

## *A Contribution to the Earthquake History of Maine*

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### ABSTRACT

**A new, detailed history of earthquakes in Maine prior to 1900 is provided. Using accounts from diaries and newspapers to supplement earlier listings, many previously uncataloged earthquakes, as well as more detailed descriptions of previously known events, have been found. Modified Mercalli intensities have been assigned to these events where possible. Historically-recorded Maine earthquakes tend to be centered in the coastal zone, clustering in the Eastport and Penobscot Valley areas. They occur mostly southeast of the Norumbega fault system.**

### INTRODUCTION

There has been an intensified interest in natural phenomena during the past several hundred years, led by scientists, but also shared by non-scientists who simply observed these events in the hope that their observations might give clues to life's problems and aid in future planning. The weather record for an individual farm might be of some use in helping with plans for breeding animals, retaining a sufficient winter food supply, siting houses and buildings, and even planting and harvesting crops. Many people, therefore, kept diaries containing records of natural phenomena. These diaries now exist virtually unused in depositories. They often note occurrences of potential interest to the modern researcher, such as observations of the aurora borealis, occurrences of the earth's magnetic aura as seen in displays in the sky, extraordinary winds, smoke in the air, the appearance of comets, the flight of meteors, and the time, duration, direction, and impact of sensible earthquakes.

When newspapers began to be published extensively, accounts of earthquakes were also of interest to editors and their readers. By seeking out such accounts it is possible to extend our knowledge of seismic events in the past, and perhaps to extend our analysis if several descriptions of the same event are located. In the 1920's, the U.S. Geological Survey commenced

systematic collection of earthquake records. Chronological and geographic listings of these findings were published in 1926, with revisions in 1934, 1939, 1941, 1947, and 1951. Subsequent additions, refinements, and revisions of the USGS catalogs appeared in 1958, 1961, 1965, 1966, 1970, and 1973. The most recent edition of this earthquake history of the United States was published in 1982, bringing the data for the country up to 1980 (Coffman and others, 1982). The compilers have been increasingly concerned with listing only those data which can be fully corroborated; and, in this century, the listings are based almost entirely on instrumental recordings. Personal descriptions of the events have tended to diminish in the literature, although they still play a role, especially when severe or traumatic earthquakes have occurred.

In our work of updating and extending the historical record of earthquakes in Maine, we have noted that interest in earth movements has not lessened, although modern accounts in the press have become stereotyped. Usually they simply repeat the accounts of the event issued by the nearest seismological station. When interviewed, however, persons who experienced an earthquake often recall the details of the event very readily. Reports like those which enlivened early newspaper and diary

accounts emerge easily, and the flavor and relative intensity of the event may be reconstructed. In fact it is our impression that the number, extent, and significance of seismic events is as great as ever in folk knowledge and history, but has been submerged and diminished somewhat by the attention given to scientific reports of events based on readings from seismographs. For these reasons we have chosen to end our search with the beginning of the twentieth century, but note that historians in the future could derive much from oral history, anecdotal accounts, and diaries in which the individual impact of an earthquake is recorded or remembered.

As the accounts of earthquakes which form the basis for this paper depend almost entirely on recollections following the actual events, they are not precise records of earth movements. Instruments were not available to the observers to record this type of information. What we report here are the accounts spoken and compiled by people who shared a common language and perceptions with which they could convey their feelings. Some of these descriptions and perceptions seem archaic to modern readers, but translation into today's equivalents (e.g. Richter magnitudes) is a dangerous and distorting act. There are several earthquake intensity scales that reflect the language and usages of former times. From these we have chosen to use the modified Mercalli scale of 1931 in this report (Appendix D), because it seems to be most closely related to the experience of contemporary observers and it has been tested against precise measurement (Barosh, 1969).

Qualitative observations and determinations of earthquake intensity are subject to human error. We have attempted to reduce this error by using multiple observations, and have assigned a relative intensity value when a substantial amount of descriptive information is available. Space precludes an extensive discussion of the historical data used to compile the earthquake tables presented here, although a few examples of our sources are presented. (A complete list of our data is available upon request from the senior author.)

Newspaper accounts of earthquakes, particularly in the latter part of the nineteenth century, recount observations by many observers, especially for the larger and more well-known events. Several examples are given below. These accounts do not always occur on the front page of the newspaper; in fact, they are much more likely to occur as editorial filler. Oftentimes the original story, which may reflect observations at a particular place, is enhanced by correspondents who recount their own experiences. Thus, the researcher cannot be content with skimming one or two pages, but must range back and forth through newspaper accounts for bits and pieces of earthquake descriptions. Even though the researchers on this project have attempted to survey every newspaper in the area from Saint John, New Brunswick, to Portsmouth, New Hampshire, up to the year 1900, and have supplemented the accounts with observations found in journals, diaries, and other compilations (Appendix A), it is probable that some seismic events remain to be located. Similar work in other parts of the United States and Canada, as

well as in Mexico, although perhaps tedious to contemplate, would add greatly to our general knowledge of the seismic history of North America.

One other matter needs to be explained with regard to historical research in matters such as these. Universal Standard Time (UST) is a relatively recent development. It was adopted in the United States only in 1883, and the time zones of the world as they are known today date from 1884. In that year a world conference established Greenwich as the prime meridian, and a universal time based on Greenwich became the standard. Prior to that conference times varied widely. In the United States times were often set by a municipality, or a county, and occasionally by a state. A series of railway accidents caused common carriers to establish standard times along their lines, but even here the times occasionally differed. In theory, railway time was consistent after 1849, but there were still problems as no standard was available for synchronization of clocks. Thus, without knowing the exact standard in use at a particular locality prior to 1884, our pre-1884 listings of the times of earthquake events are "local times" and not UST. Lists of earthquakes which are part of the record often err in this matter.

