

## GEOLOGY

# Man to Pierce Earth's Crust

**Scientists plan to drill a six-mile-deep hole through the crust of the earth and into the underlying mantle. They seek direct evidence to back up decades of geological speculation.**

By RICHARD LITELL

MAN is eagerly seeking more knowledge of what surrounds the earth in outer space but has hardly begun to probe the depths of his own planet.

He has sent rockets to the moon and beyond but is not even sure of what lies six miles beneath the very ground he walks on.

Direct sampling of hitherto unreached regions of the earth's interior could supply answers to countless scientific questions regarding the age, history and composition of the earth.

With this aim in mind, scientists are now planning to drill a six-mile-deep hole through the crust of the earth to the underlying mantle.

The earth's crust is a thin, slag-like covering of light rocks averaging 10 miles in thickness, a mere 400th of the earth's radius. Below the crust is a mantle and an inner core. Neither has ever been reached by man.

The mantle accounts for 80% of the earth's volume and is believed to be composed of a material similar to peridotite. The core is thought to be composed of a mixture of iron and nickel.

Between the mantle and the crust is a transitional layer known as the Mohorovicic (Mo-ho-ro-vic-ic) Discontinuity, commonly referred to as the Moho. Scientists know of the Moho's existence because seismic waves sent down through the crust experience an abrupt increase in velocity when they encounter this layer of chemical or physical change.

## Key to Earth's Secret

It is the Moho that scientists hope to penetrate by digging this deepest hole yet attempted by man. They will thus be able to tap the underlying mantle, whose exact composition is one of the most important unsolved problems of geophysics.

This hole will not be dug on land, however, because the earth's crust under the continents averages 20 miles in thickness, whereas under the oceans it averages only five miles in thickness. Thus, the Moho and mantle are far closer to the surface of the sea than they are to the surface of the land, even allowing for the depth of the ocean, which averages about two and a half miles.

The deepest hole yet drilled by man was a Texas oil well, 25,340 feet (almost five miles deep). But this was drilled on land through a much thicker crust and the drills did not approach the mantle.

In charge of the Mohole Project, as the attempt to drill to the Moho is called, is the

AMSOC (American Miscellaneous Society) Committee of the National Academy of Sciences-National Research Council. The entire project, the Committee believes, can be successfully carried out within four years, provided the necessary \$15,000,000 can be raised. Studies have found the project to be both feasible and highly desirable.

What little scientists already know about the structure and composition of the earth's interior has been arrived at only indirectly. They are now looking forward to a direct sampling of nature's cache of geophysical secrets.

Successful sampling of the sediments of the ocean floor, the earth's core, the Moho and the mantle can reveal the nature of marine organisms back through time and perhaps to the origin of life. It can provide clues to the origin and structure of the earth and add meaning to, or confirm, great stores of geological data accumulated during past decades. Sediments could contain an uninterrupted record of the earth's development for two billion years

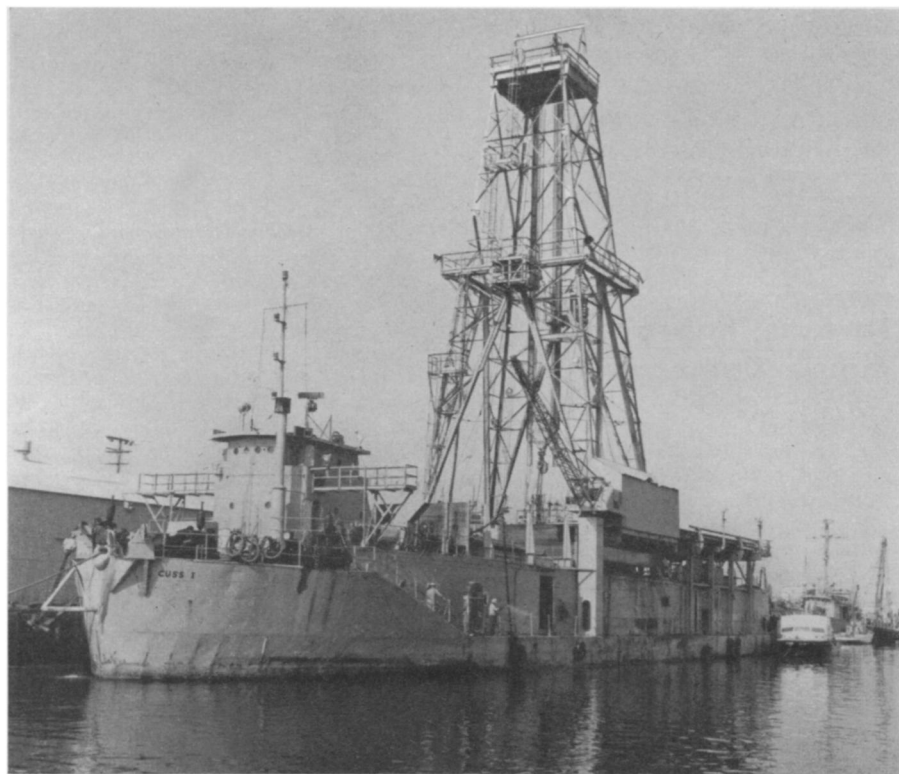
Shifts in locations of the earth's magnetic poles may be recorded in the orientation of tiny magnetic particles discovered in the drilling, and temperatures of the oceans at various times in geologic past may be revealed by biochemical studies of shells and chemical studies of calcium carbonate on ancient sea floors.

