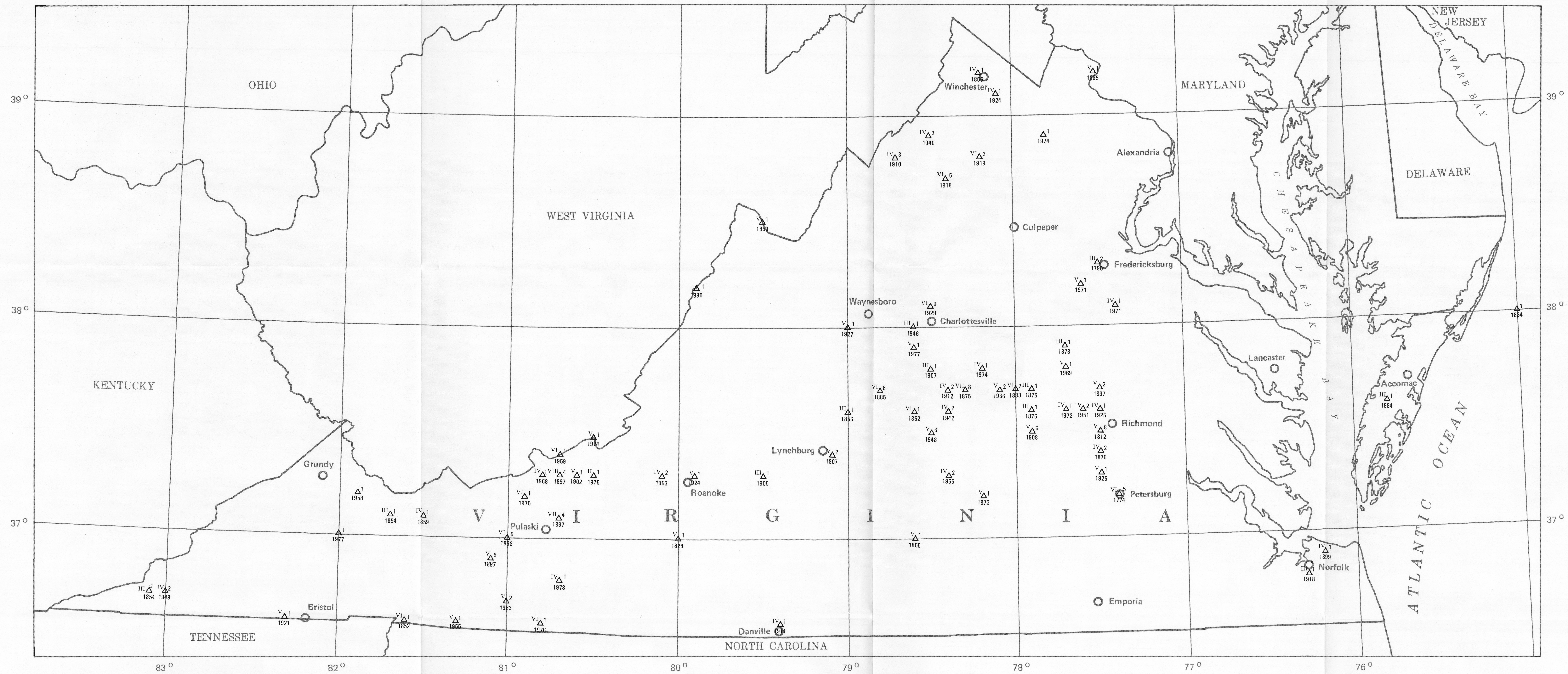
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

MISCELLANEOUS FIELD STUDIES
MAP MF-1346



SCALE 1:1 000 000

25 0 25 50 MILES

25 0 25 50 KILOMETERS

INTRODUCTION

The data shown on this map and listed in table 1 are for earthquakes that were originally included in a study of seismic risk in the United States (Algermissen, 1969). This data file has been recompiled and updated through 1980. Some revisions of epicenters and intensities in the original file have been made, and intensities have been assigned to earthquakes that previously had none assigned. Only earthquakes that had epicenters within the boundary of the State are listed in table 1, even though earthquakes that had epicenters in bordering states or countries may have been felt or may have caused damage in the State. Intensity values were updated from 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 represent best estimates of the 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 not all, especially for the earthquakes that occurred before seismic intruments were universally used.

