

# earth sciences

**Gathered at the Fall Meeting of the American Geophysical Union in San Francisco last week**

## SEISMOLOGY

### New view of the mantle

New information about the earth's mantle has been revealed by a mathematical method of analyzing more kinds of seismic data than has been possible before.

The composition of the mantle is not uniform, as had been supposed, reports Dr. Don L. Anderson, director of California Institute of Technology's seismological laboratory. The mantle has perhaps 20 percent more iron at greater depths, more silicates with depth and more magnesium at shallower levels.

Mantle temperatures were found to be considerably lower than supposed, ranging from about 1,800 degrees F. near the top to 5,400 degrees near the base.

"Our work implies," says Dr. Anderson, "that the earth has undergone a series of differentiations. We now think that the upper 250 miles of the mantle developed out of the lower part, much as the earth's crust differentiated out of the upper mantle."

It now becomes clear that the earth is layered most of the way down and that there are about ten layers in the mantle. The new work confirms the finding that the upper mantle, about 30 to 90 miles down, seems to be at least partly molten.

The molten region is a result of the fact that the temperatures increase with depth more rapidly than does the pressure.

## GEOLOGY

### Monitoring a geyser

A man-made geyser near Adel, Ore., is proving useful in revealing how action in a geyser is initiated.

Crump Geyser erupts to a height of 30 to 40 meters every 8 to 10 hours. It was created when a hole 15 centimeters in diameter was bored 35 meters into a known geothermal area.

Temperature measurements show that the water that quickly fills the geyser hole after an eruption heats unevenly. Water in the upper and lower ends of the hole remains below the boiling point for a long time. But the water near the six-meter level heats faster. Some boiling takes place, but the rising steam bubbles are quickly cooled and condensed by the upper water. The column goes critical when the upper water no longer has the heat-absorbing capacity to condense the steam from below. The upper head of water is blown off, and the geyser erupts. Dr. John S. Rinehart of the Environmental Science Services Administration's Boulder, Colo., Laboratories reported on the work.

## OCEANOGRAPHY

### Structure of ocean temperatures

High-resolution temperature measurements from the drifting Arctic Ice Island T-3 show exceptionally strong layering in the vertical structure down to depths of 500 meters.

The temperature profiles are sharply stair-stepped. Temperatures vary less than .001 degree C. over a vertical distance of 2 to 10 meters. Then in a vertical distance of less than 20 centimeters they change up to .026 degree.

There are indications this structure may be a common feature of the ocean's vertical stratification. This opposes the previous view, in which thermal microstructure in the ocean has been considered as more or less randomly distributed patches.

The new concept may change some of the ideas governing propagation of sound waves underwater, says Dr. Warren W. Denner of the Naval Postgraduate School in Monterey, Calif. One type of calculation, for instance, assumes more gradual changes in temperature. The observational work was reported by Drs. Victor T. Neal and Steve Neshyba of Oregon State University.

## SATELLITE GEOLOGY

### Infrared observations of earth

Early results from use of the experimental high-resolution infrared radiometer aboard the Nimbus III satellite (SN: 11/29, p. 509) show such devices have great potential as geological tools. This was reported by Dr. Jean Poquet, a French scientist now doing research at the Goddard Space Flight Center.

Infrared reflectance patterns depict two physiographic provinces bordered by the Nile River. Reflectance was higher on the western side and lower on the eastern side.

Former routes followed by the Nile or other rivers are clearly revealed through the reflectance pattern between Aswan and Berber. One of those former paths is shown short-circuiting the giant loop described by the present-day river.

The sand dunes of the An Nafud region are individually distinguishable, showing their orientation with respect to the prevailing winds. Sedimentary and volcanic formations are highlighted, he reports.

## SEISMOLOGY

### Jorum test caused fewer quakes

Scientists have confirmed in the last few years that underground nuclear explosions in Nevada produce small earthquakes in the vicinity of the blasts. One of the most recent, the Jorum explosion in Southern Nevada late this summer, initiated a sequence of several hundred quakes, report Drs. R.M. Hamilton and J.H. Healy of the U.S. Geological Survey.

Practically all of the shocks lie within 4 kilometers of ground-zero. These effects were significantly less than those of the December 1968 Benham test that was followed by about 10,000 earthquakes out to 13 kilometers from ground-zero, near the site of the Jorum test.

The reduction, they say, is consistent with the earlier conclusion that Benham caused the release of natural strain energy in the area of the shots, and thereby lessened the potential for stimulating earthquakes.