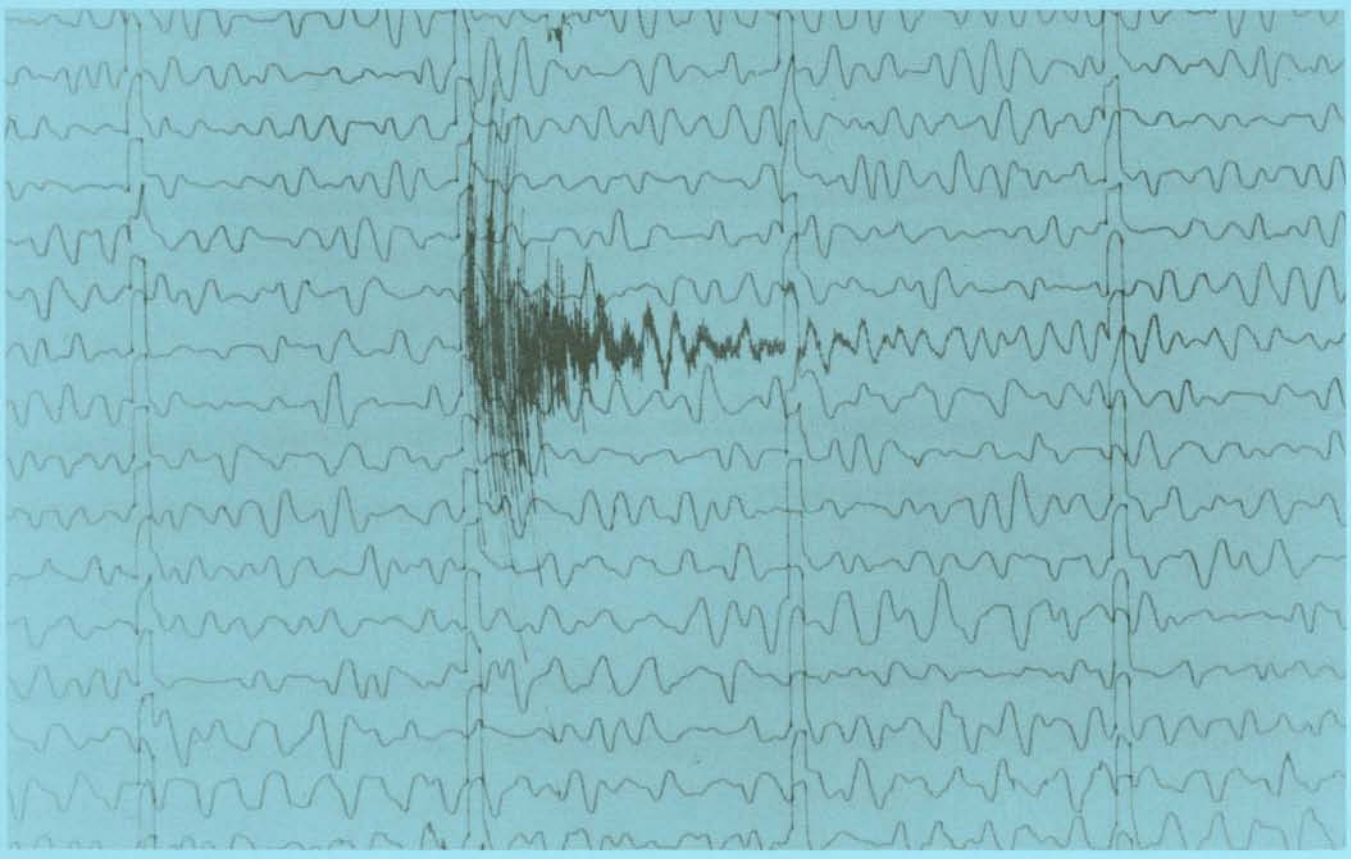
New Jersey Geological Survey
Geological Survey Report 31

CATALOG OF NEW JERSEY EARTHQUAKES THROUGH 1990



N.J. Department of Environmental Protection and Energy - Division of Science and Research

NEW JERSEY DEPARTMENT OF ENVIRONMENTAL PROTECTION AND ENERGY

The mission of the New Jersey Department of Environmental Protection and Energy is to conserve, protect, enhance, restore and manage our environment for present and future generations. We strive to prevent pollution; ensure the efficient use of safe, environmentally sound and reliable energy resources; provide opportunities for recreation and enjoyment of natural and historical resources; and promote a healthy and sustainable ecosystem.

Cover illustration: Seismograph record of a magnitude 3 earthquake (Modified Mercalli Intensity IV) centered near Spotswood, Middlesex County. This tremor occurred on January 9, 1992, and was felt in Middlesex and Monmouth Counties. This record is from a seismograph located in Guyot Hall, Princeton University.

Courtesy of Princeton University Geology Department.

New Jersey Geological Survey
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Catalog of New Jersey Earthquakes through 1990

by
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New Jersey Department of Environmental Protection and Energy
Division of Science and Research
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Modified Mercalli Intensity Scale of 1931, abridged (Wood and Neumann, 1931). Wording is that of Wood and Neumann. Effects on cars, trucks and buildings built according to modern standards may be different.

Mercalli Intensity	Equivalent magnitude*	Effects
I	1.9	Not felt except by a very few under especially favorable circumstances.
II	2.5	Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended object may swing.
III	3.1	Felt quite noticeably indoors, especially on upper floors of building but, many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing of truck. Duration estimated.
IV	3.7	During the day, felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably.
V	4.3	Felt by nearly everyone, many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop.
VI	4.9	Felt by all, many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight.
VII	5.5	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motorcars.
VIII	6.1	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motorcars disturbed.
IX	6.7	Damage considerable in specially designed structures; well designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.
X	7.3	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.
XI	7.9	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.
XII	8.5	Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into air.

* Although earthquakes of the same maximum (epicentral) intensity do not always have the same magnitudes, it is possible to estimate the magnitude with the formula: magnitude = 1.3 + (0.6 x maximum intensity). Values in the table were obtained using this formula.

EARTHQUAKES IN NEW JERSEY

Introduction

New Jersey is not especially prone to earthquakes and has had no major earthquakes within the last several hundred years. Minor earthquakes however are felt here, sometimes several within a year, and are a cause for concern when they occur.

Earthquakes occur when stress within the earth's crust causes sudden movement along a fault. Some of the energy from the release of strain travels away from the fault as seismic waves. These waves travel along the ground surface or within the crust. Their arrival is felt as an earthquake.

The size of an earthquake is stated in terms of magnitude, and its effects as intensity. Magnitude is a measure of the amplitude of seismic waves recorded by a seismograph and adjusted for distance to the epicenter. It corresponds to the energy released as seismic waves. Intensity, in contrast, is a local measurement of the effects of ground movement. Intensity is usually greatest near the epicenter and diminishes with distance.

