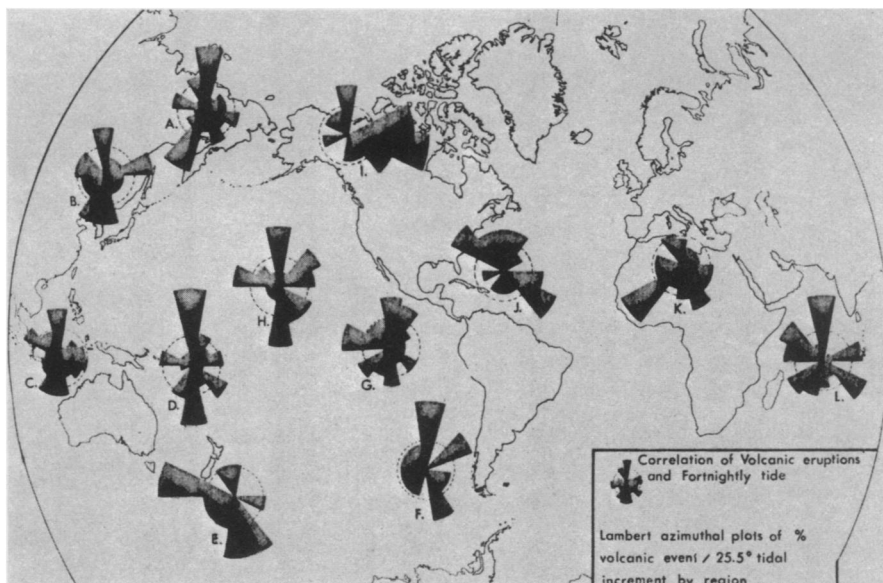


## A link between earth tides and volcano eruptions

Earth tides are motions of the land surface in response to tidal forces of the moon and the sun. They are analogous to ocean tides, but their amplitude is small in comparison. Nevertheless they can be measured and their cycles recorded. Two researchers from the University of Michigan, M. J. S. Johnston and F. J. Mauk, have found correlations between volcanic eruptions and earth tides.

The work is presented in two papers. The first appears in the Sept. 29 NATURE; the other has been submitted to the JOURNAL OF GEOPHYSICAL RESEARCH. The NATURE paper deals with a single volcano, Stromboli. The other presents a study of volcanoes all over the world.

Johnston and Mauk chose Stromboli first because volcanologists take it as a kind of model volcano. They compared eruptions of Stromboli with the earth tides at the volcano's location. Earth tides come in cycles of 12 hours, 24 hours and 14.7 days. Johnston and Mauk found a correlation with the fortnightly cycle: Stromboli tends to erupt when the amplitude of the fortnightly tide cycle is near its minimum.



Johnston and Mauk

*The circles are plots of eruptions versus phase of the earth tide. Each wedge is a day in the 14-day cycle. Time of tide maximum is up; minimum down.*

Johnston and Mauk then set out to compare eruption times since 1900 of all the world's nonsubmarine volcanoes with the phase of the earth tides at their locations. There were 680 eruptions altogether. For the whole set a correlation with earth tides was found, but the relationship is not simple. Dif-

ferent classes of volcanoes tend to erupt at different points in the fortnightly tide cycle.

"The probability of eruptions is greatest at times of maximum tidal amplitude," Mauk and Johnston conclude, although eruption probability for individual volcanoes may peak significantly at times other than the 14-day maximum.

The time of maximum probability of eruption was found to differ according to the kind of lava put out by the volcano, whether andesitic or basaltic. Both kinds showed eruption maxima at times of maximum amplitude of the fortnightly tide, but basaltic eruptions also showed a maximum at tidal minimum. These results also seem to correlate with the locations of the volcanoes, but that appears to be because geographical location tends to determine whether eruptions are andesitic or basaltic.

Johnston and Mauk did a detailed study of 18 volcanoes in the neighborhood of Japan. They found that volcanoes that prefer to erupt at or near the tidal minimum tend to be located in areas having a large crustal thickness and a small rate of horizontal deformation of the crust. Volcanoes in areas with a thinner crust and a rate of horizontal deformation greater than 3.0 centimeters per year tend to erupt at or near the time of the fortnightly tidal maximum.

The explanation of these results must necessarily be vague, Johnston and Mauk point out, because of a virtually complete lack of understanding of volcano mechanisms and what earth tides do to them. "It is easy to think of mechanisms," says Johnston, "but I would not like to specify one." □



Kendrick Frazier

*The Chinese physicians at their first U.S. press conference in Washington.*

charge.") But it did show the Chinese doctors' enthusiasm, humor, ready understanding of English (while nevertheless preferring to speak in Chinese), and pride in the demonstrated ability of China to deliver health care to its 800 million people. It also produced a dispute over the fact that the Chinese answered only questions that had been submitted in writing before a certain deadline. It was not clear whether the same restriction would hold later in the tour. The Chinese apologized, noting the long period of separation between the people of China and the U.S. "I suggest we understand each other step by step . . ."

The Chinese health-care system drew glowing remarks from Dimond. "They made a decision that getting care to the people was more important than research. They have come through with a way of taking care of all those people in their hospitals and communes that is warm. . . . Medicine is a service, and unless you treat it as a service rather than a product to sell, it will never be what it is supposed to be."

The doctors' tour is to be followed in November by a visit of Chinese scientists. A group of seven physical scientists, plus three other persons, is due to arrive in Washington about Nov. 20.