Tsunamis: Facts and Warnings

WM 1257

NO WARNINGS FOR THE INDIAN OCEAN

You have already read, heard, and seen pictures of the extent of the recent devastation. This report is focused on different information, which you are unlikely to learn about—but which will help you as you prepare for what is ahead.

On December 18, 2004, Dr. Kerry Sieh, an American expert, presented a paper at a conference in San Francisco, warning that the next giant earthquake off Sumatra could happen at any time. He said it could lift the ocean floor six feet, causing a massive tsunami which would wreck coastal areas over a very wide region.

Earlier in that year, Sieh was so concerned about the danger that he had toured parts of Indonesia, lecturing officials about the dangers. But he found that no one seemed to care. For the most part, officials, high and low, just did not believe him. Sieh probably felt like Noah warning the Antediluvians. Although small earthquakes had been felt for years, everyone was used to them. It all seemed like an abstract theory; and, besides, experts said such a catastrophe might not occur for decades. So why worry?

Sieh had even distributed posters in Sumatra, in the hope that they would be posted where the people might see them. Whether or not they were put up, he did not know. Very likely, they were trashed, lest the tourists become worried.

Seismologists elsewhere in the world knew gigantic quakes occurred every so often. And, because of their instruments, they would learn sooner than most when an immense earthquake would occur; however, no warning system was in place in the Indian Ocean.

In 2003, one Australian seismologist, attending an international conference on tsunamis, had urged the scientific community to install such a warning system in that ocean. All those present agreed it should be done. But who should do it? The scientists were busy; and the governments in the region probably would not be interested. So the matter was dropped.

Seven years earlier, Samith Dhamasaroj, Thailand's leading seismologist, had warned Thai government officials that a tidal (seismic) wave could hit the entire coastal area and would be closest to the tourist town of Phuket. "I predicted the possibility, but nobody paid any attention." He had made two recommendations: Install alarm sirens in the hotels and locate no resort buildings closer than 300 yards from the beaches.

Ignoring the warning, the government moved Dhamasaroj to another post of duty. They did not want to do anything that might upset visitors from overseas. The tourist industry was increasing fast and becoming the major source of income for Thailand. More and more resorts were being built on all the beaches.

The last giant seismic wave to produce immense damage all across the Indian Ocean was when the volcano of Krakatoa exploded in 1883. The eruption darkened the skies with ash and lowered temperatures throughout the world.

That explosion produced an immense tsunami, with massive numbers of casualties, just as this present one has done.

Research studies of coral atolls indicate that clusters of gigantic earthquakes tend to occur about every 230 years. The most recent cluster began in 1797 and ended in 1861. So any month or year now, more big jolts could occur.

On Sunday morning, December 26, 2004, shortly after Bayu Pranata, the local geophysics officer in Padang, Central Indonesia, began his shift at the seismic center—it happened.

At 7:58 a.m. hearing a strange sound, he looked out the window to see what it could be. Then he realized that the tuk-tuk-tuk sound came from a seismometer—a gauge in the room he was in. It was busily recording powerful seismic activity somewhere not far away.

Shocked, Pranata hardly knew what to do. Apparently it was a powerful earthquake which appeared to be about 8 on the Richter scale. Fearing that the quake could cause a gigantic tsunami, he telephoned the National Earthquake Center in Jakarta; but there was no response. Pranata wept.

A powerful movement had occurred about six miles below the floor of the Indian Ocean. Like lightning, the shock wave sped outward. Unlike ordinary waves, which are whipped up on the surface of the ocean by the wind, tsunamis are waves that speed outward in every direction as a gigantic impact jolt, extending from the surface to the floor of the ocean.

As an earthquake lifts the ocean floor, it heaves up a mass of water thousands of feet deep which then falls back. As the sea flattens out again, gigantic ripples race outward. A tsunami is born! Enormous energy, contained in billions of cubic yards of moving water, races outward.

In the open ocean, that energy wave can travel at 500 to 700 miles per hour. The deeper the ocean, the faster it will travel (because it is impeded the least). Yet it may only be barely detected on the surface as a long,

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low swell whose crests may be hundreds of miles apart and only a few feet high.

A tsunami can travel great distances without dissipating. In 1960, an earthquake off the coast of Chile produced a seismic wave that, in 22 hours, traveled 10,000 miles—and slammed into Japan.

