

EARTHQUAKE OF NOVEMBER 27, 1852

CA: 23:45 (L)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 43.ON, 70.9W

EVALUATION:

The earthquake of November 27, 1852 is centered near Exeter, New Hampshire (Figure 2.5.2A-15). It was felt over a 9,900 square kilometer region from the Cape Ann region north to Saco, Maine. The maximum effects, Intensity V(MM), were observed near Exeter, New Hampshire.

PERTINENT ACCOUNTS:

Daily Morning Chronicle, Portsmouth, New Hampshire, November 30, 1852

"The Earthquake, on Saturday night, was likened by some persons in this city, who happened to be up and doing, to the roaring of a chimney on fire-others supposed it to be the heavy rumbling of a loaded wagon over a paved street.

- "It was supposed by some gentlemen at Kittery Point to be a steamboat in the harbor letting off steam.

"The Salem Register calls it a 'smart shock,' and says, 'The rumbling noise and the jarring of the windows and doors were very perceptible for the space, some say, of half a minute. Some faithless ones attribute the shock to the explosion of a power-mill somewhere.'

"A lady in Greenland says the earthquake shook her house and those of her neighbors very sensibly.

"The Boston Journal says it was felt at Exeter where it shook the doors and windows violently, and in one instance jarred down some of the plastering of a dwelling house. It does not seem to have been felt at Boston.

"A very heavy explosion startled our citizens at 25 minutes before 12 o'clock, Saturday night. It came from a northerly direction and was probably from the Exeter Power Mills, though no former explosion of these mills ever produced here half so severe a concussion, or anything like the loud report and reverberation. After the shock, a roar like that of a foul chimney burning, was distinctly perceptible, in doors, for two minutes. The night was still and clear with a light air from NW-ground wet and soft.

"If this was not the effect of a great explosion it must have been one of those earthquakes and the most severe of them all, which at irregular intervals from time immemorial have visited the valley of the Merrimack. -Newburyport Herald."

Maine Democrat, Saco, Maine, December 7, 1852

"The Earthquake. -The shock of an earthquake was felt here on Saturday evening last, at thirty-five minutes after eleven o'clock. The shock here was not severe. We were standing near a stove at the time, and did not perceive any jar, but only heard the noise rumbling off in the distance in a westerly direction, and no apparent cause visible. The night was clear, the moon bright, and the air still."

"The force of the earthquake was evidently to the west of Portsmouth. At Exeter, it was felt with much violence. In Newburyport the Herald notes the minute the same as at Portsmouth. There it was thought it lasted nearly two minutes, and was much more severe than at Exeter. In Salem, it was also noticed, but it was less violent. No mention is made of it south of Salem."

EARTHQUAKE OF DECEMBER 11, 1854

CA: 00:30 (L)

EPICENTRAL INTENSITY: IV-V(MM)

LOCATION: 43.0N, 70.8W

EVALUATION:

The earthquake of December 11, 1854 is centered in southeastern New Hampshire (Figure 2.5.2A-16). The maximum observed intensity is at Newburyport, where there were unconfirmed reports of articles shaken from shelves in some cases. The distribution of intensities within the isoseismal region indicate an epicenter within the area about Exeter, New Hampshire. The earthquake was felt over an area of 4,100 square kilometers.

PERTINENT ACCOUNTS:

Exeter News Letter, The, Exeter, New Hampshire, December 11, 1854

"Earthquake -- This Monday morning at seven minutes before one o'clock, a smart shock of an earthquake was experienced in this town. The motion of the earth was quite perceptible, and its acting upon furniture and loose windows and doors, was anything but agreeable to weak nerves. The noise attending, was like that of the swift approach of a heavy carriage on frozen ground, hit when the shock appeared (sic) to be immediately beneath, it was much heavier."

Journal, The, Portsmouth, New Hampshire, December 16, 1854

"The Earthquake

"On Saturday (sic) night last, at half past 12 o'clock, a shock of an earthquake was sensibly felt in this city and vicinity. The watchmen (sic) at the Navy Yard thought they saw lightning at the time and regarded the noise as thunder. Some of our city watchmen who were at the time in Market Street, heard the commencement and passing away of the sound. It seemed to them like two distinct explosions. --probably from the sound coming through (sic) different avenues between high buildings. It rattled the door shutters near them.

"The Newburyport Herald says it was sensibly felt there at the same hour. The houses were shaken and the crockery ware in some houses was thrown down from the shelves.

"It was not felt in Salem. The Saco papers make no mention of it. Nor do those of Manchester and Concord."

"Quotes Exeter New Letter

"The direction of the sound in Portsmouth and Epping was apparently from the southeast to the northwest.

"In Greenland and in Epping it was as severely felt. As has usually been the case, rain fell the next day."

