GEOPHYSICS

Volcano Hard to Predict

The erratic history of the Taal volcano in the Philippines permitted no prediction of the recent eruption, but the causes are being studied—By Barbara Tufty

➤THE PAST BEHAVIOR of Taal volcano has been erratic and has offered scientists no pattern for predicting the holocaust that broke loose Sept. 28.

The Philippine volcano had remained quiet on the surface since 1911, when it spewed out fiery material for two weeks and killed an estimated 2,000 people. Before that, it had erupted in 1904, 1903, 1878, 1874, and in earlier years—26 times since 1572, Dr. Richard S. Fiske of the U.S. Geological Survey in Washington, D.C., pointed out.

The explosive pattern of this volcano is very erratic, he said. Not much is known about the causes that triggered the latest eruption. Perhaps water seeping from the two lakes of the unusual-shaped volcano may have set off the explosions that released massive amounts of ash, cinders, vapor and gas.

Before the eruption, Mt. Taal was a 984-foot-high volcano on a small piece of land known as Volcano Island in the middle of 15-mile long Lake Taal, about 20 miles south of Manila. A smaller lake filled part of the crater.

Like Crater Lake of Oregon, this volcano's shape resulted from an ancient explosion that had blown off the top of the mountain. The upper part collapsed and gradually filled with water in the middle of which arose smaller cones from the occasionally bubbling volcano. It was the inner cone of Mt. Taal that erupted.

Scientists cannot actually predict just when a volcano is going to erupt, said Dr. Robert Decker of Dartmouth College. Only by constant observation and calculation can they anticipate when a volcano seems ready to erupt, but even then it may be a false alarm and the volcano will quiet down again.

Geologists of the Philippine Commission of Volcanology had been taking daily temperature readings of the water around the Taal volcano. Temperatures of 86 degrees F. were reported last year, 91 degrees in June of this year and 115 degrees in July. Yet in 1953 the temperature of the lake rose even higher, the director of the Commission said. Although steam rose from the lake, the volcano did not erupt.

'Ring of Fire'

Glowing, fiery volcanoes and shuddering earthquakes have been feared by animals and man through the ages, but today scientists use them to come closer to understanding the forces that create these vast upheavals and even to predicting when they might start erupting.

More than 500 volcanoes may be active today. Most lie along the edges of continents circling the Pacific Ocean, said Dr. Robert L. Smith, U.S. Geological Survey. This volcanic belt is called the "Ring of Fire."

Some of the world's most violent volcanoes have erupted on this Ring, which stretches along the Aleutian Islands, down through Japan, into Indonesia and Java, and up the western coasts of South and North America. Hawaii, the hub of the Ring in mid-Pacific, contains the world's largest active volcano, Mauna Loa, rising 28,000 feet above the sea floor.

The eruption of Bali's Mt. Agung in March 1963 cost 2,000 persons their lives. Mighty Krakatoa exploded in 1883, flinging nearly 18 cubic miles of rock, dust and ashes more than 17 miles into the sky. Its explosions were heard 2,000 miles away in South Australia.

Another active volcano area lies around the Mediterranean Sea, including the tiny island of Vulcano that gave these fiery mountains their name. Centuries ago, the Romans believed that the hot lava fragments and clouds of ash sputtering from the mountain's chimney came from the underground forge of Vulcan, blacksmith of the gods, as he hammered out thunderbolts for Jupiter, king of the gods, and weapons for Mars, god of war.

Historical Volcanoes

In this Old World area rise several other historical volcanoes: Mt. Vesuvius, which suffocated the city of Pompeii under several feet of ashes in 79 A.D.; rumbling Stromboli off the coast of Italy; and Mt. Etna, which in 1950 had the worst eruption of all its 90 recorded explosions.

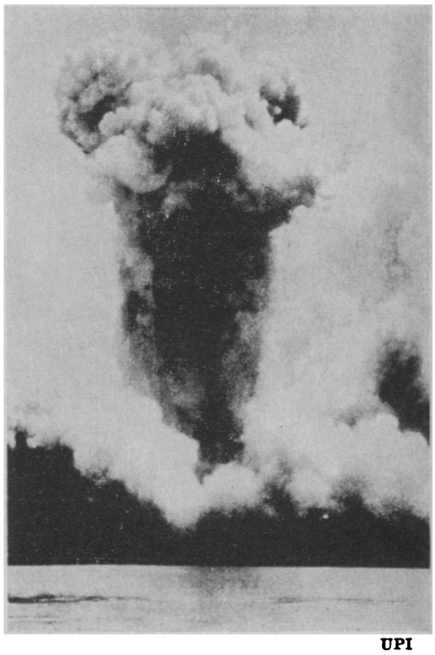
A belt of volcanoes stretches across lower Asia, down through Java and Sumatra where it joins the Pacific Ring of Fire. Another area stretches under the Indian Ocean and onto the highlands of eastern Africa. Another well known volcano area extends under the ocean from the South Atlantic Ocean along the Atlantic Ridge northward to Iceland.

These areas are lines of present-day weakness in the earth—zones where the crust is bending, straining, faulting, and along which earthquakes as well as volcanoes are frequently active. In past ages these zones of weakness used to lie in other areas, as evidenced by ancient lava beds throughout Europe, India, the Americas and elsewhere.