As this mass of energy hurtles outward, it gradually nears an island or coastal area. The ocean becomes more and more shallow. This intensifies the force of the energy wave—and it comes crashing onto the shore at great heights, depending on the magnitude of the initial earthquake shock. The height of the wave may be 15 feet or much higher. This one on December 26 was reported as 30, 35, or 40 feet high.

That wall of water just keeps rushing forward, hardly losing any height, until hills and mountains are reached. If there are no elevated areas, the wave moves right across the entire island. Later in this article, we will consider past tsunamis which were over 100 feet high. It can happen!

Not long after Bayu Pranata, in Padang, saw squiggles on his seismic charts, an automatic computer alert sent a seismologist rushing to his office in Australia.

Within 33 minutes after the quake, he issued a *tsunami warning*—but sent it only to Australian embassies. Officials in nations bordering the Indian Ocean were not warned, for fear of breaching "diplomatic protocol." Those big words mean that the orderly way for Australia to send messages to other governments is by contacting the Australian embassy in that nation, who then in turn eventually pass the warning along.

Precious time was slipping away.

In India, the seismic department dispatched an urgent fax to warn a government minister—but sent it to the wrong person. And there it set for awhile unopened.

A few minutes later, a seismic device at Nagano, Japan, began erupting. Masashi Kobayashi stared at it in disbelief. "I thought it was huge," he afterward said. "Our equipment calculated its magnitude at over 8, and that only happens a few times a year."

That seismometer triggered a calculator which immediately began comparing the jolt with 100,000 previous tremors in its memory. Yes, this was a big one.

Kobayashi immediately sent an alert to the Japan Meteorologic Agency in Tokyo. But they were not certain what to do with it; since the Indian Ocean was not in their tsunami warning network.

Very soon, computer alarms began sounding at the seismic center in Honolulu. The first scientist to look at the blue quake lines on the graph thought it might be 7 on the Richter scale; but soon they realized it was 8 or over. A huge earthquake!

A routine bulletin was issued, which predicted small changes in sea level, but added the comment that there was "no tsunami warning in effect" for the Pacific region. So relax everyone; it doesn't affect us.

Valuable time was slipping by as the scientists gradually realized that this was 9 on the Richter scale! The way it is calibrated, a 9 is 32 times more powerful than an 8.

It was clear to the scientists that this powerful undersea blast was centered in the Indian Ocean, not far from Sumatra (part of Indonesia).

A terrible tragedy was in the making; for the seismic wave, created by the quake, would soon hit many coasts. But what should be done? Who should be notified? It was a major holiday weekend for America; and most of its seismologists were gone till Monday. As for authorities in the nations bordering the Indian Ocean, they had no phone numbers for any of the coastal towns or tourist resorts. Oddly enough, they did not even have phone numbers of government offices!

"We tried to do what we could," said Charles McCreery, director of the Honolulu Earthquake Center. "We don't have contacts in our address book for anybody in that part of the world."

Some of the most sensitive earthquake equipment was the network of the Comprehensive Nuclear Test Ban Treaty Organization, which uses seismic equipment to listen for forbidden nuclear bomb blasts. The headquarters is in Vienna, Austria. Using 300 monitoring points circling the globe, it is able to gauge seismic activity, undersea disturbances, and even changes in the atmosphere!

This equipment was well-able to provide all of the rim nations around the Indian Ocean with accurate, fast warning—since many of the sensors were right there in that area of the world.

Like clockwork, the machines began whirring and recording the invaluable data, able to save thousands of lives.

But there was no one to pay any attention to it. Everyone had taken off for a long Christmas holiday week-

INSIDE A TSUNAMI

Tsunami prediction uses a principle of hydrodynamics that correlates the speed of a wave column with the square root of the ocean depth at any given point. For example, a wave in 18,000 feet of water will travel 519 miles per hour, with speed gradually slowing to 30 mph in 60 feet of water.

Decreasing depth has a braking effect on the bottom of the wave column; but the top continues to push forward, bunching up higher and higher as the shallowness of the water increases—until that wave topples with tremendous force on the shore while still moving forward at extremely fast speed.

It continues its onward surge until it reaches a part of the land that is higher than the top of the wave.

end. The place was empty.

By now, an hour or so after the main quake (although some experts were at their posts and knew about the tragedy in the making), no one knew how to warn the islands and coastal areas in the oncoming path of devastation.

Not one general warning got through to anyone of importance in any of the nations that needed to hear those warnings.

For example, it took an hour and a half for the tsunami to reach Sri Lanka. If they had been warned, thousands upon thousands of people would be alive today.