EARTHQUAKE OF OCTOBER 17, 1860

CA. 11:15 (GMT)

EPICENTRAL INTENSITY: VIII-IX(MM)

LOCATION: 47.5N, 70.1W

EVALUATION:

The earthquake of October 17, 1860 is centered in the St. Lawrence River Valley, northeast of Quebec city, near La Malbaie, about 510 kilometers from the site. The earthquake was felt over a 1,700,000 square kilometer region. It was felt throughout much of New England. Based upon intensity attenuation characteristics (Table 2.5.2-7), the intensity at the site is estimated at IV-V(MM).

EARTHQUAKE OF OCTOBER 20, 1870

CA: 16:30 (GMT)

EPICENTRAL INTENSITY: IX(MM)

LOCATION: 47.4N, 70.5W

EVALUATION:

The earthquake of October 20, 1870 is centered in the Baie St. Paul region, northeast of Quebec city about 500 kilometers north of the site. It was felt over a 2,500,000 square kilometer region including all of New England. Based on intensity attenuation characteristics (Table 2.5.2-7), the intensity at the site is estimated at V(MM).

PERTINENT ACCOUNTS:

Daily Free Press and Times, The, Burlington, Vermont, October 21, 1870
(Dispatch from Newburyport, Massachusetts)

"At twenty minutes to twelve, a slight jar was felt in this city, which was almost immediately followed by a rumbling, which lasted half a minute, jarring buildings, ringing doorbells, and shaking globes from chandeliers. In many instances the occupants ran into the streets from dwellings. It seemed to pass in a south-westerly direction."

Salem Register, Salem, Massachusetts, October 24, 1870

"At Salem, Massachusetts, 'solid and most substantial buildings felt the shock, heavy tables and dishes were sensibly shaken, horse's bells were rung, clocks were stopped in several instances, and hanging implements vibrated materially.'"

EARTHQUAKE OF MAY 12, 1880

CA: 07:45 (L)

EPICENTRAL INTENSITY: IV-V(MM)

LOCATION: 42.7N, 71.0W

EVALUATION:

The earthquake of May 12, 1880 is centered in northeastern Massachusetts (Figure 2.5.2A-19). The maximum effects are noted at Groveland, Massachusetts. The epicentral intensity is IV-V(MM). The felt area is 4,600 square kilometers.

PERTINENT ACCOUNTS:

Monthly Weather Review, May, 1880

"Newburyport, Mass., 12th, 7:45 a.m., a violent shock, houses shook in many parts of the city, the accompanying noise resembling that of a heavy barrel rolling over a chamber floor. Shocks were felt at the same time in Haverhill, Groveland and surrounding towns. Billerica, Mass., 12th, slight shock at 7:30 a.m."

Newburyport Herald, Newburyport, Massachusetts, May 13, 1880

Note: At 7:45 A.M., May 12, 1880 an earthquake was felt at some places and not at others. People had difficulty recognizing it as an earthquake, it being more noise than motion.

It was felt at Byfield, West Newbury, Haverhill, Groveland; at Amesbury the earthquake was strong enough to rattle crockery in several houses.

New York Times, New York, New York, May 16, 1880

"The Salem (Mass.) Gazette gives some further information concerning the earthquake shock which visited Eastern Massachusetts about 7:45 o'clock on Wednesday morning. It says: 'We hear reports of it in all the towns between Salem and Newburyport. In Salem, the shock was felt in all parts of the city. The accompanying sound was by some thought to be thunder; by others, an explosion as of rockblasting; and more generally as the rumbling of a wagon. In Newburyport, the shock was felt in the shaking of crockery and furniture, and in some houses sounding like persons moving in adjoining rooms. From Merrimac and Amesbury, from Georgetown and Rowley we have similar reports. At Haverhill an explosion was heard, the air vibrated, the earth trembled, people were swayed to and fro, crockery was shaken, and other signs of subterranean disturbance were noticed. At Acton, in Middlesex County, the shaking was lateral, and resembled the sensation caused by a heavily-loaded team passing over a stony street.'"

EARTHQUAKE OF AUGUST 30, 1905

CA: 10:40 (L)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 43.1N, 70.7W

EVALUATION:

The earthquake of August 30, 1905 is centered in the vicinity of Portsmouth, New Hampshire and Kittery, Maine (Figure 2.5.2A-26). It was not reported felt in Massachusetts. The epicentral intensity is V(MM). The felt area is 3,600 square kilometers. Newspaper reports from the Portsmouth Herald (August 31, 1905) that "it is rumored that chimnies were shaken down in North Hampton and Greenland" are not confirmed by The Exeter News Letter (August 31, 1905) which indicated that the earthquake was not reported from North Hampton, Greenland, Seabrook as well as other localities.

Even though The Exeter News Letter states explicitly that the event was not reported from Seabrook, it is probably more realistic in view of the relatively short epicentral distance to assume that the event was felt mildly, i.e. with an Intensity III.

PERTINENT ACCOUNTS:

Exeter New Letter, The, Exeter, New Hampshire, September 1, 1905

"West Epping - September 4 -- 'At exactly 5:39 p.m. Cambridge time, on Wednesday of last week a distinct earthquake shock was felt here. Windows and dishes rattle violently, while the report was deep, low pitched, weird and long. It must have lasted fully eight or ten seconds, time enough for me to walk from a rear room in a large house out through the front door and on to the lawn. I was on the lawn before the rumbling ceased. We have had a dozen seismic tremors in southern New Hampshire since forty years; this however if memory serves me, was the most pronounced of any.