The data in table 1 were used to compile the seismicity map. The latitude and longitude coordinates of each epicenter were rounded to the nearest tenth of a degree, and the number of events that had identical locations were counted. The triangles on the map represent epicenters plotted to the nearest 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 at that geographic location. The absence of an intensity value indicates that no intensities have been assigned to earthquakes at that location. The four-digit number shown below each 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 in Coordinated Universal Time (UTC), N. latitude, W. longitude, depth, hypocenter quality and referenced data sources, magnitude, and intensity (Modified Mercalli) and intensity source references. The letter F is recorded in the intensity column if an earthquake was felt but not enough information was available to assign an intensity. Table 1 has some basic limitations in terms of the size (magnitude or intensity) of the earthquakes listed. All felt earthquakes or those with magnitudes greater than the 2.5-3.0 range are listed. If no magnitude was computed and the earthquake was felt or an epicenter published it was included in the earthquake list. The low-magnitude events located in recent years with data from dense seismograph networks have not been included.

Listed below is an explanation of the symbols and codes used in table 1:

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 assigned locations based on felt or damage information and are listed in table 1 only to the nearest degree or tenth of a degree. 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, a 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. Determinations 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. Determinations 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 or Gutenberg, 1945), 4 = mb (Gutenberg and Richter, 1956), 5 = mbLg modified, 6 = duration or coda length, 7 = m3Hz (Lawson and others, 1979), 8 = magnitude based on felt areas or attenuation, and 9 = unknown. The source codes are listed below:
   BLA - Virginia Polytechnic Institute and State University, Blacksburg, Va.
   DEW - Dewey, J. W., and Gordon, D. W., 1983, unpublished data.
   GB - Bollinger, G. A., 1979, Seismological Society of America Bulletin, v. 69, no. 1, p. 45-63.
   JLM - Jones, F. B., Long, L. T., and McKee, J. H., 1977, Seismological Society of America Bulletin, v. 67, no. 6, p. 1503-1513.
   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.

REFERENCES

Algermissen, S. T., 1969, Seismic risk studies in the United States: Fourth World Conference on Earthquake Engineering, Santiago, Chile, January 13-18, 1969, Proceedings, v. 1, p. 14-27.
Bath, Markus, 1966, Earthquake energy and magnitude, in Physics and chemistry of the Earth, v. 7: Oxford and New York, Pergamon Press, p. 115-165.
Gutenberg, Beno, 1945, Amplitudes of surface waves and magnitudes of shallow earthquakes: Seismological Society of America Bulletin, v. 35, no. 1, p. 3-12.
Gutenberg, Beno, and Richter, C. F., 1956, Magnitude and energy of earthquakes: Annali di Geofisica, v. 9, no. 1, p. 1-15.
Lawson, J. E., Jr., Luza, K. V., DuBois, R. L., and Foster, P. H., 1979, Inventory, detection, and catalog of Oklahoma earthquakes: Norman, Okla., Oklahoma Geological Survey, text accompanying Map GM-19, 15 p.
Nuttli, O. W., 1973, Seismic wave attenuation and magnitude relations for eastern North America: Journal of Geophysical Research, v. 78, no. 5, p. 876-885.
Richter, C. F., 1958, Elementary seismology: San Francisco, W. H. Freeman and Co., Inc., 768 p.
Wood, H. O., and Neumann, Frank, 1931, Modified Mercalli Intensity Scale of 1931: Seismological Society of America Bulletin, v. 21, no. 4, p. 277-283.

