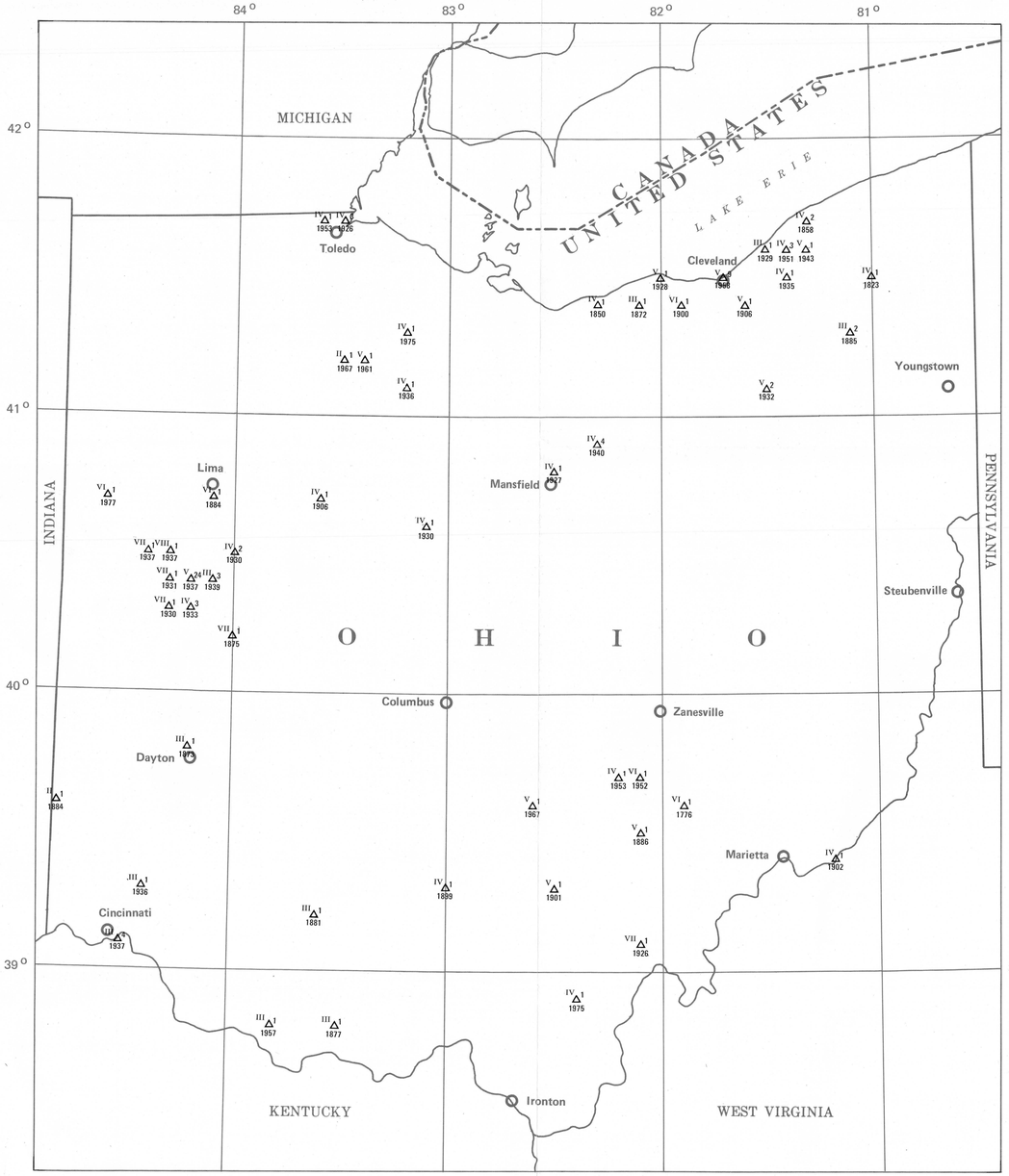
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



