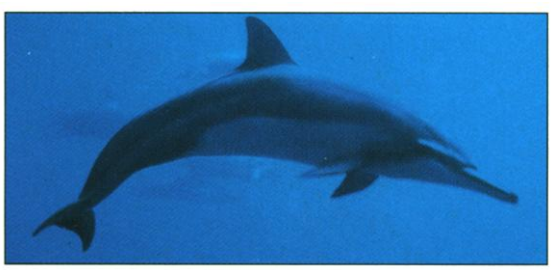
MEETING SOCIETY FOR INTEGRATIVE AND COMPARATIVE BIOLOGY

Integrating the Many Aspects of Biology

ATLANTA—At the annual meeting of the Society for Integrative and Comparative Biology, held here from 4 to 8 January, researchers studying a wide range of organisms described new insights into old topics, such as why dolphins have blubber and why leafy greens are good for you.

Blubber Springs Back

The conventional wisdom holds that the thick layer of fat under the skin of marine mammals such as dolphins and whales provides insulation and improves the buoyancy of creatures living in cool oceans. But data reported at the meeting by functional morphologist Ann Pabst of the University of North Carolina, Wilmington (UNCW), suggest another, less conventional function for this fat layer, known as blubber.



Functional fat. Blubber may turn the dolphin's tail into a spring that makes swimming more efficient.

Over the past few years, Pabst and her colleagues have poked, probed, modeled, and examined blubber in minute detail. They found that it's more than just a jumble of fat cells. The tissue contains a mix of collagen and elastin fibers that alter the mechanical properties of blubber at different places along the body. Now, studies of dolphins trained to swim in laboratory setups suggest that these mechanical properties turn the dolphin's tail into one long spring that helps it swim efficiently. "There's a mechanical method to the madness of this tissue, both in its fat cells and its mechanical weave," comments John Long, a biomechanist at Vassar College in Poughkeepsie, New York. "[Pabst] is really changing our view of how whales and dolphins swim."

Researchers have known for some time that terrestrial animals often make use of springs: A kangaroo, or even a human, stores energy in leg tendons that, when released, helps propel the body into the air. Many biomechanists have hesitated to consider that springs might aid swimming, however, as gravity plays a role in the springlike activity of legged organisms and gravity has little effect on organisms suspended in water. Instead, muscles were thought to provide all the power for swimming. But work in some invertebrates, such as squid, and a few fish suggested otherwise, and now the dolphin can be added to the list.

The idea that the dolphin tail could provide elastic energy springs in part from work by UNCW graduate student Jonna Hamilton. Working with Pabst, she found that the blubber midway along the bodies of dolphins and porpoises contains collagen and elastin fibers in a diagonal crossweave pattern. As a result, the researchers found, the blubber there is relatively stretchy. In contrast, the fibers in the blubber near the end of the dolphin tail, or fluke, tend to be closely packed, with one set running parallel to the long axis of the dolphin and another set perpendicular to it. Consequently, the blubber there is three orders of magnitude stiffer than that in the middle of the dolphin body. By studying the engineering principles that underlie the design of humanmade composite materials, the researchers realized that this range of properties set the stage for the tail to work like a spring.

To test that idea, Pabst and UNCW colleague William McLellan teamed up with marine mammalogist Terrie Williams of the University of California, Santa Cruz. Williams has two dolphins trained to push against force plates as they swim. The researchers painted nontoxic dots along one dolphin's tail and videotaped it swimming against a force plate. They observed that the stiffer blubber closer to the fluke hardly bends at all, whereas the blubber closest to the dorsal fin bends quite a lot, reaching its maximum distortion at the bottom of the tail's downstroke and then bouncing back. "At one end the blubber functions as a spring, but at the base it's [stiff] and absorbs unwanted energy," comments Robert Full, a comparative biomechanist at the University of California, Berkeley. "That's really neat."

In addition to helping biologists better understand how whales and dolphins get along in their watery world, the results are also interesting because "they tell us about how to make things," says Steve Nowicki, a comparative integrative biologist at Duke University in Durham, North Carolina. For example, Steve Wainwright of Duke University and his colleagues are building new kinds of flexible propellers, called propulsors, that resemble the dolphin's fluke. The studies of the properties and movement of the blubber and associated skeletal and muscle components near the fluke are now helping the team figure out the best way to attach this newfangled propeller to the rest of an underwater craft. And the U.S. Navy is interested, too, Pabst and others note, because of the potential to build quieter, more fuel-efficient submersibles.

Yet Another Role for the Versatile NO

Add this to the long list of reasons why you should eat your vegetables: They are rich in nitrates. Nigel Benjamin, a pharmacologist at St. Bartholomew's Hospital in London, reported at the meeting that harmless bacteria living on our tongues convert nitrates to nitrites, which in the acid environment of the stomach produce the potent pathogen-fighting chemical nitric oxide (NO). This, he proposes, helps protect the body against harmful microbes taken in with our food. Moreover, by harnessing this natural antimicrobial strategy, Benjamin's team has cured long-standing fungal infections on human skin, prompting him and his colleagues to begin developing a new line of disinfectants and antimicrobial treatments.

Benjamin was alerted to the antiseptic

Fixed feet. Persistent fungal infections *(top)* can be cured *(bottom)* with acidified nitrite treatments.

CREDITS: (LEFT TO RIGHT) VISUALS UNLIMITED; NIGEL BENJAMIN/ST. BARTHOLOMEW'S HOSPITAL AND THE ROYAL LONDON SCHOOL OF MEDICINE AND DENTISTRY

power of vegetables by his studies of NO in the body. Over the past 20 years, biomedical researchers have discovered that this ubiquitous gas has many critical roles. It is a neurotransmitter, for example, and certain white blood cells churn it out to destroy invading bacteria, fungi, and viruses. But about 5 years ago, Benjamin began to piece together another way in which the body uses NO—one that could explain how early humans were able to survive the continual onslaught of foodborne pathogens in the raw meat they ate.