Occasionally times vary as little as fifteen minutes between neighboring municipalities. Times are more apt to be standardized later in the record, as the movement which led to establishing UST dates from about 1878. Differences persist today. Some cities and counties in the United States do not observe "daylight times", nor does the state of Arizona. An event occurring in these localities can still be given an erroneous listing if the observer is not careful. Of course, prior to the mid eighteenth century, listed times for events can vary by days as the calendar in common use varied from astronomical time. (This difference persisted in many parts of the world until even later, as, for example, in Russia where the modern calendar was not adopted until 1918.)

## EXAMPLES OF HISTORICAL EARTHQUAKE RECORDS

1. A book entitled *Rambles About Portsmouth*, published in 1873, quotes from an almanac annotated by Daniel Pierce, March 18, 1755: "At 4 o'clock this morning we were roused by an earthquake. It came with a roar like thunder and shook terribly. It was immediately repeated, and both shocks held a considerable time, more than two minutes" (Adams, 1825; Brewster, 1873).

2. October 22, 1869 - *St. Croix Courier* (St. Stephen, New Brunswick), edition of October 28, 1869: "Most severe shock ever experienced. Awoke people and shook dishes from walls to floor. Some observed ground surging like waves at sea and schooners were considerably rocked at wharves. Houses were shaken and great alarm was felt."

Another account of this same event in the *St. John* (New Brunswick) *Telegraph Journal*, issue of October 23, 1869, describes the event as being 45 seconds in duration, and occur-

ring at 5:45 a.m. at a latitude of 45.9° and a longitude of 66.6°. This account says that a rumbling sound preceded the movement of the earth, which was severe enough to topple chimneys and open cracks in the wall of a brick building.

A later quake, at 5:48 a.m. that same day, lasted 15 seconds, and the wave motion was described as proceeding from east to west. The *Machias Union* (Maine) of November 2, 1869, described this earthquake as having been felt in Alexander, a nearby town, and lasting about a minute. It was described as more severe than a tornado of the same year. People and animals were frightened. "The hens flew from the roost in great fright. The sound appeared from s.w. to n.e." (The "tornado" is the famous Saxby Gale.)

3. Several months later, on March 17, 1870, another quake was felt in eastern Maine. Although not as strong, the accounts suggest the intensity of the quake. The *St. John Daily Telegraph*, March 18, 1870, reported the previous day's earthquake at 45.2° latitude and 66.1° longitude. In the midst of a bad storm, a strange noise occurred and "part of the harbor broke away."

The *Eastport Sentinel*, March 30, 1870, reporting on this same earth tremor, remarked "rumbling noise. Afterwards part of the harbour sank." This quake, in a later listing of New Brunswick seismic events, was recorded as occurring from 6:00 to 8:00, and it was remarked that the earth movement was a landslide at Sand Point in St. John harbour.

4. August 16, 1774. From the *New Hampshire Gazette* of August 19, 1774: "4 p.m. Tuesday afternoon, about 4 o'clock, a small shock of an earthquake, was felt in this and the neighboring towns."

5. June 1, 1823, 11:50 a.m. A quake lasting from 20 to 60 seconds, and proceeding toward the east, was recorded in the *Bangor Weekly Register*, June 12, 1823: "Sound of subterranean thunder. Jarring and tremulous motion of earth. Effects felt on vessels in harbor. One captain felt action as if sailing at five knots and rubbing over pebbly bottom. Also water rose eight inches by wharves and sank again immediately."

6. June 19, 1825, 10:33 p.m. From the *Oxford Observer*, June 23, 1825: "Several shocks of an earthquake were distinctly felt in this town on Monday last, the first two at 33 minutes past 10 o'clock, within a few seconds of each other, and a third about 5 minutes past midnight. The direction was from WSW to ENE and the concussion was such as to shake the houses in town, and rattle the windows with considerable violence."

The above examples are typical of the type and quality of the data which has been retrieved from these new sources.

## TABULATED EARTHQUAKE RECORDS

Appendix B summarizes the authors' research into historic seismicity in Maine and surrounding areas. It includes a preliminary effort, by two of the authors, to assign Modified Mercalli intensities to those events for which enough data are thought to be available. These events also are listed in Appendix C in descending order of intensity. We have included all reports

which differ significantly in time, which indicate a variance in reported direction, or which help in ascertaining our effort at providing Mercalli intensities. It is expected that further classification of these earthquakes will result when these data are analyzed by seismologists.

This listing should be helpful in indicating aftershocks and their character. The short time differences between some reported earthquakes probably often indicate such information, especially when both differing times and intensities are recorded. We have listed local times as reported. Appendix B lists approximately 100 events which have not previously been reported in published earthquake histories. Chiburis (1981) presented his data in modern standard time (U.S.T.), but those data are somewhat skewed where local times were involved before 1884. Some of these new data reflect our refinement of the local times used in the earlier period.

Caution should be applied by users of these data. The tables are the product of several researchers over a period of time, who felt that a more detailed listing of earthquakes in coastal Maine might be useful in interpreting recent crustal movements in this region. The authors are not trained seismologists. Thus the data are listed without much refinement, except to apply historical techniques to discard those data which are repetitive of other sources as well as those given with what are apparently wrong dates or other incorrect attributes. In the latter part of the period, and especially after the creation of standardized news gathering agencies (after the Civil War), newspapers often reprinted the accounts of earthquakes, and we have discarded such repetitive data. Our tables list accounts of earthquakes sensibly felt and reported in Maine and adjoining areas. We have focused on hitherto unknown events and newly located descriptions in our reports.

