nent and to support innovative projects.

Among other complaints, scientists say that Framework's cumbersome bureaucracy takes too long to hand out grant money and that too little money is set aside for basic research that doesn't fit into such prescribed categories as aviation or infectious disease. In the current Framework, a small fraction of funding is reserved for "generic" projects—far less than in Framework 4. Such criticisms have galvanized the lobbying arm of the new European Life Scientist Organization (*Science*, 15 September, p. 1859). Although the next iteration, Framework 6, won't start until 2003, scientists are pushing hard now, because the E.U. research directorate has begun drawing up the new Framework's contours.

New research chief. Achilleas Mitsos.

Rank-and-file researchers—some of whose complaints were endorsed in an expert panel's report this summer—now have powerful allies in agitating for change. In a speech on 14 September to the European Parliament, research commissioner Philippe Busquin promised that Framework 6 would play a bigger role in coordinating European research. And speaking with journalists last week, the research directorate's new director-general, Greek economist Achilleas Mitsos, predicted that Framework 6 will include a greater proportion of funding for projects that don't fit into the spending pigeonholes.

Mitsos also says that Framework 6 is expected to prime efforts to "link the different national and European Community research programs in a more strategic way." That picks up on Busquin's proposal for a "European Research Area" (ERA)—endorsed this summer by European science ministers—to help coordinate national research efforts in E.U. member states (*Science*, 21 January, p. 405).

Whether Busquin and Mitsos can execute their desired changes is another question. New programs and changes in E.U. policy must be endorsed by all 15 member states, as well as by the European Parliament and the commission. To help navigate this labyrinth, Mitsos's team is preparing a strategic plan, to be issued early next month, that will lay out how the research directorate plans to implement the ERA and develop Framework 6, the first draft of which is due in February.

–ROBERT KOENIG

BIOPHYSICS

For Certain Shrimp, Life's a Snap

For such a shrimp, *Alpheus heterochaelis* gets awfully violent. Whenever a delicious—or dangerous—sea creature skulks by, the dirty-green shrimp slams its snapper claw shut, blasting the visitor with a jet of water. Quite naturally, scientists have attributed the crackle of snapping shrimp colonies, much like the sound of burning twigs, to many claws banging together. But now, an unusual study reveals the shrimp's real noisemaker: bubbles.

On page 2114 of this issue, physicist Detlef Lohse of the University of Twente in the Netherlands and his colleagues report that a collapsing bubble outside the shrimp's claw causes its characteristic clack. According to this new study, *A. heterochaelis* clamps its claw so rapidly that a water jet gushing from the claw first loses and then gains pressure, causing an air bubble in the jet to swell and collapse with a pronounced "snap!" The imploding bubble generates shock waves that stun nearby prey and ward off other shrimp, who have learned to keep their distance. "These bubbles are tiny, but they have tremendous energy," remarks Lohse. Snapping shrimp may be the first animals known to create forceful "cavitation" bubbles, more commonly churned by the propellers of ships.

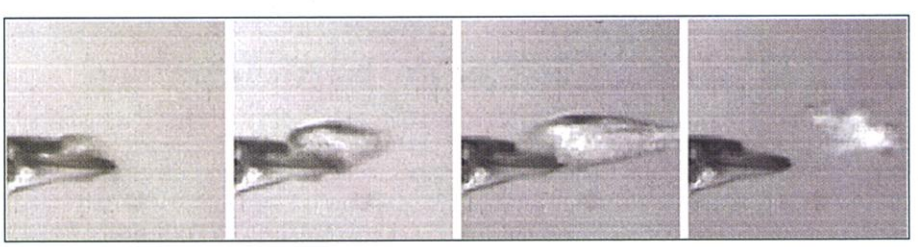
"This is one of those studies that makes you think, 'Damn, I wish I'd done that,' " says physicist Lawrence Crum of the University of Washington, Seattle. "It's a first-class piece of work." (Crum is no stranger to the surprising sounds of nature: He has recorded the underwater gas bubbles that form and then burst with a shriek when snowflakes fall on a lake.) "What's remarkable," Crum says, "is that this shrimp can move its claw fast enough to create a vapor bubble." Shrimp in the study snapped their claws shut at speeds reaching 108 kilometers per hour, Lohse says.