MODIFIED MERCALLI INTENSITY SCALE OF 1931

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, 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 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 1.--Chronological listing of earthquakes for the State of Virginia

D A T E			ORIGIN TIME(UTC)			LAT.	LONG.	DEPTH	HYPOCENTER		MAGNITUDE		INTENSITY	
YEAR	MONTH	DAY	H	M	S	(N.)	(W.)	(KM)	QUAL	REF	USGS	OTHER	MM	REF
1774	FEB	21	19	11	..	37.2	77.4 *	..	G	314	..	.. ..	VI*	55
1774	FEB	21	19	45	..	37.2	77.4 *	..	G	314	..	.. ..	V*	314
1774	FEB	22	19	..	..	37.2	77.4 *	..	G	314	..	.. ..	IV	86
1775	MAR	16	19	15	..	37.7	78.8	..	H	167	..	.. ..	IV*	167
1775	MAR	17	00	15	..	37.7	78.8	..	H	167	..	.. ..	III*	167
1775	AUG	30	07	..	..	37.7	78.8	..	H	86	..	.. ..	III*	167
1789	NOV	19	11	..	..	38.3	77.5	..	G	86	..	.. ..	III*	55
1791	JAN	13	09	..	..	37.7	78.8	..	H	86	..	.. ..	IV	167
1791	JAN	15	10	..	..	37.5	77.5 *	..	G	55	..	.. ..	IV*	55
1795	FEB	12	01	..	..	38.3	77.5 *	..	G	55	..	.. ..	III*	55
1801	FEB	11	02	..	..	37.4	79.2 x	..	I	86	..	.. ..	III*	55
1802	AUG	23	10	..	..	37.4	79.1 *	..	H	55	..	.. ..	V	167
1807	MAY	01	09	..	..	37.4	79.1 *	..	H	55	..	.. ..	V	167
1812	FEB	02	14	30	..	37.5	77.5 *	..	G	55	..	.. ..	V*	55
1812	APR	22	09	..	..	37.5	77.5 *	..	G	167	..	.. ..	IV	167
1826	AUG	10	02	..	..	37.5	77.5 *	..	G	55	..	.. ..	II*	55
1826	AUG	10	17	..	..	37.5	77.5 *	..	G	55	..	.. ..	II*	55
1828	MAR	10	03	..	..	37.0	80.0 *	..	H	55	..	.. ..	V	55
1833	AUG	27	11	..	..	37.7	78.0 *	..	H	179	..	.. ..	VI	179
1850	OCT	17	..	..	..	37.3	78.4 *	..	G	55	..	.. ..	IV*	167
1852	APR	29	18	..	..	36.6	81.6	..	G	86	..	.. ..	VI	55
1852	NOV	02	23	35	..	37.6	78.6 *	..	H	55	..	.. ..	VI	167
1853	JAN	30	..	..	..	38.9	78.5 x	..	G	167	..	.. ..	III*	167
1853	MAY	02	14	20	..	38.5	79.5 *	..	H	167	..	.. ..	V	38
1854	JAN	29	23	..	..	36.7	83.1 *	..	G	291	..	.. ..	III*	291
1854	NOV	22	21	..	..	37.1	81.7 *	..	G	55	..	.. ..	III	167
1855	FEB	02	08	..	..	37.0	78.6 *	..	G	38	..	.. ..	V	38
1856	JAN	16	08	..	..	39.2	78.2 *	..	G	55	..	.. ..	IV	167
1856	MAR	21	14	..	..	37.6	79.0 *	..	G	55	..	.. ..	III*	55
1859	MAR	22	..	..	..	37.1	81.5 *	..	G	55	..	.. ..	IV*	55
1872	MAR	01	..	..	..	36.8	79.4 x	..	H	167	..	.. ..	III*	55