## SYNTHESIS OF EARTHQUAKE DATA

The lack of extreme precision of the recorded times when the earthquakes were felt precludes accurate determination of their epicenters. However, the distribution of reported locations in both time and space demonstrates that:

1. Activity is concentrated in the coastal zone.
2. Within the coastal zone there are clusters of earthquakes in the Eastport and Penobscot Valley areas.
3. The majority of historically recorded earthquakes occur southeast of the Norumbega Fault system.
4. Earthquakes were apparently more frequently observed between 1870 and 1900 than earlier, perhaps indicating a more active seismic period during these years.

The distribution of these data has to be evaluated within the context of population distribution through time. For example, the sparse number of reports during the eighteenth century and their concentration in extreme southwestern Maine most probably reflect the population concentration of the time rather than the

real distribution of seismic events. However, the coast was thoroughly populated from 1800 to 1900, and newspapers were well established. Therefore, the distribution of quakes recorded during the latter period is probably an accurate representation of the seismic activity (Chiburis, 1981).

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#### REFERENCES CITED

- Adams, N., 1825, *Annals of Portsmouth: Exeter, New Hampshire*, C. Norris (printer).
- Barosh, P. J., 1969, Use of seismic intensity data to predict the effects of earthquakes and underground nuclear explosions in various geologic settings: U.S. Geological Survey, Bulletin 1279.
- Brewster, C. W., 1873, *Rambles about Portsmouth (First Series): Portsmouth, New Hampshire*, Portsmouth Journal.
- Chiburis, E. F., 1981, Seismicity, recurrence rates, and regionalization of the northeastern United States and adjacent southeastern Canada: Washington, U.S. Nuclear Regulatory Commission, NUREG/CR-2309, 76 p.
- Coffman, T. L., Von Hake, C. A., and Stover, C. W., 1982, *Earthquake history of the United States: Boulder, Colorado*, U.S. Department of Commerce (NOAA)/U.S. Department of the Interior (USGS), Publication 41-1 (reprinted 1982, with 1971-1980 Supplement).

#### APPENDIX A. SOURCES OF EARTHQUAKE DATA

(Numbers are provided to give a key to location of sources of events listed in Appendix B.)

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##### DIARIES

1. Theodore Lincoln, Manuscript Diaries, Dennysville, Maine, 1820-1840
2. Isaac Hasey, Manuscript Diaries, Lebanon, Maine, 1764-1808

##### NEWSPAPERS

3. Aroostook Times, 1860's
4. Bangor Daily Commercial, 1872-1900
5. Bangor Weekly Register, 1820-1829
6. Bangor Whig and Courier, 1850-1900
7. Bar Harbor Record, 1870-1890
8. Belfast Age, 1880's
9. Belfast Republican Journal, 1840-1900
10. Biddeford Weekly Journal, 1880's
11. Calais Advertiser, 1836-1900
12. Eastport Star and Washington Advertiser, 1823-1825
13. Eastport Sentinel, 1818-1900
14. Ellsworth American, 1860-1900
15. Hancock County Gazette and Penobscot Patriot, 1840's
16. Kennebec Journal, 1830-1900
17. Machias Union, 1853-1900
18. Maine Free Press, 1850's
19. New Brunswick Courier, 1811-1865
20. New Hampshire Gazette, 1757-1815
21. Northern Light (Eastport), 1828-1832
22. Oxford Democrat, 1850-1875
23. Oxford Observer, 1821-1826
24. Portland Eastern Argus, 1804-1900
25. Rockland Free Press, 1880-1900

26. St. Croix Courier, 1865-1900
27. St. John Daily Morning News, 1839-1873
28. St. John Daily Sun, 1878-1900
29. St. John Daily Telegraph, 1862-1873

##### OTHER SOURCES

30. Adams, N., 1825, *Annals of Portsmouth: Exeter, New Hampshire*, C. Norris (printer).
  31. Belknap, J., 1812, *The history of New Hampshire--Vol. III: Dover, New Hampshire*.
  32. Chiburis, E. F., 1981, Seismicity, recurrence rates, and regionalization of the northeastern United States and adjacent southeastern Canada: Washington, U.S. Nuclear Regulatory Commission, NUREG/CR-2309, 76 p.
  33. Coffman, T. L., Von Hake, C. A., and Stover, C. W., 1982, *Earthquake history of the United States: Boulder, Colorado*, U.S. Department of Commerce (NOAA)/U.S. Department of the Interior (USGS), Publication 41-1 (reprinted 1982, with 1971-1980 Supplement).
  34. Kain, S. W., 1898, List of recorded earthquakes in New Brunswick: Bulletin of the Natural History Society of New Brunswick, v. 4, p. 16-22.
  35. Kain, S. W., 1904, Recent earthquakes in New Brunswick: Bulletin of the Natural History Society of New Brunswick, v. 4, p. 243-245.
  36. Smith, Rev. T., 1856, *History of Falmouth, 1720-1787: Portland, Maine*.
  37. U.S. National Archives, Climatological Records, microfilm, Rolls 199-211.
  38. Williamson, J., 1828, 1832, *History of Maine: Augusta, Maine*.
  39. Willis, Rev. W., ed., 1849, *Journals of the Rev. Thomas Smith and the Rev. Samuel Deane: Portland, Maine*.
  40. Winthrop, John, 1630-1645, *Journal*.
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APPENDIX B. EARTHQUAKES RECORDED IN MAINE AND ADJOINING AREAS, 1638-1900

Asterisk indicates event not previously listed in earthquake catalogs, or one which differs in time of day, or day of the month from previously established lists. These listings are included to help with further analysis. Each group of closely spaced times are probably the same basic event, but some of the new descriptions may indicate foreshocks or aftershocks. A listing with the prefix of # indicates a finding which differs, or which might differ, in time from those in Chiburis (1981). These are earthquakes which may warrant further study in order to determine whether the listings tell us more about the nature of these events. Directional listings indicate the way in which the shock was felt to be moving, e.g., W-E means it was described as moving from west to east.