SEISMICITY MAP OF THE STATE OF OHIO

By

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1979

MISCELLANEOUS FIELD STUDIES
MAP MF- 1142
SEISMICITY MAP, OHIO

INTRODUCTION

The earthquake data shown on this map and listed in table 1 are a list of earthquakes that were originally used in preparing the Seismic Risk Studies in the United States (Algermissen, 1969) which have been recompiled and updated through 1977. The data have been reexamined and intensities assigned where none had been assigned before, on the basis of available data. Other intensity values were updated from new and additional data sources that were not available at the time of original compilation. Some epicenters were relocated on the basis of new information. The data shown in table 1 are estimates of the most accurate epicenter, magnitude, and intensity of each earthquake, on the basis of historical and current information. Some of the aftershocks from large earthquakes are listed but are incomplete in many instances, especially for ones that occurred before seismic instruments were in universal usage.

The data in table 1 were used to compile the seismicity map. The latitude and longitude were rounded to the nearest tenth of a degree and sorted so that all identical locations were grouped together and counted. A triangle represents the epicenter plotted to a tenth of a degree. The number of earthquakes at each location is shown on the map by the number to the right of the triangle. A Roman numeral to the left of a triangle is the maximum Modified Mercalli intensity (Wood and Neumann, 1931) of all earthquakes located at that geographic position. The absence of an intensity value indicates that no intensities have been assigned to earthquakes at that location. A year shown below a triangle is the latest year for which the maximum intensity was recorded.

EXPLANATION OF THE TABLES

The data are listed chronologically in table 1 in the following categories: date, origin time, N. latitude, W. longitude, depth, hypocenter quality and referenced data sources, magnitude, and intensity (Modified Mercalli) and intensity source references. Table 1 has some basic limitations in terms of the size (magnitude or intensity) of the earthquakes listed. Prior to 1965 all recorded felt earthquakes are listed, after 1965 only felt earthquakes or those with magnitudes above the 2.5-3.0 range are listed; the lower magnitude levels apply mostly to the eastern United States. The low magnitude events located in recent years with dense seismograph networks have not been included.

Listed below is an explanation of the symbols and codes used in the tables:

1. Leaders (..) indicate information not available.
2. Latitude and longitude are listed to a hundredth of a degree if they have been published with that degree of accuracy, or greater; however, most historical events have been published only to the nearest degree or tenth of a degree and are therefore listed at this accuracy in table 1. An asterisk (*) to the right of the longitude indicates that the latitude and longitude were not given in the source reference, but were assigned by the compilers of the data file. An (x) to the right of the longitude indicates that the event is an explosion, a suspected explosion, rockburst, or a nontectonic event; these have not been plotted on the map.
3. The letter code in the HYPOCENTER, QUAL column is defined below:
   a. Determination of instrumental hypocenters are estimated to be accurate within the ranges of latitude and longitude listed below; each range is letter coded as indicated:

A	0.0°-0.1°
B	0.1°-0.2°
C	0.2°-0.5°
D	0.5°-1.0°
E	1.0° or larger

   b. Determination of noninstrumental epicenters from felt data are estimated to be accurate within the ranges of latitude and longitude listed below; each range is letter coded as indicated:

F	0.0°-0.5°
G	0.5°-1.0°
H	1.0°-2.0°
I	2.0° or larger

4. The reference identification numbers in the HYPOCENTER, REF and INTENSITY, REF columns indicate the sources of the hypocenter and intensity. They are listed in numerical order in table 2.
5. The magnitudes listed under "USGS" are mb values (Gutenberg and Richter, 1956) published in the Preliminary Determination of Epicenters (PDE) by the National Earthquake Information Service, U. S. Geological Survey and predecessor organizations. Associated with the magnitude values listed under "OTHER" are the source code and type. Type is defined by 1 = ML (Richter, 1958), 2 = mbLg (Nuttli, 1973), 3 = MS (Bath, 1966), and 4 = mb (Gutenberg and Richter, 1956). The source codes are listed below:
   AAM - University of Michigan, Ann Arbor, MI.
   GR - Seismicity of the Earth and Associated Phenomena, B. Gutenberg and C. F. Richter, 1954, 310 p.
   OTT - Earth Physics Branch, Seismological Service of Canada, Ottawa.
   SLM - St. Louis University, St. Louis, Mo.
6. An asterisk (*) in the INTENSITY, MM column indicates that the intensity was assigned by the compiler on the basis of the available data at the time the catalog was compiled.