"Earthquake not reported from:

"Stratham, Rye, Freemont, Raymond, Nottingham, Kingston, Greenland, North Hampton, Hampton, Seabrook, Danville, Epping."

Haverhill Evening Gazette, Haverhill, Massachusetts, August 31, 1905

"Earth Quivers

"Portsmouth, New Hampshire, August 31 -- A series of earthquakes, the most severe ever experienced in this section, which, at about 5:35 to 5:40 o'clock yesterday afternoon were felt from the vicinity of Exeter to beyond Biddeford, Maine had their center of disturbance in this city, and were so severe that people, fearing the shaking houses and stores would collapse, ran in terror out of doors. The scene in the

shopping district was exciting for a number of minutes. For several seconds a tremor ran through the city, and windows, dishes, pictures, and other articles rattled. The experience of other places on the coast line and for a few miles inward was only in a less degree. The shock seemed to travel from west to east. No damage is reported.

"The shock here came at 5:35 and it was accompanied by a loud report as of thunder, followed by a rumbling. There were three distinct shocks, each with its own rumble -- 'At Hampton the shock was very plain, but it was greater toward this city, for Greenland was more affected. On the other side of the city by Kittery and down to York it was plainly heard, but at Wentworth at Newcastle the shock was not heard at all.

Portsmouth Herald, The, Portsmouth, New Hampshire, August 31, 1905

"Three (3) Earthquake Shocks

"Citizens of Portsmouth, New Hampshire, Kittery and Biddeford, Maine get a scare.

"A series of earthquake shocks, the most severe ever experienced in this section were felt here late yesterday afternoon. Buildings trembled perceptibly, dishes were shaken from shelves, and in many cases people rushed in terror from their houses into the street.

"There were three distinct shocks. In each instance the tremor was accompanied by a sound which might be caused by a distant explosion. --

"The first shock was felt a little before 5:40 p.m. and the other shocks followed soon after. In the business section of the city, the shoppers and store employees rushed out into the street, believing that the buildings were about to collapse. Each of the three shocks continued for several seconds.

"Kittery, Maine

"Three shocks felt - accompanied by heavy rumbling.

"First shock 5:38 p.m., other two in rapid succession.

"As the doors and windows were rattled by the vibrations of the earth and the lighter bric-a-brac came tumbling down from walls and mantelpieces, people ran out of doors in considerable alarm.

"Biddeford, Maine

"A slight shock felt. Distinctly felt in overlying districts. Accompanied by a sound like the rumbling of distant thunder.

"An Earth Tremor

"The earthquake shock was the most startling, being so violent as to shake pictures from the walls of houses in the South End. It is rumored that chimnies were shaken down in North Hampton and Greenland."

"Sounded like heavy object falling and rolling or like explosion. Eclipse of sun in A.M. before quake, thunder storm and lightning after quake."

EARTHQUAKE OF OCTOBER 16, 1907

CA: 00:10 (L)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 42.8N, 71.0W

EVALUATION:

The earthquake of October 16, 1907 is centered in northeastern Massachusetts (Figure 2.5.2A-27). The epicentral intensity is V(MM). The felt area is 5,600 square kilometers. Even though no explicit felt report can be found for Seabrook, it is assumed in view of the estimated epicenter in the vicinity of Haverhill, that the earthquake must have been felt at Seabrook (Intensity III-IV).

PERTINENT ACCOUNTS:

Portsmouth Daily Herald, Portsmouth, New Hampshire, October 16, 1907

"Quake shock felt

"Tuesday Evening's Jar Was of Several Seconds' Duration

"Residents of this city claim they felt the earthquake shock shortly after seven o'clock on Tuesday evening, which was reported in dispatches from Derry, this county, and Lowell, Lawrence and Haverhill, Mass.

"The shock lasted for several seconds, seemingly, and the heavy rumbling ended in an apparent explosion.

"At Derry dishes were rattled on shelves and table, but no special damage was reported."

EARTHQUAKE OF JANUARY 7, 1925

CA: 13:07 (GMT)

EPICENTRAL INTENSITY: V(MM)

LOCATION 42.6N, 70.6W

EVALUATION:

The earthquake of January 7, 1925 is located in the vicinity of Cape Ann, Massachusetts. The epicentral location and intensity were determined by Porter (1924). The isoseismal map (Figure 2.5.2A-29) is constructed from data after Porter and additional newspaper investigations. The earthquake was felt over an estimated area of 29,000 square kilometers. The maximum intensity is V(MM) at Cape Ann and vicinity. At Hampton, New Hampshire, a news item in the Manchester Union of January 8, 1925, describes the effects as follows:

"Reports from Hampton and Stratham state that the shock was distinctly felt there, causing dishes and other contents of the house to rattle, and many of the houses were shaken."