Year	Date	Time	Town(s)	County or Province	Direction	Duration (sec)	Mercalli Intensity	Reference (Appendix A)
1638	June 1		(coastal)	All	E-W	240	VII (probable)	40
1638	June 2		Kittery	York			V	30
1658	April 14		(coastal)	All				30, 38
1658			Kittery	York				38
1661	February 10			St. Lawrence Valley				32
1663	February 5	5:30 pm						
1663			(coastal)	All				34, 38
#1727	October 29	10:40 pm	Falmouth	Cumberland	NE-SW	120	VI	30
#1727	October 29	10:30 am	Kittery	York	NW-SE	120	VI-VII	38
(These are listings with old-style (Julian) dates for the well-known event usually given as November 10, 1727.)								
1732	September 16		Kittery	York			VI-VII	33
1744	June 3	AM	Falmouth	Cumberland				36, 39
1755	March 18	4:00 pm	Portsmouth/ Kittery	York		120		30, 33
1755	November 17	4:15 am	Falmouth	Cumberland		120	V-VI	
1755	November 17	AM	Kittery	York				36, 39
#1755	November 18	6:11 am	Falmouth	Cumberland	NW-SE	240	VII	38
1755	November 22	8:30 pm	Falmouth	Cumberland				36, 39
1755	December 19	PM	Falmouth	Cumberland				36, 39
*1756	November 15	3:30 am	Kittery	York				18
*1757	July 14	2:00 pm	Kittery	York			III	18
*1758	April		Kittery	York				18
#1759	February 2	2:15 am	Kittery	York			III	18
1760	February 3	3:00 am	Kittery	York			III	18, 32
1761	March 12	2:15 am	Falmouth	Cumberland			IV	36, 39
*1761	October 30	8:00 pm	Portsmouth					18
1764	September 30	12:00 noon	St. John	New Brunswick			II-III	34
*1764	November 14	12:00 mid.	Falmouth	Cumberland				36, 39
#1766	January 23	AM	Falmouth	Cumberland				36, 39
*1766	January 23	5:00 am	Falmouth	Cumberland			III	36, 39
1766	January 24		Falmouth	Cumberland			II	36, 39
*1768	June 20	1:30 pm	Kittery	York			III	18
*1768	December 28	6:40 pm	Kittery	York			III-IV	18
1769	October 19	5:00 pm	Falmouth	Cumberland			IV	36, 39
*1771	March 3	5:00 am	Kittery	York			II-III	18
*1774	August 16	4:00 pm	Kittery	York			III	18
*1775	November	12:00 noon	St. John	New Brunswick				34
*1786	January 2	7:15 am	Lebanon	York				2
*1786	January 2	7:00 am	Falmouth	Cumberland			III	36, 39
*1786	January 2	7:30 am	Kittery	York			III	18
*1786	November 29	3:00 am	Lebanon	York				2
#1801	March 1	3:30 pm	Kittery	York	NW-SE	30	IV-V	30
*1806	June 18	7:30 am	Portland	Cumberland			II-III	18
(This is apparently the same event reported as June 13 in Chiburis (1981).)								
*1807	February 25	1:40 pm	Kittery	York	NE-SW	30	III-IV	18
*1808	February 22	1:40 pm	Portland	Cumberland	NE-SW	30	III	22
*1808	June 26	2:30 am	Portland	Cumberland			IV	22
*1810	November 9	9:00 pm	Kittery	York	W-E		III-IV	33
#1814	November 28	7:16 pm	Portland	Cumberland	S-N	40	III-IV	18, 22
#1814	November 28	7:20 pm	Kittery	York		30	IV	30
*1817	May 22	8:31 am	Fredericton	New Brunswick				17
*1817	May 22		St. Andrews	New Brunswick				17
*1817	May 22	8:31 am	St. John	New Brunswick		60		17
*1817	May 22	3:30 am	Dennysville	Washington				1
*1817	May 22	3:10 am	Augusta	Kennebec		60		22
*1817	May 22	3:05 pm	Portland	Cumberland	SW-NE	3	IV	22
*1817	May 22	3:00 am	Wiscasset	Lincoln			IV	22

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APPENDIX B. CONTINUED.