Magnitude values are expressed according to logarithmic scales in which an increase of 1 represents a 10-fold increase in amplitude of the seismic wave. A 10-fold increase in amplitude represents about a 32-fold increase in energy released for the same duration of shaking. Because larger earthquakes usually last longer, the 32-fold increase may be an underestimate. Perhaps a 100-fold increase in total energy released is more typical. The largest known earthquakes had magnitudes of about 8. Magnitude values of very small earthquakes may be negative.

Numerous magnitude scales are represented in the earthquake listings in this report. Ideally each scale should show the same value for a given earthquake. Their values are usually close, but may not be identical because the different scales use different aspects of the recorded wave to determine magnitude. The best known is the Richter scale, designed by C. F. Richter in 1935 for west coast earthquakes and still in use.

Intensity scales are based on reports of felt movement, sounds, and visible effects on structures and landscapes. The most commonly used scale in the United States is the Modified Mercalli Scale (left page). Intensity values are usually reported in roman numerals to distinguish them from magnitudes.

Intensity generally decreases with distance from the epicenter. Local conditions, such as underlying soft sediment or fill, may locally increase intensity. The rate at which intensity decreases with distance depends on the geologic character of the region. Attenuation is much less in eastern North America than in the west. Eastern earthquakes are felt through areas as much as 100 times greater than western earthquakes of similar magnitude.

The Seismic Record in New Jersey

The great majority of the world's earthquakes occur along boundaries of tectonic plates, but New Jersey is 2,000 miles from the nearest plate boundary (along the Mid-Atlantic Ridge), too far away for earthquakes to be felt except by seismographs. All earthquakes felt in New Jersey have been caused instead by fault movements within the North American tectonic plate.

Within New Jersey, sporadic, minor seismic activity has been reported in three general areas:

1) In north-central New Jersey and adjacent New York, seismic activity is concentrated along several northeast-trending faults of which the Ramapo fault is the most active (Aggarwal and Sykes, 1978; Yang and others, 1978; Sbar and others, 1970).

2) Approximately 12 shocks were recorded along the Delaware Valley between Trenton and Wilmington between 1800 and 1968. Twelve more were reported in the Wilmington area between 1968 and 1973 (Sbar and others, 1975). The largest of these recent tremors, on February 28, 1973, was felt from Baltimore to Mahwah, New Jersey

3) Tremors near Raritan Bay and in the New York Bight includes a magnitude 3.5 event near Cheesequake Marsh on January 30, 1979. This seismicity has been attributed to subsidence of the crust in the Raritan Bay

embayment, one of several broad areas along the east coast in which the crust is known to be or appears to be subsiding (Barosh, 1981).

Many earthquakes felt in New Jersey are caused by shocks with epicenters outside the state. Since colonial times, major earthquakes have occurred in three areas of eastern North America: New Madrid, Missouri; Charleston, South Carolina; and the St. Lawrence region, Canada and New York. Earthquakes with estimated magnitudes of seven in each of these areas have been felt in New Jersey, but none were of sufficient intensity here to do damage. Also felt in New Jersey were moderate intensity earthquakes near Cape Ann, Massachusetts; Ossipee Lake, New Hampshire; southeastern New York; Lancaster, Pennsylvania; and minor tremors adjacent to our borders.

While there are no records of significant earthquake damage in New Jersey, the possibility of a seriously destructive event cannot be entirely discounted. With only 200 or so years or record-keeping, we cannot form a reliable estimate of earthquake activity based on the historical record. The average time between earthquakes of a given magnitude is commonly given in terms of a return period. This differs from region to region. Large earthquakes occur too seldom, especially in the east, to determine a return period directly. Return periods are instead estimated from known return periods of smaller-magnitude events. For western states, the return period is estimated to be about 70 years; for the eastern states it is closer to 300 years.

Within New Jersey, based on the historical record, we can expect that northeastern New Jersey, the lower Delaware Valley, and the Raritan Bay area will continue to experience sporadic, minor activity. Occasional shocks will be felt elsewhere in the state, and we cannot rule out the possibility of a major earthquake. Also we will continue to feel the effects of earthquakes with epicenters outside of New Jersey. While seismic waves from such distant places as New Madrid, Charleston, and the St. Lawrence area may be felt here, these centers are too distant for even major earthquakes to do significant damage. Major earthquakes in southeastern New York, Pennsylvania, or other relatively close areas might register greater intensities.

Explanation of Earthquake Listings

The earthquake listings (tables 1 and 2) and maps (figures 1 and 2) present an overview of New Jersey's recent seismic history. Table 1 lists: 1) earthquakes with epicenters in New Jersey (both those that were felt and those that we know about only because they were recorded on seismographs), and 2) earthquakes felt within New Jersey regardless of the distance to the epicenter.

Table 2 lists nearby out-of-state earthquakes not felt in New Jersey. These nearby minor shocks occur in a similar seismic setting to those in New Jersey and along geologic structures which extend into or close by New Jersey. Even though they were not felt, they are more related to New Jersey seismicity than stronger, distant shocks which were felt here.

Many of the table entries were taken directly from a previous version of this report ("Earthquakes in New Jersey", Dombroski, 1977). The primary source for new entries was "Bulletins of the Northeastern U.S. Seismic Network". Other data were from the several catalogs noted on tables 1 and 2 or from newspaper reports, oral communications, and written communications.

TIME and **DATE** are Eastern Standard Time. Seconds are not given (and not rounded to the nearest minute). All events listed, except the New Madrid earthquakes, occurred in the Eastern Time Zone. New Madrid is in the Central Time Zone.

LOCATION is that of a nearby town or geographic feature.

MAGNITUDE is the largest reported value. Magnitude type not given. For this consult the original source.

INTENSITIES are according to the Modified Mercalli Intensity Scale of 1931 (Wood and Neumann). Two intensities are listed: 1) the maximum felt (generally at the epicentral area), and 2) the maximum intensity felt in New Jersey. Intensities noted as "felt" were unspecified and presumably small.