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ACKNOWLEDGEMENTS

We thank Michael C. Hansen, Ohio Geological Survey for useful discussions and interchange of data.

Table 1.--Chronological listing of Earthquakes for the State of Ohio

DATE YEAR	MONTH	DAY	ORIGIN TIME(UTC) H	M	S	LAT. (N.)	LONG. (W.)	DEPTH (KM)	HYPOCENTER QUAL	REF	MAGNITUDE USGS	OTHER	INTENSITY MM	REF
1776	...	..	14	00	..	39.6	81.9	..	I	116	..	.. ..	VI	60
1823	MAY	30	..	..	..	41.5	81.0	..	I	76	..	.. ..	IV	76
1836	JUL	08	..	..	..	41.5	81.7	..	I	120	..	.. ..	IV	120
1850	OCT	01	..	..	..	41.4	82.3	..	I	120	..	.. ..	IV	120
1857	FEB	28	..	..	..	41.7	81.3	..	H	105	..	.. ..	IV	105
1858	APR	16	12	..	..	41.7	81.3	..	H	105	..	.. ..	IV	105
1867	JAN	13	..	..	..	41.5	81.7	..	I	120	..	.. ..	III	120
1872	JUL	23	..	..	..	41.4	82.1	..	G	116	..	.. ..	III	60
1873	APR	23	04	14	..	39.8	84.2	..	H	116	..	.. ..	III*	105
1875	JUN	18	12	43	..	40.2	84.0	..	G	38	..	.. ..	VII	38
1876	JUN	..	..	..	..	40.4	84.2	..	H	105	..	.. ..	IV*	60
1877	JAN	23	21	..	..	38.8	83.5	..	H	105	..	.. ..	III	60
1881	AUG	30	05	..	..	39.2	83.6	..	H	116	..	.. ..	III	105
1882	FEB	09	20	..	..	40.4	84.2	..	H	105	..	.. ..	V	38
1883	JAN	06	08	..	..	40.4	84.2 *	..	H	105	..	.. ..	II*	105
1884	MAR	31	19	..	..	39.6	84.8	..	H	116	..	.. ..	II	105
1884	SEP	19	19	14	..	40.7	84.1	..	G	38	..	.. ..	VI	38
1884	DEC	23	23	..	..	40.4	84.2	..	H	105	..	.. ..	III	60
1885	JAN	18	11	30	..	41.3	81.1	..	H	105	..	.. ..	III*	105
1885	AUG	15	05	05	..	41.3	81.1	..	H	105	..	.. ..	III*	105
1886	MAY	03	02	30	..	39.5	82.1	..	H	105	..	.. ..	V*	131
1889	SEP	..	..	..	..	40.4	84.2	..	H	105	..	.. ..	III	105
1892	...	..	..	..	..	40.4	84.2	..	H	105	..	.. ..	IV*	60
1896	MAR	15	07	..	..	40.3	84.2	..	G	105	..	.. ..	IV	60
1898	OCT	23	..	..	..	41.5	81.7	..	H	105	..	.. ..	III	116
1899	NOV	12	11	..	..	39.3	83.0	..	H	116	..	.. ..	IV	105
1900	APR	09	14	..	..	41.4	81.9	..	G	116	..	.. ..	VI	105
1901	MAY	17	06	00	..	39.3	82.5	..	G	38	..	.. ..	V	38
1902	JUN	14	07	..	..	39.4	81.2	..	G	116	..	.. ..	IV	116
1906	APR	20	18	30	..	41.5	81.7	..	H	105	..	.. ..	IV	105
1906	APR	23	07	12	..	40.7	83.6	..	H	105	..	.. ..	IV	116
1906	JUN	27	21	10	..	41.4	81.6	..	G	38	..	.. ..	V	38
1907	APR	12	19	28	..	41.5	81.7	..	H	105	..	.. ..	III	173
1914	...	..	..	..	..	40.4	84.2	..	H	105	..	.. ..	III	105
1925	MAR	27	04	06	..	40.4	84.2	..	H	116	..	.. ..	V	60
1925	APR	04	..	..	..	39.1	84.5	..	G	105	..	.. ..	II*	60
1925	OCT	..	..	..	..	40.4	84.2	..	G	105	..	.. ..	III	105
1926	OCT	28	07	42	..	41.7	83.5	..	G	116	..	.. ..	III	60
1926	OCT	28	10	00	..	41.7	83.5	..	G	116	..	.. ..	IV	60
1926	NOV	05	14	53	..	39.7	82.1	..	G	38	..	.. ..	VI	38
