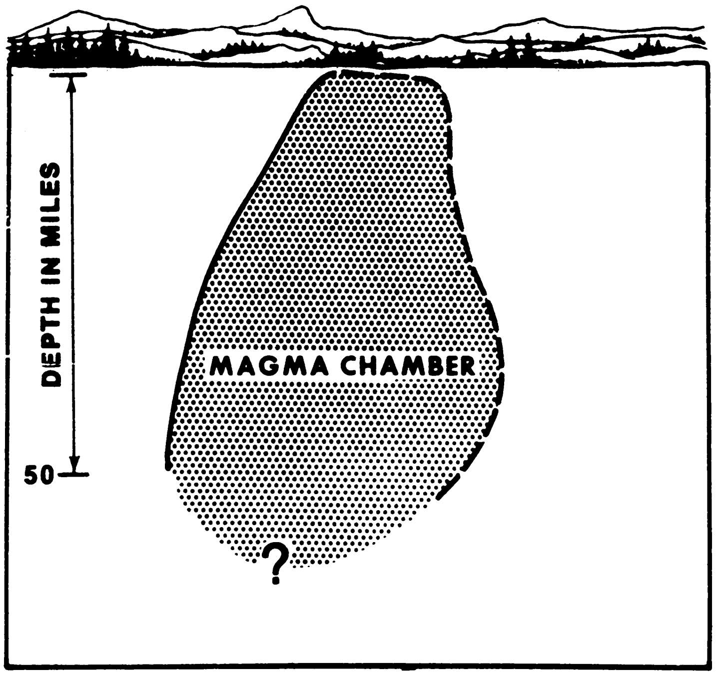
Plumbing a plausible plume



Yellowstone's magma chamber: Is it a closed hot spot or a plume welling up from the depths of the planet? An enlarged seismic network may reveal the answer, as geophysicists wait to see if it is really an example of the force that helps move the crust of the earth.

One of the more fashionable theories of geophysicists in recent years has been the idea of mantle plumes, huge upwellings of molten rock, hot liquid and gas rising from beneath the earth's crust. The titanic heat energy of such unleashed magma has been credited with creating island chains and helping drive the animated tectonics of the crust. But the plumes have been only a theory, deduced from a variety of indirect evidence.

Researchers have now found what may be a real one.

Directly beneath the seething scenery of Yellowstone National Park, says H. Mahadeva Iyer of the U.S. Geological Survey in Menlo Park, Calif., there appears to be a huge chamber of magma at least 30 miles wide and extending downward perhaps 50 miles—or more. "Geophysical evidence collected during the past summer," he says, "indicates that the subterranean chamber may actually be a plume of magma originating from several hundred miles deep within the earth's upper mantle. . . . Such plumes, if their existence were conclusively proved, could explain the sources of enormous energy that results in the splitting of continents as required by the global tectonic theory."

Yellowstone, with its bubbling springs, geysers and steaming fissures, has for years been suspected of housing such a major heat source, but it remained for Iyer and his colleagues to find a way of measuring its size, depth and composition. Fortunately, in 1963 the USGS had set up a network of 12 seismometer stations to monitor local and regional earthquakes in the park area. Iyer's team instead used the net to measure the speeds of shock waves from distant tremors as they passed through the suspected heat source.

The researchers found that, while passing through the target region, the shock waves were slowed by about 10 percent from their normal velocities. By combining this finding with knowledge of the strength and direction of the distant quakes, together with information on the structure of the earth in the surrounding region, it was virtually possible to map at least a general outline of the magma chamber, almost like charting a storm by radar.

The chamber seems to coincide approximately with the huge, 1,000-square-mile crater, or caldera, that lies at the center of the park. The caldera is believed to have been created by the most recent large volcanic eruption in the area, which took place about 600,000 years ago.

Because there are only a dozen stations in the seismic network, it has been impossible to see how deep the chamber goes—in other words, if it is really a deep-rooted plume—or even to completely determine its horizontal extent. There are plans, however, to add 14 more stations, which are likely to result in the area becoming a hot spot for geophysicists as well as for the earth. □

Ringing in new synthetic antibiotics

Scientists often try to improve upon nature but don't often succeed. The total synthesis of antibiotics is a notable exception to this postulate. It was once thought that synthesizing penicillin without *Penicillium* mold cultures was as impossible as building an antigravity machine. But chemist John G. Sheehan of the Massachusetts Institute of Technology got the whole business off the ground in 1958 by reporting the first total synthesis of Penicillin V using only commercially available raw materials and no microorganisms or enzymes. This made it possible to create new antibiotics with medicinally useful properties not possessed by natural derivatives.

Sheehan's work gave rise to other efforts in the field. Other synthetic antibiotics were produced through modifications of his techniques. A different group of antibiotics, the cephalosporins, were synthesized. And semisynthetic antibodies were produced commercially by combining the natural penicillin and cephalosporin "nuclei" with synthetic side chains.

A team at Merck, Sharp and Dohme Research Laboratories in Rahway, N.J., now has created two new cephalosporin antibiotics in which the nucleus itself was altered and not merely "fitted" with new side chains. The antibiotics are analogs of cephalothin, a commercially important broad-spectrum bactericide. Burton G. Christensen, Lovgi D. Cama and R. N. Guthikonda report in the Nov. 27 JOURNAL OF THE AMERICAN CHEMICAL SOCIETY the total synthesis of oxacephalothin and carbecephalothin. These new molecules have all the features of cephalothin, except that an oxygen atom now replaces a sulfur in the cephalosporin ring structure in oxacephalothin, and a methylene molecule (CH_2) replaces a sulfur in the carbecephalothin ring.

"This is the first time a ring system has been changed and resulted in an antibiotic just as active as the natural molecule," Cama told SCIENCE NEWS. The group decided to alter the ring rather than the side chains, hoping for increased antibiotic activity. Oxacephalothin and carbecephalothin disappointed that hope—they are not more active. But, Cama says, "they are fully as active as cephalothin."

The new antibiotics are important because they provide new nuclei to which various side chains may be attached in the search for medicinally useful molecules. Merck has applied for a patent and the team will continue to substitute atoms into nuclear ring structures, add side chains and screen for new antibiotic properties. □