter how difficult the ethical issue is. The duty of the scientist is to provide that knowledge. Scientists certainly should become activists when there is a known physical change in the environment that can be very damaging. No one would say that astronomy would be out of line by reporting that a kilometer-wide meteorite is going to hit the earth in three weeks. And I've never felt any qualms whatsoever by pointing out that we are destroying a large part of the world's biodiversity by our actions.

There's opposition, of course. Take abortion, for example. You can make a case that a very early fetus is a human being and shouldn't be destroyed, although that's pushing it if you take that approach. You could also make a case that a fertilized ovum shouldn't be destroyed. The opposing view (deals with the) rights of a woman to her own body, and also in instances where the infant has a serious genetic disease. In these cases, you have a strong counter-argument favoring abortion. But it has to be granted that these are two perfectly rational, defensible points of view. This is where I don't think scientists can get too much involved. What I'm concerned about is those people who oppose abortion even in pretty serious cases, not because they've reasoned it out, but because their religious leaders tell them to oppose it, and to me, that's very sad.

RinR: *The sociobiology controversy of the late 1970s. That was an ugly time for you.*

Wilson: Well, it was. It was a time when leftist ideology prevailed. Not religious ideology—I never had any problem with the religious folk, from the right so to speak—it was an era of dogmatic leftist ideology in dominating academia. The brain is a blank slate—that was

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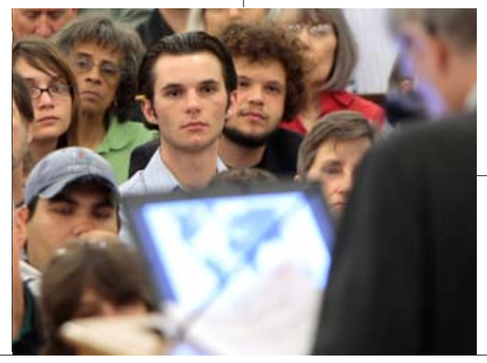


WILSON'S "CONGREGATION" sat with rapt attention to hear what the father of biodiversity had to say about Darwin's legacy. In June, Wilson returned to FSU for a celebration of his 80th birthday that included a day-long colloquium coordinated by Michael Ruse, philosopher of science and history.

PHOTOS: MARK WALLHEISER

AN EVOLUTIONARY EPIC

"EVERYTHING you've ever wanted to know about evolution is in here," said **Joe Travis**, tapping the cover of *Evolution: The First Four Billion Years*. And at 979 pages, who's to argue the point? Travis, professor of biological science and dean of FSU's College of Arts and Sciences, co-edited the book, published by Belknap Press (Harvard) in January, with **Michael Ruse**, FSU professor of history and philosophy. In contributing the foreword to this masterful collection of essays on evolutionary biology, E.O. Wilson wrote that the book's "multiplicity of authors" provide "state of the art" information on the dozens of topics they address.

Travis (pictured at right) and Ruse spent six years collecting, editing and writing material for the book, easily the most comprehensive treatment of evolution to appear in this 200th birthday year of Charles Darwin. The tome includes essays written by a number of current FSU scholars besides Travis and Ruse, plus articles by the university's scientist alumni.

Covered in the sprawling content are essays on the origins and history of evolutionary thought (it may well have begun in the mind of a 5th century B.C. Greek philosopher named Empedocles) the evolution of organic molecules; the evolutionary basis of disease and the historic (and continuing) conflict between evolution and religion. Eugenie Scott, executive director of the National Center for Science Education and a well-known champion of keeping religion and science separate in American classrooms, contributed a bracing chapter on the rise of American anti-evolutionism.

In summarizing their yeoman effort in the book's introduction, Travis and Ruse reflect on what Darwin never knew—essentially how right he was on so many things. Today, the father of evolution would be dumbfounded to learn how spectacular discoveries in molecular biology and behavioral genetics have turned many of his most provocative notions into incontrovertible, testable, scientific facts.

But despite the profound insight modern science has revealed about what life is and how it morphs over time, the authors acknowledge the endless mysteries ahead: "There are few topics in science with so many exciting new facets which reveal that despite all we have learned, there is much more to be discovered."

—F.S.

PHOTO: FSU PHOTOLAB

FLORIDA STATE'S FRIENDSHIP with Wilson began many years ago when the Harvard-based biologist served on national boards with some of the university's top biologists. Evolutionary ecologist (and dean of the university's College of Arts and Science) Joe Travis, left, chats with Wilson about the release of ***Evolution: The First Four Billion Years,*** which he co-edited with Michael Ruse. Wilson wrote the book's introduction.

INTERVIEW (CONTINUED)

the dogma. It wasn't just the evidence—all the evidence in the '70s was against that idea. But because of the social sciences, they had decided the brain was a blank slate, and all of their theories were based on that. I said that was wrong, and *had* to be wrong. Well, the Marxists, the left—Stephen J. Gould, for example—built their reputations by taking that opposite, dogmatic view. It was a lot of garbage.

RinR: *You once wrote: "Political ideology can corrupt the mind, and science." Science, of course, isn't supposed to work this way. But some critics charge that academia, including science, is rife with PC (political correctness) and to the detriment of us all.*

Wilson: I agree with them. I know more and more people who are getting tired of political correctness. I saw Harvard University just become hopeless in this respect. The universities in this country were, for a time, places where there was the *least* freedom of thought. There were taboo subjects, and there still are. You still can't talk about race, for example, and thank God for Obama. He takes a lot of the weight off our shoulders. He's a role model for African-Americans. So if you want to talk about race in honest terms you don't feel like you're beating up on African-Americans any more.

> "PC PERMEATES AND I HOLD LITTLE RESPECT FOR MANY OTHERWISE HIGHLY REGARDED ACADEMICS WHO HAPPILY GO ALONG WITH WHATEVER IS POLITICALLY CORRECT..."

But at any rate, PC permeates (the academy) and I hold little respect for many otherwise highly regarded academics who happily go along with whatever is politically correct in what they say and what they write, science be damned. The problem is that most scientists are pedestrian thinkers. They aren't that smart. Most don't know what the hell they're talking about. They're well trained in a little branch of science, but they have to throw a lot of energy into it to get to the front, to make a few original discoveries to get the grants. Look, the scientific literature has been increasing in quantity, doubling every 15 to 20 years. It's much harder for the younger scientist today to actually make a (discovery of true significance) because of all the (career) pressure and the result is that they don't have time to think about these larger issues. So they just throw in the towel. And you get (prominent scientists) today who are willing to betray science in terms of presenting a politically correct opinion as opposed to what the overwhelming scientific evidence shows.