1927	JAN	29	..	..	..	40.9	81.2 x	..	H	121	..	.. ..	V	121
1927	FEB	17	05	30	..	40.8	82.5	..	G	116	..	.. ..	V	60
1928	SEP	09	21	..	..	41.5	82.0	..	G	1	..	.. ..	V	60
1928	OCT	27	..	..	..	40.4	84.1	..	G	116	..	.. ..	III	60
1929	MAR	08	09	06	..	40.4	84.2	..	C	38	..	.. ..	V	38
1929	JUN	10	..	..	..	41.5	81.7	..	G	105	..	.. ..	III	60
1929	SEP	17	19	16	..	41.6	81.5	..	G	116	..	.. ..	III	173
1930	JUN	26	21	45	..	40.5	84.0	..	G	3	..	.. ..	IV	60
1930	JUN	27	07	23	..	40.5	84.0	..	G	3	..	.. ..	IV	60
1930	JUL	11	00	15	..	40.6	83.1	..	G	105	..	.. ..	IV	60
1930	SEP	29	22	50	..	40.3	84.2	..	G	60	..	.. ..	III	60
1930	SEP	30	20	40	..	40.3	84.3	..	C	38	..	.. ..	VII	38
1930	OCT	..	..	..	..	40.4	84.2	..	G	116	..	.. ..	III	60
1931	MAR	21	15	48	..	40.4	84.2	..	G	105	..	.. ..	III	60
1931	APR	01	00	15	..	40.4	84.1	..	G	105	..	.. ..	III	60
1931	JUN	10	08*	30	..	41.3	84.0 x	..	G	..	..	.. ..	V	105
1931	SEP	20	23	05	03.5	40.43	84.26	005	C	176	..	.. ..	VII	38
1931	OCT	08	14	30	..	40.4	84.2	..	G	105	..	.. ..	III	60
1932	JAN	21	..	..	..	41.1	81.5	..	G	105	..	.. ..	V	105
1933	FEB	23	03	20	..	40.3	84.2	..	G	105	..	.. ..	IV	105
1935	MAY	26	..	..	..	41.5	81.4	..	H	121	..	.. ..	III	60
1936	JAN	31	07	30	..	41.1	83.2	..	G	116	..	.. ..	IV	105
1936	OCT	08	16	30	..	39.3	84.4	..	G	105	..	.. ..	III	60
1936	DEC	26	01	15	..	39.1	84.5	..	G	105	..	.. ..	III	60
1936	DEC	26	02	05	..	39.1	84.5	..	G	105	..	.. ..	III	60
1937	MAR	02	14	47	33.3	40.51	84.38	000	B	176	..	.. ..	VII	38
1937	MAR	03	09	50	..	40.4	84.2	..	G	116	..	.. ..	V	60
1937	MAR	03	09	55	..	40.4	84.2	..	G	116	..	.. ..	III	60
1937	MAR	09	05	44	35.7	40.48	84.30	009	B	176	..	5.5GR 3	VIII	38
1937	APR	23	17	15	..	40.4	84.2	..	G	116	..	.. ..	III	60
1937	APR	27	17	..	..	40.4	84.2	..	G	116	..	.. ..	III	60
1937	MAY	02	17	05	..	40.4	84.2	..	G	116	..	.. ..	V	105
1937	OCT	17	04	25	..	39.1	84.5	..	G	105	..	.. ..	III	60
1939	MAR	18	11	..	..	40.4	84.2 *	..	G	60	..	.. ..	II	60
1939	MAR	18	13	03	..	40.4	84.1	..	G	105	..	.. ..	III	60
1939	JUN	18	02	20	..	40.4	84.2	..	G	116	..	.. ..	IV	60
1939	JUL	09	11	50	..	40.4	84.2	..	G	116	..	.. ..	II	60
1940	MAY	31	17	00	..	41.1	81.5	..	G	105	..	.. ..	II	60
1940	JUN	16	02	30	..	40.9	82.3	..	G	105	..	.. ..	IV	105
1940	JUL	28	09	30	..	40.9	82.3	..	G	105	..	.. ..	III	105
1940	AUG	15	10	35	..	40.9	82.3	..	G	105	..	.. ..	III	105
1940	AUG	19	03	30	..	40.9	82.3	..	G	105	..	.. ..	III	105
1943	MAR	09	03	25	25.0	41.61	81.33	005	B	176	..	5.5OTT 1	V	105
1944	NOV	13	11	52	..	40.4	84.2	..	G	116	..	.. ..	III	60
1948	JAN	18	..	..	..	41.7	83.5	..	G	116	..	.. ..	III	60
1950	APR	20	..	..	..	39.8	84.2 x	..	G	116	..	.. ..	IV	105