Year	Date	Time	Town(s)	County or Province	Direction	Duration (sec)	Mercalli Intensity	Reference (Appendix A)
*1817	May 22	3:15 am	Bangor	Penobscot		60	IV	3
*1817	October 2	11:55 am	Kittery	York			III	18
*1819	July 21		Dennysville	Washington				1
*1821	May 4	2:45 am	Jackson	Waldo				22
#1821	May 5	7:30 am	Bangor	Penobscot	NW-SE		V	3
1821	May 5	7:30 am	Belfast	Waldo		20	IV	13
*1821	July 9	9:15 pm	Eastport	Washington		5		11
*1823	June 1	11:50 am	Bangor	Penobscot	NW-SE	20-60	IV	3
	(This may be the event listed as June 10 in Chiburis (1981).)							
1824	July 9	9:15 pm	Eastport	Washington			IV	34, 37
*1825	June 19	10:33 pm	Paris	Oxford	WSW-ENE		IV	21
*1828	July 28	9:45 am	Brunswick	Cumberland				14
	(Chiburis (1981) lists an event on July 25.)							
*1829	August 27	10:00 pm	Belfast	Waldo			IV	7
*1829	August 27	10:15 pm	Bangor	Penobscot				3
*1844	December 18	4:00 am	Portland	Cumberland				7
#1851	January 3	11:45 pm	Belfast	Waldo	W-N	15	IV	7
1851	January 30	5:30 pm	Calais/Eastport	Washington		50	III-IV	1, 37
*1853	July 17	10:30 am	Portland	Cumberland			IV	4
	(Chiburis (1981) has a different time which may be incorrect.)							
1854	December 10		Kittery	York				22, 33
*1855	January 16	7:00 pm	Portland	Cumberland				4
#1855	January 18		Portland/ Bangor	Cumberland/ Penobscot				4
1855	February 8	6:30 am	Machias	Washington		90	V	15
1855	February 8	6:30 am	St. John	New Brunswick		40-50	V	34
1855	February 8		Eastport	Washington				11
*1855	February 9	6:45 am	St. John	New Brunswick			IV	25
*1855	February 15	7:00 am	Calais	Washington				4
#1855	February 18	6:00 am	Bangor	Penobscot			IV	4
1855	February 18		Waterville	Kennebec				4
#1855	February 18	5:30 am	Belfast	Waldo			III	7
1855	February 18		Waterville	Kennebec				22
*1857	October 31	7:40 am	Belfast	Waldo			IV	16
1857	December 8	8:00 pm	Bangor	Penobscot			IV	4, 16
*1857	December 23	2:00 pm	Augusta	Kennebec			IV	4
*1857	December 23		Wiscasset	Lincoln				4
*1857	December 23		Waterville	Kennebec				16
*1857	December 23	6:30 pm	Lewiston	Androscoggin			VI-VII	32
	(These listings for December 23, 1857 are examples of new reports of a fairly well-known event.)							
*1859	October 26	2:00 am	Calais	Washington				9
*1859	October 26	2:30 am	St. John	New Brunswick				17, 25
*1860	October 17	6:25 am	St. John	New Brunswick		20-30		25
1860	October 17	6:00 am	Machias	Washington				15
1860	October 17	6:00 am	Augusta	Kennebec			IV	14
1860	October 17	6:00 am	Bangor	Penobscot		50-60	IV	4
1860	October 17	6:00 am	Belfast	Waldo			III-IV	7
1860	October 17	6:00 am	(coastal)	All	N-S	8	IV	22
1860	October 17	6:00 am	Gorham	Cumberland			V-VI	22
1860	October		Houlton	Aroostook			V-VI	1
1860	October 17	6:00 am	Paris	Oxford			III-IV	22
#1861	January 25	5:45 am	Steuben	Washington		60	III	37
*1861	January 25	4:00 pm	Eastport	Washington				11
#1861	January 25	4:00 pm	Steuben	Washington		60		37
*1861	January		Bethel	Oxford				4
#1862	January 23	8:30 pm	Pembroke	Washington				37
*1868	March 15		Hitchborn	Waldo				7
#1869	October 22	5:45 am	St. Stephen	New Brunswick			V	24
#1869	October 22	5:44 am	St. John	New Brunswick		15-20	V	27
#1869	October 22	5:20 am	St. Andrews	New Brunswick			IV	27
1869	October 22		St. Stephen	New Brunswick				27
1869	October 22	5:45 am	Fredericton	New Brunswick		35	VII	27
1869	October 22	5:45 am	Machias	Washington		25-45		15
1869	October 22	5:45 am	St. John	New Brunswick		20	IV-V	25

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APPENDIX B. CONTINUED.

