



1-31-1994

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Tvedtnes, John A. (1994) "Historical Parallels to the Destruction at the Time of the Crucifixion," *Journal of Book of Mormon Studies*: Vol. 3 : No. 1 , Article 11.

Available at: <https://scholarsarchive.byu.edu/jbms/vol3/iss1/11>

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BRIGHAM YOUNG UNIVERSITY • PROVO, UTAH

Title Historical Parallels to the Destruction at the Time of the Crucifixion

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Reference *Journal of Book of Mormon Studies* 3/1 (1994): 170-86.

ISSN 1065-9366 (print), 2168-3158 (online)

Abstract To the nonbeliever, the wide variety of destructive forces unleashed in the New World at the time of Christ's crucifixion seems preposterous or, at the very least, unscientific. The account in 3 Nephi 8-9 mentions the simultaneous occurrence of earthquake, fire, strong winds, extensive flooding, the complete burial of cities, and thick darkness. An examination of known great natural disasters in historical times reveals that the Book of Mormon in no way exaggerates. All of the destructive forces mentioned in 3 Nephi 8-9 can be readily explained in terms of the tectonic forces that result from the encounter of the plates on which the continents and the oceans lie. The complex variety of destructive forces that we normally consider to be separate phenomena of nature is, in reality, strong evidence for the historicity of the Book of Mormon account.

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Abstract: To the nonbeliever, the wide variety of destructive forces unleashed in the New World at the time of Christ's crucifixion seems preposterous or, at the very least, unscientific. The account in 3 Nephi 8-9 mentions the simultaneous occurrence of earthquake, fire, strong winds, extensive flooding, the complete burial of cities, and thick darkness. An examination of known great natural disasters in historical times reveals that the Book of Mormon in no way exaggerates. All of the destructive forces mentioned in 3 Nephi 8-9 can be readily explained in terms of the tectonic forces that result from the encounter of the plates on which the continents and the oceans lie. The complex variety of destructive forces that we normally consider to be separate phenomena of nature is, in reality, strong evidence for the historicity of the Book of Mormon account.

The great destructions which took place among the Nephites and Lamanites at the time of Christ's crucifixion can be likened to the effects of hurricanes and tornadoes as well as tectonic activity such as earthquakes and volcanic eruptions. The cataclysm began with a "great storm, such an one as never had been known in all the land," followed by "a great and terrible tempest" and "terrible thunder" that "did shake the whole earth as if it was about to divide asunder. And there were exceedingly sharp light-

nings, such as never had been known in all the land” (3 Nephi 8:5–7). In the land northward,¹

the whole face of the land was changed, because of the tempest and the whirlwinds, and the thunderings and the lightnings, and the exceedingly great quaking of the whole earth; and the highways were broken up, and the level roads were spoiled, and many smooth places became rough. And many great and notable cities were sunk, and many were burned, and many were shaken till the buildings thereof had fallen to the earth. . . . And there were some who were carried away in the whirlwind. . . . And thus the face of the whole earth became deformed, because of the tempests, and the thunderings, and the lightnings, and the quaking of the earth. (3 Nephi 8:12–14, 16–17)

The destruction lasted “for about the space of three hours,” though some said “that the time was greater” (3 Nephi 8:19). It was followed by a “thick darkness” which people could “feel,” and which would not permit the kindling of fire (3 Nephi 8:19–22). The darkness lasted for three days (3 Nephi 8:23).

In the land southward, which was least affected (3 Nephi 8:11–12), “the city of Zarahemla did take fire, . . . the city of Moroni did sink into the depths of the sea, and the earth was carried up upon the city of Moronihah, that in the place of the city there became a great mountain” (3 Nephi 8:8–10; cf. 9:3–5).

Other cities, probably located in the land northward, suffered similar fates. Gilgal was “buried up in the depths of the earth” (3 Nephi 9:6), along with four other cities (3 Nephi 9:8). Three additional cities sank and were covered with water (3 Nephi 9:7), while another four burned (3 Nephi 9:9–10).

The account suggests, at first glance, that all the destructive forces of nature had been unleashed at once. However, they can all be explained by a single phenomenon—the movement of tectonic plates.