By the time the earthquake wave had traveled 3,500 miles and was nearing the coast of East Africa, news of the horrible disasters and loss of life in Asia had preceded it. The waves still produced terrible destruction, especially in Somalia; but in one nation—Kenya—word of the thousands of deaths had arrived. The authorities were able to evacuate the people. However, the warning had come from news of deaths in Asia, *not from seismic monitoring centers!*

On one island in the Indian Ocean, Simeulue, most of the people escaped unharmed. Over the decades, they had taught their children about the seismic wave of 1907, which had killed thousands on the island. The citizens never forgot the message; and, when they felt the quake, they immediately fled to the hills behind the coastal areas. The majority of the island's 70,000 people remembered what their parents had taught them and escaped the waves which followed the quake.

But there were others who also escaped:

Suddenly, with great beating of wings, thousands of egrets and cormorants rose from the placid coastal water off Sri Lanka and flew inland. Yet, to the people, nothing seemed amiss. Wildlife was sensing what had occurred thousands of miles away.

Animals of all kinds, *with no exceptions,* rushed inland to higher ground. Wild elephants trumpeted as they ran to safety. Some elephants were carrying tourists at the time. They hurried to higher ground, carrying their mahouts and astonished tourists with them—and saving their lives. As soon as the elephants reached an elevation slightly higher than the highest wave would later reach, they stopped. Eventually, the waves arrived—and stopped at the feet of those elephants.

Elephants that were chained generally broke their chains and ran off. In one instance, an elephant, as it ran, reached down and picked up a child which had fallen and carried it to safety.

Men in charge of wildlife reserves saw the animals fleeing to the hills. Throughout the entire devastated areas surrounding the Indian Ocean—not one dead animal was found (unless it was tied securely by a rope or chain, or inside a house and unable to leave). Planes and helicopters, flying overhead, could not spot a single dead animal. None could be seen on the ground by the survivors.

This entire tragedy occurred on a day when the weather was mild, the sun was warm, and no tropical storms were anywhere. As for the sea, it was unusually calm.

Is the United States in danger of a tsunami? The newspapers may tell you that we are comparatively safe, because a special Pacific warning system is in place. (It is a 26-nation network of seismic, tidal, and sea-level monitors.)

Yet this is only a warning system; it is not going to stop the waves! They will still hit the U.S. coast and cause great desolation.

Seismic waves can be generated by earthquakes in various parts of the Pacific Basin. As we have learned, each wave can travel thousands of miles with little loss of energy. Every low-lying coastal area on the West Coast is in danger.

Here is information on what could easily happen if a powerful earthquake occurred along one of several underwater faults (crack lines) in the Pacific Northwest:

Hundreds of minor quakes have been recorded along the Juan de Fuca and Explorer cracks over the past 25 years. Those faults are quite similar to the subterranean system of cracks that recently triggered the gigantic tsunami in the Indian Ocean. The faults off the coast of Oregon, Washington, Canada, and Alaska are capable of producing earthquakes fully as large as the December 25 quake.

About 45,000 people in Washington State live within 0.6 miles of the ocean. In Oregon, about 90,000 people live within 0.6 miles of the ocean. If a quake was powerful enough, it could drive a wall of water toward Seattle and Vancouver. The Puget Sound basin has its own network of faults—right next to those cities—which would be fully capable of generating large earthquakes and seismic waves.

Flooding from a major earthquake would cover a

DISCOVERING THE POWER OF LANDSLIDES

In 1973, research scientists discovered that landslides could produce extremely large tsunamis. Underwater earthquakes generally produce no more than a 30-foot seismic wave. But a landslide can produce gigantic ones! In Latrea Bay, Alaska, a huge section of rock had fallen off—producing a 450-foot high tsunami! Swiss scientists built a model and discovered that landslides could produce tsunamis up to 520 meters [1,706 feet] high!

Scientists now fear that the Cumbre Vieja volcano on La Palma, the largest island in the Canary Island chain *(see box on next page)* will eventually break off. That mountain consists of two types of rock: the outer one does not hold water, while the one beneath does. An eventual slide is inevitable. There are 40 million people living along the East Coast of the United States.

sizeable amount of inhabited coastal land in Vancouver, Seattle, Tacoma, and adjacent areas.

Almost instantly, such a shock would overflow those cities—almost before a warning could be sounded.

It is known that a very powerful earthquake, close to the Puget Sound, occurred in 1700.