AREA FELT is a rough approximation, in square miles, of the area from which reports were received. Some values

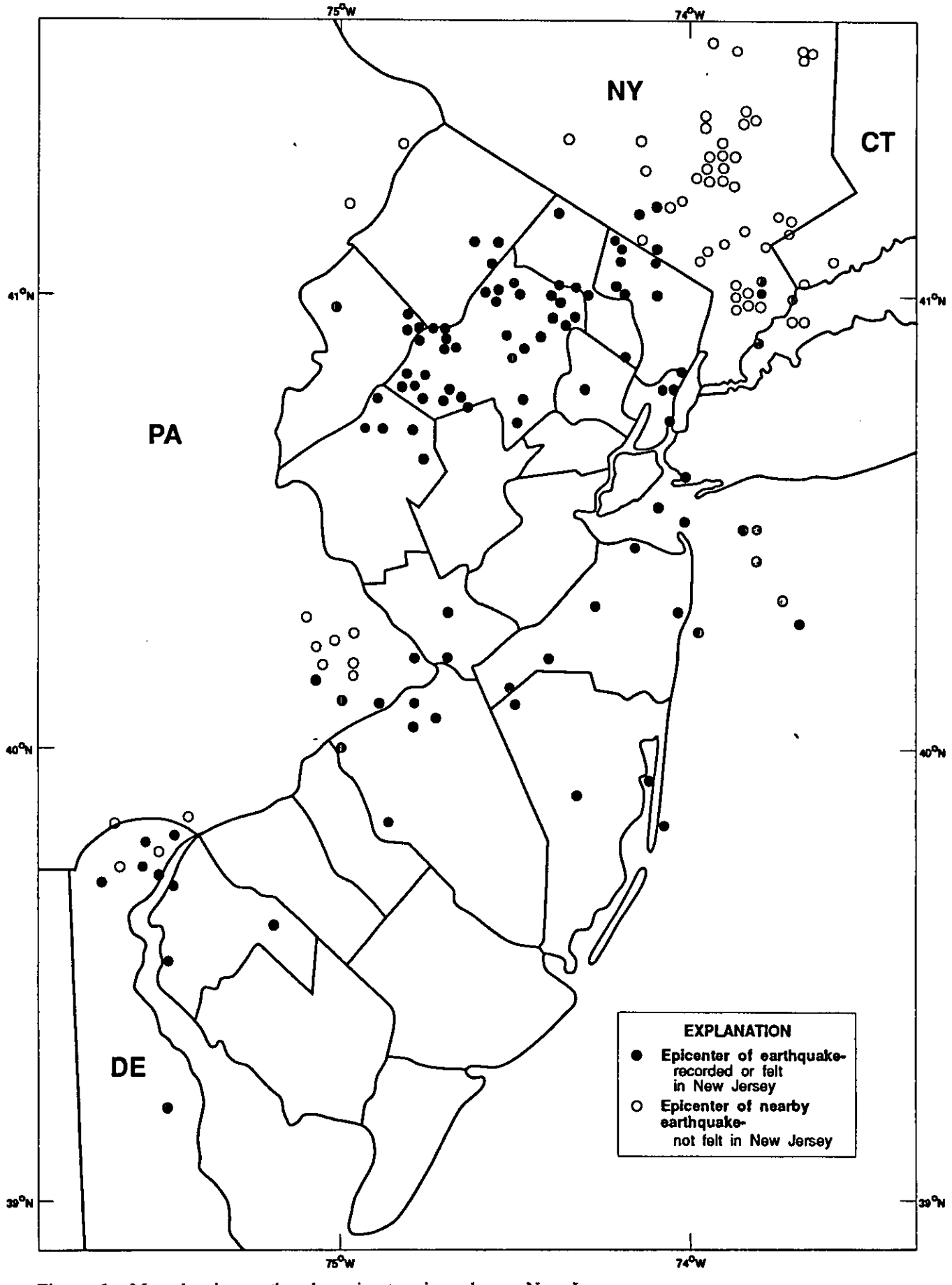

Figure 1. Map showing earthquake epicenters in and near New Jersey.

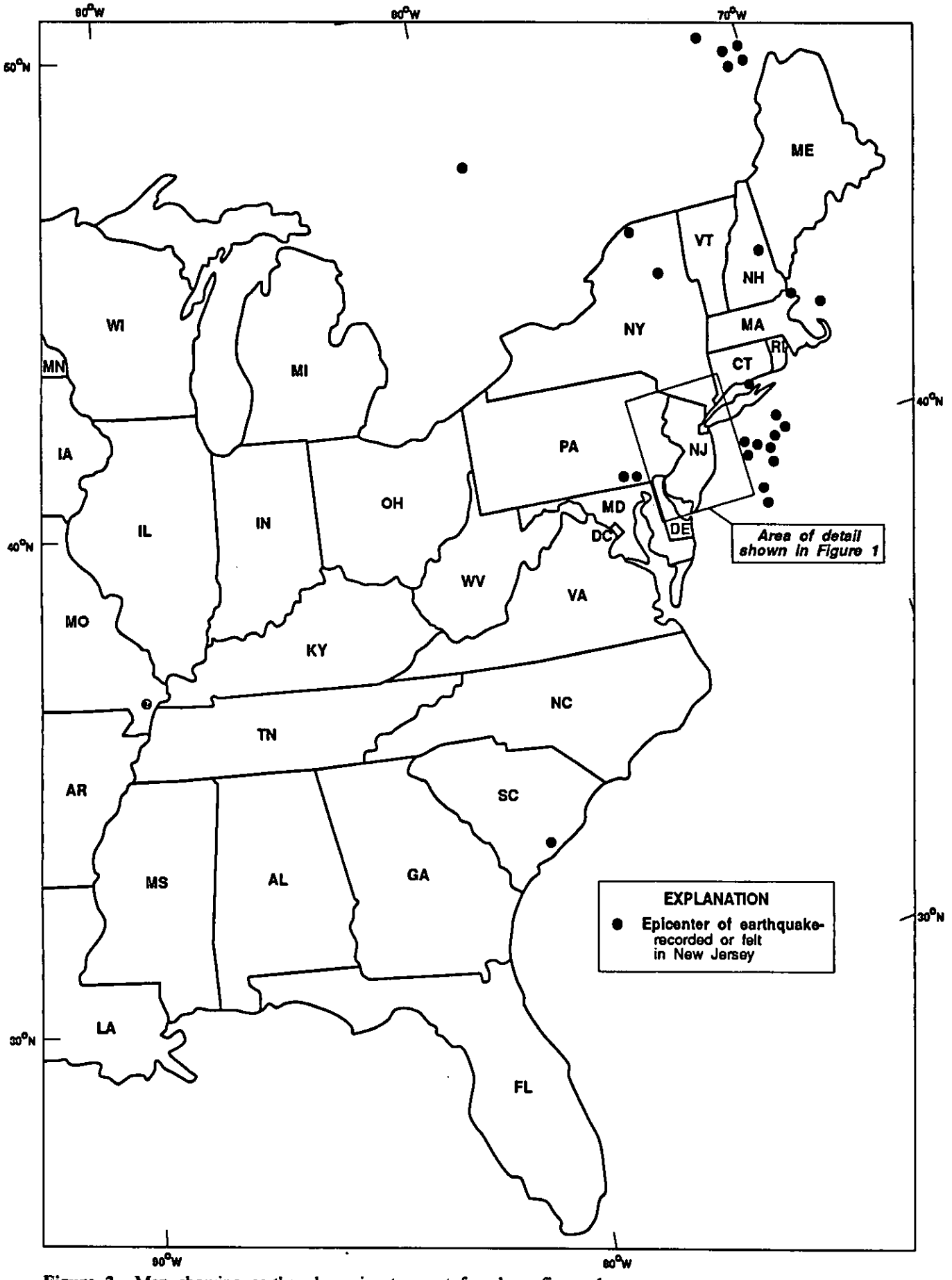

Figure 2. Map showing earthquake epicenters not found on figure 1.

were given explicitly in the source of data; others were measured from isoseismal maps or estimated from felt-report data.