PERTINENT ACCOUNTS:

Porter, William W. II (1924)

"Intensity

"The region known to be affected by the earthquake of January 7, 1925, consists of a roughly semicircular area limited on the east by the Atlantic Ocean, and on the south, west, and north by a circular curve passing from a short distance south of Providence, Rhode Island, north-northwest to Worcester, Massachusetts, to Fitchburg, to Manchester and Rochester, New Hampshire, and to the seacoast near Kennebunk, Maine, about thirty-eight miles south of Portland. The position of the inner isoseismic line is very poorly defined, as the entire disturbance was of such small magnitude that an accurate quantitative determination of its effects is impossible. However, reports by C. W. Brown of Brown University, Associated Press dispatches, communications from various newspapers and from individuals, and a personal canvass of the northern area indicate that in general, the shock was of greater intensity within the area enclosed by the inner line: a chimney collapsed in Lynn; dishes and other articles were displaced from shelves; pictures fell from walls; and various reports indicate greater intensity in the inner area. The expression on the map of this difference in intensity is the inner isoseismic line, which merely traverses an indefinable zone of gradation between the two areas."

"Greatest Intensity: Barely V, Rossi-Forel Scale. The region of greatest intensity appears to have been Cape Ann. Plaster fell from the ceiling of Redmen's Hall, Rockport; near Lanesville a clock stopped at ten minutes past eight, and bottles 'danced a regular jig' on the drug store shelves; houses were sharply jarred; and the shock was noted by a large percentage of the population. This is the only area where the shock was reported to have been felt by pedestrians out of doors. W. F. Eldrege of Rockport stated that an undulatory wave seemed to stop him abruptly while walking.

"Almost universally the shock was compared to the vibrations produced by a motor truck being driven over rough pavement. In approaching Cape Ann, the size of the truck alluded to increased, and on the Cape, the consensus of opinion was that the vibrations were much too severe to have been produced by a truck.

"At one point on the Cape coal was being unloaded from a truck at the time of the earthquake, and a verbal report stated that a concussion was produced which felt as though the truck had crashed into the house. In Haverhill a contrasting report stated that the disturbance sounded as though a truck had bumped into the house, but that the jar was insufficient.

"Intermediate Intensity: IV +, Rossi-Forel Scale. Next to Cape Ann, the most severely affected regions were Merrimack Valley in northeastern Massachusetts, and the shore district north of Boston, including Lynn, Malden, Salem, Beverly, Marblehead, Nahant, and Ipswich. The inner isoseismic line incloses this region, the general effects of which have been listed above. One feature, however, recieved undue emphasis in press reports. The crack a mile long in Groveland Street, Haverhill, proved to be a series of short breaks in the asphalt with a total length of about fifty yards. Similar cracks are of common occurrence at this time of year due to frost action, and it is probable that tension existed, and that the actual fracture was induced by the seismic vibrations.

"The direction of movement of the disturbance is in most cases very vaguely defined. The one outstanding indication of direction occurred in Haverhill, where sixteen rolls of congoleum rugs were overturned from the east-southeast. These rolls, measuring nine feet in length, and with a diameter of about a foot, were free to fall in any direction except toward the south. The three men who were present at the time of the earthquake were positive that the direction of fall of all the rolls was from the east-southeast. So far as is known, no fixed objects were displaced in this area. The report of a broken water main in Haverhill due to the earthquake is unfounded.

EARTHQUAKE OF MARCH 1, 1925

CA: 02:19:20 (L)

EPICENTRAL INTENSITY: IX (MM)

LOCATION: 47.6N, 70.1W

EVALUATION:

The earthquake of March 1, 1925 is centered in the La Malbaie region, northeast of Quebec city, 525 kilometers north of the site. It was felt over nearly 5,000,000 square kilometers. The major damage occurred in the St. Lawrence River Valley, particularly on soft alluvial soils. Isoseismals (Figure 2.5.2A-30) indicate that the intensity at the site was about IV (MM).

PERTINENT ACCOUNTS:

The Union, March 2, 1925, Manchester, New Hampshire

"All sections of Hampton Beach were in the path of the earthquake, Saturday evening around 9:20. No damage was reported. At the Coast Guard station on the North beach, the shock was only slightly felt. The captain of the guard said the ocean was undisturbed during the earth's tremor.

"At (sic) Hampton Beach, people living in a cottage reported that dishes shook in the cupboards and a pan under the sink fell to the floor. They were not aware that it was an earthquake until a little later when informed over the radio."

EARTHQUAKE OF OCTOBER 9, 1925

CA: 13:55 (L)

EPICENTRAL INTENSITY: VI(MM)

LOCATION: 43.7N, 71.1W

EVALUATION:

The earthquake of October 9, 1925 has its epicenter in central New Hampshire (Figure 2.5.2A-31). The epicenter is poorly defined and the published location of Smith (1962) is retained. The epicentral intensity is VI(MM). The felt area is 17,700 square kilometers. The earthquake was not felt at localities such as Sanford and Kennebunk, Maine, and Portsmouth, New Hampshire, and is inferred from the isoseismal map (Figure 2.5.2A-31) to have not affected the site.