We'll never get completely rid of political correctness in the universities.

RinR: *About "the molecular wars" which you write passionately about in your autobiography,* The Naturalist*—you expressed optimism that we were going to turn that around. But are we?*

Wilson: We're headed there now. I admit it's a hard sell. But do you realize Jim Watson *(James D. Watson, co-discoverer of the molecular structure of DNA)* and I are now close buddies? He and I have been on Charlie Rose Show and on the stage in several places. He's on the board of directors of the Wilson Foundation. He has been saying that natural history is absolutely essential now.

We have to have more general naturalists. To hire and promote a young naturalist whose only interest is molecular phylogeny or some narrowly focused subject that uses molecular tools to address the issue—no, that's not the answer. We have to have more general naturalists, people who are experts on groups of organisms, but we're not training them. And do you know why?

RinR: *Because there's no money in it.*

Wilson: Quote yourself. That's right. The reason why there are not more Bruce Means is the money. Molecular biology is married to medicine, Catholic-style, no divorce! It's been the recipient of vast amounts of money. Molecular biologists are not rich because they're successful; they are successful because they're rich. If you could convince the public and our political leaders that understanding biodiversity and the way that the environment is put together is vital for the public health and the future of the country, money would flow in and pretty soon you'd have coleopterists and herpetologists lined up for faculty positions and we'd have a return to what we used to have, what we ought to have, of people who really know about organisms.

It's crazy. How can you study ecosystems and know what's happening in them if you don't know what's in them? It's sort of like taking medicine, without knowing 90 percent of what's in the body.

And this latest push to bar-code organisms. What good is that? Are you going to say that this bar code eats that bar code? If you remove that bar code from the ecosystem the rest of the bar codes will collapse? Makes no sense.

I have a running argument with my friend Dan Janzen *(naturalist, biologist, U. Penn)*. I asked him to do a paper, and he said "I'll do this paper if you'll say we need to bar code all the species that have been described and characterized morphologically." And I wrote back and said, "Dan, I'll be glad to say that, but in return you have to say it is useless to go out bar coding things that you have not identified by morphological criteria, given names to, or treated at the organismal level."

A Place, A Purpose, A Panacea

BY ELIZABETH BETTENDORF

Biologist and author Anne Rudloe lives, works and thinks in one of the last, unspoiled corners of Florida's marine environment.

JACK AND ANNE RUDLOE walk the water's edge at Mashes Sands Beach in the Florida Panhandle, not far from their marine lab.

PHOTO: MARK WALLHEISER

Anne Rudloe wants to know who's the bravest kid in the class.

The question is more rhetorical than dare: Almost as fast as she can ask, nearly two dozen giddy fifth graders from an Episcopal school in Ormond Beach plunge skinny arms into a shallow saltwater tank, vying for the honor of being first to catch a horseshoe crab.

After a few minutes of splashing and wriggling, a red-faced boy emerges ebullient, T-shirt soggy, but a victorious crabber nonetheless: "I'm the bravest!" he declares. "I won!"

Over more shouts and whoops, Rudloe concedes, "you're the bravest—the winner." Not that anyone seems to care—or hear for that matter—they're having way too much fun.

Rudloe is no grade-school teacher, but she has a pretty good sense of what makes kids tick. With two grown boys of her own, she's adept at coaxing even the smallest visitor to interact with the sea critters that she and husband, Jack, gather for their environmental education center and marine aquarium, Gulf Specimen Marine Lab in Panacea, Florida.

For the past decade, the fifth-grade class from St. James Episcopal School has made an annual spring pilgrimage to Panacea, an unincorporated, eye-blink coastal village 45 minutes southwest of Tallahassee between the St. Marks National Wildlife Refuge and the Apalachicola National Forest.

They're among 400 school groups and 18,000 visitors who trek annually to this scrappy, Gulf Coast town to visit a local landmark that remains a holdover from Florida's pre-Disney past.

It's part non-profit biological supply company, part research lab, part open-air schoolhouse. And in a generation when "the mega-theme park doomed the old world of roadside attractions" as Florida historian Gary Mormino writes in *Land of Sunshine, State of Dreams* (2005, University Press of Florida) the Rudloes' roadside gem has long attracted a loyal following.

"I think we are probably the last of the old-time mom-and-pop Florida tourist attractions that still survive," Rudloe mused one warm, buggy spring morning in between school field trips.

During the warm months, Anne spends much of her time like this, amid noisy bands of excited children. It's not unusual to find her behind the cash register in the gift shop or explaining a nursery habitat ("where shrimp, crabs and fish all go to grow up") to kids in a salt marsh. On this particular morning, she even sells two tickets at six bucks a pop to a couple of senior citizens who've wandered into Gulf Specimen for a look around.

A no-nonsense, plainspoken woman who favors long-sleeves, khakis, comfortable shoes and no makeup, Anne Rudloe is about as down-to-earth as they come.

Rustic Roadside Attraction

A marine biologist, researcher, and longtime FSU adjunct professor of biological science, Rudloe has led legions of students on field trips to study the coastal ecosystems of the Florida Panhandle. She has built a life studying invertebrate biology, oceanography, ecology and environmental issues—literally from a 300-foot-long "living" dock a few steps outside her back door.

Besides operating as a learning facility, Gulf Specimen Lab is also home to a small, but thriving biological supply outfit that supplies sea horses, starfish and crabs for academic research and teaching.

ANNE RUDLOE leads a discussion with a high school group from Lake Butler, Florida at the Gulf Specimen Marine Lab in Panacea, Florida.

PHOTOS: MARK WALLHEISER

For the first-time visitor, finding the lab requires resolve. A couple of wooden signs point the way along U.S. Highway 98 through town and then down a quiet street staggered with stilt houses and slash pines and achingly beautiful glimpses of Dickerson Bay, an intense denim blue in the late morning light.

Before Florida amended its constitution to ban most forms of net fishing in state waters in November 1994, Panacea survived as a traditional fishing village, albeit one with a colorful past. In the early 1890s, Panacea was a cracker-town resort sporting hotels and boardwalks and restorative baths where ailing tourists came to soak in the abundant mineral springs. Panacea—Greek for "healing all"—is actually the town's second name; it's original name, Smith Springs, didn't quite pack the same panache for local boosters who wanted to grow tourism in the late 19th century.