1872	JUN	05	03	..	..	37.7	78.0 *	..	H	55	..	.. ..	IV*	55
1873	OCT	03	12	45	..	37.2	78.2	..	G	86	..	.. ..	IV	167
1875	MAR	10	17	00	..	37.7	77.9 *	..	G	55	..	.. ..	III	167
1875	DEC	23	04	45	..	37.7	78.3 *	..	G	55	..	.. ..	VII	86
1875	DEC	23	..	..	..	37.7	78.3 *	..	G	55	..	.. ..	II*	55
1875	DEC	26	17	..	..	37.5	77.9 *	..	G	55	..	.. ..	III*	55
1876	JAN	03	02	30	..	37.6	77.9	..	G	86	..	.. ..	III	167
1876	DEC	21	15	30	..	36.9	81.1	..	G	86	..	.. ..	II*	55
1876	DEC	23	04	45	..	37.4	77.5	..	G	86	..	.. ..	IV*	55
1876	DEC	23	08	..	..	37.4	77.5 *	..	G	55	..	.. ..	IV*	55
1878	JAN	03	00	..	..	37.9	77.7 *	..	H	55	..	.. ..	III*	55
1879	SEP	01	12	..	..	36.9	81.1 *	..	G	167	..	.. ..	II*	167
1882	APR	02	..	..	..	38.6	78.7 x	..	H	55	..	.. ..	IV*	55
1884	MAR	30	01	00	..	37.6	75.8 *	..	H	55	..	.. ..	III*	55
1884	AUG	15	..	..	..	38.0	75.0	..	H	86	..	.. ..	...	..
1885	JAN	03	02	12	..	39.2	77.5	..	G	38	..	.. ..	V	38
1885	FEB	02	12	10	..	36.9	81.1	..	G	86	..	.. ..	IV	86
1885	OCT	10	04	35	..	37.7	78.8	..	G	55	..	.. ..	VI	38
1885	OCT	10	05	35	..	37.7	78.8 *	..	G	55	..	.. ..	III*	55
1897	MAY	03	17	18	..	37.1	80.7	..	G	55	..	.. ..	VII	55
1897	MAY	03	19	..	..	37.1	80.7 *	..	G	71	..	.. ..	III*	71
1897	MAY	03	21	10	..	37.1	80.7 *	..	G	55	..	.. ..	III*	55
1897	MAY	03	23	..	..	37.1	80.7 *	..	G	55	..	.. ..	III*	55
1897	MAY	31	18	58	..	37.3	80.7	..	G	55	..	.. ..	VIII	190
1897	JUN	29	03	..	..	37.3	80.7 *	..	G	55	..	.. ..	IV*	55
1897	SEP	04	11	..	..	36.9	81.1	..	G	86	..	.. ..	III*	55
1897	OCT	22	03	20	..	36.9	81.1	..	G	55	..	.. ..	V	55
1897	NOV	27	20	56	..	37.7	77.5	..	G	86	..	.. ..	IV*	167
1897	DEC	18	23	45	..	37.7	77.5	..	G	55	..	.. ..	V	55
1898	FEB	05	20	..	..	37.0	81.0	..	G	86	..	.. ..	VI	38
1898	FEB	06	02	..	..	37.0	81.0 *	..	G	55	..	.. ..	II*	55
1898	NOV	25	20	..	..	37.0	81.0	..	G	86	..	.. ..	V	38
1899	FEB	13	09	30	..	37.0	81.0	..	G	55	..	.. ..	V	55
1899	MAR	03	..	..	..	36.9	76.2 *	..	G	55	..	.. ..	IV*	55
1902	MAY	18	04	..	..	37.3	80.6 *	..	G	55	..	.. ..	V	189
1905	APR	29	..	..	..	37.3	79.5 *	..	G	55	..	.. ..	III	86
1907	FEB	11	00	30	..	37.8	78.5	..	G	86	..	.. ..	III	55
1907	FEB	11	13	22	..	37.7	78.3	..	G	55	..	.. ..	VI	55
1907	FEB	11	13	45	..	37.7	78.3 *	..	G	55	..	.. ..	III*	55
1908	AUG	23	08	30	..	37.5	77.9 *	..	G	55	..	.. ..	III*	55