LATITUDE and **LONGITUDE** of epicenter are in degrees and minutes, rounded to the nearest minute.

DEPTH is rounded to the nearest 0.1 kilometer. Some sources reported depth only to the nearest kilometer.

SOURCE OF DATA gives the sources of information for each earthquake.

Acknowledgements

This report was reviewed by Kenneth Woodruff of the Delaware Geological Survey and Russel Such of the Lamont-Dougherty Geological Observatory of Columbia University.

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Table 1. Earthquakes which occurred in or were felt in New Jersey.

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
02/05/1663	17:30	47 36 70 06	St. Lawrence River			felt	75,000		B
11/10/1727	22:40	42 48 70 48	Near Newbury, MA		IX	felt	75,000		B
12/18/1737	23:00	40 48 74 00	Near NY City		VII	felt			A
11/18/1755	04:11	42 30 70 00	E of Cape Ann, MA		VIII	felt	300,000		A
11/29/1783	22:50	41 00 74 30	W of NY City		VI	VI			B
05/18/1804			Felt at NY City		III	felt			B
12/16/1811	03:15	36 36 89 36	New Madrid, MO Many other very strong shocks.	8+	XII	V	2,000,000		A
12/16/1811	09:15	36 36 89 36	New Madrid, MO Equal to 3:15 shock. Dozens of aftershocks.	8+	XII	V	2,000,000		A
01/23/1812	10:00	36 36 89 36	New Madrid, MO Dozens of aftershocks.	8+	XII	V	2,000,000		A
02/07/1812	04:45	36 36 89 36	New Madrid, MO Aftershocks continued for at least a year.	8+	XII	V	2,000,000		A
01/25/1841	a.m.		NY City		III	felt			B
09/02/1847			Felt from RI to Philadelphia, PA		V	felt			B
09/29/1847		40 30 74 00	Near NY City Felt from RI to Philadelphia, PA		V	felt			B
09/09/1848	22:00		Near NY City Felt from RI to Philadelphia, PA		V	felt			B
10/17/1860	06:00	47 30 70 00	Canada		IX	felt	700,000		A
03/05/1861	12:00		Newark, NJ 2 shocks		III	III			B
10/20/1870	11:30	47 24 70 30	Quebec, Canada		IX	felt	1,000,000		B
10/09/1871	09:40	39 42 75 30	Wilmington, DE		VII	felt			A
07/11/1872	05:25	40 54 73 48	New Rochelle, NY		V	felt	100		A
12/10/1874	22:25	40 54 73 48	Westchester County, NY		VI	felt	5,000		A
09/10/1877	09:59	40 06 74 54	Near Burlington, NJ		V	V	300		A
03/25/1879	19:30	39 12 75 30	Delaware River		V	felt	600		A
08/10/1884	14:07	40 36 74 00	Near NY City	5.0	VII	VII	70,000		A
08/31/1886	21:51	32 54 80 00	Charlston, SC	6.9	X	IV	2,000,000		A
03/09/1893	12:30	40 36 74 00	NY City		V	felt			B
09/01/1895	06:09	40 42 74 48	Near High Bridge, NJ		VI	VI	35,000		A
04/23/1910			NJ Coast		IV	IV	2,000		A

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
01/26/1921	18:40	40 00 75 00	Near Riverton, NJ		V	V	150		A
02/28/1925	21:19	47 36 70 30	Canada		VIII	IV	2,000,000		A
06/01/1927	07:20	40 18 74 00	NJ Coast		VII	VII	3,000		A
01/24/1933	21:00	40 12 74 42	Near Trenton, NJ		V	V	600		A
11/01/1935	01:04	46 48 79 06	Canada	6.3	VII	felt	1,000,000		B
09/30/1937	17:08	40 48 74 18	Verona, NJ		III	III			B
05/16/1938	14:25	40 48 74 18	Verona, NJ		III	III			B
07/29/1938	02:44	41 00 73 42	NY City, Westchester and Rockland Counties, NY		felt	felt			B
08/22/1938	22:36	40 06 74 30	Central NJ		V	V	5,000		A
08/27/1938	17:36	40 12 74 24	Felt at Trenton, NJ		III	III			B
12/06/1938	14:38	40 48 74 18	Verona, NJ		III	III			B
09/12/1939	20:22	40 48 74 00	Felt at Union City, NJ		III	III			B
11/14/1939	21:54	39 36 75 12	Salem County, NJ		V	V	6,000		A
12/20/1940	02:27	43 48 71 18	Near Ossipee Lake, NH	5.8	VII	felt	150,000		B
1943	p.m.	41 06 74 12	Mahwah, NJ & Suffern, NY		V	V	5		C
07/24/1943	00:18	40 00 72 42	Off NJ Coast		II	II			B
09/04/1944	23:39	44 54 74 48	Massena, NY	5.9	VIII	felt	175,000		B
04/01/1947	08:25	41 00 74 18	Pompton Lakes, NJ		III	III			B
09/03/1951	20:26	41 12 74 06	Rockland County, NY	4.4	V	felt	5,500		A
08/16/1953	23:22	40 18 74 00	Bergen County, NJ		IV	IV			B
03/31/1954	16:25	40 18 74 00	Monmouth County shoreline, NJ		IV	IV			B
03/23/1957	14:03	40 48 74 48	West-central NJ		VI	VI			A
12/27/1961	12:06	40 12 74 48	PA-NJ border		V	V	150		A
03/06/1962			6 mi. from Ogdensburg, NJ	0.3					C
08/11/1962			12 mi. from Ogdensburg, NJ						C
10/13/1962			Pompton Plains, NJ	1.0					C

[1]Modified Mercalli; Intensities listed as "felt" were unspecified and presumed small.

[2]Sources of data:

A, B, C: Dombroski, 1977, as follows:
A: Eppley, 1965
B: Smith, 1962, 1966
C: Newspaper reports, oral and written communications, etc.

L: Regional Seismicity Bulletins of the Lamont-Doherty Network (1976-88).