The first clue came about 7 years ago, when Benjamin was trying to quantify the amount of NO in the body by measuring nitrate excretion, which was at first thought to result primarily from NO. He realized he first needed to know how much nitrate enters the body as part of the diet and how that nitrate is used. Several years of experiments, both in the test tube and with people, revealed that the digestive tract is quite adept at absorbing nitrate and that at least some of it winds up as nitrite, concentrated up to 10-fold, in saliva. Nitrates and nitrites came under fire in the 1970s as food additives because they can be converted to nitroso compounds, which can be potent carcinogens. But Benjamin reasoned that the body wouldn't concentrate nitrite in saliva to the degree that it does if it didn't also play a beneficial role.

His group subsequently showed that in the rat mouth, an enzyme called nitrate reductase converts nitrates to nitrites. Curiously, the rats themselves weren't producing the enzyme: The researchers could only find a bacterial form, and germ-free rats, it turned out, had no trace of the enzyme at all. Two years later, the team demonstrated that most of the nitrite is churned out by benign species of *Staphylococcus* bacteria, primarily from hideaways in the deep clefts at the back of the tongue, where oxygen is relatively scarce. The bacteria use the nitrate as an electron acceptor for anaerobic respiration, then release the resulting nitrite into the saliva. There, Benjamin says, it is swallowed, in "up to a liter of saliva per day" for a person.

At the meeting, he described the fate of this nitrite once it hits the stomach's acids: By sticking tubes down the throats of volunteers fed a helping of lettuce (a high-nitrate vegetable), the researchers detected a rise in NO concentration from 15 parts per million to 400—a concentration high enough to "kill any bacteria that we have swallowed," says Henry Trapido-Rosenthal, a molecular biologist at the Bermuda Biological Station for Research. Having a sterile stomach explains "why we and other vertebrates didn't die out from diarrheal disease," he notes. "There are very important implications for medicine."

Indeed, Benjamin and his colleagues are already exploring some of those implications. He and Tony Ormerod of the Aberdeen Royal Infirmary showed that a combination of acidic and nitrite creams can clear up persistent skin infections, such as athlete's foot, which is caused by a fungus. It also combats viral infections, such as molluscum contagiosum, which causes lots of bumps on the skin. The results make nitrite products "an intriguing possibility for [treating] fungal infections," says Esther Leise, who studies NO function at the University of North Carolina, Greensboro.

Benjamin and his colleagues are hoping that acidified nitrite will find its way into the market, both as a treatment for fungal infections and, in another form, as a new type of disinfectant. "[These products] will be ecologically safe," much more so than chlorine-based disinfectants, he predicts. As for dietary advice: Benjamin can't recommend adding bacon to meals, as smoking produces a range of nitrogen-based compounds, some of which may be toxic to the body. But he does have this word of advice for lovers: "Eat salad before you kiss."

–ELIZABETH PENNISI

TAXONOMY

Researchers Cash In on Personalized Species Names

Looking for that extra-special gift for a loved one who seems to have everything? Help is at hand. In return for a donation to biodiversity research, you can have a previously unknown species of orchid, or mosquito, or sea slug, named after them and recorded in the scientific literature for perpetuity. The scheme for generating the zoological equivalent of vanity plates, dubbed BIOPAT, was registered last week as a nonprofit organization in Germany. Its founders hope it will become a valuable source of funding for the unglamorous fields of systematics and taxonomy, as well as supporting conservation in the new species' home countries.

Recent research suggests that one-tenth or fewer of the species that exist on Earth today are described in the scientific literature. Although 10,000 new species are described every year, thousands lie nameless in museum drawers. "In our collections we have 500 or 600 new animal species," says Gerhard Haszprunar of the State Zoological Collection in Munich, one of the institutions behind BIOPAT. The problem, he says, is "getting the money to work on the material."

A critter's scientific name—the genus and its individual species name—is usually defined by the taxonomist who first describes the species and often refers to its appearance or where it was found, but can immortalize the collector or whoever supported the research. These traditions are not always followed, however: Recently a marine snail of the genus *Bufonaria* was named *borisbeckeri* after the German tennis player, while a Colombian tree frog was granted the moniker *Hyla stingi* by a fan of the British rock star. Once a name is published together with the species' first description in a scientific journal, it becomes internationally recognized.

German taxonomists, led by the Federal Agency for Technical Co-operation, decided it was time to cash in on the endless name giving. Interested amateur naturalists, or even multinational corporations, can browse a photo gallery of unnamed species on the BIOPAT Web site (www.biopat.de). After spotting their adoptee, they can bestow a Latin name of their choice for a donation starting from $2800 for individuals, or more for corporations. Half of each donation will go to the institution where the species was studied; the rest will be spent on protecting biodiversity in its country of origin.

Species for sale. For a small donation, this frog can share your name.

CREDIT: BIOPAT

Some researchers fear that money may sully the scientific process of defining species. "A researcher might put himself under pressure to describe species as new, which may have been described before already," says Rüdiger Krause of the Zoological Museum at Dresden. To reduce such temptations, BIOPAT will not offer an unnamed species unless a researcher first has a description accepted for publication in a peer-reviewed journal or approved by a BIOPAT advisory committee. If the scheme catches on, the organizers hope to enlist more research museums in Germany and abroad. Says BIOPAT president Claus Bätke of the Federal Agency for Technical Co-operation: "We already have some definite orders."

–SABINE STEGHAUS-KOVAC

Sabine Steghaus-Kovac writes from Frankfurt, Germany.