These days, most people road-trip to Panacea to eat oysters at a handful of mom-and-pop restaurants or just pass through on their way to Apalachicola—a stretch that's among the most scenic in Florida because of its coast-hugging vistas of pine trees and water.

The area was originally part of a vast long-leaf pine ecosystem that once extended from North Carolina to Texas. Close to the coast, long-leaf pines give way to slash pines, a common variety that grows in profusion across the coastal belt and in fresh-water wetlands. Panacea is dense with second-growth slash pines thanks to being logged heavily in the 1920s.

"We have a rule at Gulf Specimen—we don't cut trees here if we can at all avoid it," Rudloe says. "We could use this space a lot more intensively if we cut the trees out of it—but that's the charm of the place."

To the first-time visitor, the lab is at once fetching and unselfconsciously retro—but never kitsch. Blue and white cottage-style buildings spread out over a compound of eight lots so thick with pines, cabbage palm, magnolia and rare, coastal dwarf live oak that if one studies the site on Google Earth, it's hard to see the buildings for the trees.

Plunked in the center of the compound is an airy wooden pavilion where busloads of school kids gather before touring the open-air buildings filled with bath-tub-like, 500-gallon tanks of marine specimens—most geared for hands-on learning. In 1990, Anne pushed to open Gulf Specimen to the public and turn it into a non-profit teaching lab. It now boasts 8,500-square-feet of interior exhibition space and enough aquaria to hold 30,000 gallons of seawater. The long dock at the Rudloes' home—a short walk from the lab—allows visiting school children a chance to study living creatures they most likely would never encounter otherwise.

All told, the lab typically houses nearly 200 species of marine animals, including sea turtles, and myriad varieties of fish and invertebrates collected from the nearby Gulf of Mexico. More than half the aquarium's capacity is devoted to displays of larger species like moray eels, sharks, sea turtles and spiny and slipper lobsters.

The compound was cobbled together slowly, over four decades on the income the Rudloes took in as freelance natural history writers, researchers, teachers, and earnings from their marine specimen operation. "It was always hand-to-mouth," says Jack Rudloe, Anne's

A HIGH SCHOOL GROUP from Lake Butler listen to Rudloe while on a lab and coastal tour in Panacea.

husband of more than 30 years. "We're not part of the state, we don't have an endowment. It's always been very much bootstrapping."

A Florida Love Story

A transplant from Brooklyn who grew up in Lanark Village—a nearby retirement community—Jack settled in Panacea in 1962 as a teenager. Fresh out of FSU, where, according to family lore, Jack's academic career fizzled after about three months, he was eking out a living shrimping—a job that allowed him to hang around and keep species the local fishermen considered trash.

At first, the little marine lab subsisted on the proverbial shoestring—actually on a lot less the way Anne Rudloe tells it. "Jack owned a used station wagon, a bucket and a dog," she says. "He lived on the property in a house trailer with his mom."

The couple met in 1971 by chance at a gas station in Panacea. In truth, the meeting was chance laced with a lucky thread of connection. As an undergraduate studying biology at Mary Washington College in Virginia, Anne remembers seeing deliveries of scallop specimens from a place in Florida she'd never heard of.

"We used to get these boxes up there that said 'Gulf Specimen' and 'Panacea, Florida' and there was always this joke about 'what could a town like Panacea possibly be like?'"

The day Anne stopped in Panacea to gas up, she was actually finishing a course at the U.S. Naval base in Panama City where she was studying underwater research and diving techniques for her master's in oceanography.

"We were all on the Navy base and we all wore jumpsuits with these big arm patches that said: 'Scientists in the Sea,'" Anne remembers. "When the class finished I was coming down to FSU's marine lab one day and I pulled into the gas station, wearing my little zoot suit and you know, I'm not the most feminine looking person. Jack sees me and says: 'Is that a man or a woman?' So he came over and we started talking."

Anne told Jack she had once been a customer of the lab and that she was working on a thesis that involved collecting animals that live in sea grass beds.

"I had to identify everything, which is one of the absurdities of graduate students because you are expected to do taxonomy on everything that's in a habitat," she recalls. "I was having a terrible time with the tunicates—I couldn't identify them. Jack said 'I've got tunicates.' I said: 'You know what they are?'

"It wasn't 'come see my etchings,' it was 'come see my tunicates.' That's when I met him. I've been here ever since."

The Rudloes live down the street from the lab in a stilt house cobbled together from a World War II barracks building they once bought for $500. Jack chronicled the house in his book, *The Living Dock* (2003, Great Outdoors Publishing Company).

"Everyone in town laughed at us," Jack recalls.

Inside, it's plain and unpretentious, with upholstered chairs as worn as old sweatshirts, nests that Anne likes to curl up on while she reads or pecks away on her laptop and her cat sleeps nearby. In late April, an afternoon breeze sails through the rooms and the view through old, salt-misted windows is like heaven, a Wolf Kahn painting of bay and blue sky that seems to go on forever.

PHOTOS: MARK WALLHEISER

(above) **THE RUDLOES** give a tour of their lab to a visiting elementary school. *(bottom)* **ANNE** looks through a seine net with a high school group from Lake Butler. The students pulled the net at Fiddler's Point in Panacea.

The Rudloes live down the street from the lab in a stilt house cobbled together from a WW II barracks building they once bought for $500.

PHOTO: MARK WALLHEISER

PHOTO: ANNE RUDLOE

PHOTO: STATE LIBRARY & ARCHIVES OF FLORIDA

(from left) **HEADING OUT** to the Gulf of Mexico in *The Beagle* to collect specimens for the lab; **A YOUNG ANNE** Rudloe gets suited up in a heavy hard-hat diving suit at the U.S. Naval base in Panama City in 1970 as part of the Navy's Scientists in the Sea program *(far right)* **SPORT FISHERMEN** from an earlier era in Panacea display a prize catch—a smalltooth sawfish. Now a federally and state protected species, today's sawfish population is estimated to be no more than 10 percent of what it was in the 1950s.

Steinbeck and Specimens

Jack got his first break in the early 1960s, when an FSU biology professor asked him to send horseshoe crabs to an exhibit at the World's Fair in Seattle. He packed the creatures in sawdust—"not such a good idea," he recalls in retrospect—and shipped them airfreight across the country. Despite his distaste for formal schooling, Jack maintained a keen interest in both biology and literature.