Smaller than a finger, *A. heterochaelis* lives in warm, shallow seawater, often burrowing below coral rubble or among oyster clumps in tide flats. Each shrimp sports one ordinary claw and one snapper claw, which looks like a mottled green boxing glove and can grow to half the shrimp's size. Muscles on each side of the snapper claw slowly contract, cocking the claw open like a revolver—until an unfortunate little crab, for instance, triggers the claw to slam shut. Together, hundreds of trigger-happy shrimp make a colony, snapping day and night. During World War II, the Navy launched some of the first acoustic studies on the shrimp, whose constant crackle drowned out submarine-detecting sonar.

The new study was sparked a few years ago, when Barbara Schmitz, a zoologist at the Technical University of Munich in Germany, was shooting video of shrimp in her lab and noticed the curious flash of a bubble in some pictures. At a 1999 meeting, she approached Lohse, who studies bubble dynamics. They decided to collaborate.

To catch the bubbles in action, the scientists, with Twente researchers Michel Versluis and Anna von der Heydt, tethered seven shrimp on a platform inside Schmitz's lab aquarium. Then they planted a 40,000-frame-per-second camera above, or sometimes below, the aquarium and dangled a hydrophone, or underwater microphone, into the water. Over and over, the researchers tickled each shrimp's snapper claw with a paintbrush, recording its reaction, for a total of 108 experiments.

Every time, the shrimp's claw snapped shut—followed, hundreds of microseconds later, by the loud collapse of a bubble in the ensuing water jet. The video shows an air bubble forming between a shrimp's closing claw and then blasting away along with the water jet before the claw shuts. Some 300 microseconds later, the bubble balloons to about



Bubble blast. On high-speed video, a tiny bubble forms between the shrimp's claw and then blasts away, where it will shatter with a "snap!" The collapsing bubbles stun nearby prey. Top, the trigger-happy *Alpheus heterochaelis* with its snapper claw.

CREDITS: (LEFT TO RIGHT) COURTESY OF THE EUROPEAN COMMISSION; R. STREIF; M. VERSLUIS AND B. SCHMIDT

3 millimeters and then shatters, leaving a cloud of tinier bubbles that quickly dissolve. On audio, the big bubble break, or cavitation, invariably broadcasts a loud snap. "What we hear must be bubble noise," says Schmitz. "The recordings are quite convincing."

To work out the physics of this crustacean cavitation, the researchers simulated it with a numerical model. Their model relies on a phenomenon called Bernoulli's Principle: When liquid moves above a certain speed, its pressure drops, and vapor bubbles in the liquid expand. But if the pressure rises again, those bubbles will implode. And that's precisely what happens with a snapping shrimp, Lohse says, as the water jet spewing from its claw returns to normal pressure. The team's calculations of bubble shape and speed closely mirror the lab recordings, Lohse adds.

"The study makes a nice case for cavitation," agrees physicist Michael Buckingham of the Scripps Institution of Oceanography in La Jolla, California. Buckingham wonders, however, whether suction pad–style membranes on the back of the shrimp's claw—and not the closing of the claw itself—cause the bubbles. For that matter, no one knows how many of the roughly 400 snapping shrimp species blow bubbles, or how the talent evolved. On these matters, the shrimp fall strangely silent. **–KATHRYN BROWN**

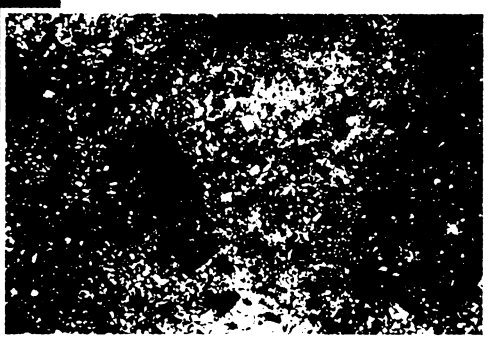
Kathryn Brown is a writer in Alexandria, Virginia.