¹ The regional nature of the cataclysm—affecting mostly the “land northward”—is discussed in my article, “The Timing of Christ’s Appearance to the Nephites,” in John W. Welch, ed., “When Did Jesus Appear to the Nephites in Bountiful,” F.A.R.M.S. paper, 1989.

Earthquakes and Volcanic Eruptions

The earth's surface is comprised of a series of plates that form the land masses and the ocean bottoms. Floating on magma, a superheated liquified matter, these plates are constantly in motion—albeit very slow motion. Where they meet, fractures called faults are formed. Movement along the fault line can be either parallel or at an angle. Pressure builds up along the fault until one of the plates slips free of the other's frictional grasp, causing the tremor known as an earthquake.

The major faults lie along the lines where the oceanic plates meet those of the land masses. The earth cracks and buckles along these lines, resulting in the uplifting of mountains and the shifting of land masses. When magma is allowed to escape along the fault line, it comes out in the form of lava, which cools and forms rocky plateaus or cone-shaped volcanic peaks.

Once a volcano is formed and the rock cools, it may become dormant for many years—sometimes centuries. But stress along the plate intersection lines can result in occasional rebirth of long-dead volcanoes, sometimes accompanied by earthquake.

The greatest earthquake and volcanic zone lies around the perimeter of the Pacific basin, where the oceanic plates meet the land. Places like the Philippines, Japan, Alaska, the west coast of the United States, Mexico, Guatemala, Colombia, Peru, and Chile are noted for their frequent earthquakes and occasional volcanic eruptions.

When a severe earthquake or volcanic explosion occurs in or near the ocean, another potentially destructive phenomenon results: the tsunami. The Japanese word is often rendered “tidal wave” in English, though it has nothing to do with tides. It denotes a gigantic wave, sometimes hundreds of feet high, that results from tectonic activity sufficiently strong to stir up the oceanic waters. A typical tsunami travels at speeds of hundreds of miles an hour, sometimes as fast as five hundred miles an hour. When it reaches land, the gigantic wave crashes ashore, leaving death and destruction in its wake.

An example of the combination of earthquake, fire, volcanic eruption, and tsunami was seen on April 18, 1902, when an earthquake destroyed Guatemala City. Twelve thousand people died by

quake and the ensuing fire. The earthquake produced a tsunami and Guatemala's Tacaná volcano erupted the same day. On November 19, 1822, the eruption of the Pacific volcano Galung Gung triggered an earthquake across the ocean in Valparaiso, Chile. The Chilean shoreline rose four feet and 10,000 people died. The eruption of Bezymianny volcano in the Russian province of Kamchatka in September 1955 resulted in 1,285 earthquakes during a period of three weeks.

Wind, Lightning, and Darkness

While it is not impossible that a hurricane may have accompanied tectonic activities at the time of Christ's crucifixion, there are tectonic explanations for the tempest, whirlwind, and lightning described in 3 Nephi. The explosive force of some volcanic eruptions has been great enough to cause severe winds. Huge balls of burning gases from volcanoes have also been known to create firestorms whose winds are fierce.

Great displays of lightning have also been observed in the ash-laden volcanic clouds thrown up from volcanoes. Such displays were photographed when the small island of Surtsey was created in November 1963 by a volcanic eruption in the Atlantic Ocean, not far south of Iceland.

Tephra or volcanic ash is also known to block sunlight, creating the illusion of night at midday. This was demonstrated by the eruption of Mount Pinatubo in the Philippines in June of 1991. Within days, the ash fall at Clark Air Force Base was so severe that the base was abandoned. U.S. Air Force personnel returning to the site soon after the beginning of the eruptions found buildings collapsed and thick layers of ash. Day became night throughout a large area, and at this writing (January 1992), dust spewed by the volcano into the stratosphere continues to produce spectacular sunsets and to affect weather patterns in much of the world.