The molten rock of volcanoes may originate in the mantle, where temperatures reach as high as 5,000 degrees F. and pressures build to more than a million times that found at sea level.

Added to this are huge pressures built up from earth movements, shifts in rock masses or from expanding water vapor or carbon dioxide gas in the molten rock.

This fluid rock, called magma, rises from underground reservoirs through cracks and crevices in the earth's crust where it then spills out in a form known as lava. Lava may flow anywhere—on mountain slopes, flat plains or on the ocean floor. If the magma rises long enough in a certain area, a chimney is formed through the increasing debris of lava and ash, and a volcano is born.



UPI

TAAL VOLCANO—A mushroom of smoke and steam billows from the Taal volcano after the explosion which buried hundreds of residents of the volcanic island under a river of hot lava. The volcano had been dormant since 1911 when it took several thousand lives.

Some volcanoes "let off steam" in a relatively gentle manner, with cool dark-colored lava flowing at a rate of 50 to a few hundred yards an hour, said Dr. Smith. By erupting frequently, these gentle volcanoes do not often build up internal pressures for sudden explosions.

Other volcanoes, however, erupt violently and cause widespread devastation. Such explosions often occur when a volcano has been inactive for many years and the chimney has been plugged by lava solidified from the last flow. The gases trapped in the heart of the crater generate tremendous pressures until suddenly the top blows off, and lava, steam, rocks and ashes explode into the sky and cover the surrounding land.

An erupting volcano usually produces a great billowing cloud composed mostly of condensed moisture mixed with carbon dioxide and perhaps hydrogen and nitrogen, hydrochloric acid gas and yellow sulfur vapor. Quick flashes of lightning may light the clouds.

Geologists group volcanoes into four main kinds, Dr. Smith said—cinder cones, composite cones, shield volcanoes and lava domes.

Cinder cones are the simplest type of vol-

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canoes. They are relatively low-lying volcanoes made up of lava fragments, like a pile of furnace debris. They are formed when large amounts of expanding gas break the molten lava up into a bubbling froth and fine spray of solid particles, or shatter solid material into great clouds of dust and rock fragments.

One of the most spectacular cinder cones rose out of a quiet cornfield in 1943, before the astonished eyes of the farmer and other citizens of nearby Paricutin village in Mexico. This surprising volcano, first to appear in North or South America in 200 years, started one day with a thin column of white fume, grew 25 feet by the next day, 500 feet in the first week, and was more than 1,000 feet high in 10 weeks, spewing ashes like black snow for 200 miles.

After nine years of activity, Paricutin stopped erupting as suddenly as it had begun and now is one of many cinder cones considered dormant in western Mexico.

The second type of volcano—composite cone—is built of alternating layers of lava flow and volcanic ash and cinder. Some of the world's most beautiful volcanoes are composed of countless lava-ash layers, rising to great heights and sometimes capped majestically with snow—Mt. Fuji in Japan, Mt. Hood in Oregon and Mt. Rainier in Washington.

Shield volcanoes, the third type, are formed from many flows of lava pouring in all directions from a central vent or group of vents, slowly building a broad, gently sloping cone. Some of the largest volcanoes in the world are shield-types, Dr. Smith said. The mid-Pacific Hawaiian Islands are composed of clusters of these volcanoes, built up thousands of feet from the bottom of the sea.

The fourth type volcano, lava domes, are sometimes accompanied by the most destructive eruptions known to man. These domes are created from the plugs of very viscous or pasty lava that extrudes much like toothpaste from the vent of the volcano. Mt. Pelee on the island of Martinique is a lava dome volcano. In 1902, after 50 years of calm, the stiff lava plug began to push out of the top until it towered 1,000 feet high. Suddenly the side of the cone gave way and a glowing cloud of suffocating gas, ash, sand and steam swept down over the countryside, engulfing the town of St. Pierre where the entire population of about 30,000 people was asphyxiated, boiling the harbor waters and overturning ships.

Yet volcanoes are not all bad, Dr. Smith pointed out. They have formed great plains such as the Deccan Plateau of India and the Columbia River plateau in the U.S., and have built such islands as the Aleutians, Hawaii and Iceland. They also add such rich nutrients as potash to the soil, creating good farmland.

As the magma rises, it can bring with it useful gases from below, such as sulfur that changes into a solid. Sulfur is mined from craters in South America, New Zealand and Japan. Tin, tungsten, gold and other metals have been brought from the hot inner depths of the earth to the surface, where man can mine them. Many diamonds have been found in necks of old volcanoes.

Best method of keeping tabs on active volcanoes it with tiltmeters. These meters are placed around a volcano to record the amount of expansion and contraction. As magma wells up from the mantle, the entire volcano swells outward like an inflating balloon, tilting the sides outward. If the magma pours out or moves down again inside the chimney, the mountain deflates, and the sides tilt inward.

One of the newest devices for spotting volcanic disturbances is an infrared radiometer that measures temperature differences due to rising hot air and steam. This equipment, mounted on airplanes last year by the Geological Survey, detected heat changes around the Hawaiian caldrons that correlated with volcanic eruptions.

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