N: Bulletins of the Northeastern U.S. Seismic Network (Oct.- Dec.,1975 through Jan.-Mar., 1988).

U: U.S. Geological Survey, National Earthquake Information Center, Earthquakes in the United States, quarterly reports (Jan.-Mar., 1974 through Oct.-Dec.,1982), annual reports (1981 through 1984).

P: U.S. Geological Survey, Preliminary Determination of Epicenters, monthly listings (Feb.,1982 through, Sept.,1990).

Table 1 (continued)

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
12/20/1962			Pompton Plains, NJ	2.0					C
06/24/1963			17 mi. from Ogdensburg, NJ	0.5					
12/10/1968	04:13	40 06 75 00	Near Riverton, NJ	2.9	V	V			C
08/14/1969		41 00 74 36	Lake Hopatcong, NJ (Sbar and others, 1970)	1.0					C
09/14/1969		41 00 74 36	Lake Hopatcong, NJ (Sbar and others, 1970)	1.0					C
10/06/1969		41 00 74 36	Lake Hopatcong, NJ (Sbar and others, 1970)	1.3	IV	IV	13		C
10/10/1969		41 00 74 36	Lake Hopatcong, NJ (Sbar and others, 1970)	1.0					C
11/03/1969		41 00 74 36	Lake Hopatcong, NJ (Sbar and others, 1970)	1.0					C
12/29/1972	01:34	41 00 74 12	Wyckoff, NJ		III	III	10		C
02/05/1973		41 00 74 06	Hohokus, NJ		II	II	5		C
02/28/1973	03:21	39 43 75 26	Northern Salem County, NJ Felt from Mahwah, NJ to Baltimore, MD (Sbar and others, 1975)	3.8	VI	IV	3,000		C
04/28/1974	10:19	39 42 75 42	Wilmington, DE	2.5	IV	felt	5		C
06/09/1974	16:45		Atlantic City to Wildwood, NJ		V	V	100		C
06/17/1974	14:30		Atlantic City to Wildwood, NJ		IV	IV	50		C
09/22/1974	09:00		Atlantic & Ocean Counties, NJ						C
09/23/1974			Atlantic & Ocean Counties, NJ						C
09/25/1974			Atlantic & Ocean Counties, NJ						C
01/19/1975	01:30	41 06 74 06	Mahwah, NJ						C
02/09/1975			W of Bricktown, NJ						C
10/12/1975	03:30	40 18 74 42	Princeton, NJ						C
11/06/1975	noon		Atlantic City, NJ Not detected by seismographs		felt	felt			C
11/09/1975	22:02	41 11 74 23	Greenwood Lake, NJ	1.8				5	N
01/17/1976	10:09	40 59 74 23	Riverdale, NJ					4.3	L
03/11/1976	16:07	41 01 74 23	Riverdale, NJ	2.8	V	V	100	1	N,L,U
03/12/1976	05:28	40 57 74 20	Riverdale, NJ	2.2	felt	felt		4.6	N,L
04/13/1976	10:39	40 48 74 02	Ridgefield, NJ	3.1	V	V	250	3.1	N,L,U
05/11/1976	02:55	40 29 73 48	Offshore of Sandy Hook, NJ Foreshock	1.9					N,L
05/11/1976	08:18	40 29 73 48	Offshore of Sandy Hook, NJ	2.8				1	N,L
06/26/1976	14:45	39 39 72 30	Atlantic Ocean	2.8				1	L
06/26/1976	14:45	39 50 72 29	Atlantic Ocean	2.9					N,L
10/27/1976	20:10	40 53 74 29	Denville, NJ Foreshock	1					N,L

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
10/27/1976	20:13	40 53 74 29	Denville, NJ	1					N,L
10/28/1976	01:47	40 53 74 29	Denville, NJ Aftershock	1					N,L
12/05/1976	08:00	40 48 74 48	Schooleys Mountain, NJ		III	III	2		C
12/05/1976	11:32	40 46 74 46	Schooleys Mountain, NJ	1.8	felt	felt	2	3.4	N,L,C
12/06/1976	23:55	40 46 74 46	Schooleys Mountain, NJ	1.7	felt	felt	2	5.1	N,L,C
12/11/1976	07:26	40 43 74 01	Lower Hudson River Possibly not an earthquake.	1.8				1	L
01/06/1977	19:05	41 01 74 31	Near Green Pond, NJ					19	N,L
01/21/1977	15:50	39 54 74 19	Lakehurst, NJ	2.7				6	N,L
02/10/1977	14:14	39 46 75 32	Wilmington, DE	2.0	V	V	3		N,C
03/10/1977	11:22	41 11 74 09	Suffern, NY	2.2	IV	III	100	6	N,L
06/10/1977	07:48	40 42 74 53	High Bridge, NJ	1.1				6	N,L
07/02/1977	06:13	40 42 74 56	Hampton, NJ	2.3				7.3	N,L
10/27/1977	04:22	41 04 74 35	Sparta, NJ	1.5				6	N,L
11/27/1977	08:57	41 01 74 13	Oakland, NJ	1.8				5	N,L
December 1977			Schooleys Mountain, NJ Dec, 1977. 117 minor shocks read on portable seismographs, none felt. (Yang and others, 1978)						L
12/04/1977	18:50	40 49 74 46	Schooleys Mountain, NJ	1.8	felt	felt			N,L
12/04/1977	18:51	40 49 74 46	Schooleys Mountain, NJ	2.1	felt	felt			N
12/06/1977	12:51	40 49 74 46	Schooleys Mountain, NJ	1.6	felt	felt			N,L
12/07/1977	03:34	40 49 74 46	Schooleys Mountain, NJ	1.7	felt	felt			N,L
12/08/1977	11:35		Schooleys Mountain, NJ	1.5					L
12/22/1977	23:55	40 49 74 46	Schooleys Mountain, NJ	2.3	felt	felt			N,L
12/23/1977	11:20	40 49 74 46	Schooleys Mountain, NJ	1.4	felt	felt			N,L
12/24/1977	05:25	40 49 74 46	Schooleys Mountain, NJ	1.6	felt	felt			N,L
12/25/1977	10:39	40 49 74 46	Schooleys Mountain, NJ	1.5	felt	felt			N,L

[1]Modified Mercalli; Intensities listed as "felt" were unspecified and presumed small.

[2]Sources of data:

A, B, C: Dombroski, 1977, as follows:
A: Eppley, 1965
B: Smith, 1962, 1966
C: Newspaper reports, oral and written communications, etc.

L: Regional Seismicity Bulletins of the Lamont-Doherty Network (1976-88).

N: Bulletins of the Northeastern U.S. Seismic Network (Oct.- Dec.,1975 through Jan.-Mar., 1988).

