Fighting the mite: May the best bee win

In a few weeks, entomologists will transport a special strain of honeybees from the marshy island of Grand Terre, off the coast of Louisiana, to selected sites in the southern part of the state. Scientists and beekeepers hope the transfer will mark the beginning of the end for a mite infestation that has swept through much of the United States since 1984, leaving millions of honeybees gasping for breath.

The tracheal mite, *Acarapis woodi,* makes its home in the breathing tubes of adult honeybees. By restricting oxygen intake, it robs the bee of crucial energy needed for flight, reducing the insect's lifespan by one-third. "It's like an adult [human] with emphysema," says geneticist Thomas E. Rinderer of the Agricultural Research Service (ARS) in Baton Rouge, La. The infection shortens by about two-thirds the time available for summertime bees to pollinate crops and produce honey, he adds.

Long established in Europe, the tracheal mite today poses a serious threat to U.S. hives. Chemical efforts to destroy it have met with limited success, Rinderer says. Menthol, a traditional remedy for human sore throats, can clear the mites from bee breathing tubes, but has proved most effective only in autumn, he notes. Winter temperatures prevent menthol crystals from vaporizing, leaving the mites unchecked; spring treatment may cause the menthol to mix with honey; and summer heat elicits such rapid vaporization that bees temporarily flee the irritant, abandoning their hives and broods. "It's a very chancy treatment," Rinderer says.

He and his colleagues have now turned to what they hope will become a mightier weapon: breeding. Last July, an ARS researcher brought back 15 queen honeybees, individually packaged in tiny cages, from Buckfastleigh, England. The strain had been painstakingly bred for resistance to tracheal mites by a 92-year-old monk named Brother Adam, who has practiced beekeeping for 76 years.

Now quarantined on Grand Terre, the queens and their progeny – known as the Buckfast strain – should receive state certification of good health on Jan. 14, allowing transport to the mainland late this month for large-scale propagation, Rinderer says. This spring, he plans to send Buckfast bees to researchers in areas where the tracheal mite has taken a significant toll. Over the next three years, scientists will compare the Buckfast bees' resistance with that of three other bees – a Yugoslavian strain resistant to a mite that attacks bee larvae, a hardy commercial bee not bred for mite resistance, and a native Louisiana strain that will serve as a control. The strain showing the greatest resistance will then be bred with native honeybees throughout the nation in an effort to conquer the parasite once and for all. – *R. Cowen.*

ARS

Eggs and immature tracheal mites block breathing tube of honeybee. Inset: Closeup of mite.

Lab-grown shells mimic seashore version

You don't have to be a shellfish to grow a seashell. Now even humans can accomplish this feat with a simple laboratory setup and some processing tips from sea-dwelling shell makers.

The technique could lead to novel ceramics, perhaps for surrogate bones and teeth.

Fabricating ceramics for tableware, tools and other products almost always involves high temperatures, rugged chemical conditions and lots of fuel. Yet marine animals such as clams and sea urchins fashion their intricate bioceramic shells and spines under mild, comfortable conditions. Collaborating scientists at Pennsylvania State University in University Park and the Royal Technical University in Bratislava, Czechoslovakia, sought to create tough synthetic ceramics through similar low-temperature reactions.

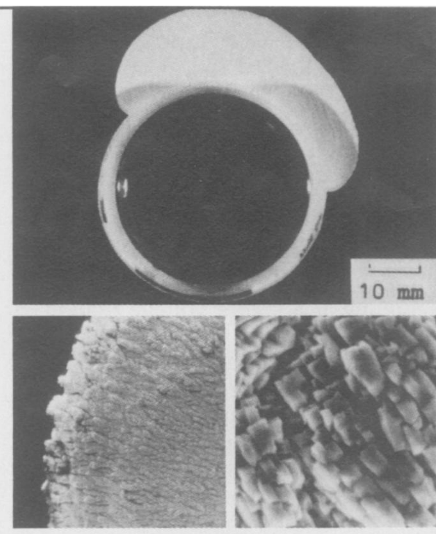
The team now reports growing shell-shaped formations composed mostly of calcium carbonate, the primary mineral in seashells, by adding hydroxyethyl cellulose (HEC) – a complex sugar, or polysaccharide – to mineral-saturated solutions. Small amounts of polysaccharides, proteins and other organic compounds play pivotal, though poorly understood, roles in biological mineralization processes such as bone formation and shell growth.

The experimental shell-growing apparatus held a beaker of calcium chloride powder within a larger beaker of sodium carbonate powder. The researchers added just enough HEC-spiked solution to each beaker to form a liquid bridge over the inner beaker's lip, linking the solutions in the two containers. As the solutions diffused into one another over several days, some lifelike mineralization occurred, says Rustum Roy of Penn State.

Along the outside of the inner beaker, calcium and carbonate ions assembled into a thin, white, solid layer with a gentle upward curve. "The overall shape of the body of the precipitate resembles that of a mollusk shell," the researchers write in the December 1990 JOURNAL OF MATERIALS RESEARCH. Scanning electron microscope observations suggest the resemblance partly extends to the shell's underlying arrangement of tiny crystal platelets, Roy adds.

However, this comparison breaks down in several ways, notes biomaterials scientist Mehmet Sarikaya of the University of Washington in Seattle. Calcium carbonate in the lab-made shells mostly assumes a structure known as vaterite, not the tougher calcite and aragonite mineral forms common in such biological edifices as abalone shells and sea urchin spines. The vaterite microcrystals also pack together less densely than related minerals in natural shells.

"The lesson we learned is how little we understand about biomineralization," Roy says. And that means more work for the new year. – *I. Amato*



Roy et al./JOURNAL OF MATERIALS RESEARCH

Several-inch synthetic shell on side of beaker (top) and two scanning electron microscope views of vaterite structures.