Occasionally, other disastrous effects result from volcanic eruptions. Toxic chemicals such as sulfur dioxide, carbon dioxide, and fluorine, can cause both illness and death. The eruption of the Lakagigar fissure in southeastern Iceland in June 1783 produced a blue haze that spread over Europe, western Asia, and North Africa during an eight-month period. Crops were spoiled in

Scotland and the finish was ruined on copper pots in England. Dust fell on northern Italy and the obscuring of the sun produced an unusually cold winter throughout Europe in 1783–84. In Iceland, trees withered and died, crops yellowed, and grasses nearly died out. Horses, sheep, and cattle sickened, the flesh and hide often rotting on their bodies before death came. Fish disappeared from Icelandic coastal waters for nearly a year. The Haze Famine caused the death of more than 10,000 people in Iceland—a fifth of the population—over a three-year period. Boils and growths appeared on the bodies of the sick, their gums swelled, and their teeth fell out.

When the Earth Moves

When an earthquake hit the Yellowstone Park region on August 17, 1959, most viewed it as a very serious matter. The shores of Montana's Hebgen Lake were tilted by the upheaval, submerging cabins at one end and lifting docks high and dry at the other. But the tremor was minor compared to what happened five years later.

The great Alaska earthquake of March 27, 1964, was 4,000 times as powerful as the largest known nuclear explosion and several hundred times more powerful than all the nuclear weapons exploded to that date. This vast power provoked the largest land area deformation in historic times. More than 100,000 square miles of the earth's surface were vertically displaced. Streets in Anchorage were lowered by twenty feet and the earth resonated for weeks afterward.

Resulting tsunamis up to thirty feet high built up in Prince William Sound and devastated towns along Alaska's southern coast. Nearly half the fishing boats of Kodiak Island were sunk or smashed and two of its three fish canneries were carried away by the waters. The waves, racing at 400 miles an hour, swept over beaches in Hawaii, Japan, and the west coast of the United States. Four children on an outing with their parents were swept from the beach at Depoe, Oregon. Twenty-foot waves hit Crescent City, California, 1,600 miles away, smashing 150 stores and killing a dozen people. The ground was lifted beneath such distant cities as

Houston, Texas (four inches), and Cape Kennedy, Florida, and the levels of well water jumped abruptly as far away as South Africa.

The Alaska quake lasted for seven full minutes. In many places, the ground reacted to the quake as if it were water and moved as waves of the sea. Some houses in Anchorage were moved as much as a quarter mile from their original location. The devastation was so complete that 75% of the state's commerce and industry was destroyed.

Still, the Alaska and Yellowstone disasters resulted in minimal loss of human life, as did the famous San Francisco earthquakes of 1906 and 1989 and the Los Angeles earthquake of 1993. None of these attained the 8.9 Richter scale reading of the 1906 earthquake in Quito, Ecuador, and the one that hit Honshu, Japan, in 1933.

Though not to be taken lightly, the destructive nature of the most well-known U.S. quakes cannot compete with other earthquakes and volcanic eruptions of historic times, whose description reads like a page from 3 Nephi. Perhaps more comparable are the following earthquakes that have resulted in the largest loss of life for single natural disasters:

- It is estimated that more than 800,000 people died in a Chinese earthquake in 1556 that wreaked havoc in three provinces.

- Perhaps as many as 100,000 people lost their lives during the 1669 eruption of Sicily's Mount Etna, during which the daytime sky was blackened by ash and smoke, while boulders weighing as much as 300 pounds were propelled several miles through the air.

- In 1803, the city of Edo (now Tokyo), Japan, was destroyed by an earthquake, and 210,000 people died.

- In January 1855 an earthquake in southeastern New Zealand lifted a block of the Rimutaka mountain range measuring 90 miles by 20 miles by ten feet. Such a feat would require the simultaneous explosion of several thousand atomic bombs.

- In 1857, Tokyo was again hit by an earthquake that triggered a tremendous firestorm, resulting in the loss of 107,000 souls.

- On December 28, 1908, an earthquake struck the Sicilian port-city of Messina. More than 90% of the town's buildings collapsed within minutes. A 26-foot tsunami followed. Ruptured gas

mains set the city ablaze. Some 90,000 people died in Messina, 40,000 in the nearby Italian town of Reggio Calabria, and another 27,000 in other cities and towns along both sides of the strait separating Sicily from the mainland of Italy.

- More than 200,000 people perished in a quake in Kansu province, China, in December 1920.