Year	Date	Time	Town(s)	County or Province	Direction	Duration (sec)	Mercalli Intensity	Reference (Appendix A)
1869	October 22	5:45 am	Fredericton	New Brunswick		30	V	25
1869	October 22	6:00 am	Gagetown	New Brunswick				27
#1869	October 22	5:48 am	St. John	New Brunswick		15	V	34
#1869	October 22	5:30 am	Augusta	Kennebec		60	IV-V	14
1869	October 22	5:30 am	Augusta	Kennebec		60	IV	14
1869	October 22	5:30 am	Bangor	Penobscot	NE-SW	30	V	4
1869	October 22	5:30 am	Belfast	Waldo		60	IV	7
1869	October 22	5:30 am	(coastal)	All		60		7
#1869	October 22	5:20 am	Wiscasset	Lincoln		180		7
1869	October 22		Ellsworth	Hancock				12
#1869	October 22	5:15 am	Portland	Cumberland		30	IV	22
#1869	October 22	5:00 am	St. John	New Brunswick				7
1869	October 22	5:30 pm	Paris	Oxford		30	IV	22
*1870	March 17	11:00 am	St. John	New Brunswick			IV	27
1870	March 17	6-8 am	St. John	New Brunswick				34
*1870	March 18		St. John	New Brunswick				11
1870	October 20	11:40 am	Westfield	New Brunswick		6		27
1870	October 20	11:45 am	Fairville	New Brunswick			IV	27
1870	October 20	11:45 am	St. John	New Brunswick			IV	27
1870	October 20	11:45 am	Fredericton	New Brunswick		4-7	V	27
1870	October 20	11:40 am	Welsford	New Brunswick		7		27
1870	October 20	11:45 am	St. George	New Brunswick				27
1870	October 20	11:40 am	St. Stephen	New Brunswick			III-IV	27
1870	October 20	11:40 am	Machias	Washington		30	IV	15
1870	October 20	11:00 am	St. Stephen	New Brunswick				24
#1870	October 20	12:00 noon	St. John	New Brunswick		2-3		25
1870	October 20	11:43 am	Fredericton	New Brunswick		2		34
#1870	October 20	11:00 am	Eastport	Washington		30		37
1870	October 20	11:30 am	Augusta	Kennebec	N-S	30	VI-VII	14
1870	October 20	11:30 am	All	All		30	VI-VII	14
1870	October 20	11:30 am	Bangor	Penobscot	SW-NE	30-40	VI	4
1870	October 20	11:30 am	Belfast	Waldo		25	V	7
1870	October 20	AM	Ellsworth	Hancock	NE-SW	30-40	VI	12
1870	October 20	11:30 am	Rockland	Lincoln	NE-SW		V	23
1870	October 20	11:30 am	Paris	Oxford	NE-SW	30-40	VI-VII	22
#1872	January 9	PM	Quebec	Quebec				23
#1873	January 11	5:00 am	Brunswick	Cumberland				2
#1873	February 22	7:30 am	St. George	New Brunswick			III	24
1873	February 22	7:25 am	Eastport	Washington				7, 27
#1873	April 17	4:00 pm	Waterville	Kennebec				4
#1874	February 12	6:30 am	Saco	York			III	23
1874	February 27	11:00 pm	Machias	Washington			IV	15
1874	February 27	10:40 pm	Eastport	Washington				11
1874	February 27	10:45 pm	St. Stephen	New Brunswick			IV	24
1874	February 27	10:40 pm	Eastport	Washington				37
1876	November 20	12:40 pm	Machias	Washington		30		2, 15
1876	November 20	PM	Eastport	Washington			III	15
1876	November 24	12:45 pm	Eastport	Washington				11
#1877	February 18	2:20 pm	Portland	Cumberland			IV	2, 14
#1880	April 3	2:30 am	Fort Fairfield	Aroostook				7, 23
1881	January 20		Bath	Sagadahoc		10		33
#1881	July 31	9:45 pm	Bangor	Penobscot	N-S	20	IV-V	2, 4
1882	December 19	5:20 pm	Biddeford	York			IV	2, 8
1882	December 19	5:24 pm	South Berwick	York	W-E	8-10	IV-V	14, 22, 23
1882	December 31	PM	Machias	Washington			IV	15
1882	December 31	9:56 pm	St. John	New Brunswick			IV	26, 34
1882	December 31	9:55 pm	Eastport	Washington				11, 37
1882	December 31	PM	St. John	New Brunswick				24
1882	December 31	9:30 pm	Belfast	Waldo	NE-SW		IV	23
1882	December 31	10:00 pm	Rockland	Lincoln				6, 14
1882	December 31	PM	Bangor	Penobscot			IV	2, 4
*1883	January 1	5:00 am	Machias	Washington			IV	15
*1883	January 5		Kezar Falls	Oxford				22
#1884	January 26		Rothsay	New Brunswick			III	27, 34

D. C. Smith and others

APPENDIX B. CONTINUED.

Year	Date	Time	Town(s)	County or Province	Direction	Duration (sec)	Mercalli Intensity	Reference (Appendix A)
#1884	January 27	PM	St. John	New Brunswick				15
1884	January 27	PM	Rothesay	New Brunswick				24
1884	August 10		Kittery	York				33
*1884	August 14	PM	Bar Harbor	Hancock		30	IV	5
1884	December 7	3:00 am	Calais	Washington				23
1885	June	10:00 am	Grand Manan	New Brunswick				34
*1888	July 21	PM	Winthrop	Kennebec		30	IV	2
#1888	August 15	PM	Augusta	Kennebec				23
1888	August 15	8:20 pm	Winthrop	Kennebec		30	IV	5, 7
*1889	January 26		Charlotte	Washington				
1896	March 22	8:35 pm	Machias	Washington				15
1896	March 22	8:30 pm	St. Stephen	New Brunswick		55	III	24
1896	March 22	8:30 pm	Eastport	Washington			III	11
1896	March 22		St. Stephen	New Brunswick				24
1896	March 22	7:56 am	Eastport	Washington		4-5	III	34, 37
1896	March 22		Grand Manan	New Brunswick		2-3	III	34, 37
1896	March 22	8:45 pm	St. Andrews	New Brunswick		3	III	34
1896	May 15	11:00 pm	Fredericton	New Brunswick				34
*1896	September		Ellsworth	Hancock				12
#1897	January 26	11:30 am	Machias	Washington		30	IV	9
1897	January 26	AM	Campobello	New Brunswick				34
1897	January 26		Charlotte	Washington			IV	15
1897	February 14	9:00 am	Grand Manan	New Brunswick		2		34
#1897	September 25	1:00 pm	Houlton	Aroostook	NE-SW	2-3	II-III	1
1897	September 25	1:00 pm	Olamon	Penobscot			VI-VII	2
1897	September 25	PM	Old Town	Penobscot		3	IV-V	4
1897	September 25	1:00 pm	Bangor	Penobscot			VI	4
1897	September 25	1:00 pm	Bar Harbor	Hancock	E-W		V-VI	5
1897	September 25	1:00 pm	Belfast	Waldo	NE-SW		IV-V	6
1897	September 25	1:05 pm	Ellsworth	Hancock			IV	12
1897	September 25	1:05 pm	Northport	Waldo		45		7
1897	September 25		Farmington	Franklin	NE-SW	5		7
1897	September 25	1:00 pm	Waterville	Kennebec	N-S			7, 14
1897	September 25	1:00 pm	Bangor/Brewer	Penobscot	N-S	45-60	IV	2, 4
1897	September 25	1:40 pm	Machias	Washington		several seconds		15
*1897	September 30	1:00 pm	Calais	Washington		2-3	IV	9
1898	August 14	3:00 am	Oak Point	New Brunswick				35
#1898	September 17	10:54 am	Belfast	Penobscot (2 aftershocks: 11 sec. and 45 sec. later)				7
1899	October 5	6:30 am	Wiscasset	Lincoln			IV	32

