

## GEOLOGY

# Mighty Hole in the Earth

Scientists are preparing to drill deeper into Mother Earth than ever before—more than six miles through the ocean and outer crust into the interior of this ancient planet.

By BARBARA TUFTY

► THE WORLD'S DEEPEST HOLE, six miles down and only a few inches wide, will permit scientists to examine first-hand the structure of this planet, which has been circling the sun for billions of years.

The scientists hope to uncover fossils and sediments that will tell them about the history of earth, as well as meteorites to help explain the mysteries of outer space. They plan to examine the effects of high temperatures and immense pressures generated under the earth's surface, and to determine the materials and compositions of rock never seen before.

This is Project Mohole—an endeavor on the part of the United States to extend man's knowledge of our planet by exploring the mantle, that unknown region lying beneath the relatively thin crust of earth.

## Man's Curiosity

For centuries man has climbed high peaks and dug deep into the earth in an effort to satisfy his restless curiosity and understand more about the nature of earth.

For the sake of adventure, he has descended into dark caverns cut by rivers and explored caves lying under mountain ranges. For the sake of gold he has gouged two miles deep to follow the golden veins in South African rock, and for the sake of oil he has drilled more than four miles straight down into Texas earth.

Yet all this is only a mere pin-prick scratching upon the crumbled crust of the earth's surface, compared with the proposed probing into the mass of rock that lies beneath.

## Structure of Earth

Scientists believe that the earth is formed of different layers like coatings of a ball. The outside coat of the earth is the crust, a thin layer that is composed basically of granite and basalt rocks, and ranges in thickness from about 2.5 to 45 miles—being thickest beneath the continents and thinnest beneath the oceans.

Under this crust lie denser rocks that mark a boundary between the crust and the mantle. This transition is named the Mohorovicic discontinuity, called Moho for short. The name comes from a Yugoslav seismologist, Andrija Mohorovicic (pronounced Moe-hoe-roe-veech-ik), who, early in this century, observed that shock waves from a large earthquake of 1906 traveled through the earth at two speeds.

The slower waves traveled at expected speeds as they passed through the rocks of the earth's crust. The faster waves, Mo-

horovicic found, must have traveled through a layer of denser and more elastic rocks underlying the crust.

Beneath the Moho boundary lie 1,800 miles of mantle, a region of high heat and pressures where the severest of the world's earthquakes may originate. Under the mantle is a 1,300-mile thick region of liquid nickel and iron, called the outer core. This surrounds the inner core, or "heart," of the planet, believed to be a ball of iron and nickel about 1,600 miles in diameter.

The reason the crust varies in thickness, scientists believe, is because it seems to "float" on the denser rocks of the mantle in the same manner that icebergs float on the ocean. An iceberg floats with most of its mass submerged in a condition called isostatic balance. A similar adjustment seems to take place within the earth's crust, so that where the mountains are highest, the crust extends farthest down, and where the

bottom of the ocean is deepest, the crust is thinnest.

For this reason, Mohole scientists have decided to reach the mantle by drilling through the ocean floor, where the crust is only five or less miles thick.

Project Mohole is part of the United States' contribution to the 20-nation Upper Mantle Project, a proposal to explore and study the upper mantle and crust, which was first presented to the scientific community at the XII General Assembly of the International Union of Geodesy and Geophysics in Helsinki in 1960. Catching the imagination of laymen as well as scientists, the multi-million-dollar Mohole project has encountered much controversy and disagreement over the scope, methods, personnel and materials with which to do the work.

## Renewed Impetus

After many discouraging delays and bickerings, the Mohole project has been given renewed impetus with the announcement that the hole will be drilled in the mid-Pacific Ocean at a spot about 100 miles north-northeast of Maui in the Hawaiian Islands. The National Science Foundation, which finances and administers the project, announced that at this spot, 22 degrees and 22 minutes north latitude, and 155 degrees and 28 minutes west longitude, the water depth is 14,000 feet and the estimated depth from sea level to the mantle is about 31,000 feet.

This means that a huge drilling rig, suspended on a floating platform, will dangle cables and equipment through nearly three miles of seawater to the ocean floor where actual drilling will start. This feat has been compared to leaning out of a window 12 stories high with a long string of spaghetti and trying to drill a hole in the sidewalk.

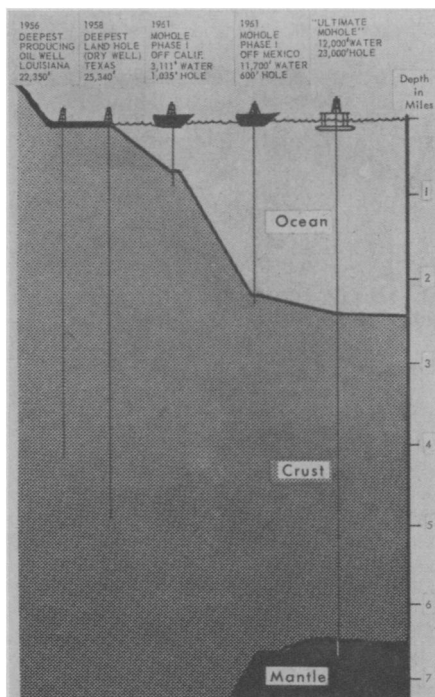
The proposed drilling rig will be a platform topped by a drilling derrick, 375 feet high from keel to top. The platform will rest on six huge columns supported by two remote-controlled diesel-powered submarines, each 390 feet long. During drilling operations, these submarines will be submerged about 50 feet.