- On September 1, 1923, the "great Kwanto earthquake" struck the Japanese cities of Tokyo and Yokohama, followed by a 36-foot-high tsunami and enormous fires. About 140,000 people died and 100,000 were seriously injured. More than 560,000 homes were destroyed, leaving a million and a half people homeless. A vast crowd of 30,000 taking refuge in a public park was instantaneously incinerated by a firestorm sweeping through Tokyo.

- In 1939, an earthquake in Erzincan, Turkey, killed 40,000 people.

- Some 242,000 people were killed and another 164,000 seriously injured by the 1976 earthquake in Tangshan province, China. The quake, which measured 8.5 on the Richter scale, generated five thousand times more energy than the atomic bomb that destroyed the Japanese city of Hiroshima in 1945. In the city of Tangshan, 95% of the civil buildings and 80% of the industrial plants were destroyed or suffered severe damage. The quake had been immediately preceded by a series of flashing, multicolored lights, visible at a distance of 200 miles.

- On December 7, 1988, a gigantic earthquake took 25,000 lives in Soviet Armenia and destroyed several cities and towns.

A series of three earthquake tremors that hit Jamaica on June 7, 1692, were so violent that two mountains were moved nearly a mile from their original positions. Port Royal abruptly sank into the ocean and within just minutes much of it lay under fifty feet of water. Nearly two thousand people died. Hundreds of people fell into the deep cracks which formed in the ground, and their rotting corpses filled the air with a noxious stench for months.

On the morning of November 1, 1755, an earthquake hit Lisbon, Portugal. Within two minutes, 30,000 people were crushed to death by falling buildings. Another 20,000 or more perished in the fires that soon broke out or drowned in the fifty-foot tsunamis that swept into the port. Of the town's 20,000 houses, 17,000 were

destroyed. The tremors were felt over 1.5 million square miles, by a third of Europe's population. Rivers in Scandinavia and Scotland surged wildly. Church chandeliers swayed in the Netherlands and Germany. An army barracks in Luxembourg, a thousand miles away, fell, killing 500 soldiers. Across the Mediterranean, in Morocco, 10,000 people died from the tremors and the tsunamis. The tsunami reached England five hours after the quake and arrived in the West Indies a short four hours later.

In 1772, the Papandayang area of Java was hit by a series of earthquakes, one of which split a mountain and created a large depression six miles wide and 15 miles long, into which an entire town of 2,000 people disappeared.

A series of earthquakes devastated western Calabria, at the tip of Italy's toe, during a two-month period in 1783. Countless fissures—some as wide as 150 feet—formed. Some of them tapped deep springs of boiling water and mud, which shot up scalding geysers. More than 30,000 people died.

On December 15, 1811, the first of a series of large quakes took place in the Mississippi basin near New Madrid, Missouri. It was accompanied by a storm resembling a tornado. The sky was filled with black clouds and fierce lightning, accompanied by a sulfurous odor. Swamps were drained as large tracts of lands rose or fell. For a brief time, parts of the Mississippi flowed uphill and two temporary waterfalls were created. Of the nearly 2,000 tremors that struck the area during the next three months, the strongest managed to flatten hundreds of square miles of forests, alter the course of the Mississippi River, turn thousands of acres of prairie into swamp, submerge whole islands, produce massive landslides, and destroy New Madrid, lowering the ground beneath it some fifteen feet.

The final and most powerful quake occurred on February 7, 1812, and was felt over an area of 1.5 million square miles (nearly half the continental USA). The tremor was felt in Detroit, 600 miles distant, and in parts of Canada. It rattled windows and shook chandeliers as far away as Washington, D.C. (750 miles away), and New Orleans (500 miles away), and rang church bells in Boston, Massachusetts (1,100 miles away), and Charleston, South Carolina. People in Pittsburgh, Pennsylvania, were roused from sleep.

An earthquake at Charleston in August 1886 destroyed or damaged most of the town's buildings and killed 60 people. Felt throughout most of the eastern United States, it caused minor damage to the upper floors of buildings as far away as New York City (600 miles) and Chicago (750 miles).

