

Huge Seismic Sea Waves; Their Cause and Effect.

A advance copy of the Pilot Chart of the North Pacific ocean for February, and published at the Hydrographic office under the authority of the secretary of the navy, has been received by Prof. James E. Tammie through the courtesy of Congressman Joseph Howell. The chart contains an article on earthquake seismology which is timely in the face of the terrible disaster in Sicily last month, and is here reproduced in full:

On Monday morning, Dec. 28, between 8 and 9 o'clock, all Italy was shaken by severe earthquakes; the seismic disturbance was most violent in Calabria and Sicily, and the great loss of life and destruction of property which occurred were accompanied by marine disasters caused by seismic sea waves. According to the descriptions the following are given, after the earthquake, the sea at first receded from a distance from the shores of Calabria and eastern Sicily and then a great wave 32 feet high advanced upon the shore with an appalling power and destructiveness. This is the usual march of events in connection with far the greatest number and most dangerous kind of seismic sea waves, and hence it is important that the attention of mariners should be drawn to such characteristics of the phenomena as will lead to the taking of adequate precautions against their effects.

Great multitudes of people live in cities by the sea and are subjected to the dangers arising from seismic sea waves, and yet, if a place of refuge exists, they usually have ample time to escape; and even the ships in the harbor will generally be safe, if they promptly put to sea on the first sign, after the earthquake, of the withdrawal of the water, which always indicates that the sea bottom has sunk. Thus, by the study of the laws of the physical world and the diffusion of the resulting useful knowledge, the interests of safety may be derived from some of the most dreadful forces in nature, and in the course of time, the interests of civilization may be enormously enhanced.

Aristotle correctly associated seismic sea waves with earthquakes; and even Homer assigned those great disturbances of the sea to Poseidon's trident, which was also the means employed for raising up islands from the bottom. The withdrawal of the water from the shore after an earthquake and its return as a great tidal wave, due to Aristotle and implied in his description of the pathetic calamity of the destruction of Helike in 373 B. C., which was due to the subsidence of a portion of the sea bottom in the Gulf of Corinth.

TWO GENERAL CLASSES.

There are two general classes of seismic sea waves. The first is due to the sinking of the sea bottom, and is characterized by a withdrawal of the

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water after the earthquake, to be followed later by the return of a great wave; and the second is due to the uplift of the bottom, and is characterized by the sudden rise of the sea without any previous withdrawal from the shore. Most of the historical inundations of the sea have been due to waves of the first class. The phenomena usually noted are: First, an earthquake; second, after a short interval, the sea is noticed to be drawing away, laying bare the bottom, where it is ordinarily deep enough for ships to anchor; third, after an interval of an hour or so, the sea is seen to be returning as a mighty wave, washing everything before it, and thus carrying ships shoreward and stranding them; fourth, having once swept the shore, the sea again withdraws and lays bare the harbor as before, and after about the same interval again returns as a second great wave. This periodic movement of the sea may be kept up for quite awhile, and sometimes quiet is not restored for a day or two. Among the well known historical sea waves of the first class which might be mentioned, we shall cite only a few typical cases. As that which overwhelmed Helike in 373 B. C.; the waves at Callao in 1724 and 1730; the wave following the Lisbon earthquake in 1755; the waves of Acre in 1833, and Iquique in 1877; the wave on the Japanese coast in 1896. In all these cases the water first withdraws from the shore—not suddenly but slowly, as in the draining away of a tide, though somewhat more rapidly. Then, of course, the sea bottom sinks, and the water was drawn away to fill up the depression in the level caused by the falling of the bottom. When the currents meet at the center an elevation is produced by their mutual impact, and when this collapses under gravity the first great wave comes ashore. The elevation then subsides into a depression as at first, and the currents again flow in and force up the level a second time; and, with the second collapse another wave is sent ashore, and so the oscillation of the sea continues sometimes for a day or two, before it finally quiets down.

Sediment waves of the second class are produced by the uplift of the sea bottom into ridges or submarine plateaus and islands. In such cases the water rises suddenly without previously withdrawing from the shore.

LISBON DISASTER.

The most disastrous in its effects of any of the examples of the second class is that which occurred in connection with the Lisbon earthquake of 1755. The seismic disturbance to which this wave was due occurred under the sea off the coast of Portugal in latitude 39 degrees north and longitude 11 degrees west. The water drained out from the land to such an extent that the bed of the river Tagus was left dry, and half an hour after the most severe shocks were over, a series of waves 30 to 40 feet in height broke on the shore, and sweeping inland caused the death of 100,000 persons and enormous destruction of property. These waves extended along the coast, engulfing the villages for several miles to the south and reaching as far as Morocco. The shock was felt at Oporto, Cadiz, Madrid, and French, and waves were propagated throughout the Atlantic to the coast of America. At Cadiz the waves rose to 60 feet, at Madeira to 12 feet, and the sea was disturbed 120 miles out to sea. Vines that vessels were violently shaken and men standing on deck were thrown down.