So much for Oregon and Washington. Southern Alaska is also a dangerous place; and so is California.

Much of the population of the San Francisco Bay Area, Los Angeles, and San Diego live and work in localities not far above sea level. A warning system might give them advance notice (for those who heard the warning); but the oncoming tsunami waves would inundate large areas, regardless of how much warning the citizens had received. Very likely, the water would pour in while many were still in traffic jams, trying to flee to higher ground.

In 1883, Krakatoa volcano in the East Indies erupted; and the entire island collapsed in 820 feet of water. A tsunami of tremendous force traveled around Java and Sumatra, killing 36,000 people with walls of water that reached 115 feet in height.

In 1896, on the eastern coast of Japan, waves, 82 to 115 feet high, smashed more than 100,000 homes and drowned 26,000 people.

In 1946 at Unimak Island, near Alaska, a magnitude 7.2 earthquake set in motion a seismic sea wave great enough to wipe out not only Scotch Cap Lighthouse and five men inside—32 feet above sea level—but also the radio antenna perched at 103 feet!! The wave traveled onward to Hawaii and killed 159 people and produced millions of dollars of damage.

The 1964 Alaska earthquake produced great damage, not only from the quake but also from tsunamis which repeatedly struck Anchorage and Valdez. —*vf*

CANARY ISLANDS VOLCANO COULD TRIGGER A MONSTER ATLANTIC COAST TSUNAMI

The eruption of the Cumbre Vieja volcano, in the Canary Islands, could trigger a "mega-tsunami" that would devastate Atlantic coastlines with waves as high as 330 feet, scientists said on Wednesday, December 29, 2004. *More on this later in this brief article.*

The largest island group in the Atlantic Ocean is the Canaries. Because they can be reached by favorable winds from Europe and Africa, the islands were an important base for early voyages to the new world. Although they were claimed by Portugal in 1341, because the pope was greater than kings—he gave them to Spain three years later! (But, ignoring the infallibility of a papal decree, Spain took them back later and today owns them.)

There are several volcanoes on the Canaries. One, on the island of Tenerife is 3,715-meters high. Christopher Columbus recorded a 1492 eruption (probably Teide) on Tenerife. Over the centuries, one after the other of the volcanoes has exploded, collapsed, or caused landslides. Thick pumice deposits occur on the sides of all the volcanoes, showing strong activity in past centuries.

In some instances, one volcano after another has blown up within just a few months. For example, Siete Fuentes erupted on January 31, 1704. Volcan Fasnia on January 5, 1705, and Montana Arenas on February 2, and Montana Negra on May 5, 1706.

The Las Canada Caldera formed after a major collapse at an earlier time. Volcan Chahorra erupted in 1798; and another eruption blew out its side on 1909. Many of these eruptions were quite violent. Orotava and Guimar valleys, on the island of Tenerife, were formed when the steep volcanic sides of Teide slid into the sea. It erupted most recently in 1909. In the past, the northern segment of Teide has produced several landslides into the ocean. Teide, elevation 12,188 feet, is the third largest volcano on Earth, after Mauna Loa and Mauna Kea in Hawaii.

Then there is the Cumbre Vieja volcano on La Palma Island. This is the one mentioned in the first paragraph of this brief article, which experts especially point to as one the experts are especially concerned about.

It is believed that such an eruption would cause a massive chunk of rock to break off and crash into the ocean, producing a gigantic wave of water that would crash into the coast of Eastern United States.

Simon Day, of the Hazard Research Center at the University College of London, said that Cumbre Vieja should be carefully monitored for any signs of activity, so a warning could quickly be sounded. Such a wave would devastate areas, some more and some less, extending from South America, the Caribbean Islands, eastern America, Greenland, Iceland, Ireland, Britain, Europe, and Africa. The energy released by the collapse would be equal to the electricity consumption of the entire United States in half a year. Immediately after the landslide, a dome of water (possibly 3,000 feet high and tens of miles wide) would form, then collapse and rebound outward. Within 10 minutes, the tsunami would have moved a distance of almost 155 miles.

On the west Saharan shore, waves would probably reach heights of 330 feet. Florida and the Caribbean would be hit with waves that could be 165 feet high, about 8-9 hours after the landslide.

Wave heights toward Europe would be smaller; but sustantial waves would hit the coasts of Britain, Spain, Portugal, and France.

It is estimated that the water would penetrate several miles inland; and the devastation would cause trillions of dollars in damage.