On January 24, 1939, a powerful earthquake in south-central Chile affected a strip of land 50 miles wide and 200 miles long. The towns of Concepcion and Chillan were destroyed. Of Chillan's 50,000 inhabitants, 10,000 died and 20,000 were injured. A thousand died in the collapse of a movie theater. In all, 50,000 people died and 60,000 were injured, while 700,000 were left homeless. Nearby volcanoes glowed red but, to the relief of residents, did not erupt.

In 1960, an earthquake triggered fires and a tsunami that killed at least 10,000 people in Agadit, Morocco.

On May 31, 1970, a quake on the Pacific Ocean floor fifteen miles off the Peruvian coast killed 70,000 people and set off landslides and avalanches in the Andes Mountains. A mass of ice, snow, mud, rocks, and boulders, estimated at 90 million cubic yards, fell from the 12,000-foot summit of Nevado de Huascaran (Peru's highest peak). Sweeping down at 200 miles an hour and covering a horizontal distance of seven miles, it buried the town of Yungay, Ranrahirca. At least 25,000 people died under ten to forty feet of debris.

Two mild earthquakes went nearly unnoticed in Managua, Nicaragua, on December 22, 1972. But no one failed to note the three larger tremors that came just after midnight. The third reduced at least 70% of the city to rubble, killing 5,000 people, injuring 20,000, and leaving 250,000 homeless.

The earthquake that hit Mexico City on September 19, 1985, destroyed 500 buildings and damaged 3,300. More than 9,000 people lost their lives and 30,000 were injured. Some 95,000 were left homeless as fires from ruptured gas mains continued the destruction begun by the quake.

Tsunamis

Tsunamis are among the most destructive of the forces unleashed by earthquakes. A 1596 quake near the Japanese shore

created a tsunami that destroyed the island of Uryu-Jima, resulting in the death of more than 4,000 people. In 1737, a tsunami more than 200 feet high slammed into northern Japan and part of the Kamchatka peninsula of Russia, leaving a watermark on a cliff face 210 feet above sea level at Cape Lopatka, Siberia.

In 1868, an earthquake off the coast of Chile generated a series of tsunamis that crashed into the harbor of Arica. A U.S. Navy steamship was carried three miles up the coast and two miles inland, where the crew found themselves at the foot of the cliff where the watermark on the rock showed the wave had broken against it 47 feet above the ground. A nearby British three-masted ship had lost its crew and had been spun so violently by the water that the heavy anchor chain had been wrapped over and over around the ship's hull.

On June 15, 1896, an earthquake shook the Sanriku district of the Japanese island of Honshu. Twenty minutes later, a 100-foot tsunami struck at 500 miles an hour, sweeping away 10,617 houses and damaging 2,456. A total of 27,122 people died and 9,247 were injured.

On April 1, 1946, nature played a cruel April fool's joke. Two earthquakes centered in the ocean 90 miles southeast of Unimak Island in the Aleutian chain of Alaska created a destructive tsunami. A 115-foot wall of water rushed at 75 miles an hour to destroy the lighthouse at Scotch Cap on Unimak. Building speed to 490 miles an hour, the tsunami crossed the 2,300 miles to the Hawaiian island of Oahu in a little more than four and a half hours. A total of seven waves hit Hawaii.

The north coast of Kauai was hit by 45-foot waves, while 50-foot waves hit the island of Hawaii. The highest waves to hit Oahu were 36 feet. Waves 20 to 32 feet high leaped over the breakwater in the city of Hilo, flooding the downtown section of the city. In all, 1,400 homes were destroyed and 159 people died, 96 of them in Hilo.

On December 21 of the same year, an undersea quake off the Japanese island of Honshu produced a tsunami that destroyed several thousand ships and wiped 50 towns from the map. Some 2,000 people died and half a million were left homeless.

The Chilean earthquake of May 1960 sent a tsunami speeding at more than 500 miles an hour out into the Pacific Ocean. The

Hawaiian town of Hilo was devastated, but the early warning system established after the 1946 disaster made it possible to save all but 60 people. A total of 438 people were killed when the tsunami hit Japan and the Philippines.

Volcanic Eruptions

The past decade or so has seen renewed volcanic activity in many parts of the world. The eruption of Washington state's Mount St. Helens came as a surprise to most of us, who thought the volcano permanently dormant. Other major eruptions have occurred in Mexico, the Philippines, and Colombia. Hawaii's land mass continues to increase daily as lava flows to the sea from Mount Kiluea.