A second—and unlikely—break came when he struck up a correspondence with author John Steinbeck, himself an amateur marine biologist, who, over a span of eight years in the 1960s, wrote long, advice-filled letters to the young marine collector. For both men, the friendship was sincere and mutual. Jack gave Steinbeck a flat rock with four sea whips he found while snorkeling. Steinbeck gave Jack the valuable, original artwork from his 1941 book, the *Sea of Cortez*, which the Rudloes have since loaned to FSU's Strozier Library.

Over the years, Jack continued supplying live marine animals to academic scientists, eventually growing the establishment to serve 1,300 clients annually, mostly university science departments who use the specimens for education and research. A small staff of long-time employees run the lab now, trawling for specimens in the aquarium's 26-foot customized collecting boat, the *Beagle*, named after Darwin's ship, and then packing specimens in clear, plastic bags of water (think high-tech versions of that goldfish won at the school fair) and shipping them around the world.

In many ways, the stories of Anne and Jack Rudloe go hand-in-hand. They are both mavericks, passionate naturalists, specimen collectors and scientists (albeit Jack's encyclopedic knowledge of local marine life was amassed from years of self-study). They've also shared a lifelong devotion to environmental activism, waging so many battles that, according to some locals, Jack likes to joke, "the streets would have been paved in gold and there would have been endless prosperity if it hadn't been for us."

Anne's career, though, has been more tightly tethered to FSU. Teaching just comes naturally to her, and transforming the lab from a marine specimen outfit into a kid-friendly, educational attraction was her idea. After earning a master's degree in oceanography in 1972—and in '78 a Ph.D. in biology—from Florida State, she began a career as an FSU adjunct professor in biological science. She's been at it almost non-stop since, sharing with students her love of Florida's coastal upland and spring ecosystems, and marine biology in general.

Her hands-on teaching techniques were inspired by an unorthodox botany class she took in graduate school that made her wonder "how stress and watching the clock in a lecture hall ever got identified as a valid educational technique in the first place."

She's taught her "experiential" classes everywhere from FSU's Panama City campus to the university's Claude Pepper Center and Center for Professional Development on the main campus in Tallahassee, as well as for the university's departments of oceanography and urban and regional planning. Her favorite classroom, though, was almost always offbeat, most notably perhaps, the aft deck of a research boat in the Gulf. It wasn't uncommon to find her with students 12 miles offshore at 3 a.m., enjoying a field trip in her popular course "Coastal Environments of the Big Bend."

"We slog through marshes, pull beach seines, snorkel in sea grass meadows, hike across barrier islands, go down the watershed of an undeveloped estuary, and discover the rare, endemic wildflowers blooming in the globally endangered longleaf pine forests that grow behind the salt marshes," she wrote in the 2002 spring issue of FSU's marine lab newsletter. "The professor of record—me—is often upstaged by the real teachers of this class—the land and sea themselves."

On a recent spring morning, Kevin O'Connell, dean of students at St. James Episcopal School in Ormond Beach, accompanied the Rudloes and his class on a trek through a nearby saltmarsh. "This is the finest marine lab I've been associated with in 20 years of education," he said. "It's very hands-on, the staff is very educated and the kids are always so engaged." O'Connell sees the lab as more than just a run-of-the-mill field trip; he sees it as a visceral learning experience kids won't soon forget.

One of the lab's most popular exhibits, "Monsters of the Deep," is the product of a specimen-collecting trip the Rudloes organized for the New York Aquarium. Although educational, it recalls the old-school roadside sightseeing spectacle that colored Florida tourism in the mid-20th century. A series of brass portholes with preserved deep-sea animals inside, the "monster" is actually a foot-long sea roach—the largest isopod (a type of crustacean) in the world: "Isopods are really roly-poly bugs," Anne explains. "Most of them aren't very big, but this species is huge."

Giant sea roaches normally live in 1,200 feet of water at the edge of the continental shelf. Anne and Jack say they were the first to bring a really big one back alive from the deep Gulf, though "since then they've become quite the thing," Anne says. "You see them all over the Internet and a lot of aquariums have them. But we had the first ones. The kids love this exhibit because it hand cranks and it's so interactive."

PHOTO: MARK WALLHEISER

The Rudloe Reader

For many who know of the Rudloes' work, their writing is the first thing that springs to mind. Together, they've had nine books published (seven of them Jack's) and have co-authored a third, on the pink shrimp, awaiting publication. They also have a portfolio of natural history writing, essays, journal articles, newspaper columns, and articles for such magazines as *National Geographic* and *Smithsonian*. Their books include:

Anne:

- *Butterflies on a Sea Wind: Beginning Zen* (Andrews McMeel Publishing, 2002)
- *Priceless Florida: Natural Ecosystems and Native Species* (Pineapple Press, 2004)—co-authored with Bruce Means and Ellie Whitney

Jack:

- *The Sea Brings Forth* (Knopf, 1968)
- *Erotic Ocean* (Crowell, 1971)
- *The Living Dock at Panacea* (Knopf, 1977)
- *Time of the Turtle* (Random House, 1979)
- *The Wilderness Coast: Adventures of a Gulf Coast Naturalist* (E.P. Dutton,1988)
- *Search for the Great Turtle Mother* (Pineapple Press, 1995)
- *Potluck* (Out Your Backdoor Press, 2003)

Panhandle Darwinism

In North Florida's Wakulla County, a rural, deeply religious bastion of conservative Protestantism, evangelicals outnumber mainline Protestants four to one. Mentioning evolution to visiting school groups can be touchy business.

The majority of kids who visit Gulf Specimen Marine Lab travel by bus from area elementary schools. Most know little or nothing about marine animals, and even fewer have a clue who Charles Darwin was or what he did.

Anne Rudloe never lets Darwin get in the way of her young visitors' enjoyment of the facility that she and husband Jack own and manage as an educational center.

"I don't think it's the proper time, and we don't have the time anyway, to launch into the issues of religion and evolutionary biology," she says. "Instead I use the opportunity to speak of what some churches call 'creation care' or stewardship of God's creations. If God created all this, what gives us the idea that we have the right to destroy it? Biblical dominion, I assert, means caring for, not destroying."

For older groups, she's comfortable calling horseshoe crabs "living fossils," comparing them to similar fossils found in marine sedimentary rocks high in the Alps.

That backfired one day, Anne recalls, when a parent listened and then merrily exclaimed: "Well, then that proves that Noah's flood really happened!"

