Archaeology

Skeleton opens Dor to ancient quake

Researchers had nearly wrapped up summer excavations at the fortress site of Dor on the Israeli coast last August when an investigator clearing shattered remains from the floor of a structure noticed the bones of a human foot poking out of the debris. Archaeologists worked quickly over the next two days and found that the foot was connected to the crushed, contorted skeleton of a woman whose remains may help clear up how the Israelites wrested control of the city from the Phoenicians around 3,000 years ago.

The Old Testament notes that Dor and two nearby fortress settlements evaded conquest by the Israelites in the time of Joshua, but around 200 years later, in 965 B.C., all three sites fell under the dominion of King Solomon. However, the Bible does not describe how the transition of power occurred. Some scholars have assumed that King David, Solomon's father and an accomplished military commander, defeated Dor and its sister cities in battle.

But the Iron Age skeleton and its surroundings suggest that Mother Nature, not David's military prowess, undid Dor. "Doreen," as investigators dubbed the unfortunate woman, apparently died violently in a sudden, catastrophic earthquake that devastated Dor and left it vulnerable to David's army, asserts archaeologist Andrew Stewart of the University of California, Berkeley.

Doreen (shown below) seems frozen in surprise and fright, Stewart says. Her body is twisted and her hands cover her face. The earthquake apparently sent a six-foot stone wall tumbling down on her and on a storage bin full of pottery. Two boulders crushed Doreen's skull, and a jagged pottery fragment pierced her head as she fell, Stewart contends. A rock struck her right hand and drove a finger into her nose. Her spinal column was pushed up into her brain case.

Stewart

Chunks of Phoenician bichrome pottery lay scattered around Doreen's skeleton. These vessels were imported by the seafaring Phoenicians to the Israeli coast about 1000 B.C., "give or take 50 years," Stewart maintains. Phoenician bichrome displays distinctive red and black designs on buffed clay.

Masses of brick cover the floors of Doreen's dwelling and additional structures explored by Stewart's team. Metal tools, flint knives, coins, and other valuable items also remain, indicating that raiders did not sack the city.

"It's reasonable to suspect that an earthquake leveled Dor as well as the two nearby fortress sites," Stewart argues. Previous archaeological digs at Dor's neighboring sites have uncovered signs of massive destruction, he says.

All three locations lie within an earthquake zone that runs from Israel across the Red Sea and into north Africa, Stewart notes. Dozens of documented earthquakes occurred in the vicinity of Dor prior to A.D. 800, he says.

Successive waves of settlers controlled Dor, beginning with the Canaanites during the 13th century B.C. The Phoenicians occupied the site around 1100 B.C.

Stewart will return to Dor next summer for his eighth consecutive year of field work. (Israeli archaeologists first excavated the site in 1980.) It is unlikely that additional human skeletons will turn up, Stewart maintains. Relatives of quake victims usually dug them out of the rubble for burial.

"It looks as though nobody bothered to dig in the room where Doreen lay," Stewart remarks. "Finding her skeleton was an incredible stroke of luck."

Earth Science

Focused quake waves hit Bay Area

When the Loma Prieta earthquake struck on Oct. 17, 1989, it caused surprisingly severe damage to San Francisco and Oakland, both of which sit about 100 kilometers from the quake's epicenter in the Santa Cruz mountains. Even as the Bay Bridge and other structures were collapsing, however, some cities much closer to the quake suffered significantly less damage, a paradox that has seismologists scratching their heads. Two researchers now think they have answered the riddle of Loma Prieta's long-distance punch.

Using a powerful new computer model, Anthony J. Lomax and Bruce A. Bolt of the University of California, Berkeley, have tested how seismic waves traveled through the crust as they radiated away from the center of the magnitude 7.1 quake. The study shows that geological structures in the region caused the shaking in San Francisco and Oakland to reach double the level expected for a quake of that size.

The study supports a theory raised soon after the quake which suggests that a fraction of the extra vibrations were reflected waves (SN: 4/21/90, p.251). This idea holds that some downward-directed seismic waves bounced off the 25-km-deep Moho – the boundary between the crust and mantle – and were focused up toward the surface in the vicinity of San Francisco and Oakland.

The computer modeling suggests that a second type of focusing came into play as well. Geologic structures refracted waves that normally would have passed to the east or west of San Francisco and Oakland, funneling the vibrations so that they hit the metropolitan region. On the west, hard rocks on the Pacific side of the San Andreas fault caused seismic waves heading toward Alaska to bend toward the Bay Area. On the east, thick sediments under the Santa Clara Valley caused waves heading toward Nevada to bend toward San Francisco and Oakland, the researchers report in the Oct. 2 GEOPHYSICAL RESEARCH LETTERS.

The Moho bounce and wave refraction caused extra-strong waves to focus on a region between the two cities measuring 10 km wide by 15 km long, according to Lomax and Bolt. In a sense, these cities were hit by bad luck – a combination of the earthquake's location and the presence of nearby geologic structures. Human factors also played a role. The researchers note that many of the damaged structures in San Francisco and Oakland were built on soft sediment and landfill, which amplified the shaking.

Armada begins study of Western Pacific

Hundreds of scientists from 19 nations will embark next week on a mammoth study designed to investigate how the western Pacific Ocean plays a fundamental role in Earth's climate. The four-month effort, based out of northeast Australia, will involve seven satellites, seven aircraft, 14 ships, 34 instrumented buoys, and 37 weather stations.

Called the Coupled Ocean-Atmosphere Response Experiment, the project will probe the atmosphere and ocean in the vicinity of a huge pool of warm water that straddles the equator. Water temperatures in the pool prompt tremendous amounts of evaporation and rainfall that stir the equatorial atmosphere. During an El Niño warming, such as happened last year, the pool shifts far to the east, causing major disruptions in the weather around much of the globe. El Niño warmings recur erratically every four to seven years. Between these events, the warm pool sometimes shifts far back to the west, spurring another weather-altering phenomenon known as La Niña cooling – a feature that currently may be developing.

By investigating the warm pool, researchers hope to gather data that will improve computer models used in forecasting how Earth's climate will evolve in the future.