On the morning of May 18, 1980, a strong earthquake shook the area of Mount St. Helens. A few seconds later, the volcano exploded with force five hundred times that of the atomic bomb that leveled the Japanese city of Hiroshima. The shock wave instantaneously snapped off six million trees, scattering them like straws over an area of 130,000 acres and up to 150 miles away. It is estimated that the explosive shock wave traveled at 250 miles an hour. Boulders up to 60 feet in diameter were blown or carried five miles from their original location. All life was destroyed in a fan-shaped area 17 miles long. Some 5,200 elk and 6,000 black-tailed deer perished, many of them from suffocation. Fishermen 16 miles from the blast were severely burned and survived only by jumping into the water.

An ash plume shot 63,000 feet into the air and moved east. Its approach was observed by climbers on the 11,800-foot summit of Mt. Adams, 35 miles away. They observed lightning in the huge cloud. Ten minutes later, the temperature around them rose by 15 degrees as the hot ash reached their position, and static electricity discharged from their ice-axes.

Midnight darkness fell at noon in parts of Washington, Idaho, and Montana, as ash from the volcano spread into the atmosphere. Some 800,000 tons of ash fell on Yakima, Washington, 85 miles east of Mount St. Helens. A vast quantity of ash circled the globe for years, affecting sunsets in various parts of the world. More than a cubic mile of matter had been blown away from the

mountain. Formerly 9,677 feet high, it was reduced to 8,400 feet at the southern rim of the volcanic caldero and 6,800 feet at the northern rim.

A vast area around the volcano was covered by mud formed from a mixture of ash and melted snow. The superheated mud, measuring up to 800 degrees Fahrenheit, flowed downhill at speeds approaching 50 miles an hour, and reached the town of Toutle, 25 miles from the peak. Thirteen miles of the Toutle River valley was filled with mud a mile wide and hundreds of feet deep. Part of the mudslide into Spirit Lake, six miles north of the summit, overtopped a ridge 1,200 feet high.

When the hot mud reached the Toutle River, the river's temperature rose to 90 degrees. Flowing into the larger Cowlitz River, it raised the temperature to 80 degrees, killing all the fish (estimated at half a million). Timber swept up by the mudflow formed a 20-mile logjam in the Columbia River. Within 18 hours after the eruption, debris had narrowed the normally 40-foot-wide Columbia River (the nation's second largest) to a mere 14 feet. River bottoms were raised at least twelve feet. Twenty-six lakes completely disappeared and 27 more were severely damaged, and millions of fish perished. By November of the following year, the U.S. Army Corps of Engineers had removed from the three rivers some 100 million cubic yards of debris.

The Colombian volcano Nevado del Ruiz erupted on November 13, 1985, expelling millions of tons of ash seven miles into the stratosphere. Cooling in the frigid air, it fell on snow that had been melted by hot magma inside the volcano. A fifteen-foot-high flow of cold mud rushed down the valley through the town of Armero, 30 miles from the volcano, burying 80% of the town's buildings and killing 20,000 of the town's 22,500 people within minutes. As the torrent rolled on, it warmed and became a steaming river as much as fifty feet deep, which engulfed other villages.

Over the centuries, hundreds of thousands of people have lost their lives in volcanic eruptions. In 1772, for example, the entire top half of Java's 8,750-foot Mount Papandayan sank into a pool of lava, taking down with it forty villages and 3,000 people. In 1793, the Japanese island volcano Unsen was obliterated by an explosion that killed 50,000 people. Pumice thrown out by the

volcano floated on the sea in layers thick enough to enable people to walk on the porous stones.

During late April and early May of 1902, Mount Pelée, on the West Indian island of Martinique, began rumbling and spewing hot ash. On May 2, the mountain shot up a dense black cloud laced with brilliant lightning. For several days, ash fell like snow on the nearby port city of St. Pierre. On May 5, a mass of boiling mud rushed down to the sea, carrying fifty-ton boulders and burying alive forty workers in a sugar mill. Electrical disturbances from the volcano knocked out the city's electricity.

