RESEARCH NOTES

THE CHEMISTRY OF THE OCEANS

In the course of study to determine the impact of biological processes on the chemistry of the oceans, a Caltech scientist has found sea animals that can make the mineral fluorite (CaF_2). Heinz Lowenstam, professor of paleoecology, has established conclusively that at least three small animals—the opossum shrimp, deep sea snails, and a sea slug called a nudibranch—deposit fluorite, a crystalline compound, in their mineralized tissues.

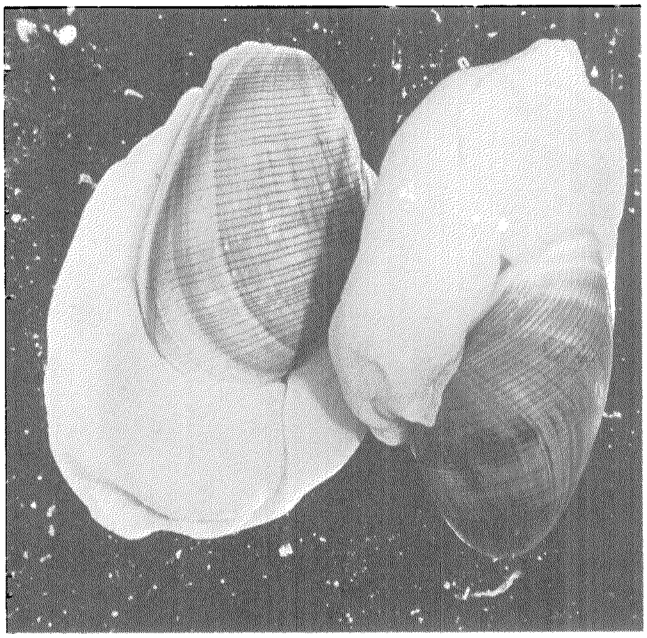
The shrimp extract fluorine from the sea to make tiny button-shaped stones (statoliths) that function as balancing organs, enabling the shrimp to sense direction. The animal sheds its exoskeleton, with the statolith, as many as 40 times in a lifetime. The opossum shrimp are a major food source for fish, whales, and other marine animals; and the statolith, which is not digested, is excreted to become part of the sediment on the ocean floor.

The molted and excreted statoliths are commonly ingested by bottom-feeding creatures that can digest some of the organic framework and excrete free crystals of fluorite. Dr. Lowenstam suggests that this process may account for much of the fluorite accumulation on the sea floor.

Observations also suggest that where huge populations of the shrimp exist, their large-scale fluorite precipitation seems to influence the fluorine content of the surrounding seawater during certain seasons. For many years geologists believed that fluorine-bearing sediments were derived only from weathering products of rocks on land and from submarine volcanos.

Dr. Lowenstam's work was conducted in cooperation with Duncan McConnell of Ohio State University. Specimens for their experiments were gathered in coastal waters of Denmark and near Puget Sound in Washington. The researchers also

Heinz A. Lowenstam, Caltech professor of paleoecology.



The deep sea snail is one of three marine animals in which deposits of fluorite have been discovered.

investigated deep sea snails and nudibranches. Fluorite was found in the gizzard plates of snails, collected in water from 180 to 200 feet deep near Denmark's Faeroe Island in the Norwegian Sea. Nudibranches were found to have a very high fluorine content—as much as 18 and 19 percent—in their spicules, small mineralized spines formed by the tissues.

The researchers used two methods—x-ray diffraction and electron probe analysis—to identify the presence of fluorite in the shrimp and snails. First they mechanically removed the statoliths and gizzard plates from the specimens. One portion was examined with the electron probe microanalyzer to determine the major chemical constituents; the other portion, finely ground into a powder, was studied for its x-ray diffraction patterns.

