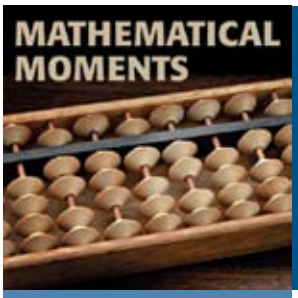

Preserving the Past

Structures that have stood for thousands of years are now crumbling because of air pollution. Mathematicians are using models that incorporate factors such as humidity, temperature, and the level of pollution to better understand the degradation process (which occurs when pollutants reacting with water vapor transform the outer surface of stone into a vulnerable layer of porous gypsum). The models, based on differential equations, can point to better strategies for restoring ancient monuments, perhaps preventing their destruction.

One difficulty in modeling the deterioration is that the process depends heavily on constantly changing conditions among many variables, such as humidity. Due to this large number of relevant features, simplifying assumptions are made–for example, that the air temperature equals that of the gypsum layer along the air-gypsum boundary–to make the models manageable. The resulting non-linear equations are then solved numerically, and despite the simplifications, the predictions are accurate. Researchers who developed these models have recently discovered the following: that there is a humidity threshold below which stone isn't converted to gypsum, that removing existing gypsum can be counterproductive, and that the size of the advancing decaying front varies with the square root of both time and the concentration of pollutants.

For More Information: "Lost Beauties of the Acropolis: What Mathematics Can Say," by Antonio Fasano and Roberto Natalini, *SIAM News*, July/August 2006.

Image by Mario Lapid, courtesy of Sacred Destinations, www.sacred-destinations.com.

AMS
American Mathematical Society

*The **Mathematical Moments** program promotes appreciation and understanding of the role mathematics plays in science, nature, technology, and human culture.*

www.ams.org/mathmoments