Two days later, La Soufrière, a volcano on the nearby island of St. Vincent, erupted and sent a steam cloud 30,000 feet into the air. Hot falling ash destroyed vegetation over a third of the island. A fifty-foot mass of boiling mud formed in the Rabaka Dry River and began flowing downhill. Parts of the valley had up to 200 feet of mud, while mud deposits in the valley of the Wallibou measured up to 60 feet. Nearly 1,600 people died and much property was lost. The ash cloud, traveling at 50 miles an hour, affected a wide expanse of the nearby Caribbean Sea.

On May 7, the day of the eruption on St. Vincent, a black cloud full of vivid lightning rose from Mt. Pelée, whose summit glowed in the early morning hours. The next morning, at 7:52 A.M., the side of the volcano burst open and a huge wall of fire from superheated steam, gases, and ash rushed down the mountainside at a hundred miles an hour and engulfed the nearby port city of St. Pierre, traversing the five miles in less than a minute. The seering heat, perhaps up to 1900 degrees Fahrenheit, instantaneously carbonized many objects and killed people. Within a minute after the gaseous cloud passed, oxygen returned to the air and the city burst into flame. All of this was observed from ships at sea near the island. (More than a dozen ships anchored in the port had been burned.) From aboard the Pouyer-Quertier, eight miles at sea, observers felt the intense heat and soon thereafter witnessed the fall of red-hot stones and ash on the ship's deck. The heat from the burning town was so intense that at 11:30 A.M. a ship from Fort de France was unable to approach the shore. When finally able to go ashore, visitors found a layer of ash nearly a foot thick, with drifts up to several feet high. Every tree in town

had been destroyed. So great had been the force of the blast that clothing had been torn from people an instant before they died.

Only two of the 30,000 people in town survived the holocaust, and those two were severely burned. One of them, speaking in terms reminiscent of the account in 3 Nephi, told of the terrible wind followed by a sudden darkness, a shaking of the earth, and then a tremendous blast of heat.

When Mt. Katmai, Alaska, erupted on June 6, 1912, the explosion was heard 750 miles to the southeast in Juneau. Heavy volcanic ash fell in both Juneau and in the Yukon valley 1,000 miles from the volcano. Day turned to night for three days at Kodiak Island, 100 miles southeast. Observers on the U.S. Coast Guard cutter Manning, at Kodiak Island, reported on June 7 that it was impossible to see a lantern at arm's length. Pumice and ash in the sea made floating rafts capable of sustaining a man's weight. An estimated eight to nine cubic miles of rock was ejected by the explosion, followed by five cubic miles of tephra. Ash fell on Puget Sound and acid rain from the volcano destroyed clothes hanging outdoors at nearby Vancouver, British Columbia, 1,500 miles away.

The most powerful explosion known in history took place on April 5, 1815, when the volcanic mountain Tambora erupted on the Indonesian island of Sumbawa. Ten thousand people on Sumbawa and nearby islands were killed instantaneously, and 82,000 more died from the famine and disease that followed. The sound of the explosion was heard as far away as 1,600 miles.

Tambora ejected some thirty-six cubic miles (170 billion tons) of volcanic debris into the stratosphere. The thick ash cloud produced complete darkness on islands up to 370 miles away for three days. Circling the globe many times over and joining with ash from the 1812 eruption of La Soufrière in the West Indies and the 1814 eruption of Mt. Mayon on the Philippine island of Luzon, it produced spectacular orange sunsets as far away as England, and parts of Europe and North America experienced no summer in 1815. Snow fell in some parts of New England as late as July and August, with frost recorded every month from June through September. Crop failure resulted in widespread famine and food riots in France and England.

One of the most well-known eruptions in modern times was that of the volcanic island of Krakatoa in the Sunda Strait separating Java from Sumatra, Indonesia, on August 26–27, 1883. We are fortunate to have eye-witness accounts from survivors on the nearby coasts of Java and Sumatra, as well as log books of ships passing through the strait. The steam cloud produced by the volcano's first eruption at two o'clock on the afternoon of August 26 shot 25 miles into the sky.