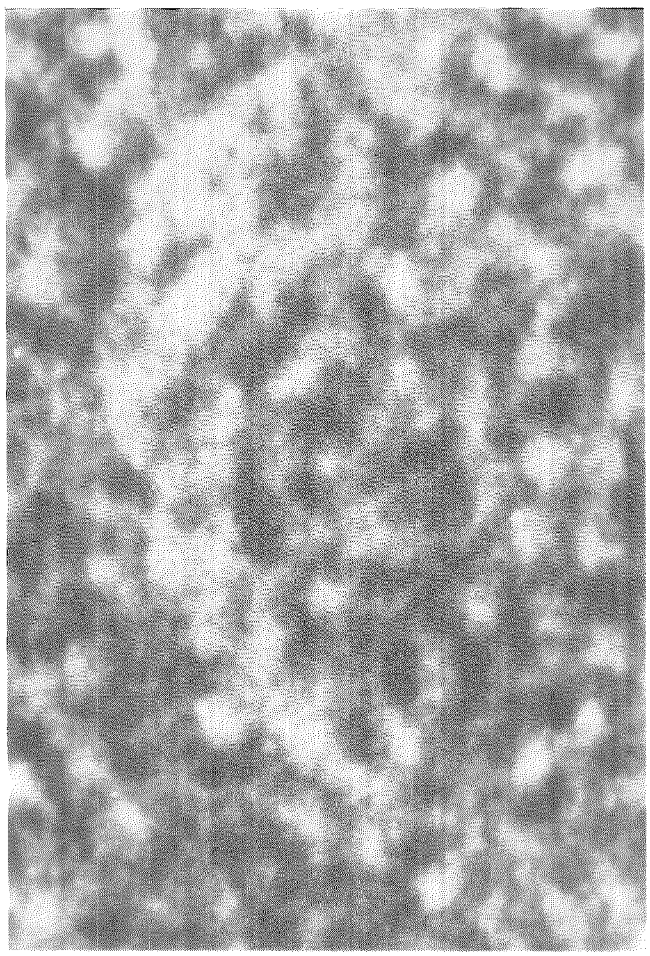
A RARE GLIMPSE INTO MOLECULAR STRUCTURE

An electron micrograph of a short length of a DNA molecule, recently presented by Caltech graduate student Jack Griffith as part of a scientific paper, has now been snapped up by the press and identified dramatically as "the first picture of the coiled structure of life's basic genetic material."

Griffith is unwilling to attach quite this much significance to the photograph. He will go so far as to agree that the micrograph *may* contain visual evidence of the 16-year-old theory of the double-stranded helical structure of DNA, proposed by Crick and Watson in 1953. The faint outlines of two intertwined strands can be discerned in his picture, which has been magnified 7,300,000 times. And when measurements were done on the micrograph, all the relevant dimensions were in good agreement with the known parameters of DNA.

Still, with characteristic scientific reluctance, Griffith describes his picture as "Exciting—yes! Beautiful—yes! Proof—no!"

"We cannot be certain," he says, "that the helical structure observed in this micrograph is real and not an artifact or a fortuitous structure that *looks* like the Watson-Crick structure. Such rare glimpses into molecular structure may be hints of statistically sound micrograph data to come, or they may be erroneous artifacts created by the machines that visualize them."



Electron micrograph of a portion of a DNA molecule, taken by Caltech graduate student Jack Griffith. The crescent-shaped helical structure which runs top to bottom, slightly left of center, may be the first visual evidence of the structure of DNA.

David Marsh, Caltech research fellow in chemistry.

ALLERGENS AND ALLERGOIDS

A Caltech chemist has found a way to take most of the side effects out of medication now used to relieve allergic reactions. Drugs now in use employ an allergen, a form of the same natural irritant found in pollens and other sources of plant and animal materials. Present medication employs the native allergen. When injected as medication, the allergen causes formation of a specific blocking antibody to neutralize the natural irritant. However, the amounts of native allergen which can be administered are severely limited by the risk of general allergic reaction.

Research fellow David Marsh has been able to alter the allergen to make what he calls an "allergoid"; by doing so he can almost eliminate the unwanted allergic reaction (by over 99.8 percent), as tested on human white blood cells, bronchial tubes, and skin. However, the desirable blocking antibody production, as measured in guinea pigs, is maintained at up to 60 percent of that of the allergen. Immunization of humans has yet to be performed.

To make allergoids, natural allergens, such as may be extracted from ragweed pollen, are incubated in a diluted form with formaldehyde and the amino acid lysine for 32 days at 90 degrees Fahrenheit. The resulting altered configuration is an allergoid.

It seems likely that allergoids will be superior to native allergenic materials in therapeutic usage since, potentially, much higher doses could be given to allergy patients with greater safety. Higher doses would mean greater amounts of protective blocking antibodies with fewer injections than current practice dictates. Marsh hopes the material will become clinically available within three years.

Marsh, who began the research in England, is working at Caltech with Dan Campbell, professor of immunochemistry. They have also collaborated with Lawrence Lichtenstein, M.D., associate professor of medicine at Johns Hopkins, and with Zack Haddad, M.D., director of pediatric allergy and immunology at the Los Angeles County—USC Medical Center. The research is supported by the U.S. Public Health Service and Hollister-Stier Laboratories in Spokane.