"Or," Anne shot back, unruffled: "is it evidence of plate tectonics and the geological uplift of sea floor sediments to form mountains?

"I don't think she knew what I was talking about."–**E.B.**

CYPRESS CATHEDRAL: Anne and Jack Rudloe relax in the cool tannic water of a cypress swamp on their property adjacent to the St. Marks National Wildlife Refuge in the Florida Panhandle.

PHOTOS: MARK WALLHEISER

ANNE RUDLOE examines a seahorse during a specimen-collecting trip in the Gulf of Mexico.

Naming the Beasts

As naturalists, the Rudloes solidly share a philosophy about biological research: no matter how much money is behind it, research done in a lab can never be a substitute for observation in the field. Both staunchly adhere to the old-school principles of taxonomy, the science—and sometimes art—of classifying living things.

Once the dominant tool of biologists, taxonomy as a discipline has lost much of its luster since the 1950s, when scientists began acquiring the genetic tools and skills in biochemistry to sort through life at the molecular level. As a consequence, entire fields of biological inquiry—dozens of "ologies" that focus on specific groups of plants and animals—have all but disappeared. From herpetology (the study of snakes and amphibians) to lepidopterology (the study of butterflies and moths), specialists in the nomenclature, classification and life histories of living organisms have become an endangered species of biologist.

As a stalwart defender of the taxonomic approach to studying living organisms, Anne is passionate about the subject. She believes (as does world-renowned biologist E.O. Wilson) that identifying plants and animals in a lab, without understanding how they co-exist in the wild, is pointless if the goal is to understand how environments work. "The differences among organisms are often very small. It takes an expert. Taxonomy is the key to everything in ecology," she says flatly.

Over the years, Anne and Jack have seen their skills in taxonomy pay off, and often in unexpected ways. They've been able to observe evolution at work, for example, right out their back door. They have observed first-hand the (previously discovered) mutations in closely related species living on both of Florida's coasts, giving rise to new sibling species of such organisms as toadfish and sea pansies. They've marveled at how some invertebrate species vary geographically, notably in the Panacea fiddler crab *(Uca panacea)* and its close cousin, the sand fiddler *(Uca pugilator)*.

Anne has also devoted considerable research into the behavioral ecology of the horseshoe crab *(Limulus polyphemus)*, one of the oldest marine invertebrates on the planet. By the early 1980s, she had become

JACK AND ANNE RUDLOE relax and talk in Anne's meditation shed overlooking their cypress swamp. A practicing Buddhist, Anne often uses the austere shed for meditation.

(above) **JACK** Rudloe points out the size of a small, adult hawksbill sea turtle to elementary school children at the Gulf Specimen Marine Lab in Panacea. *(right)* **SORTING** through specimens on the Rudloe's boat, *The Beagle*, named for the famous vessel that carried Darwin.

a recognized authority on the behavior of the crab's larval stages, and how juveniles and adults adapted them to the different environments they inhabit. Her work looked at the way tidal rhythms of activity allow these odd-looking creatures to avoid predators.

Interestingly, horseshoe crab larvae emerge from their nests in much the same way that baby sea turtles do, she notes, "digging their way to the surface at the highest full moon high tides." The hatchlings emerge at night and orient themselves by moonlight to stay at the surface as the surf sweeps them seaward. Adults later orient to the breeding beaches by the motion of wave surge, she said.

As for her most recent research, she laments the lack of a long-term trajectory, but knows this often is the life of adjunct researchers. This isn't always a bad thing career-wise, she said. "I've jumped around from horseshoe crabs to electric rays to mysid shrimp to sea turtles. In a way it's good because it's much more diverse and broad-based than if I had worked on one species my whole career."

For the past few years, she and Jack have been working on a cooperative research venture between Florida State's Coastal and Marine Laboratory and their organization. The goal is to amass an annotated checklist of the marine flora and fauna of the Northeastern Gulf of Mexico—an inventory of all that lives in the region.

The first checklist of the area was created in 1949 by the late Winston Menzel, an oceanography professor at FSU who was known for his pioneering research on crabs and mollusks. Menzel's list was last revised and updated in 1957, says Jack, who, along with Anne, contributed updates to that version over the years. It's a huge—and hugely important—project because it can provide baseline information for documenting long-term changes in the northern Gulf, where Anne says tropical species of marine fauna are becoming as common as native species.

Panacea Peace

During the first decade of her career, though, Anne struggled with the issue of whether she should stay or leave the seaside rhythms of her Panacea niche.

Though she's seemingly well adjusted, making the decision to accept college adjunct teaching—a low-paying job without health or retirement benefits—as her lot in life, didn't come easily. The dilemma haunts many academics who can't get a full-time tenure track position at the same institution where they earned their doctorate. And it sent Anne on a spiritual search that lasted years.

"You generally do not stay where you get your Ph.D.— at least not at most universities, and certainly not at FSU," says Anne, who after a lot of soul searching, ultimately decided to stay put in Panacea.

"I wanted to become a college professor. And I had all these delusions that I could stay here and overcome that. It didn't happen, so it's been a struggle personally," she says.

Her struggle eventually led her down a new path, a road to spirituality. For some years now, she's been one of the few practicing Buddhists in Wakulla County.

PHOTOS: MARK WALLHEISER

"Buddhism talks about the interdependence of all beings. And evolution is a reflection of that..."

"The reason I got interested in Zen meditation was trying to cope with the ego disappointments of not succeeding in becoming a college professor. It's very simple. I finally realized I wasn't going to make the mountain come to Mohammed and I had to make the choice whether to stay here or whether to move and try to have a conventional career and become an academic."

These days, she's known around academia as both serious scientist and serious Buddhist, a pairing, she insists, that isn't incongruous.

"Buddhism talks about the interdependence of all beings. And evolution is a reflection of that," she says. "Buddhism extends it to the world of consciousness, but it doesn't have any dogmatic prescriptions."

The path to spirituality helped her face the truth about her own career path, one that veered off course and never quite got back on again. But Anne soon discovered it helped her in a completely unexpected way. Among those who know her—and a lot who don't—it's no secret that for the past four years she's waged a ferocious battle with colon cancer.

The story is out there on a YouTube video. Against a woodsy, breathtaking backdrop of the North Florida coast, Anne talks about the cancer and her views on life and death—a performance that's serenely eloquent yet unscripted. The diagnosis came after a routine colonoscopy revealed a tumor that she later learned had metastasized. Long trips to Tampa for second opinions at H. Lee Moffitt Cancer Center followed. Months of chemotherapy made her so sick she landed in the hospital. After the cancer spread to her liver, an experimental treatment at a hospital in Thomasville has kept her alive.