U: U.S. Geological Survey, National Earthquake Information Center, Earthquakes in the United States, quarterly reports (Jan.-Mar., 1974 through Oct.-Dec.,1982), annual reports (1981 through 1984).

P: U.S. Geological Survey, Preliminary Determination of Epicenters, monthly listings (Feb.,1982 through, Sept.,1990).

Table 1 (continued)

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
12/26/1977	11:54	40 49 74 46	Schooleys Mountain, NJ	1.7	felt	felt			N,L
12/27/1977	05:41		Schooleys Mountain, NJ	1.4					L
1978			Schooleys Mountain, NJ Jan.-Apr., 1978. 11 minor shocks, none felt. No additional data available.						L
02/15/1978	00:28	40 55 74 26	Boonton, NJ	1.6				6	N,L
04/03/1978	18:57	40 32 74 05	Offshore of Sandy Hook, NJ	2.0					N,L
05/17/1978	11:19		Bloomingdale, NJ Heard		felt	felt			L
05/17/1978	20:29	41 01 74 20	Bloomingdale, NJ Heard	1.5	felt	felt		6	N,L
05/18/1978	22:52		Bloomingdale, NJ Heard		felt	felt			L
06/12/1978	23:59	40 60 74 34	Sparta, NJ						L
06/15/1978	23:59	40 59 74 34	Sparta, NJ						N
06/30/1978	15:13	41 05 74 12	Mahwah-Oakland, NJ Heard	2.9	V	V	100	5	N,L,U
06/30/1978	15:14		Oakland, NJ Heard. Aftershock.	2.8					L
06/30/1978	15:15		Oakland, NJ Heard. Aftershock.						L
06/30/1978	17:39	41 05 74 12	Mahwah-Oakland, NJ Heard	2.2	III	III	20	6	N,L,U
01/17/1979	07:56	40 20 73 43	Offshore of Sandy Hook, NJ					1	N,L
01/30/1979	11:30	40 19 74 16	Cheesequake, NJ	3.5	V	V	3,600	5	N,L,U
02/01/1979	20:17	40 47 74 42	Chester, NJ	1.9				1.2	L
02/01/1979	21:26	40 46 74 40	Chester, NJ	1.9	III	III			N,L,U
02/01/1979	21:34	40 45 74 39	Chester, NJ	1.8					L
02/01/1979	22:12		Chester, NJ	1.5					L
02/01/1979	22:14		Chester, NJ	1.0					L
02/01/1979	22:14	40 46 74 40	Chester, NJ						L
02/23/1979	05:21	40 49 74 49	Chester, NJ					12	L
02/23/1979	05:23	40 48 74 49	Chester, NJ		IV	IV		13	L,U
02/23/1979	12:18	40 46 74 43	Chester, NJ	1.8				6.4	L
03/09/1979	23:49	40 43 74 30	Bernardsville, NJ	3.1	V	V	250	3	N,L,U
03/22/1979	07:35	40 54 74 42	Lake Hopatcong, NJ					1	N,L
03/05/1980	12:06	40 10 75 04	Abington, PA	3.5	IV	IV	300	7.9	N,L,U
03/11/1980	01:00	40 09 75 05	Abington, PA	3.7	V	IV	600	5	N,L,U

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
03/25/1980	13:54	40 58 75 01	Hainesburg, NJ	2.8				5	N,L
04/05/1980	06:49	39 50 74 03	S of Seaside, NJ	2.9				6.2	N,L
08/02/1980	12:21	40 26 74 09	Keyport, NJ	3.1				7.6	N,L,U
08/30/1980	04:19	39 50 74 52	Medford, NJ	3.0				2.2	N,L,U
03/19/1981	03:51	40 56 74 22	Boonton, NJ	2.0				9.6	N,L
05/18/1981	02:22	41 06 74 12	Ramsey, NJ	2.1				8.7	N,L
06/21/1981	00:04	41 04 74 35	Denville, NJ	1.8				8.5	N,L
10/21/1981	11:49	41 08 72 34	Long Island Sound, NY	3.5	V	III	6,500	6.4	L,U
03/21/1982	20:09	40 25 73 48	Offshore of Sandy Hook, NJ	1.8				9.3	N,L
03/29/1982	04:37	39 58 73 09	50 mi. offshore of Seaside, NJ	2.0				0.1	N,L
03/29/1982	04:37	40 01 73 10	S of Long Island, NY	2.2				13	N
04/12/1982	17:14	40 03 74 48	Near Mount Holly, NJ	2.4		V	V	7.4	N,L,U,P
07/22/1982	15:49	41 05 74 06	Ramsey, NJ	0.6				10	L
07/28/1982	23:37	39 56 74 06	Seaside Hights, NJ	2.4				10	N,L
09/16/1982	01:36	41 07 74 38	Franklin, NJ	1.6				00.5	N,L
01/14/1983	17:22	38 45 72 53	75 mi. off Atlantic City, NJ	2.2				10	N,L
02/06/1983	04:52	40 38 74 46	Oldwick, NJ Foreshock	1.5				6.2	L
02/19/1983	00:45	40 38 74 46	Oldwick, NJ	2.7		IV	IV	6.1	N,L,U,P
02/21/1983	16:13	39 47 73 12	S of Long Island, NY	2.6				20	N,L
03/19/1983	00:42	39 01 72 53	Offshore	2.2				9.8	L
04/25/1983	05:06	40 17 73 40	S of Long Island, NY	2.0				7.6	N,L
06/01/1983	04:50	40 52 74 31	Dover, NJ	1.5				5.2	N,L
09/06/1983	05:44	40 50 73 58	Fort Lee, NJ	1.5				7.1	N,L
09/08/1983	14:35	40 26 72 07	Offshore	2.9				26	L
09/15/1983	18:17	41 08 74 13	Ringwood, NJ	1.5				9.1	N,L

[1]Modified Mercalli; Intensities listed as "felt" were unspecified and presumed small.

[2]Sources of data:

A, B, C: Dombroski, 1977, as follows:

A: Eppley, 1965

B: Smith, 1962, 1966

C: Newspaper reports, oral and written communications, etc.

L: Regional Seismicity Bulletins of the Lamont-Doherty Network (1976-88).

N: Bulletins of the Northeastern U.S. Seismic Network (Oct.- Dec.,1975 through Jan.-Mar., 1988).

U: U.S. Geological Survey, National Earthquake Information Center, Earthquakes in the United States, quarterly reports (Jan.-Mar., 1974 through Oct.-Dec.,1982), annual reports (1981 through 1984).

P: U.S. Geological Survey, Preliminary Determination of Epicenters, monthly listings (Feb.,1982 through, Sept.,1990).

