Archaeology

Undersea dig explores ancient village

Ongoing excavations at an approximately 8,000-year-old settlement submerged in the Mediterranean Sea near Israel offer a look at the complexities of ancient village life, according to a report in the summer JOURNAL OF FIELD ARCHAEOLOGY.

"This is not only the largest and best-preserved prehistoric settlement ever found on the sea floor, it is the only one known to contain [undisturbed human] burials," say Ehud Galili, an archaeologist at the Israeli Antiquities Authorities in Jerusalem, and his co-workers.

Yearly excavations at the site, called Atlit-Yam, began in 1984. Work occurs only during September, when strong underwater currents abate and water temperatures rise. Erosion along Israel's coast exposed enough of Atlit-Yam and several other prehistoric sites to allow for their discovery by underwater archaeologists in the early 1980s. Radiocarbon dates indicate that people inhabited Atlit-Yam from around 8,100 to 7,500 years ago. Residents apparently abandoned the settlement to avoid rising seawater or advancing sand dunes that may have preceded flooding by the sea, the researchers contend.

A wide range of activities – including fishing, hunting, farming, and perhaps the penning of wild animals – allowed year-round occupation of the village, they hold.

Many bones at the site come from deepwater fish. Perforated stones retrieved by investigators may have served as sinkers for fish nets, and bone points may have allowed for spearing of fish from boats, Galili's team maintains.

Some of the 15 human skeletons uncovered so far, mostly in single burials, show tooth loss and damage that may have resulted from biting ropes or thin leather straps while fashioning fish nets, they add.

Ribs and vertebrae make up most of the animal bones – primarily from goats and cattle – found at Atlit-Yam, a pattern typical of butchery, the Israeli scientists note. Incisions on many bones probably resulted from cutting apart carcasses with sharpened stone tools, they say.

Goat and cattle bones at the site exhibit a wide range of sizes typical of isolated herds unable to breed with other wild animals, the team says. Thus, residents may have captured and kept these animals for slaughter at a later time, they argue.

A large hoard of charred wheat also turned up at the site. Marshes that once bordered the village would have provided good soil for wheat fields, Galili's team asserts.

Late dates in East Polynesia

A review of 147 radiocarbon dates obtained from material in sites throughout East Polynesia, an area bordered by Hawaii, New Zealand, and Easter Island, suggests that humans lived in that part of the world much later than some scientists have thought.

The earliest human presence in East Polynesia occurred in the Marquesas Islands between A.D. 300 and A.D. 600, assert Matthew Spriggs of the Australian National University in Canberra and Atholl Anderson of the University of Otago in Dunedin, New Zealand. Settlement began between A.D. 600 and A.D. 950 on most other islands and not until A.D. 1000 or shortly thereafter in New Zealand, the two archaeologists contend.

Other researchers cite radiocarbon evidence for colonization of the Marquesas during the first millennium B.C. and Hawaii and Easter Island by A.D. 400. But these dates prove unreliable for several reasons, including likely contamination of some samples before analysis and the inability to associate other samples with human-made relics, Spriggs and Anderson argue.

Humans apparently spread throughout East Polynesia relatively quickly, possibly hopping from one island to another as they depleted easily obtained food sources, such as reef fish and turtles, the researchers propose in the June ANTIQUITY.

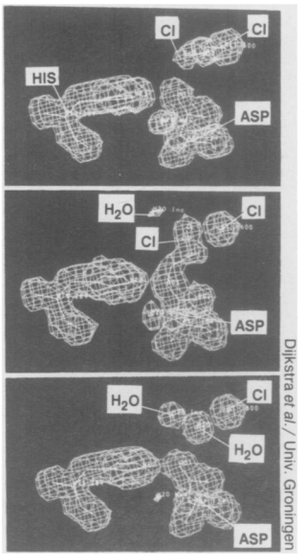
Biochemistry

Stop-action crystallography tracks enzymes

Thanks to those ever-adapting soil bacteria, nature has come up with its own ways to get rid of pollutants (SN: 8/15/92, p.107; 3/14/92, p.175). Some microbes, for example, have evolved enzymes that break down chlorinated compounds into less toxic components.

Now a Netherlands research team seeking to understand how these enzymes work and to improve upon nature's cleanup efforts has caught one in the detoxification act.

The investigators manipulated the temperature and acidity of solutions containing crystals of haloalkane dehalogenase from a nitrogen-fixing bacterium, *Xanthobacter autotrophicus*. This slowed the speed of the reaction – typically much faster than a second – between the enzyme and its substrate. This enabled them to use X-ray diffraction to determine the positions of the atoms at different stages of the reaction. Koen H.G. Verschueren and his colleagues at the University of Groningen describe their results in the June 24 NATURE.



Simplified computer graphic shows (top) 1,2-dichloroethane near two amino acids (HIS and ASP) at the active site; (middle) one free chloride (Cl) and linkage of chlorinated compound with amino acid (ASP); and (bottom) at the end of the reaction, only chloride and water at the active site.

The data confirm that the enzyme breaks up the pollutant in two steps, not one, as some researchers have suggested, says Bauke W. Dijkstra, a crystallographer with the group.

The team first placed enzyme crystals in an acidic solution (pH 5) with 1,2-dichloroethane, cooling it to 4°C. Under those conditions, the chlorinated molecule binds to the enzyme but no reaction occurs. Warming the solution to room temperature, allowed the enzyme to break the bond between one chlorine and a carbon atom of the molecule. Finally, making the solution less acidic (pH 6.2) pushed the reaction further.

The three stop-action atomic structures they obtained suggest that the chlorinated molecule winds its way through a narrow channel in the enzyme to the active site, an isolated internal pocket where the reaction occurs. Once there, it encounters a water molecule that the amino-acid side chains use to detoxify the incoming molecule.

During the first step, a chloride ion breaks away, allowing the rest of the molecule to link with an amino acid as an ester molecule, Dijkstra explains. The negatively charged ion helps make another nearby amino acid more able to attract a positive hydrogen from one water molecule. In the second step, that disrupted water molecule turns the ester into an alcohol, which is then released from the active site. The chloride leaves last.

"The problem is that this enzyme is not very active," says Dijkstra. "It's a relatively young enzyme; in an evolutionary sense, there hasn't been enough time for the bacteria to adapt."

Although eventually the enzymes would become more efficient, he and his colleagues hope to make them work faster and process more kinds of contaminants by manipulating the bacteria in the laboratory. "If we can understand the mechanism, then we may be able to improve the activity," he says.

Dijkstra expects others will try this crystallographic approach to study the activity of other enzymes.