1908	AUG	23	09	30	..	37.5	77.9	..	G	55	..	.. ..	V	55
1908	AUG	23	15	00	..	37.5	77.9 *	..	G	55	..	.. ..	III*	55
1908	AUG	23	19	30	..	37.5	77.9 *	..	G	55	..	.. ..	III*	55
1908	AUG	24	01	..	..	37.5	77.9 *	..	G	55	..	.. ..	III*	55
1910	FEB	08	14	00	..	38.8	78.7 *	..	G	55	..	.. ..	IV	86
1910	FEB	08	14	05	..	38.8	78.7 *	..	G	55	..	.. ..	III*	55
1910	FEB	08	14	30	..	38.8	78.7 *	..	G	55	..	.. ..	III*	55
1910	MAY	08	21	10	..	37.7	78.4	..	G	55	..	.. ..	IV*	55
1911	FEB	10	10	22	..	36.6	79.4	..	G	86	..	.. ..	IV*	189
1912	AUG	08	01	00	..	37.7	78.4	..	G	86	..	.. ..	IV	55
1917	APR	19	..	..	..	37.0	81.0 *	..	I	55	..	.. ..	II*	55
1918	APR	09	18	08	..	38.7	78.4	..	G	86	..	.. ..	II*	55
1918	APR	10	02	09	..	38.7	78.4	..	G	55	..	.. ..	VI	55
1918	APR	10	07	..	..	38.7	78.4	..	G	86	..	.. ..	V*	186
1918	APR	16	13	40	..	38.7	78.4	..	G	86	..	.. ..	IV*	55
1918	APR	19	16	55	..	36.8	76.3	..	F	189	..	.. ..	III	189
1919	SEP	06	02	46	..	38.8	78.2	..	G	55	..	.. ..	VI	55
1919	SEP	06	03	46	..	38.8	78.2 *	..	G	187	..	.. ..	V*	187
1919	SEP	06	09	..	..	38.8	78.2 *	..	G	187	..	.. ..	III*	187
1920	JUL	24	..	..	..	38.7	78.4	..	G	86	..	.. ..	IV	86
1921	JUL	15	..	..	..	36.6	82.3	..	G	55	..	.. ..	V	55
1921	AUG	07	06	30	..	37.8	78.4 x	..	G	55	..	.. ..	V	55
1924	JAN	01	05	..	..	39.1	78.1 *	..	G	55	..	.. ..	IV*	55
1924	DEC	26	04	30	..	37.3	79.9	..	G	38	..	.. ..	V	38
1925	MAY	16	01	30	..	37.3	77.5	..	H	86	..	.. ..	V*	55
1925	JUL	14	21	20	..	37.6	77.5 *	..	G	55	..	.. ..	IV	86
1927	JUN	10	07	16	..	38.0	79.0	..	G	55	..	.. ..	V	55
1928	OCT	30	11	45	..	37.5	77.5	..	G	1	..	.. ..	IV	1
1929	DEC	26	02	56	..	38.1	78.5	..	G	189	..	.. ..	VI	38
1929	DEC	26	05	..	..	38.1	78.5 *	..	G	189	..	.. ..	IV*	189
1930	SEP	15	07	40	..	37.5	77.5	..	G	3	..	.. ..	III*	3
1931	OCT	06	03	15	..	37.7	78.3	..	G	86	..	.. ..	III*	4
1932	JAN	05	04	05	..	37.6	78.4 *	..	G	5	..	.. ..	IV*	189
1932	DEC	25	..	..	..	37.2	77.4 x	..	G	5	..	.. ..	II*	5
1933	JAN	27	01	00	..	37.2	77.4 x	..	G	189	..	.. ..	IV*	189
1933	JUL	23	15	..	..	37.7	78.3	..	G	86	..	.. ..	III	6
1934	APR	03	02	05	..	37.2	77.4 *	..	G	7	..	.. ..	III*	7
1935	FEB	10	23	45	..	37.2	77.4 *	..	G	8	..	.. ..	IV*	8
1936	APR	09	12	42	..	38.1	78.5	..	G	86	..	.. ..	III	86