PERTINENT ACCOUNTS:

Concord Daily Monitor, Concord, New Hampshire, October 9, 1925

"An earthquake, slight in intensity, but generally felt throughout the Merrimack Valley, the Winnepesaukee Lake region and in the northeastern part of the state along the Maine border, was felt today in Concord by several persons. No damage beyond the breaking of window glass in Ossipee, the tumbling of chimneys in two or three towns, and the dumping of canned goods from shelves in Ossipee and Effingham Falls stores, was reported.

EARTHQUAKE OF MARCH 18, 1926

CA: 21:09 (L)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 42.8N, 72.8W

EVALUATION:

The earthquake of March 18, 1926 is centered in southern New Hampshire, near the town of New Ipswich (Figure 2.5.2A-32). The epicentral intensity is V(MM). The felt area is 4,800 square kilometers. Published research by Neumann (1925-1927) indicates that the felt reports were mainly in south-central New Hampshire and adjacent Massachusetts. There is no indication that coastal localities in southern Maine, New Hampshire, or northeastern Massachusetts reported the shock.

PERTINENT ACCOUNTS:

Manchester Union, The, Manchester, New Hampshire, March 19, 1926

"Southern N.H. Shaken By Slight Earthquake

"Slight earthquakes are reported to have occurred in four sections of southern New Hampshire yesterday afternoon.

"Towns and cities affected by the tremblor are Manchester, Nashua, Milford, Amherst, Wilton, Mont Vernon and Greenfield, according to dispatches received last night.

"All the shocks were felt at 3 o'clock, or shortly after. Wilton, Milford, Amherst and Mont Vernon are grouped in a semicircle about 12 miles from Nashua, while Greenfield is 25 miles from the Gate City.

"Reports indicate that the 'quake did not last the same length of time in each of the cities and towns. In Milford it lasted for 15 minutes. (sic) Manchester 20 seconds and other places felt it for fully half a minute.

"Manchester and Nashua felt only brief shocks, while Milford and surrounding towns experienced the temblor for at least 15 seconds.

EARTHQUAKE OF DECEMBER 20 AND 24, 1940

CA: 07:27:26 (GMT) (DECEMBER 20)

CA: 13:43:44 (GMT) (DECEMBER 24)

EPICENTRAL INTENSITY: VII(MM)

LOCATION: 43.8N, 71.3W

EVALUATION:

Both earthquakes are centered near Ossipee, New Hampshire. The isoseismal map (Figure 2.5-2A-37) shows that the Intensity VII(MM) effects occurred at Tamworth and Wonalancet, New Hampshire. Damage of Intensity VI(MM) was noted in numerous localities in central New Hampshire and western Maine. The shocks were felt over an estimated area of more than 786,000 square kilometers including all of New England, New York, and New Jersey.

The intensity at the site, as shown by the isoseismal map, Figure 2.5.2A-37, is IV(MM). In the vicinity of the site, at such places as Portsmouth and Durham, New Hampshire, and Amesbury, Newburyport, Salem, and Gloucester, Massachusetts, the earthquakes were felt by many people, and were well accompanied by the creaking of buildings and the rattling of dishes, windows, and doors.

EARTHQUAKE OF JULY 29, 1954

CA. 19:57:06 (GMT)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 42.7N, 70.7W

EVALUATION:

The epicenter of the earthquake was located off the coast of north-eastern Massachusetts, about 15 miles south-southeast of the site. The epicentral location was determined from seismograms recorded at Weston Observatory, Weston, Massachusetts, and at the Harvard Seismograph Station, Harvard, Massachusetts. The earthquake was felt from Lynn, Massachusetts, on the south to Kittery, Maine, on the north, and up to 20 miles inland over a 4,100 square kilometer area.

The quake was most strongly felt along the Massachusetts coast from Gloucester to Salisbury. In this area there were a few reports of small objects overturned, dishes and glassware knocked over, and clocks stopped (Newburyport Daily News, July 30, 1954; Gloucester Daily Times, July 30, 1954). Outside of this area, the earthquakes's effects consisted mostly of dishes, windows, and doors rattling.

Based upon press descriptions and reports collected by Weston Observatory through a canvass card survey, the intensity of this earthquake in the vicinity of the site was III-IV(MM).

EARTHQUAKE OF APRIL 26, 1957

CA. 11:40:06 (GMT)

EPICENTRAL INTENSITY: VI (MM)

LOCATION: 43.6N, 69.8W

EVALUATION:

The epicenter for this event was located off the coast of Maine, about 71 miles northeast of the site. Slight damage of Intensity V to VI (MM) occurred in the Portland area (Figure 2.5-2A-39). The quake was felt over 82,500 square kilometers including most of Massachusetts, Vermont, New Hampshire, and southern central Maine. The isoseismal map prepared by the United States Coast and Geodetic Survey (see Figure 2-5.2A-39) shows that the intensity at the site was no higher than IV (MM).

