Water storage spurred growth of Maya cities

An oasis on a parched savanna draws a crowd of thirsty animals. That same principle applies on a much grander scale to the emergence of "Classic period" city-states in the Maya lowlands between A.D. 250 and A.D. 900, say anthropologists who have reexamined detailed maps of one such site.

The ancient Maya city of Tikal, in northern Guatemala, lacked a permanent water source such as a river or spring, as did other lowland sites in Guatemala, southern Mexico, Belize and Honduras. To provide water throughout the four-month annual dry season, residents constructed reservoirs fed by clay-lined drainage ditches, report Vernon L. Scarborough of the University of Cincinnati and Gary G. Gallopin of the State University of New York at Buffalo.

Tikal's reservoir system proved a liquid magnet for lowland inhabitants struggling with yearly droughts, and the city's population peaked at 60,000 to 80,000 around A.D. 750. Indeed, Scarborough and Gallopin argue in the Feb. 8 SCIENCE, the ability to control water critically influenced the growth of most lowland Maya cities, as well as the emergence of political control by an elite class serving Maya kings.

At many of these lowland Maya urban centers, spurts of population growth followed by temporary abandonment probably corresponded to fluctuations in annual rainfall and the availability of stored water, adds anthropologist Richard E.W. Adams of the University of Texas at San Antonio, in a commentary accompanying the research report. Adams asserts that the lack of sufficient water reserves in times of drought, rather than military or political conflict, may have caused the permanent abandonment of the earliest lowland cities, such as Nakbe (SN: 1/27/90, p.57).

Scarborough and Gallopin reconstructed Tikal's reservoir system from previously published maps of the ancient city. Six groups of paved drainage systems fed water into at least 10 central reservoirs, they maintain. The researchers estimate that the reservoirs received at least 900,000 cubic meters of water annually through the drainage setup, suggesting a far greater water-storage capacity than previously thought, Adams points out.

The controlled release of water from central reservoirs into smaller storage basins on the outskirts of Tikal would have supported year-round crop cultivation, the investigators note, although it remains unclear how the Maya released water from the central reservoirs.

Central Tikal also contains "residential reservoirs," apparently intended to store water for individual households. A few small reservoirs were attached to domestic residences, but none of these received water from the central reservoirs, the researchers say.

Massive building projects toward the end of the Classic period created quarries that may also have served as reservoirs and helped promote Tikal's growth, Scarborough and Gallopin suggest. In areas with seasonal water shortages, reservoirs acted as an underrecognized spur to urban growth, they conclude.

– B. Bower

Grapefruit juice gives drug an added punch

Tangy grapefruit juice may pack an unwanted punch. Canadian researchers have discovered that an experimental antihypertensive drug, if taken with grapefruit juice, can cause a rash of side effects, including rapid heart rate, facial flushing and dizziness.

"This is the first example of a pharmacokinetic interaction between a citrus juice and a drug," study coauthor David G. Bailey told SCIENCE NEWS. The results underscore the potential for hazardous effects when people consume certain foods with specific drugs, he says.

The new finding has its roots in an earlier study at the University of Western Ontario in London, in which Bailey and his colleagues attempted to determine the interactions between alcohol and an antihypertensive drug called felodipine, used in some European countries and now in clinical testing in the United States and Canada. Bailey recalls using grapefruit juice to mask the slightly sweet taste of alcohol. To their surprise, the researchers found that blood levels of felodipine among the volunteers – even those who drank grapefruit juice without alcohol – soared well beyond the expected values.

At first, the team suspected a problem with the study's methodology. But when painstaking inquiry ruled out other explanations, they decided to investigate the grapefruit juice itself.

They started by selecting six men, aged 48 to 62, with mild hypertension. Each volunteer took 5 milligrams of felodipine followed by water, grapefruit juice or orange juice. After drawing blood samples and recording blood pressure and heart rate, the scientists repeated the process on later days, switching the drinks so that each person eventually took the drug with each of the three liquids.

When the men took the felodipine pill and drank grapefruit juice, their blood levels of the drug reached about three times the amounts measured when they took the same dose with water or orange juice. On average, grapefruit juice doubled the drug's effect on blood pressure (which decreased) and heart rate (which increased), Bailey says. Not surprisingly, grapefruit drinkers reported more cardiovascular symptoms such as dizziness, facial flushing, headache or rapid heartbeat after taking felodipine, the team notes in the Feb. 2 LANCET.

Bailey speculates that grapefruit juice, but not orange juice, may contain a substance that inhibits an enzyme that breaks down felodipine, thereby leaving more of the drug circulating in the bloodstream. Although the researchers used super-concentrated fruit juices in this trial, Bailey thinks felodipine taken with off-the-shelf grapefruit juice could yield noticeable cardiovascular symptoms.

The felodipine finding raises questions about whether other high blood pressure drugs interact with grapefruit juice or other foods. When the researchers went on to study nifedipine, a U.S.-approved hypertension drug, they found that the concentrated grapefruit juice increased the drug's blood concentrations, but only slightly. Among the six healthy volunteers, only one showed an adverse reaction, reporting a mild headache after treatment.

– K.A. Fackelmann

Scorpion toxin tells an evolutionary tale

To thrill visitors at his lab, Hervé Rochat sometimes picks up a scorpion and rubs its belly with his finger. Do not try this at home.

The venom that trickles from the tail of the tickled arachnid contains a cocktail of powerful, protein-based toxins that has kept Rochat and his co-workers busy for two decades. In the Jan. 22 BIOCHEMISTRY, the team reports the discovery of a scorpion toxin that may represent a molecular ancestor of the dozens already identified by scientists who study scorpion venom.

Scorpions, notorious for the defensive stings they inflict when disturbed by humans, also use their poisons offensively to paralyze prey such as insects, other scorpions or small vertebrates. Their specific neurotoxic action makes these chemicals useful as molecular tools for studies of nerve-cell behavior. They may also hold promise as models for safer and more selective insecticides.

Biochemist Erwann P. Loret, working with Rochat's group at the National Center for Scientific Research in Marseilles, France, isolated the new toxin from the venom of the North African species *Androctonus australis* Hector. In Greek, Loret notes, *androctonus* means "killer of man." These large scorpions – some the size of a hand – kill several thousand people each

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