Back in the 1980s, she and Jack paid $9,000 for a patch of cypress swamp that elbows St. Marks National Wildlife Refuge, 25 miles south of Tallahassee. A few years ago, they built a tiny "meditation" shed on the property. It's all wood and glass and too small even for a bathroom. The only amenities are a portable, camping toilet, a mattress and a folding canvas chair. The view is all the décor Anne needs. From the wrap-around porch it's as if a visitor has stepped into a Clyde Butcher photograph of cypress trees and black swamp water.

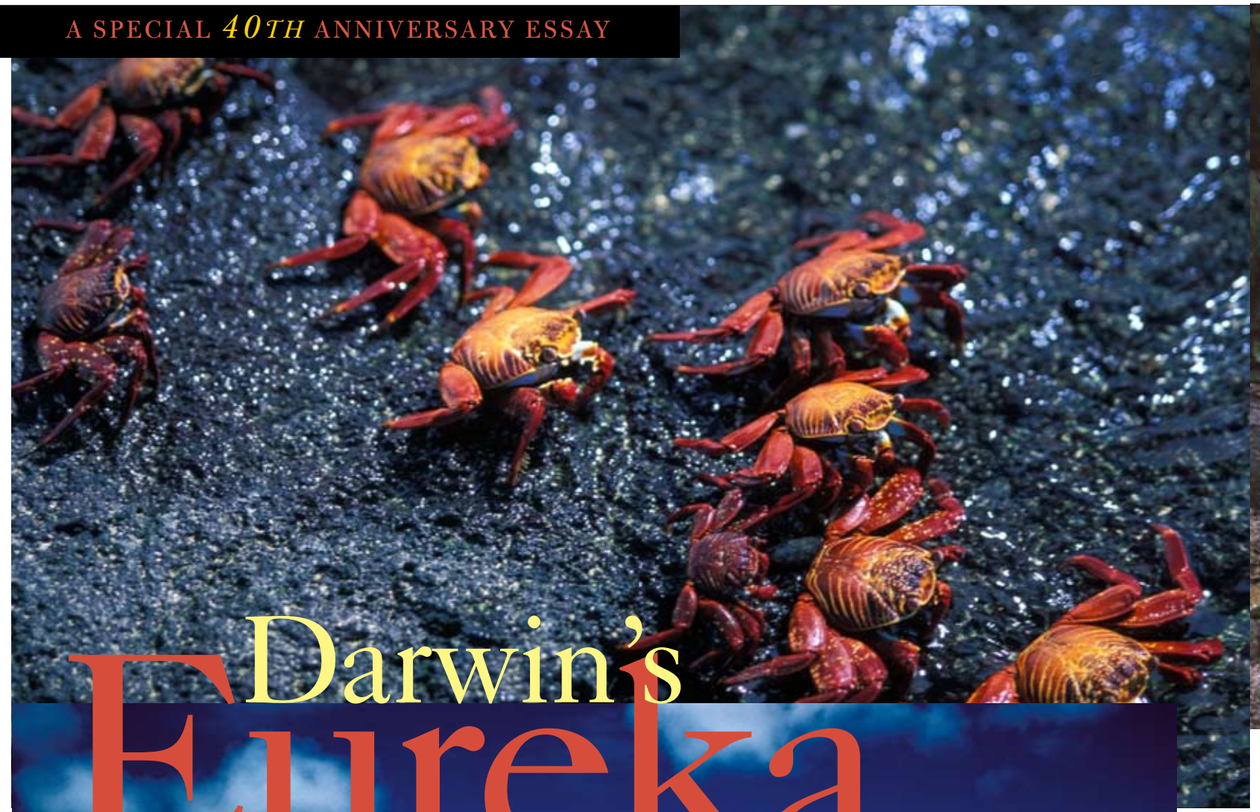
"I spend as much time as I can here in meditation," she says. "The traditional retreat schedule used in the Zen school that I'm part of is too strenuous for me now—so I spend a lot of time here meditating in the woods alone. It can be challenging with all the bugs we have around here at this time of year."

She worries a lot about the future of Gulf Specimen, about who will see to the logistics of an operation that requires constant attention to details—the kind that keeps the doors open—from grants to permitting to "paying the electric bill."

Their youngest son, Cypress, now 25 and a student at FSU, works at the lab full-time and is interested in mastering the enterprise's day-to-day operations. It's a glimmer of hope for Anne and Jack, who would love to know their "old-time mom-and-pop" Florida tourist aquarium has a future.

Late on a fine, Florida spring afternoon, the last of a gaggle of school children trail out of the lab compound and head for their bus. The Gulf Coast light is warm and honey-gold and natives know that it can make a person serene and content if taken in large doses. Anne helps lock up the gift shop and prepares to head down the road to the old stilt house, a place she's got no intention of leaving. She's in the moment and exactly where she wants to be.

"I made the decision to stay here because it's such a rich area biologically. I love this area. This is one of the last, great places. A person could spend a lifetime here exploring."



Darwin's Eureka Moment

ISLAND TIME: *(opposite page, top)* Sally Lightfoot crabs scurry across lava rock. *(bottom)* A pair of sugar loaf tuff cones on James Island near where Charles Darwin stayed. *(above)* A land iguana with a lava lizard riding piggyback. Means photographed the iguana on Santa Fe Island, part of the Galapagos. The islands' vast endemic species were studied by Darwin on the voyage of *The Beagle* in 1835.

PHOTOS: D. BRUCE MEANS

BY D. BRUCE MEANS

Tortoises, sunflowers, mockingbirds, or finches? Which of these gave Charles Darwin a eureka moment—that flash of inspiration when it suddenly dawned on him that plants and animals radically change over time?

On his famous, five-year voyage on *HMS Beagle* Darwin spent less than six weeks in 1835 in the Galapagos Islands, a volcanic archipelago lying astride the equator about 600 miles due west of Ecuador on the South American continent. Brief though it was, Darwin's visit to the Galapagos ultimately changed everything scientists thought they knew about how nature works. For 150 years, scientists have speculated about what single discovery may have triggered Darwin's eureka moment about the origins of species.