EARTHQUAKE OF OCTOBER 16, 1963

15:31:01.8 (GMT)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 42.5N, 70.8W

EVALUATION:

The epicenter for this earthquake was located in Massachusetts Bay, southeast of Cape Ann about 27 miles southeast of the site.

The earthquake was felt over approximately 17,800 square kilometers of northeastern Rhode Island, eastern Massachusetts, southeastern New Hampshire, and extreme southwestern Maine.

von Hake and Cloud (1965) list this earthquake as Intensity VI(MM). They report damages at Somerville (fallen plaster - Intensity VI(MM)) and at Winthrop (cracked windows - Intensity V(MM)), but these reports "were not substantiated" by Breitling (1965). The one instance of damage in Somerville apparently occurred in a building which was either poorly constructed or had undergone settlement prior to the earthquake. The Coast and Geodetic Survey report states that "cracks in the foundation and pantry became large" which indicates that the cracks were present prior to the earthquake.

Breitling's isoseismal map (Figure 2.5-2A-40) shows a maximum intensity of IV(MM) on land. Analysis of press reports and of a canvass card survey conducted by Weston Observatory show that the maximum effects at many towns in eastern Massachusetts consisted of houses rocked, windows and dishes rattled, and knickknacks thrown from the shelves (Amesbury and Methuen).

Based on Breitling's investigations and reports collected by Weston Observatory through a canvass card survey, the intensity of this earthquake in the vicinity of the site was IV(MM).

EARTHQUAKE OF OCTOBER 30, 1963

17:36:57.9 (GMT)

EPICENTRAL INTENSITY: IV-V (MM)

LOCATION: 42.7N, 70.8W

EVALUATION:

The epicenter for this earthquake was located in northeastern Massachusetts, about 13 miles south of the site. The epicentral location was determined from seismograms recorded at four stations of Weston Observatory's New England Seismic Network (stations are located at Weston, Massachusetts; Berlin, New Hampshire; Milo and Machias, Maine). The earthquake was felt in northeastern Massachusetts from north Boston, and in adjacent portions of southeastern New Hampshire over a 5,900 square kilometer area.

A questionnaire canvass conducted by the Weston Observatory indicated that the intensity of the earthquake was IV (MM). However, the press report for a few instances of cracked plaster and other minor damage in the Ipswich-Rowley area (Salem Evening News, October 31, 1963) indicate that the intensity may have been as high as V (MM) near the epicenter. *"The intensity of the tremor was felt particularly in Ipswich and in Rowley. Householders in Rowley reported that dishes rattled and lamp fixtures swayed"* (Salem Evening News, October 31, 1963).

Based on the press descriptions and questionnaire survey conducted by Weston Observatory, the estimated intensity of this earthquake at the site was IV (MM).

EARTHQUAKE OF OCTOBER 21, 1971

00:54:46.2 (GMT)

EPICENTRAL INTENSITY: V(MM)

LOCATION: 42.7N, 71.15W

EVALUATION:

The earthquake of October 21, 1971 was reported by Coffman and von Hake (1971) as felt in several Merrimack Valley communities at Intensity V(MM). It was not reported felt in any coastal New Hampshire area.

PERTINENT ACCOUNTS:

Coffman and von Hake (1973)

"Northeastern Massachusetts. The shock shifted objects and shook buildings at a few towns in northeastern Massachusetts. Int. V at Andover, Billerica, Methuen, Newburyport, and Tewksbury. Int. IV at Georgetown, Gloucester, Groveland, Ipswich, Lawrence, Merrimac, Middleton, North Andover, Reading, and Wakefield, Mass., and Salem, N.H. Int. II at Lowell and Wilmington, Mass."

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TABLE 1
AFTERSHOCKS OF THE EARTHQUAKE OF NOVEMBER 9, 1727
FROM THE MINISTER'S RECORD (1727-1748)
OF THE REV. MATTHIAS PLANT

YR	DATE		TIME (LOCAL)	INTENSITY* EVALUATION (MM)
	MO	DA		
1727	11	09	2300	F
1727	11	09	2335	IV
1727	11	09	2354	F
1727	11	10	0215	F
1727	11	10	0410	F
1727	11	10	0545	IV
1727	11	10	1530	F
1727	11	10	1700	F
1727	11	11		F
1727	11	11	1010	F
1727	11	11	1435	F
1727	11	11	1933	F
1727	11	11	2042	F
1727	11	12		F
1727	11	13		F
1727	11	14	1700	IV-V
1727	11	14	2400	F
1727	11	15	0410	F
1727	11	15		F
1727	11	16	1630	F
1727	11	16	2300	F
1727	11	17	1000	F
1727	11	18	1120	IV
1727	11	19		F
1727	11	23	1630	F
1727	11	24	0400	F
1727	11	26	1430	F
1727	11	30	2200	F
1727	12	01		F
1727	12	01		IV
1727	12	10		F
1727	12	12		F
1727	12	16		IV
1727	12	19	1000	IV
1727	12	28	2230	IV
1727	12	29	0400	F
1728	01	04	2300	IV-V
1728	01	09		F
1728	01	12	1400	F
1728	01	14	2100	F
1728	01	17	1800	F
1728	02	04	2130	IV
1728	02	04	2130	IV
1728	02	04	2130	IV
1728	02	05	1300	F
1728	02	08	0630	IV
1728	02	08	1000	F

TABLE 1 (cont'd.)