Table 1 (continued)

Date	Time	Latitude(° ') Longitude(° ')	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
10/07/1983	05:18	43 56 74 15	Blue Mountain Lake area, NY. Felt throughout northeastern U.S. and Canada	5.3	VI	IV	200,000	13	N,P
11/17/1983	14:55	39 44 75 35	Wilmington, DE	2.2	V	felt		4.8	N,P
01/19/1984	18:03	39 43 75 32	Wilmington, DE	2.4	IV	felt	50	4.0	N,U
03/12/1984	01:34	40 16 73 57	Asbury Park, NJ	2.0				10	N
03/31/1984	17:28	40 29 73 50	6 mi. S of Brooklyn, NY	2.1				8	N
04/22/1984	20:36	39 55 76 21	Near Lancaster, PA Felt in 8 states	4.4	VI	IV	22,000	5	U,P
05/12/1984	22:18	40 55 74 32	Mount Hope, NJ	2.1				5.6	N
06/03/1984	02:04	41 00 74 24	Kinnelon, NJ	1.3				0.2	N
06/06/1984	12:44	40 46 74 29	Near Morristown, NJ	1.7				7	N
08/01/1984	20:03	40 53 74 42	Mount Olive, NJ	1.7				5.7	N
10/25/1984	02:18	40 53 74 41	Near Mount Olive, NJ	2.0				7.1	N
12/02/1984	20:52	40 55 74 43	Byram, NJ	1.5				1.0	N
12/13/1984	15:13	40 55 74 43	Byram, NJ	1.7				3.7	N
12/15/1984	09:02	40 53 74 42	Byram, NJ	1.8				7.8	N
12/17/1984	01:52	40 55 74 43	Byram, NJ	1.6				4.8	N
08/20/1985	11:56	39 56 72 27	45 mi. S of Long Island, NY	2.2				0.3	N
10/19/1985	05:07	40 59 73 50	Ardsley, NY. Felt in 6 states and Canada	4.0	VI	V	12,000	6	N,P U
10/21/1985	05:37	40 59 73 50	Ardsley, NY. Felt in NY, NJ and CT	3.3	V	IV	2,000	5	U
02/08/1986	04:18	40 53 74 41	Flanders, NJ	1.7				5.7	N
02/22/1986	23:03	40 46 74 54	Port Murray, NJ	1.8				1.1	N
06/29/1986	01:32	40 57 74 24	Kinnelon, NJ	1.5				4.1	N
07/14/1986	23:22	41 07 74 34	Franklin, NJ	1.5				5.6	N
09/15/1986	17:34	40 08 74 31	Near New Egypt, NJ	2.3				3.5	N
09/15/1986	17:45	40 06 74 48	Near Roebling, NJ	1.9				5	N
11/23/1986	16:29	40 57 74 49	Tranquility, NJ. Felt in Sussex and Warren Counties, NJ	2.8	felt	felt		7.4	N,P
04/24/1987	02:07	40 55 74 44	S of Mohawk Lake, NJ	1.9				3.4	N
05/16/1987	05:01	40 52 74 11	Near Paterson, NJ	1.4				3.1	N
08/04/1987	23:47	40 55 74 48	SW of Newton, NJ	1.7				2.6	N

Date	Time	Latitude(° ′) Longitude(° ′)	Location/Comments	Magnitude	Intensity[1]		Area felt (sq. mi.)	Depth (km)	Sources of data[2]
					Maximum	NJ			
08/05/1987	19:07	40 54 74 47	SW of Newton, NJ	1.1				1.8	N
08/05/1987	19:25	40 55 74 47	SW of Newton, NJ	1.1				2.0	N
12/06/1987	03:36	40 04 74 44	Burlington, NJ	2.1				2.5	N
11/25/1988	18:46	48 07 71 11	Southern Quebec. Felt in NJ and Washington, DC	5.9	VII	felt	600,000	29	P
10/22/1990	20:34	39 31 75 30	Hancock's Bridge, NJ Felt in NJ, DE and PA	3.2	V	V	1,000	10	P

[1]Modified Mercalli; Intensities listed as "felt" were unspecified and presumed small.

[2]Sources of data:

A, B, C: Dombroski, 1977, as follows:

A: Eppley, 1965

B: Smith, 1962, 1966

C: Newspaper reports, oral and written communications, etc.

L: Regional Seismicity Bulletins of the Lamont-Doherty Network (1976-88).

N: Bulletins of the Northeastern U.S. Seismic Network (Oct.- Dec.,1975 through Jan.-Mar., 1988).

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P: U.S. Geological Survey, Preliminary Determination of Epicenters, monthly listings (Feb.,1982 through, Sept.,1990).

Table 2. Nearby out-of-state earthquakes not felt in New Jersey.

Date	Time	Latitude(° ′) Longitude(° ′)	Location /Comments	Magnitude	Maximum Intensity[1]	Area felt (sq. mi.)	Depth (km)	Source of data[2]
05/17/1974	10:08	41 12 75 00	Dingmans Ferry, PA	0.5				C
06/27/1974	11:33	41 18 74 48	Dingmans Ferry, PA	0.5				C
03/05/1976	23:14	41 10 73 49	Ossining, NY				9.2	L
08/20/1976	17:08	41 07 73 54	Mount Pleasant, NY	2.5			6.2	L
09/22/1976	04:04	41 17 73 57	Indian Point, NY	1.8			7.5	L
11/21/1976	23:43	41 00 73 52	Yonkers, NY	1	felt		5	N,L
09/02/1977	00:53	41 19 73 55	Peekskill, NY 1 foreshock, 10 aftershocks	2.4			3	N,L
09/02/1977	08:09	41 19 73 55	Peekskill, NY Aftershock					N
09/02/1977	17:22	41 19 73 55	Peekskill, NY Aftershock					N
09/02/1977	19:04	41 19 73 55	Peekskill, NY Aftershock					N
09/02/1977	19:08	41 19 73 55	Peekskill, NY Aftershock					N
09/14/1977	06:06	41 19 73 55	Peekskill, NY Aftershock					N
09/17/1977	13:47	41 12 74 00	Haverstraw, NY				1	N,L
09/29/1977	13:44	41 19 73 55	Peekskill, NY Aftershock				2	N
10/13/1977	19:09	41 34 73 57	Newberg, NY	2.2				L
12/09/1977	12:33	41 33 73 53	Hopewell Junction, NY	2.3			4.8	L
01/13/1978	00:15	41 24 73 58	West Point, NY				1.6	L
01/14/1978	13:47	41 24 73 58	West Point, NY	1.3			1.0	L
01/15/1978	02:41	41 23 73 58	West Point, NY	1.7			3.4	L
02/10/1978	04:37	41 16 73 59	Tompkins Cove, NY				9.3	L
03/05/1978	02:53	41 21 74 09	Highland Mills, NY	2.1	III		5	N,L,U
07/16/1978	01:39	39 54 76 13	Lancaster, PA	3.1	V			N
07/23/1978	18:02	41 19 73 56	Peekskill, NY	2.1			2.0	L
09/18/1978	23:11	40 59 73 52	Yonkers, NY	1.8			4.6	L
02/11/1979	02:21	41 11 73 45	Near Croton Reservoir, NY	2.0			11	L
06/02/1979	14:20	41 21 74 22	Goshen, NY	3.0				L
12/01/1979	11:14	41 21 74 22	Pine Island, NY	2.0			1	N,L
12/30/1979	09:15	41 09 73 43	Mount Kisco, NY Heard in CT	3.0	IV	200	4.0	L,U
12/30/1979	09:19	41 10 73 43	Mount Kisco, NY	2.2	III		3.7	N