ARCHAEOLOGY

A Victim of the Black Sea Flood Found

Have deep-sea explorers uncovered the drowned dwelling of some of Noah's less fortunate contemporaries? Archaeologists are mulling over tantalizing images of what appears to have been a house of wood and mud littered with human artifacts now 91 meters beneath the Black Sea. The find lends further credence to the claims of two oceanographers that a torrent equaling 200 Niagara Falls cascaded from the Mediterranean Sea 7500 years ago, driving Neolithic peoples living along the Black Sea coastline inland (*Science*, 20 February 1998, p. 1132). But whether the catastrophe gave rise to the biblical account of Noah's Flood and spread farming into central Europe, as the researchers speculate, we can't yet say.

Oceanographer Robert Ballard of the Institute for Exploration in Mystic, Connecticut, led the expedition during which the discovery was made. He used the same combination of underwater technology and informed searching as he employed when he made his other famous finds, including the *Titanic*, the *Bismarck*, and two Phoenician ships—the oldest shipwrecks ever discovered in deep water. Guiding a remotely operated vehicle across a sea-floor target initially identified in a sonar survey, Ballard and his colleagues on the National Geographic Society–sponsored expedition came upon



Flood detritus? A beveled log *(above)* and a likely stone tool *(right)* mark what appears to be a flooded home.

"one of the most astonishing things I've ever seen," said the expedition's chief archaeologist, Fredrik Hiebert of the University of Pennsylvania in Philadelphia, whose research centers on Neolithic sites onshore from the find off the Turkish south coast of the Black Sea.

In a shipboard interview provided by the society, Hiebert recounted what to date other archaeologists have seen in a few grainy images. "... We were coming along the flat, slightly sloping plane of the bottom of the Black Sea today. It was almost featureless. ... We found a rectangular site some 4 meters across and maybe double that in length. ... Here were hewn beams in a rectangular form along with branches that seemed to be stuck in layers of mud. What we were looking at was a melted building made out of wattle and daub. Now, this is the typical type of construction for the ancient inhabitants along the Black Sea coast. And here we're seeing it under 300 feet [91 meters] of water. ... As we went very carefully—practically inch by inch—over this site, we began to see stone tools. ... I don't know if they're hammers or chisels ... but it's quite clear that they were worked by human hands. ... We also found fragments of ceramics. ... This is a remarkable find."

Archaeologists who have seen the few images released on the nightly news or the society's Web site (www.nationalgeographic.com) are definitely intrigued. "There do seem to be some traces of human activity," says archaeologist Peter Bogucki of Princeton University. "Based on these photos, they have found highly suggestive evidence of human habitation," says archaeologist Andrew Moore of the Rochester Institute of Technology in New York. But like others, he adds, "I would like to see the objects themselves." Some, such as wood suitable for carbon-14 dating, may be retrieved on this expedition.

The presumed discovery would lend support to the scenario put forth 3 years ago by oceanographers William Ryan and Walter Pitman of Columbia University's Lamont-Doherty Earth Observatory in Palisades, New York, in which rising sea level in the Mediterranean after the last ice age eventually breached the Bosporus strait and expanded the existing freshwater lake by a kilometer or more a day. The geologic evidence has largely persuaded archaeologists of the reality of the deluge, says Moore, but "there is a great deal of skepticism of the larger claims of cultural change." The requisite coastal population may have been there at the time of the flood, says Moore, but the links to a forced migration that spread agriculture and prompted flood myths are "still tenuous ones for most scholars."

–RICHARD A. KERR

BROOKHAVEN LAB

Forbes Loses in Fallout From Reactor Fight

A New York congressman who sided with environmentalists to kill a nuclear research reactor at Brookhaven National Laboratory in Upton, New York, has been defeated in a stunning primary upset. Representative Michael Forbes, who switched from the Republican to the Democratic party last year, lost last week by a narrow margin to Regina Seltzer, the 71-year-old widow of a Brookhaven chemist. The defeat is a blow to the national Democratic party, which had strongly backed Forbes, but is welcome news to many Brookhaven scientists.

Forbes had alienated many of the lab's 3000 employees in recent years when he urged the Department of Energy (DOE) to shut permanently the High-Flux Beam Reactor, which leaked tritium (*Science*, 25 February, p. 1382). Although DOE chief Bill Richardson decided last year to close the facility, many scientists accused Forbes of politicizing the issue and currying favor with influential Long Island environmentalists. Seltzer,