Conflicting theories on the nature and composition of many regions can be resolved and the opportunity will exist for possible unexpected discoveries to be made.

Although a hole in the ocean floor a good distance from the continental shelf is not expected to yield any rich oil deposits, the petroleum industry could profit from the experimental work of this project, which could lead to faster, better and cheaper techniques for deep drilling and coring.

The average depth to the Moho from the surface of the sea (seven and a half miles), although far less than from land, is still beyond the reach of present drills. But by seismic surveying techniques it is possible to locate thin places in the ocean basins where the total depth to the Moho is less than 32,000 feet, or about six miles. These depths are probably within reach "if the best modern drilling equipment and technology can be assembled."

Two promising ocean sites have been in-



**FLOATING DRILL**—The CUSS 1, with a center drilling well, has been used to drill for oil in the waters of the continental shelf off California. Presently able to drill about 12,000 feet, it can probably be modified so that it can drill deep below the ocean bottom to a depth of 18,000 feet.

vestigated for the Committee thus far. One is in the Atlantic about 200 miles north of Puerto Rico, where the depth to the Moho is estimated to be 31,500 feet. Another is in the Pacific off Mexico between Guadalupe and Clipperton Islands. The latter now seems more promising but final site selection will not be made until after the first of the year.

The choice is a difficult one, for a favorable combination of many desired conditions must be sought. Weather and wave conditions must not hamper the work, the depth to the Moho must be small, the distance to a base of supplies must be short, the site must be truly representative of the crust in ocean basins, and an ample amount of sediment for coring operations must be present.

Also a thorough knowledge of local current activity must be on hand to help solve the problem of maintaining a drilling ship's position. Directly above the hole a ship's position must not be permitted to vary in a radius of more than two percent of the depth of the water (240 feet in 12,000 feet of water).

Preliminary work now under way includes studies of how an existing ship can be modified, exploration of promising sites and examination of promising ideas.

### First Phase Drill Ship

The first phase of the project will consist of modifying a drilling ship for deep-water operations. This ship will be used within 18 months to drill a series of preliminary holes not to exceed 18,000 feet in depth. This is to test equipment and obtain engineering design data. Included will be comparisons of rotary, turbo and sound drilling methods and testing of various coring devices.

Until such information is obtained by direct experiment at sea, no one knows how to proceed with the design of a rig that will be capable of reaching the mantle—more than two miles deeper.

This first-phase ship might be the 1,479-ton floating drill rig CUSS 1, now used for oil drilling in waters of the continental shelf off California. The preliminary and first-phase work is estimated to cost \$3,000,000.

The second phase, to cost \$9,500,000, will begin with the application of engineering data found in the first phase to the design of a new drilling ship. The ship will then be built (probably an existing hull will be rebuilt), will undergo shakedown tests, move into position on the final site and drill to the mantle.

The third phase covers the scientific direction of all the work and analysis of all results and is estimated to cost \$2,500,000.

The Committee hopes that half the needed \$15,000,000 will come from the Government and half from private industry.

Actually no one deep hole will be able to supply all the information desired but it will be a step in the right direction. Many scientists would like to see other nations drill Moholes of their own.

The Russians have already announced they have the equipment and capability to do the job and it is probably safe to surmise that they too intend to drill into the mantle.

Science News Letter, October 31, 1959

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