2 of 3

DATE			TIME	INTENSITY*
YR	MO	DA	(LOCAL)	EVALUATION (MM)
1728	02	09	0100	F
1728	02	09		F
1728	02	10	1350	V
1728	02	10	1530	F
1728	03	04	0030	F
1728	03	11	1315	F
1728	03	17	2345	F
1728	03	23		F
1728	03	28	0300	F
1728	03	30	1340	F
1728	03	30	2100	F
1728	05	03		F
1728	05	09	1700	F
1728	05	16		IV
1728	05	23	0940	F
1728	05	28	2000	F
1728	06	02		F
1728	06	02	1000	F
1728	06	04	2300	F
1728	06	17	0300	F
1728	06	19	0300	F
1728	06	22	0900	F
1728	07	14	0200	F
1728	07	30	1000	IV
1728	08	02	0315	IV
1728	08	05		F
1728	09	28	0400	F
1728	11	20	0400	F
1729	01	29	2000	F
1729	02	02	2400	F
1729	03	30	1400	IV
1729	08	06		IV
1729	09	19	1530	F
1729	10	08	1630	F
1729	11	09	2240	F
1729	11	25	0800	IV
1729	12	08	2000	IV
1730	02	19	2000	F
1730	02	19	2400	F
1730	03	09	0145	IV
1730	03	30		F
1730	04	23	2000	IV
1730	08	08	0900	F
1730	08	26	0800	F
1730	11	25	0900	F
1730	11	25	0900	F
1730	12	05	2020	F
1730	12	17	2245	F
1730	12	22	1845	F

YR	MO	DA	TIME	INTENSITY*	EVALUATION (MM)
1731	01	12	1900	IV	
1731	01	22	2400	IV	
1731	03	18	1700	F	
1731	06	08	0900	F	
1731	07	16		F	
1731	09	01	2100	F	
1731	10	12	2300	IV	
1732	02	18	1900	F	
1733	01	10		F	
1733	03	12		F	
1733	10	30	2400	F	
1734	01	27	2200	F	
1734	07	10	0315	F	
1734	10	20	1020	F	
1734	11	27	0600	F	
1735	02	13	1745	F	
1735	04	01	1030	F	
1736	02	13	1745	F	
1736	07	24	0915	F	
1736	10	12	0130	F	
1736	11	23	0200	IV	
1736	11	23	0600	F	
1737	02	17	1615	F	
1737	09	20	1020	IV	
1740	12	25	0635	F	
1741	01	29	0400	F	
1741	02	05	1550	F	
1742	04	08	0645	F	
1742	09	24	1730	F	
1743	08	21	1700	F	
1744	05	24		F	
1744	05	27	1115	F	
1746	08	13		F	
1747	01	17	2400	F	
1747	12	14	0430	F	
1747	12	17	1600	F	
1748	03	22	0645	F	

*F indicates unassigned intensity, inferred to be $\bar{III}(MM)$.

TABLE 2

RECORD OF AFTERSHOCKS OF THE 1727 EARTHQUAKE
AT NEWBURY AND MARBLEHEAD, MASSACHUSETTS

DATE (O.S.)	TIME (LOCAL)	EXCERPTS TAKEN FROM ORIGINAL MINISTER'S RECORD BOOKS KEPT BY REV. MATTHIAS PLANT AT NEWBURY, MASSACHUSETTS	RECORD OF AFTERSHOCKS AT MARBLEHEAD, MASSACHUSETTS
October 29	--	"...and Eight more immediately followed louder than the rest that followed and lasted al y ^e week sometimes breaking with loud clasps 6 times or oftener in a day and as oftern in y ^e night..."	"...There were about 7 or 8 small rumblings, after this, heard before one of the clock;..."
October 30	2:15 a.m.		"...there were two others, one only heard the other felt."
	4:10 a.m.		"...we heard another."
	5:45 a.m.		"...another,"
	3:30 p.m.		"...we heard it again,..."
	5:00 p.m.		"...the same afternoon;..."
	-- p.m.		"...and I am told by some that were up in the following Night, that they heard the rumbling twice or thrice;..."

TABLE 2 (Cont'd.)