Date	Time	Latitude(° ′) Longitude(° ′)	Location /Comments	Magnitude	Maximum Intensity[1]	Area felt (sq. mi.)	Depth (km)	Source of data[2]
01/17/1980	05:12	41 16 73 55	Peekskill, NY 12 aftershocks	2.4	V	25	5	N,L
01/17/1980	05:13	41 16 73 55	Peekskill, NY Heavy waves on Hudson River	2.9	V	25	3.3	N,L,U
03/02/1980	06:54	40 13 75 05	Abington, PA	2.8				N,L
03/05/1980	12:20	40 11 75 04	Abington, PA	3.1			5	N,L
03/11/1980	11:16	40 15 74 59	Abington, PA	2.8			1.8	N,L
04/24/1980	19:23	41 21 74 22	Florida, NY	2.4				N
05/02/1980	10:23	40 10 74 59	Langhorn (Abington), PA	2.8			5	N
05/02/1980	14:02	40 14 75 02	Jamison (Abington), PA	3.0				N,L
05/06/1980	23:32	41 01 73 52	Ardsley, NY	2.6				N,L
05/11/1980	20:38	41 17 74 08	Harriman, NY	2.4			5.9	L
05/20/1980	16:33	41 21 74 22	Florida, NY	2.6			2.3	N
09/03/1980	23:30	41 07 73 47	Thornwood, NY	3.2	IV		13	N,L,U
09/26/1980	19:48	41 32 73 41	Pawling, NY	2.5			5.5	L
10/15/1980	12:02	41 15 73 53	W of Croton Reservoir, NY	1.5			2	L
12/12/1980	18:04	41 18 73 55	Annsville, NY	2.3			15	L
07/31/1981	10:51	40 11 74 59	NE of Philadelphia, PA	1.8			0.7	L
08/20/1981	11:00	40 17 75 07	NE of Philadelphia, PA	2.1			2.0	L
12/13/1981	11:55	41 07 73 54	Rockland Lake, NY	1.0			12	L
08/17/1982	23:30	41 07 74 09	Suffern, NY	1.8			6.0	N,L
01/21/1983	16:21	40 57 73 40	Rye, NY	2.2			0.2	N,L
02/26/1983	14:59		Pawling, NY	3.0	VI		6.7	L,P
02/26/1983	15:16	41 33 73 41	Pawling, NY Aftershock	1.2			6	L
03/02/1983	15:16	41 33 73 41	Pawling, NY Aftershock	1.6			7.2	L
03/26/1983	23:45	41 09 73 51	Ossining, NY	1.0			10	L
04/04/1983	20:07	41 02 73 40	Greenwich, CT	1.4			14	L
04/12/1983	03:06	39 51 75 27	Near Wilmington, DE	2.4			7.2	L
05/05/1983	00:30	41 25 73 51	Candlewood Hill, Canopus Lake, NY	1.0			13	L

[1]Modified Mercalli; Intensities listed as "felt" were unspecified and presumed small.

[2]Sources of data:

A, B, C: Dombroski, 1977, as follows:
A: Eppley, 1965
B: Smith, 1962, 1966
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Table 2 (continued)

Date	Time	Latitude(° ′) Longitude(° ′)	Location /Comments	Magnitude	Maximum Intensity[1]	Area felt (sq. mi.)	Depth (km)	Source of data[2]
07/28/1983	06:55	41 05 73 35	Stamford, CT	1.9			2.8	L
08/28/1983	20:46	40 57 73 42	Mamaroneck, NY	0.8			8.9	L
09/12/1983	21:46	41 16 73 58	Verplank, NY	1.4			11	L
09/12/1983	22:53	41 16 73 58	Verplank, NY	1.9			10	L
12/12/1983	00:15	39 50 75 40	NW of Wilmington, DE	2.0	felt		5	P
12/22/1983	18:47	41 05 73 58	West Nyack, NY	0.5			16	N
01/26/1985	14:06	40 59 73 49	Ardsley, NY. Felt in Westchester Co., NY	2.2	IV	20	5.2	N,P,U
03/21/1985	21:35		Lancaster County, PA		III			U
05/09/1985	21:47	40 59 73 50	Ardsley, NY	1.8			5.6	N
10/10/1985	20:47	39 46 75 34	Wilmington, DE Felt in Wilmington area	1.9	felt			U
10/20/1985	02:55	39 46 75 33	Wilmington, DE Felt Wilmington area.	1.7	felt			U
01/04/1986	22:35	40 59 73 49	S of Ardsley, NY	2.5	IV		6.4	N,P
03/28/1986	22:42	40 59 73 50	S of Ardsley, NY	1.5			6.3	N
04/22/1986	02:28	40 59 73 49	S of Ardsley, NY	2.7	IV		5.3	N,P
05/02/1986	08:54	39 44 75 39	Wilmington, DE	2.5			.01	N
10/05/1986	13:08	41 13 74 01	Thiells, NY	1.8			10	N
11/29/1986	15:01	41 19 73 54	Peekskill, NY	1.0			11	N
12/20/1986	08:15	40 60 73 50	S of Ardsley, NY	1.9	felt		5.0	N,P
01/13/1987	07:27	40 60 73 50	Ardsley, NY	0.9			4.2	N
02/22/1987	14:20	41 19 73 55	Annsville, NY	-0.2			1.0	N
05/03/1987	07:19	41 20 73 55	Annsville, NY	1.1			9.3	N
09/30/1987	02:14	41 06 73 57	Rockland Lake, NY	1.7			7.2	N
11/20/1987	00:54	41 24 73 50	Peekskill, NY	1.1			7.7	N

[1]Modified Mercalli; Intensities listed as "felt" were unspecified and presumed small.

[2]Sources of data:
A, B, C: Dombroski, 1977, as follows:
A: Eppley, 1965
B: Smith, 1962, 1966
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