LIMA EARTHQUAKE.

The great catastrophe of Lima, on October 28, 1742, was marked by a withdrawal of the water from the coast, followed by a wave which is reported to have been 80 feet high, and which swept over Callao. Twenty-three ships in the harbor were sunk, and four were carried far inland, and a similar series of events occurred after the earthquake of 1746.

On the coast of Chile in 1835, after the earthshaking shock, the sea retired, and then returned in a series of three waves 20 feet high, the reflex action of which swept everything toward the sea.

After an earthquake on the coast of Peru and Chile in 1865, due to a large wave, large waves were generated far inland. The country for several miles inland, destroying towns and causing the death of 30,000 people. At Arica, the U. S. S. Waterloo was carried to a position a quarter of a mile inland, from which she was removed still further inland by a wave of inundation attending the great earthquake at Iquique in 1877. In connection with this latter disturbance, the water was withdrawn from the shore to the extent of 50 yards, and the waves which afterwards devastated the coast are stated to have been from 20 to 80 feet high. The effects were observable over almost the whole of the Pacific Ocean in the Samoan Islands the sea rose from 8 to 3 feet; in New Zealand and Australia the oscillations ranged in amplitude from 3 to 20 feet; and in Japan, from 5 to 10 feet.

On June 28, 1896, a world-shaking submarine earthquake occurred in Taiwan, and the trough-like abyss in the bed of the ocean just southwest of Japan. After the characteristic withdrawal of the water, the coast was inundated over a length of 300 miles by waves said to reach to the height of 50 feet. A two-masted schooner was washed 300 yards inland. The destruction of life and property was very great. The disturbance was not felt by anyone distance over 300 miles, a distance too great of the disaster that had occurred until their return to the coast.

SAFEST OUT AT SEA.

The lesson to be impressed upon mariners in the light of these experiences is that the chances of safety in shipping are much increased by proceeding to sea if practicable, immediately after the occurrence of an earthquake; and this is especially to be advised if the water of the harbor is found to be draining away after the initial shock. Subsequent waves have been felt in the great oceans and sea waves are not generally dangerous to vessels, because their very great length and moderate height gives them a gentle slope, and their period is very much longer than that of ordinary sea waves.

By a study of the charts of dangerous sounding throughout the world, it can be told quite clearly what the expected state of seismic activity of any given region should be, for wherever there are very deep oceanic troughs situated between continents, ridges, culminating either below or above the surface of the ocean, disturbances of the crust of the earth are likely to be prevalent. In these regions the forces of nature are, in fact, generally engaged in building up the edges by forcing under them material pushed from beneath the undermined floor of the adjacent deepening trough.

Although the Mediterranean sea, the Azores, the West Indies and the west coast of South America are districts of seismic activity, it is generally recognized by investigators that the most active regions of seismic disturbances are those in Alaska, Kuriles, and Japanese Islands, and in the East Indies. Prof. Dutro, United States army, in his book entitled "Earthquakes in the Light of the New Seismology," relates the tremendous power of the mighty earthquakes in the Aleutian region, and also calls attention to the prevalence of seismic sea waves follow-

ing the earthquakes. "The profound depths of the ocean just off the eastern part of the American chain is one of the great breeding grounds of world-shakers. A rather small basin in the ocean bottom has here a depth of nearly 4,000 fathoms, and the descent to it is by a long and strong gradient."

In the Bakerian lecture to the Royal Society, 1898, Prof. Milne treats of great earthquakes and says that "the most active district is at present that of the East Indies."

After great earthquakes in the Aleutian region, new islands are frequently raised from the sea and several new

volcanoes have broken out within historical times. Solomons sea waves of the first class frequently follow, the water first withdrawing from the center of the islands toward the trough to the south and then returning after a great wave. This shows that the sea bottom to the south sinks after the earthquake by which the region is visited. As the islands and, in fact, the whole mass of submarine mountains are uplifted by the disturbance and the sea bottom afterwards sinks, it seems that lava is expelled from beneath the trough and pushed under the adjacent range. The bed of the sea then gives

down to fill up the partial cavity from which the molten rock has been ex-

pelled.

COULDNT BE IMPRESSED.

Bradley Martin, Jr., who has married Miss Anna Lamp of Pittsburg, has a dry humor that has been likened to Mark Twain's. On his last visit to America the young man went to Niagara for the first time.

He was accompanied on his tour by a Harvard instructor, who admires nature profoundly. The instructor hoped to see Mr. Martin impressed,

almost overcome, by Niagara's grandeur. The young man, for a joke, was determined to disappoint his friend.