Explosions during the afternoon and night were heard up to 240 miles away, and people living along the west coast of Java, more than fifty miles distant, were unable to sleep. The largest explosion occurred at ten o'clock in the morning. It broke windows and cracked walls up to a hundred miles away. The sound was heard 2,250 miles to the east in central Australia and 3,000 miles to the west on the island of Rodriguez, near Madagascar. Air pressure waves from the explosion circled the globe six and a half times and were detected by barometric instruments. The eruption's force has been calculated at 30,000 megatons, which is a million times greater than that of the Hiroshima atomic bomb.

The dust cloud from the ten o'clock explosion rose to a height of 50 miles and lightning was observed within the cloud, with static electrical phenomena around some of the ships in the strait. Several billion tons of rock, comprising an estimated five cubic miles of matter, had cut the island's size by two-thirds. By midafternoon of August 27, the settling dust had completely obliterated the sun as far away as Badong, nearly 240 miles to the east. Ash fell as far away as 2,000 miles to the west and south of Krakatoa, even reaching the northwestern shore of Australia.

Two new islands were created by the debris from the eruption, but they were soon reduced to sand bars by violent wave action. A deadly hail of red-hot matter killed hundreds of people on nearby islands.

The resulting tsunamis, some up to 175 feet in height and traveling at 400 miles an hour, destroyed nearly 300 towns and villages bordering the Sunda Strait, resulting in the loss of 36,380 lives. Many villages simply slipped into the sea, never to be seen again, and several islands disappeared from the map. The 10,000 inhabitants of the town of Tetlok Betong, 50 miles away on the island of Sumatra, perished in the waves. The gun-boat Berouw,

anchored in the town's harbor, was carried nearly two miles inland and deposited some 30 feet above sea level. The Sumatran town of Kalimloang was hit by an 80-foot wave. Sebesi island, north of Krakatoa, was completely engulfed in water and all 3,000 of its inhabitants drowned. At Tjaringin, Java, only one tree survived the wall of water. Coral torn from offshore was carried seven miles inland. The nearby town of Perimbang, ten miles from the sea, was submerged. Another Javan town, Merak, experienced a tsunami that destroyed houses atop a 135-foot hill; only two of the town's 3,000 inhabitants survived.

By the time the tsunami reached Ceylon, it was still eight feet high. Nine hours after the eruption, a tsunami engulfed the harbor of Calcutta, some 2,000 miles from Krakatoa, and damaged river boats. Lesser rises in water levels were recorded at Mauritius, Cape Horn, and even in the English Channel.

An estimated 6,500 ships and boats were destroyed by the hurricane-force winds, falling debris, and seismic waves. Most of the lighthouses in the Sunda strait were destroyed. Large rafts of floating pumice were later spotted as far away as 7,500 miles in the Indian Ocean.

Fire and Ash

The volcano is nature's greatest source of fire. It not only spews burning gases and rocks, but it ignites flammable materials which can continue to burn long after the volcanic flames have subsided. Forests and human dwellings are readily destroyed by volcanoes, as Hawaiian lava flows have demonstrated in recent years.

Large forest fires produce vast quantities of smoke that have been known to cause darkness at midday in distant places. Wind-born soot and ash from such a fire (not kindled by volcanic activity) caused the sky to grow dark over an area from New Jersey to Maine on May 19, 1780. Indeed, there were eighteen such occurrences in that area between 1706 and 1910, one of the most severe being in November 1716.

The thick darkness that followed the cataclysm at the time of Christ's crucifixion is described as a "vapor" that would not permit the kindling of fire. Ash- and dust-laden air would explain

this phenomenon. The depletion of the oxygen supply following the great fires would have made it impossible to kindle torches.

Conclusion

Critics of the Book of Mormon have suggested that the vast array of destructive forces described in 3 Nephi are impossible. But an examination of tectonic activity in various parts of the world shows that all of these phenomena are not only possible, but expected. It is significant, too, that some of the best examples of the kinds of natural phenomena described in the Book of Mormon have occurred in the very area—Mesoamerica and the nearby Caribbean—where most Book of Mormon scholars place the story in 3 Nephi. The fact that such phenomena are known in nature does not detract from the miraculous nature of the events surrounding Christ's crucifixion. The Lord is more than capable of using natural phenomena to accomplish his purposes.