## Steady Platform Required

In order to keep the free-floating Mohole platform steady on a location about 500 feet in diameter during the three years of drilling, a dynamic positioning system will use radar, sonar and computer equipment to keep the craft steady and compensate for forces of winds and currents.

Experimental drilling will take place in 1967 in sites off the West Coast ranging from the Panama Canal to Washington, and first steps in drilling the world's deepest hole from sea level will start in 1968.

Scientists chose the Hawaiian site over other proposed areas for several reasons,



National Science Foundation

**DOWN, DOWN, DOWN—Digging deeper into the crust of the earth, men have already plunged drills nearly five miles into the outer crust that surrounds our planet. Now a new drilling site is set off the Hawaiian Islands, and Project Mohole scientists hope to drill through the crust into the mantle, 35,000 feet below the ocean surface.**

NSF officials said. One reason is that the estimated depth to the mantle is less here than at other sites, and another is the weather conditions and ease of operating procedures. Sites near San Juan, Puerto Rico, and the Caribbean island of Antigua were finally discarded because of potential danger from hurricanes and because the sea bottom is badly faulted at one site.

Russian scientists are approaching the study of earth's structure in another method —by studying shock waves from man-made blasts and earthquakes on the land and by drilling a series of five holes in the earth ranging across their land from the Caspian Sea eastward toward the Kurile Islands above Japan.

Seismic waves, as shock waves within the earth are called, have long been studied by geologists and seismologists as a method of analyzing the earth's structure. Set off by man-made explosions, earthquakes, volcanoes or other huge shifts in the earth, these waves travel outward from the point of strain, somewhat like circular ripples that radiate outward when a stone is tossed into a pond.

By comparing the length of time and structure of these different shock waves as they reach the surface of the earth, geologists have learned much about the earth's interior.

• Science News Letter, 88:26 July 10, 1965

#### GEOLOGY

### Explosions to Increase Natural Gas Yield

► **UNDERGROUND** nuclear explosions in the Rocky Mountain region could increase total natural gas production about seven times above today's levels, a study reported in Washington, D.C., has shown.

The study, called "Gasbuggy," is part of the Plowshare program to develop industrial and scientific uses for nuclear explosives. "Gasbuggy" was conducted by staff personnel from El Paso Natural Gas Company, the U.S. Atomic Energy Commission and the U.S. Bureau of Mines.

The scientific team investigated using nuclear explosives to break up gas-bearing formations in order to increase yield rates from natural gas fields. The study showed that nuclear explosives would do the job.

The team recommended setting off an underground blast from which no radioactive material would reach the surface in the San Juan basin of New Mexico. The El Paso Natural Gas Company plans to obtain authorization for conducting the test jointly with the AEC.

If approved, the experiment would be the first Government-industry use of a nuclear explosive for industrial purposes in the world.

Large quantities of natural gas cannot now be recovered because the rocks in which the gas is contained are too porous. The nuclear blast would create a large reservoir into which the gas could flow freely, forming a "well" that could be tapped.

Preliminary cost estimates indicate the experiment would cost about \$3 million, in addition to the charge for the nuclear explosive. The AEC would make extensive studies to assure containment of radioactive material.

• Science News Letter, 88:27 July 10, 1965

## Nature Note

### Termites

► **TINY WHITE INSECTS**, the termites, have the largest and most complex societies known in the animal kingdom. Their colonies, sometimes housing millions of termites, function under a form of communism in which labor—and there is little play—is divided essentially into three basic, highly specialized castes: soldiers for defense, workers for nutrition and kings and queens for reproduction.

The soldiers, which include both sexes with sterile reproductive organs, have strong biting jaws. Certain termite species have evolved a nozzle-like projection of the head to shoot a sticky secretion or volatile poisonous gas at enemies. The workers, also sterile, care for and feed the queen and king and constantly lick and tend the eggs to protect them from mold and dampness.

The one egg producer of the colony is the queen, a huge immobilized female with an abdomen 100 times as large as normal. She has one function: simply to lay eggs—and some tropical queens lay as many as 7,000 eggs each day. Kings and queens sometimes reign over their colonies for 10 or more years before their offspring are allowed to develop into sexual individuals which sprout wings, swarm and feebly fly away to start a new colony.

These creatures are not ants, but are of the Isoptera order, related to the roaches. Wood is their main food, and they cause enormous damage to houses and structures in all warm climates. Since wood is composed largely of lignin and cellulose that are hard to digest, the creatures have a special arrangement—millions of microscopic protozoans and bacteria inhabit their intestines and help change cellulose into easily absorbed sugar.

• Science News Letter, 88:27 July 10, 1965

#### ENGINEERING

### Bottomless Tank at Sea Is Safe and Spills No Oil

► **A BOTTOMLESS** oil tank floating at sea like a huge inverted bucket, is both safer and less likely to contaminate its contents than conventional storage containers.

The tank, made of fiber glass reinforced plastic, works simply because oil is lighter than water. Oil is pumped in from the top of the tank as it floats, forcing seawater out of the bottom. In the reverse process, the water level rises as oil is taken out.

Since the tank is completely full of liquid at all times, no air pockets can form, and the danger of fire or explosion is greatly reduced. Also, any heavy impurities in the oil just settle out the bottom and down to the ocean floor, instead of forming a sludge that would contaminate new supplies of oil.

The tank is leakproof, but in case of an accident, an "oil fence" is floated outside the tank to prevent any loose oil from spreading.

The Swedish-built tank, developed by Sea-Tank Metod AB, Stockholm, was reported in New Scientist, 25:708, 1965.

• Science News Letter, 88:27 July 10, 1965

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