1951	DEC	03	07	02	..	41.6	81.4	..	G	116	..	.. ..	IV	24
1951	DEC	07	21	..	..	41.6	81.4 *	..	G	60	..	.. ..	II	60
1951	DEC	21	20	..	..	41.6	81.4	..	G	116	..	.. ..	II	60
1952	JUN	20	09	38	09.4	39.72	82.09	013	B	176	..	.. ..	VI	38
1953	MAY	07	23	32	..	39.7	82.2 *	..	G	60	..	.. ..	IV	60
1953	JUN	12	04	45	..	41.7	83.6	..	G	105	..	.. ..	IV	26
1955	MAY	26	18	09	..	41.5	81.7	..	G	38	..	.. ..	V	38
1955	JUN	29	01	15	33	41.5	81.7	..	G	38	..	.. ..	V	38
1956	JAN	27	12	03	26	40.4	84.2	..	G	105	..	4.4OTT 1	V	38
1957	JUL	23	13	03	..	38.8	83.8	..	G	105	..	.. ..	III	105
1958	MAY	01	22	46	31	41.5	81.7	..	G	38	..	.. ..	V	38
1961	FEB	22	09	45	03	41.2	83.4	..	G	38	..	.. ..	V	38
1967	APR	08	05	40	30.7	38.64	82.56	007	B	176	4.5	3.5GS 2	V	38
1968	JUL	26	15	02	53.7	40.4	84.2	..	F	122	3.0	.. ..	III	122
1974	SEP	29	02	26	18.2	41.16	83.49	000	A	176	..	3.0SLM 2	II	93
1975	FEB	03	10	31	..	41.3	83.2 *	..	F	87	..	.. ..	IV	87
1975	FEB	16	23	21	33.6	39.86	82.38	000	B	176	4.4	3.3SLN 2	IV	87
1977	MAR	09	08	48	17.1	41.0	83.5 x	000	A	97	..	.. ..	V	97
1977	JUN	17	15	39	47.3	40.71	84.58	005	A	94	..	3.2AAM 2	VI	94

MODIFIED MERCALLI INTENSITY SCALE OF 1931

Adapted from Sieberg's Mercalli-Cancani scale, modified and condensed.

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 when 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, swung 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 chimneys in some instances. Broke dishes, glassware, in considerable quantity, also some windows. Fall of knick-knacks, 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 stream banks. Rang large church bells, etc. Suspended objects made to quiver. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary buildings, considerable 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 roof-line (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: racked, tumbled down, wooden houses in some cases; 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 when loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and stream banks. Landslides considerable from river banks 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 dams, dikes, embankments. Severe to well-built wooden 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, pipe lines 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 sea-waves ("tidal" waves) of significant magnitude. Damage severe to wood-frame 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 pipe lines 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 river banks, 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.

Table 2.—List of data sources

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