

Fickle Sun Brought Down Ancient Emperors

by Dennis T. Avery

A North China cave stalagmite just produced an amazingly precise record of China's rainfall over the past 1800 years, proving that variations in the sun's activity—through weaker monsoons and poor rice crops—helped bring down three historic Chinese dynasties (the Tang, Yuan, and Ming dynasties).

In contrast, the sun sent abundant rainfall for the Song Dynasty, producing rich rice harvests, social stability, and population growth through the 10th-13th centuries—a period known to the world as the Medieval Warming. The Chinese recorded the Song abundance in both historic documents and cave-wall paintings.

Paleoclimatologists used uranium-thorium dating of the layered deposits in the stalagmite, linking them to the rainfall records within a remarkable 2.5 years—thus permitting the rainfall-dynastic analysis. Lawrence Edwards of the University of Minnesota was a lead author of the study, published in the journal *Science* November 7, 2008.

The China study found that the cave stalagmite rainfall record followed solar variability even more closely than it followed the northern hemisphere's temperatures. A strong correlation was also found between the weak monsoons of the Late Tang Period in China and a Swiss record of Alpine glaciers advancing during the cold temperatures of the 9th century. The European glacier advance was followed by Alpine glacial retreat from the late 9th to 14th centuries, correlating with the Medieval Warming and the Song Dynasty's prosperity.

Half a world away, the decline of the Roman Empire is reflected in the layers of a stalagmite from Soreq Cave near Jerusalem. The stalagmite, analyzed with an Ion Mass Spectrometer at the University of Wisconsin, shows the Eastern Mediterranean becoming drier as Roman and Byzantine power waned from 200 AD to 700 AD. The stalagmite record shows especially sharp drops in precipitation about 100 and 400 AD.

Hunger, produced by the extended droughts of the late Roman Warming may have driven the barbarian tribes from Eastern Europe and the Near East to the gates of Rome seeking food. But Rome itself may then have had grain shortages, since the Roman "granary" in North Africa also tends to get less rainfall as the warm periods wane and the tropical rain belts move back to the south. Without steady supplies of grain, the Roman hold on its Mediterranean Empire was probably doomed.

The stalagmite cores "look sort of like tree rings in the cross-section," says co-author Ian Orland, "Only instead of looking at the ring widths, we're looking at the geochemical composition of each ring." Oxygen isotopes in the calcium layers and organic matter flushed into the cave by surface rain—and trapped in the mineral layers—contain the climate information.

This is a relatively recent way of looking at world history. Scientists have only known about the moderate, solar-driven 1,500-year climate cycle since 1984. Evidence found in ice cores, seabed sediments, ancient tree rings and fossil pollen as well as in cave stalagmites from every continent show it has produced seven previous global warmings since the last Ice Age ended 12,000 years ago. Maureen Raymo of Boston University found the cycle extending more than one million years in the microfossils of the North Atlantic seabed south of Iceland. (*Nature*: 392, 1998)

Researchers are still working to link the physical evidence of warming/cooling shifts to the events of world history while the rest of us watch the unfolding story with awe and anticipation.

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