APPENDIX C. KNOWN MAINE EARTHQUAKES RANKED BY MODIFIED MERCALLI INTENSITY  
(Attribution by C. Fox and D. Smith)

Year	Date	Time	Locality	Direction	Duration (sec)	Mercalli Intensity
1638	June 1		Coast	E-W	240	VII
1755	November 18	6:11 am	Falmouth	NW-SE	240	VII
1727	October 29	10:30 am	S. Coast	NW-SE	120	VI-VII
1732	September 16		Kittery			VI-VII
1857	December 23	2:00 pm	Maine			VI-VII
1755	November 17	4:15 am	S. Coast		120	VI-VI
1860	October 17	6:00 am	Maine and N.B.	N-S	50-60	V-VI
1821	May 5	7:30 am	Bangor	NW-SE	20	V
1855	February 8	6:30 am	N. Coast and N.		90	V
1869	October 22	5:45 am	Maine and N.B.	NE-SW	15-60	IV-VII
1801	March 1	3:30 pm	Kittery	NW-SE	30	IV-V
1881	July 31	9:45 pm	Bangor	N-S	20	IV-V
1882	December 19	5:24 pm	S. Coast	W-E	8-10	IV-V



Contribution to earthquake history of Maine

APPENDIX C. CONTINUED.

Year	Date	Time	Locality	Direction	Duration (sec)	Mercalli Intensity
1761	March 12	2:15 am	Falmouth			IV
1769	October 19	5:00 pm	Falmouth			IV
1808	June 26	2:30 am	Portland			IV
1817	May 22	3:05 am	Maine	SW-NE	60	IV
1823	June 10	11:50 am	Bangor	W-E	20-60	IV
1824	July 9	9:15 pm	Eastport			IV
1825	June 19	10:33 pm	Paris	WSW-ENE		IV
1829	August 27	10:00 pm	Belfast			IV
1851	January 3	11:45 pm	Belfast	W-N	15	IV
1853	July 17	10:30 am	Portland			IV
1855	February 9	6:45 am	St. John			IV
1855	February 18	6:00 am	Maine			IV
1857	October 31	7:40 am	Belfast			IV
1857	December 8	8:00 pm	Bangor			IV
1869	October 22	5:15 am	Portland		30	IV
1870	March 17	11:00 am	St. John			IV
1874	February 27	10:45 pm	N. Coast and N.			IV
1877	February 18	2:20 pm	Portland			IV
1882	December 31	PM	Machias			IV
1882	December 31	9:30 pm	Mid-N. Coast	NE-SW		IV
1883	January 1	5:00 am	Machias			IV
1888	July 21	PM	Winthrop			IV
1888	August 14	PM	Bar Harbor		30	IV
1888	August 15	8:20 pm	Central Interior		30	IV
1897	January 26	11:30 am	Machias		30	IV
1897	September 30	1:00 pm	Calais		2-3	IV
1899	October 5	6:30 am	Wiscasset			IV
1870	October 20	11:40 am	Maine and N.B.	NE-SW	2-40	III-VII
1897	September 25	1:00 pm	N. and Central Int.	NE-SW	2-3	III-V
1766	December 28	6:40 pm	Kittery			III-IV
1807	February 25	1:40 pm	Kittery	NE-SW	30	III-IV
1810	November 9	9:00 pm	Kittery	W-E		III-IV
1814	November 28	7:16 pm	S. Coast	S-N	40	III-IV
1851	January 30	5:30 pm	Calais		50	III-IV
1757	July 14	2:00 pm	Kittery			III
1759	February 2	2:15 am	Kittery			III
1760	February 3	3:00 am	Kittery			III
1761	October 30	8:00 pm	Kittery			III
1766	January 23	5:00 am	Falmouth			III
1768	June 20	1:30 pm	Kittery			III
1774	August 16	4:00 pm	Kittery			III
1786	January 2	7:00 am	S. Coast and Int.			III
1786	January 2	7:30 am	Kittery			III
1808	February 22	1:40 pm	Portland	NE-SW	30	III
1817	October 2	11:55 am	Kittery			III
1861	January 25	5:45 am	Steuben		60	III
1873	February 22	7:25 am	Eastport			III
1873	February 22	7:30 am	St. George			III
1874	February 12	6:30 am	Saco			III
1876	November 20	12:40 pm	N. Coast		30	III
1884	January 26		Rothsay			III
1896	March 22	7:56 am	N. Coast and N.		4-5	III
1896	March 22	8:30 pm	N. Coast and N.		55	III
1764	September 30	12:00 noon	St. John			II-III
1764	November 14	12:00 pm	Falmouth			II-III
1771	March 3	5:00 am	Kittery			II-III
1806	June 18	7:30 am	Portland			II-III
1766	January 24		Falmouth			II

## APPENDIX D. MODIFIED MERCALLI INTENSITY SCALE OF 1931 (UNABRIDGED)

I. Not felt - or, except rarely, under especially favorable circumstances. Under certain conditions, at and outside the boundary of the area in which a great shock is felt: sometimes birds, animals, reported uneasy or disturbed; sometimes dizziness or nausea experienced; sometimes trees, structures, liquids, bodies of water, may sway - doors may swing, very slowly.

II. Felt indoors by few, especially on upper floors, or by sensitive or nervous persons. Also, as in grade I, but often more noticeably: sometimes hanging objects may swing, especially where delicately suspended; sometimes trees, structures, liquids, bodies of water, may sway, doors may swing, very slowly; sometimes birds, animals, reported uneasy or disturbed; sometimes dizziness or nausea experienced.