Stopping on only four of the larger islands, Darwin busied himself collecting plants and animals and talking with the local inhabitants in the most fascinating place he'd ever seen. During his stay on James Island, he visited a low crater with a shallow briny lake in its center from which locals were procuring salt. There among the bushes yet lay the skull of a sealing-vessel captain who had been murdered by his shipmates a few years previously. Camping nearby, Darwin recorded oppressive heat, but at higher elevations, a "green and flourishing vegetation."

He never knew it at the time, but Darwin had stepped into an evolutionary laboratory unmatched anywhere on the planet, except possibly the Hawaiian Islands, which also sit atop a moving oceanic crustal hotspot. Like all volcanic islands, the Galapagos offer scientists some powerful clues about the rate of evolution of species because they are easily datable by geologists. The oldest island which Darwin visited first, Chatham, is estimated to be about 5 million years old; the youngest, Narborough, is a veritable youngster at a paltry one million.

Darwin was intrigued by everything he saw. He collected as many specimens of animals and plants as he could during the short time he had on the islands. It was only after John Gould, a famous ornithologist, analyzed his bird skins back in England

HE NEVER KNEW IT AT THE TIME, BUT DARWIN HAD STEPPED INTO AN EVOLUTIONARY LABORATORY...

MORE PLAUSIBLY, DARWIN'S EUREKA MOMENT...MIGHT HAVE COME WHILE CONTEMPLATING THE THREE SPECIES OF MOCKINGBIRDS HE COLLECTED ON DIFFERENT ISLANDS.

PHOTOS: D. BRUCE MEANS

WILD THINGS: ***(opposite page)*** **Galapagos tortoises lounge in the mud of Isabella Island in the Galapagos.** ***(above, clockwise)*** **The famed scenic vista from Bartolome to James Island; cactus finch on Santa Cruz Island; a hood mockingbird on Espanola; flightless cormorant, Fernandina Island; Galapagos tortoise resting**

that finches took their place in Darwin's thinking about the evolution of species. (Gould informed Darwin that he had found no less than 14 species new to science—every single one of them a finch, and every one only found in the Galapagos Islands.)

But even though his name has been famously associated with finches, the tiny birds weren't likely the source of any "eureka moment" Darwin may have had. In *Voyage of the Beagle*, published in 1839, here's what Darwin had to say about the birds that are now famously known as Darwin's Finches: *"Unfortunately most of the specimens of the finch tribe were mingled together...."*

In other words, his first encounter with Galapagos finches didn't figure into his thoughts on the evolution of species. That all changed, of course, with the publication of his seminal work 20 years later, *On the Origin of Species,* in 1859.

More plausibly, Darwin 's eureka moment—if indeed he ever had one—might have come while contemplating the three species of mockingbirds he collected on different islands. These abundant songbirds captured his imagination and he wrote of them: *"My attention was first thoroughly aroused, by comparing together the numerous specimens, shot by myself and several other parties on board, of the mocking-thrushes, when, to my astonishment, I discovered that all those from Charles Island belonged to one species* (Mimus trifasciatus); *all from Albemarle Island to* M. parvulus*; and all from James and Chatham Islands...belonged to* M. melanotis."

Even plants might claim to have been the inspiration that got Darwin to question the dogma of the time that species were never-changing. Darwin wrote: *"...thus, Scalesia, a remarkable arborescent genus of the Compositae, is confined to the archipelago: it has six species: one from Chatham, one from Albemarle, one from Charles Island, two from James Island, and the sixth from one of the three latter islands...not one of these six species grows on any two islands."*

As it turns out, a "Mr. Lawson"—a British official who oversaw Galapagos affairs for the Ecuadorian government—may have planted the first kernel of evidence of evolution in Darwin's mind:

"I have not as yet noticed by far the most remarkable feature in the natural history of this archipelago; it is, that the different islands to a considerable extent are inhabited by a different set of beings. My attention was first called to this fact by the Vice-Governor, Mr. Lawson, declaring that the tortoises differed from the different islands, and that he could with certainty tell from which island any one was brought.

"I did not for some time pay sufficient attention to this statement, and I had already partially mingled together the collections from two of the islands. I never dreamed that islands, about 50 or 60 miles apart, and most of them in sight of each other…would have been differently tenanted...."

Four years after his Galapagos visit and with ample time for reflection, Darwin mused in *Voyage: "But it is the circumstance, that several of the islands possess their own species of the tortoise, mocking-thrush, finches, and numerous plants, these species having the same general habits, occupying analogous situations, and obviously filling the same place in the natural economy of the archipelago, that strikes me with wonder."*

And he was clearly fast on the track of his seminal idea: *"Hence, both in space and time, we seem to be brought somewhat near to that great act—that mystery of mysteries—the first appearance of new beings on earth..."*

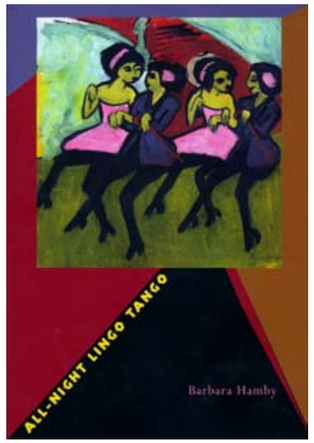
Truth is, Darwin may never have had a true eureka moment at all. After *Voyage* was published, he spent the ensuing 20 years mulling over his original observations bolstered with information supplied him by various specialists who studied his collections.

In all likelihood, instead of being struck with the proverbial eureka moment, the "Father of Evolution" arrived at his theory of natural selection after slow and careful deliberation—a practice befitting the greatest biologist—and some would argue scientist—of all time.

EDITOR'S NOTE

D. Bruce Means is executive director of Coastal Plains Institute and since 1976 has served as courtesy professor of biological science at Florida State. A field ecologist with more than 45 years' experience, his main research interests include fire ecology, longleaf pine ecosystems, tropical biology and herpetology. His latest book, Stalking the Plumed Serpent and Other Adventures in Herpetology, *was published in 2008 by Pineapple Press.*

reviews



DANCING IN THE DARK

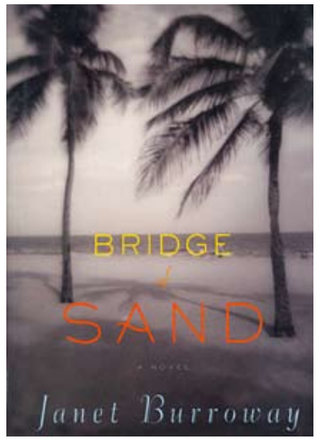
All-Night Lingo Tango by Barbara Hamby: University of Pittsburgh Press, 2009, 80 pages, $14.95

Reading the poetry of Barbara Hamby, who teaches within FSU's creative writing program, is like being at a party, dancing to tropical rhythms while watching film noir and drinking high-octane cocktails all at the same time. Hamby, a writer in residence at Florida State and the author of three previous poetry collections, gives the reader an intimate look inside her mind, and it's a lot of fun in there.

