Ancient site taps into soldiers' brew

Historical accounts from ancient Greece, Rome, and other early civilizations describe the systematic doling out of alcoholic beverages to soldiers along with food, weapons, and other military rations. Archaeologists now have evidence that military officials distributed beer and wine to members of the Mesopotamian army around 5,500 years ago, about the time that writing was invented.

"Beer and wine residue in vessels found at Godin Tepe in western Iran could be the earliest known indications of alcoholic beverages in military rations," asserts Virginia R. Badler of the University of Toronto.

She presented evidence supporting this theory last week in Atlanta at the annual meeting of the American Anthropological Association.

Badler directs ongoing excavations at Godin Tepe, an outpost inhabited from about 3500 B.C. to 3100 B.C. The Mesopotamians, who founded the world's first major civilization in what is now southern Iraq, built and maintained the settlement at a key location along an ancient trade route that extended from the Mediterranean Sea to China, Badler says.

Incisions carved on the inside of a large, two-handled jar found at Godin Tepe contain calcium oxylate, a bitter-tasting sediment produced during the brewing of barley beer (SN: 11/7/92, p.310). A small hole between the two handles would have allowed fermentation gases to escape during brewing. Excavations at nearby sites have yielded similar vessels, all of which show the stylistic influence of Mesopotamia, Badler holds.

"The presence of beer in a jar type foreign to Godin Tepe indicates that in addition to writing, cylinder seals, and several unique pottery types, the lowland Mesopotamians introduced to this region the technology for making a new or improved alcoholic beverage," she contends.

The inside of another large jar recovered at Godin Tepe bears traces of tartaric acid, a chemical component of wine (SN: 5/4/91, p.279).

Both the beer and wine containers turned up in a single room situated within a rectangular complex of structures, according to Badler. A pair of windows on one side of the room faces what was an inner courtyard formed by the structures, she notes.

Investigators also found approximately 2,000 small clay balls bunched together on the floor near one of the room's windows. Mesopotamian warriors used slings to heave these hard spheres at opposing armies, the Toronto researcher notes.

"At that time, clay 'sling balls' were weapons of war," she adds.

Members of an organized army, probably consisting in part of local residents, apparently queued up in the courtyard to receive rations of food, alcoholic drinks, and ammunition handed out through the two windows, Badler contends.

The rectangular arrangement of the structures indicates that they may have constituted a fort where Mesopotamian soldiers could protect the valuable trading post from thieves and invaders, she suggests. Excavations have uncovered the remains of an oval-shaped defensive wall that surrounded the fort, Badler points out.

Beer and wine rations for ancient soldiers may have served a dual purpose, she adds. Alcoholic beverages offered the obvious reward of intoxication to men who led a rough and dangerous life. In addition, since many early armies subsisted on marginal amounts of food, beer and wine consumption added much-needed calories to their daily diets, Badler argues.

Perhaps beer-loving Mesopotamian soldiers experienced enough hunger pangs to come up with this motto: "Tastes great, more filling." — *B. Bower*

Viewing crystal growth on an atomic scale

How does a crystal grow?

Precisely which processes permit random, energetic atoms, bouncing chaotically on a surface, to organize themselves into a neatly ordered lattice has never been entirely clear.

Do the atoms roll easily into neat rows on the forming crystalline surface? Or do they bounce around randomly until they lodge in an available slot? And once an atom has settled near the edge of an emerging layer, is it attracted to, or repulsed by, the atomic forces generated there?

Such questions have led Gert Ehrlich, a materials scientist at the University of Illinois at Urbana-Champaign, and his colleagues to study the behavior of metal atoms adsorbed onto metal surfaces from low-temperature vapors. Using a field ion microscope, they have managed to observe single iridium atoms settling into position on closely packed iridium planes, revealing, among other things, a previously unseen "empty zone" near the lattice's edge, Ehrlich said last week in Boston at a meeting of the Materials Research Society.

"The appearance of this empty zone was unexpected," Ehrlich says. "It may have important implications for the growth of crystals at low temperatures."

In the standard model of crystal growth, layers of atoms form in regular, stepped planes, Ehrlich says.

In the case of metal lattices, atoms from a vapor are thought to settle onto a layered surface and diffuse. Eventually, those diffusing atoms strike a lattice step and become incorporated into the edge of that layer.

However, Ehrlich reports that observations of vaporized iridium atoms incorporating themselves into iridium planes reveal "a much more diverse" picture. Along the edge of ascending steps, an empty zone more than two atoms wide regularly emerges; diffusing atoms will not settle there. That empty zone forms, Ehrlich believes, because of attractive forces that "suck in" atoms near the step's edge.

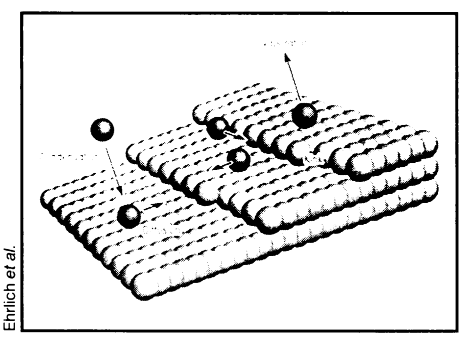
His group's observations also show that atoms tend to diffuse to the edge of descending steps of crystalline planes, then stop.

"They won't just roll over the edge, as originally envisioned," he says. Rather, the atoms "get trapped at the top of the step and remain stuck there. Only after thermal excitation do they become incorporated into the crystal structure."

Under rare conditions, an atom will burrow into the lattice by pushing nearby atoms aside, the group finds. In one case, a rhenium atom condensing atop a cluster of iridium atoms appeared to move an iridium atom out from the edge and take its place. Such atomic behavior does not fit predictably into the current model of lattice formation, Ehrlich notes.

As a result of these observations, Ehrlich believes more detailed experimental work is needed to understand how atoms become incorporated into lattice steps.

"We're developing a new view that is changing our understanding of how crystals actually grow." — *R. Lipkin*



Ehrlich *et al.*

A schematic diagram showing how metal atoms from a vapor become incorporated into a metal lattice with ascending and descending steps.