DATE (O.S.)	TIME (LOCAL)	EXCERPTS TAKEN FROM ORIGINAL MINISTER'S RECORD BOOKS KEPT BY REV. MATTHIAS PLANT AT NEWBURY, MASSACHUSETTS	RECORD OF AFTERSHOCKS AT MARBLEHEAD, MASSACHUSETTS
October 31	10:00 a.m.		"...there was a pretty strong one."
	6:35 p.m.		"...an other;..."
	7:33 p.m.		"...an other;..."
	8:42 p.m.		"...and a Fourth Time...and I am told was heard several times in the Night after."
November 2	Night	"...somewhat abated..."	"...the Earthquake heard twice last night."
November 3	-- p.m.	"...3 very loud claps..." (i.e. referring to the three reported November 3-4; also at Marblehead, time given as evening and about midnight)	"...it was heard again last night;..."
November 4	4.00 a.m.	"...about y ^e Brake of day..."	"...and a very considerable one that made our windows jar."
November 4	10:00 p.m.	"...we also had it upon Saturday..." (no time given).	"...some say they heard it about 4..." (original illegible, Weston Geophysical).

TABLE 2 (Cont'd.)

EXCERPTS TAKEN FROM ORIGINAL MINISTER'S RECORD BOOKS KEPT BY REV. MATTHIAS PLANT AT NEWBURY, MASSACHUSETTS		RECORD OF AFTERSHOCKS AT MARBLEHEAD, MASSACHUSETTS	
DATE (O.S.)	TIME (LOCAL)		
November 5	4:30 --	"....we also had 'it...Sabbath..." (no time given).	"It was distinctly heard about 4h 30 ^m just after we came from meeting."
November 5	11:00 p.m.		"...and I am told about 11 at night they heard it again."
November 6	10:00 a.m.	"...much abated in ye noise and terror."	
November 7	11:00 a.m.	Not reported by Plant	"...it was plainly heard..." "...so that it has been heard about 30 times in the compass of the 9 or 10 days past."
<p>Weston Geophysical Note: significant textural differences in the original Minister's Record and the account in the Philo- sophical transactions published years later. Descriptions are taken from the original record.</p>		<p>Weston Geophysical Note: the record ends on November 7, 1727. The letter, written at Marblehead, Massachusetts is dated November 8, 1727.</p>	

TABLE 3
AFTERSHOCKS OF THE 1755 EARTHQUAKE

<u>DATE</u>	<u>TIME</u>	<u>REPORTING LOCALITIES</u>
Nov. 18, 1755	5:29 a.m.	Massachusetts: Amesbury [†] , Boston, Chelmsford, Essex County, Marshfield, Northampton, Salem, Westborough, Worcester; Maine: York; New Hampshire: Bedford; Rhode Island: Exeter.
Nov. 18, 1755	4:00 p.m.	Kittery, Maine.
Nov. 19, 1755	10:00 p.m.	Massachusetts: Chelmsford, Ipswich; Maine: York.
Nov. 20, 1755	Not Given	York, Maine.
Nov. 22, 1755	8:27 p.m.	Massachusetts: Amesbury [†] , Boston, Chelmsford, Essex County, Lynn, Marshfield, Northampton, Plymouth, Worcester, Westborough; Maine: Portland, York; New Hampshire: Hampton, Portsmouth; Rhode Island: Exeter, Newport; New York: New York.
Dec. 19, 1755	10:00 p.m.	Massachusetts: Boston, Essex County, Marshfield; Maine: Portland.
Mar. 11, 1756	3:00-4:00 p.m.	Reported in "towns east of Boston."
Mar. 15, 1756	Not Given	Reported along the coast from Salem, Massachusetts to Wells, Maine.

[†]Amesbury reports are uncertain and are not used in consideration of aftershocks.

TABLE 4

SUMMARY OF OBSERVATIONS[†] ON AFTERSHOCKS

Chauncy (1755):

"...These are all the shocks we have had in this town, tho' elsewhere they have been more numerous. In some places they have felt 5 or 6; in others 10 or 11; & in others still, at least 20."

Mayhew (1755):

"...Many other shocks have been felt since the first and the greatest, to the eastward and northward of Boston; at 20, 30, 40, and 50 miles distance, if not farther."

Winthrop (1755):

"...Since the reading of this lecture, there has been another small shock, viz. on Friday the 19th of December in the evening, exactly at 10 o'clock; the sky being then perfectly clear, and a very gentle gale at S.W. It was preceded by the peculiar noise of an Earthquake about 3 or 4 seconds, and the jarring lasted near as long; causing the window-shutters and door of the chamber, in which I then was, to clatter. Those of my family, who were in a lower room, perceived nothing of the shake, though they heard the noise. These are the only shocks that I have been sensible of; though it is said, that many others have been felt in the Province of New-Hampshire, since the first great one."

Winthrop (1757):

"...These four are the only shocks, that I have been sensible of from the 18th of November last to this date; tho' more are said to have been felt in other parts of the country to the northward of us...."

"The center of our former earthquakes, as well as of this, seems to have been near the river Merrimac, about the latitude of 43° north, and 40 miles north from hence; many shocks having been felt in that neighbourhood, which did not extend to this place."

Williams (1785):

"...Many others, but very small, were felt in different parts of the Massachusetts and New-Hampshire, for several months after."

[†]Account arranged chronologically in order of publication.