Their first view of the falls was by moonlight. The great water was

beautiful under the pale light of the moon, and the air was filled with deep, sweet music. Mr. Martin really was moved, but he yawned. Lighted a cigarette and said:

"Let's go."

His poor friend was thunderstruck at such indifference.

"Look how that mighty river pours over into that deep abyss."

"Well," said Mr. Martin, "What is there to prevent it?"—Washington Herald.

"Of course not," said Mr. Martin. "What is there to make such a fuss about?"

"Look," cried the Harvard boy,

"look how that mighty river pours

over into that deep abyss."

"Well," said Mr. Martin, "What is there to prevent it?"—Washington Herald.

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Silkolines
At 6 3-4c a yard

4,000 yards New Figured Silkolines, new Art Patterns, new Color effects, yard wide, Value 12c. Monday, limit 12 yards to a customer, at a yard 6¹c

MONDAY
Ladies UNION SUITS
Best \$1.25 Grades, 85c
Ladies' high grade, fine ribbed hand finished, pure white Union Suits, in light weight, for present or early spring wear, all sizes best \$2.25, on sale Monday 85c

MONDAY
\$2.25 Bagdad Couch Covers
At \$1.19 each
100 Heavy Tapestry Couch Covers, in Bagdad effects, 3 yards long and 60 inches wide. Value \$2.25. Monday, limit 1 to a customer, at each \$1.19

MONDAY
12 1-2c
White India Linon
At 6 3-4c a yard
600 yards of White India Linon, made of fine long thread Egyptian cotton, Bookfold. Value 12c. Monday, limit 12 yards to a customer, at a yard 6¹c

MONDAY
\$2.00 per bolt
White English NAINSOOK
At \$1.39 a Bolt
50 pieces White English Nainsook, 38 inches wide, 12 yards in each bolt. Regular \$2.00. Monday, limit 1 bolt to a customer, at a bolt \$1.39

MONDAY
\$3.00 per Bolt
White English Long Cloth
At \$1.89 a Bolt
100 pieces White English Long Cloth, fine mohair, tightly woven, free from dressing, 28 inches wide, regular \$3.00. Monday, limit 1 bolt to a customer, at a bolt \$1.89

MONDAY
\$1.00 Damask Breakfast
CLOTHS
At 59c each
150 Bleached Damask Breakfast Cloths in new designs, with Morden open work borders. Regular \$1.00. Monday, limit 1 to a customer, at each 59c

MONDAY
Embroideries
Up to 12¹ Values at 5c
Cambric Embroidery edgings and insertion, a great variety of patterns up to 12¹ Values, on sale Monday at 5c

MONDAY
10c
Chambrays
At 6 1-4c a yard

500 pieces new Chambrays, new designs, fast colorings, in dotted, striped, checked and the new border effects. Value 10c a yard. Monday, limit 12 yards to a customer, at a yard 6¹c

MONDAY
\$4.00 Children's COATS \$1.63
75 children's Coats, bearskin and crushed plush, for tots from 2 to 6 years. Worth fully \$4.00. They'll go at \$1.63

MONDAY
1000 UNTRIMMED HATS
Children's beavers, satin and velvet, untrimmed hats, in black and brown, regular 10c wash fabric. Monday, limit 12 yards to a customer, at a yard 10c

MONDAY
\$2.25 House SUITS 95c
Two piece house Suits of fleeced cambric, in neat designs. Worth fully \$2.25. Monday, limit 1 to a customer, at a yard 95c

MONDAY
Reductions on Silks and Velvets
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An extraordinary reduction in COLORED SILK & VELVET still continues with a wide selection of colors in all the leading popular shades. You will be surprised to see the prices. The \$1.98 quality is special for Monday and week. 39c

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Brown, Drab and Grey Effects, in good substantial fabrics, all strictly up to the minute in style and pattern. 44-90 Values, all to go at 95c

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\$1.88 Dress Goods for 69c a yard
PIECES PLAIN AND NOVELTY, 14 to 26 INCH DRESS GOODS, CONSISTING OF NEAT CHECKS, NOVELTY STRIPE, HOME SPUN PLAIN DRESS PLANNELS, ALBATROS, ETC. REGULAR 60c AND 65c VALUES; TO CLOSE OUT AT A YARD 69c

PIECES PLAIN AND NOVELTY, 14 to 26 INCH DRESS GOODS, CONSISTING OF NEAT CHECKS, NOVELTY STRIPE, HOME SPUN PLAIN DRESS PLANNELS, ALBATROS, ETC. REGULAR 60c AND 65c VALUES; TO CLOSE OUT AT A YARD 69c

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SAME STYLE SHOE AS ABOVE, only with large eyelets and blucher Cut, at a pair \$2.20

ANY FEET SHOE OR SLIPPER in the entire stock for ladies goes this week, at a pair, all to go at \$1.17

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