III. Felt indoors by several, motion usually rapid vibration. Sometimes not recognized to be an earthquake at first. Duration estimated in some cases. Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away. Hanging objects may swing slightly. Movements may be appreciable on upper levels of tall structures. Rocked standing motor cars slightly.

IV. Felt indoors by many, outdoors by few. Awakened few, especially light sleepers. Frightened no one, unless apprehensive from previous experience. Vibration like that due to passing of heavy, or heavily loaded trucks. Sensation like heavy body striking building, or falling of heavy objects inside. Rattling of dishes, windows, doors; glassware and crockery clink and clash. Creaking of walls, frame, especially in the upper range of this grade. Hanging objects swung, in numerous instances. Disturbed liquids in open vessels slightly. Rocked standing motor cars noticeably.

V. Felt indoors by practically all, outdoors by many or most: outdoors direction estimated. Awakened many, or most. Frightened few - slight excitement, a few ran outdoors. Buildings trembled throughout. Broke dishes, glassware, to some extent. Cracked windows - in some cases, but not generally. Overturned vases, small or unstable objects, in many instances, with occasional fall. Hanging objects, doors, swing generally or considerably. Knocked pictures against walls, or swung them out of place. Opened or closed doors, shutters abruptly. Pendulum clocks stopped, started, or ran fast, or slow. Moved small objects, furnishings, the latter to slight extent. Spilled liquids in small amounts from well-filled open containers. Trees, bushes, shaken slightly.

VI. Felt by all, indoors and outdoors. Frightened many, excitement general, some alarm, many ran outdoors. Awakened all. Persons made to move unsteadily. Trees, bushes, shaken slightly to moderately. Liquid set in strong motion. Small bells rang - church, chapel, school, etc. Damage slight in poorly built buildings. Fall of plaster in small amount. Cracked plaster somewhat, especially fine cracks in chimneys in some instances. Broke dishes, glassware, in considerable quantity, also some windows. Fall of knickknacks, books, pictures. Overturned furniture in many instances. Moved furnishings of moderately heavy kind.

VII. Frightened all - general alarm, all ran outdoors. Some, or many, found it difficult to stand. Noticed by persons driving motor cars. Trees and bushes shaken moderately to strongly. Waves on ponds, lakes, and running water. Water turbid from mud stirred up. Incaving to some extent of sand or gravel streambanks. Rang large church bells, etc. Suspended objects made to quiver. Damage negligible in buildings of good design and construction, slight to moderate in poorly built or badly designed buildings, adobe houses, old walls

(especially where laid up without mortar), spires, etc. Cracked chimneys to considerable extent, walls to some extent. Fall of plaster in considerable to large amount, also some stucco. Broke numerous windows, furniture to some extent. Shook down loosened brickwork and tiles. Broke weak chimneys at the roofline (sometimes damaging roofs). Fall of cornices from towers and high buildings. Dislodged bricks and stones. Overturned heavy furniture, with damage from breaking. Damage considerable to concrete irrigation ditches.

VIII. Fright general - alarm approaches panic. Disturbed persons driving motor cars. Trees shaken strongly - branches, trunks, broken off, especially palm trees. Ejected sand and mud in small amounts. Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters. Damage slight in structures (brick) built especially to withstand earthquakes. Considerable in ordinary substantial buildings, partial collapse: threw out panel walls in frame structures, broke off decayed piling. Fall of walls. Cracked, broke, solid stone walls seriously. Wet ground to some extent, also ground on steep slopes. Twisting, fall, of chimneys, columns, monuments, also factory stacks, towers. Moved conspicuously, overturned, very heavy furniture.

IX. Panic general. Cracked ground conspicuously. Damage considerable in (masonry) structures built especially to withstand earthquakes: threw out of plumb some wood-frame houses built especially to withstand earthquakes; great in substantial (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames; serious to reservoirs; underground pipes sometimes broken.

X. Cracked ground, especially where loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and streambanks. Landslides considerable from riverbanks and steep coasts. Shifted sand and mud horizontally on beaches and flat land. Changed level of water in wells. Threw water on banks of canals, lakes, rivers, etc. Damage serious to structures and bridges, some destroyed. Developed dangerous cracks in excellent brick walls. Destroyed most masonry and frame structures, also their foundations. Bent railroad rails slightly. Tore apart, or crushed endwise, pipelines buried in earth. Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.

XI. Disturbances in ground many and widespread, varying with ground material. Broad fissures, earth slumps, and land slips in soft, wet ground. Ejected water in large amounts charged with sand and mud. Caused seawaves ("tidal" waves) of significant magnitude. Damage severe to woodframe structures, especially near shock centers. Great to dams, dikes, embankments, often for long distances. Few, if any, (masonry) structures remained standing. Destroyed large well-built bridges by the wrecking of supporting piers, or pillars. Affected yielding wooden bridges less. Bent railroad rails greatly, and thrust them endwise. Put pipelines buried in earth completely out of service.

XII. Damage total - practically all works of construction damaged greatly or destroyed. Disturbances in ground great and varied, numerous shearing cracks. Landslides, falls of rock of significant character, slumping of riverbanks, etc., numerous and extensive. Wrenched loose, tore off, large rock masses. Fault slips in firm rock, with notable horizontal and vertical offset displacements. Water channels, surface and underground, disturbed and modified greatly. Dammed lakes, produced waterfalls, deflected rivers, etc. Waves seen on ground surfaces (actually seen, probably, in some cases). Distorted lines of sight and level. Threw objects upward into the air.