A few of the poems in her latest do feel dark and quiet, ground into the nitty-gritty of daily life, with a passing hint at despair. There's more than one reference to all-night bouts of insomnia saved at least partially by personal entreaties to music, Marlene Dietrich and Max von Sydow. "I Find an Entrance to Hell" describes an encounter with the author, her mother and a decidedly unsympathetic staffer at the Social Security office in Honolulu, a moment often felt but rarely described so well, and with so much wit.

Some of the poems are light and airy as egg whites, shot through with wry humor delivered like a snickering, whispered aside, like "Ode to Cake, Catcalls, Eggs, With a Minor Scary Reference to the End of the World," a celebration of food that begins with the embarrassment of trying to avoid eggs while with a vegan friend at Spanish restaurant with a cute waiter. The poem finds its way into longing a bit for lost youth before settling into serious talk about cake and, just before finishing up, flirts with the apocalypse. Others are complex and intricate odes involving Greek gods and intellectual ideas.

The book includes a sort of guide in the back to each of its three sections, describing the reasoning behind the groupings and describing inspirations, approaches, or just thoughts Hamby had while working them up. It's a reminder of how the poet sets things up, a glimpse of the artistic machinery going on backstage that makes the whole party possible.**—Kim MacQueen**



SHOULD I STAY OR SHOULD I GO?

Bridge of Sand by Janet Burroway: Houghton Mifflin Harcourt Publishers, 2009, 329 pages, $25.00

Janet Burroway's latest novel starts in Pennsylvania, as a funeral limo makes its way past the smoke of 9/11 fires. At its heart is Dana, a senator's widow, headed to his funeral. The service is overshadowed by reports of the September 11 disaster and what little mourning she does for him—their marriage having died years before with an infant daughter—looks more like imagined scenes of terrorism, of what it must have been like to fall from the Twin Towers. She spends the weeks afterward moving away from her former life, detaching a little more every day.

Rootless, Dana shifts south in much the same way she was shifted throughout her childhood, by parents who couldn't and wouldn't stay in one place. And it's when she gets into the car, leaves her old life behind and hits the road that the novel itself really gets going. About the time Dana crosses the Florida/Georgia border, Burroway's lush, loving descriptions of the southern landscape kick in, and soon you almost can see the car itself on Highway 98, brackish water on the left, forest on the right, folks battening down against the hurricane, the sulfur smell of pulp mills in the wet, heavy air.

Ignoring the advice of one of her few friends—"Don't sell the house and don't fall in love"—Dana looks up an old flame in southern Georgia and finds an interracial love affair and a whole mess of trouble. The object of her affection has a three year-old daughter and an estranged wife who won't give up, who sends Dana a letter threatening to "whip her bony white ass." She flees again, but can't get rid of thoughts of Cassius—and stealing away to see him only brings more, scarier threats. It's enough to make anybody's wanderlust kick back in again, unless they were to decide to settle in and wait for love to show up and claim them. The character of Dana is both compelling and compassionately drawn, and it's a treat to watch and wait to see where she's headed next.

—Kim MacQueen

portrait

PHOTO: RAY STANYARD

ASSOCIATE PROFESSOR OF INTERIOR DESIGN **JILL PABLE**

INTERIOR DESIGNER JILL PABLE whips out a tape measure and spiral-bound sketchbook and mulls the possibilities.

The room at Tallahassee's HOPE Community—a transitional housing shelter at the Big Bend Homeless Coalition—measures just 9-by-12 feet, yet sleeps a family of four. A modest dresser and pair of bins beneath two bunk beds are heaped with a family's shoes, clothes and children's books.

How, wonders Pable, a Florida State associate professor of interior design, can she give this family—as well as thousands of other homeless families—more privacy and storage? How can good design make the six weeks or so a family spends in a cramped shelter dormitory less stressful?

In what has been called the nation's worst economic crisis since the Great Depression, families make up the fastest growing segment of America's homeless population. Even before things got so grim, Pable was focusing her own academic research on improving shelter design for transient families (her design concepts for the homeless have been published in the Journal of Interior Design, the respected scholarly publication in her field).

Now national president of the 700-member Interior Design Educator's Council, Pable spent the early part of her career working in commercial design, including a two-year stint at Universal Studios in Orlando. She became interested in designing for the homeless as an assistant professor in the department of design at California State University at Sacramento. There, Pable and her students began studying the design needs at an 80-bed Salvation Army shelter.

"Students lost a lot of fear about the homeless and their eyes were opened to the great need that exists for the underprivileged," says Pable, whose students' design solutions were spotlighted in a local fund-raising campaign.

Currently, two of Pable's FSU interior design graduate students are seeking a patent on a prototype for a cradle that enables a parent in a shelter to nurture an infant without the child being in the same bed — thereby averting the risk of a smothering injury or death.

Over the next year, Pable will take a modest ($10,000) research grant from FSU and study the effects of architectural control factors in homeless shelters.

She'll test her ideas out at the HOPE Community, a transitional community for the homeless where she volunteers, just a few miles from FSU's campus.

Staff members at the facility say they are seeing an upswing in the number of clients admitted, particularly among the middle class and educated.

"It's rough out there. We've had a couple of people come in who have Ph.D.s," says Cheryl Mixer, a resident assistant at HOPE. "We're seeing more what you would call 'middle class,' lots of parents and children."

Pable's ideas for making life more dignified for residents, include upgrades as simple as room-darkening window treatments; bedside reading lights; wall-mounted fans; ample, accessible storage; and walls painted with magnetic paint (so that children can easily hang artwork and messages). These things all "encourage a sense of control," Pable explains. "And when you give people a better sense of control they may feel less helpless in these circumstances and are better able to seek stable housing and employment."

—Elizabeth Bettendorf

Jill Pable, *associate professor of interior design, earned her Ph.D. in secondary education with an emphasis in instructional technology and architecture from the University of South Florida in 2000. In 2009 she was the recipient of an FSU research grant to study better design for homeless shelters.*