1937	FEB	03	01	26	..	37.7	78.7 x	..	H	189	..	.. ..	IV*	189
1940	MAR	26	02	00	..	38.9	78.5 *	..	G	13	..	.. ..	III*	13
1940	MAR	26	03	28	..	38.9	78.5 *	..	G	13	..	.. ..	IV*	13
1940	MAR	26	05	01	..	38.9	78.5 *	..	G	13	..	.. ..	II*	13
1942	JAN	03	07	30	..	37.4	79.1 x	..	G	15	..	.. ..	III*	15
1942	OCT	07	02	15	..	37.6	78.4 *	..	G	15	..	.. ..	IV*	189
1945	OCT	10	19	43	..	37.7	78.3 *	..	G	18	..	.. ..	III*	18
1945	OCT	12	19	00	..	37.5	78.5 *	..	G	18	..	.. ..	IV*	18
1945	OCT	30	01	29	..	37.5	78.5 *	..	G	18	..	.. ..	IV*	18
1946	MAY	24	19	40	..	38.0	78.6 *	..	G	19	..	.. ..	III*	19
1948	JAN	05	02	45	..	37.5	78.5 *	..	G	21	..	.. ..	III*	21
1948	JAN	05	03	20	..	37.5	78.5 *	..	G	21	..	.. ..	V*	21
1948	JAN	05	04	00	..	37.5	78.5 *	..	G	21	..	.. ..	III*	21
1948	JAN	05	06	00	..	37.5	78.5 *	..	G	21	..	.. ..	III*	21
1948	MAR	26	23	48	..	38.1	78.5	..	G	86	..	.. ..	III*	21
1949	MAY	08	11	01	..	37.6	77.6 *	..	G	22	..	.. ..	V	86
1949	SEP	16	21	30	..	36.7	83.0 *	..	G	68	..	.. ..	III*	68
1949	SEP	17	09	30	..	36.7	83.0 *	..	G	22	..	.. ..	IV*	22
1950	NOV	26	07	45	..	37.7	78.3 *	..	G	23	..	.. ..	V	86
1951	MAR	09	07	00	..	37.6	77.6 *	..	G	24	..	.. ..	V*	24
1952	SEP	11	03	15	..	38.1	78.5	..	G	86	..	.. ..	IV	25
1952	SEP	11	03	35	..	38.1	78.5 *	..	G	25	..	.. ..	III*	25
1953	FEB	07	07	05	..	37.7	78.1 *	..	G	26	..	.. ..	IV	26
1955	JAN	17	12	37	..	37.3	78.4 *	..	G	28	..	.. ..	IV	28
1955	SEP	28	07	01	41.5	36.6	81.3	..	F	166	..	.. ..	V	28
1958	OCT	23	02	29	44.3	37.21	81.91	005	A	201	..	.. ..	...	..
1959	APR	23	20	58	39.5	37.40	80.68	001	A	201	..	3.8DEW 2	VI	105
1959	JUL	07	23	17	..	37.3	80.7 *	..	F	189	..	.. ..	IV	32
1959	AUG	21	17	20	..	37.3	80.7 *	..	F	189	..	.. ..	IV	32
1963	JAN	17	11	40	26.8	37.3	80.1 *	..	G	36	..	.. ..	IV	36
1963	JAN	17	14	26	50.8	37.3	80.1 *	..	G	36	..	.. ..	IV	36
1963	OCT	28	22	38	35	36.7	81.0	033	B	36	..	2.9JLM 5	V	36
1963	OCT	29	01	57	..	36.7	81.0	..	C	36	..	.. ..	IV*	36
1966	MAY	31	06	18	59.5	37.66	78.13	002	A	201	3.5	3.6GB 2	V	81
1968	MAR	08	05	38	15.7	37.28	80.77	008	A	201	3.9	4.1BLA 2	IV	74
1969	DEC	11	23	44	37.4	37.84	77.67	001	B	201	..	3.5BLA 2	V	42
1970	JUL	30	08	48	53.0	37.00	82.16x	007	A	201	3.8	3.3JLM 5	...	..
1970	JUL	30	15	15	16.9	36.99	82.21x	012	A	201	2.0	3.7JLM 5	...	..
1971	SEP	12	00	06	27.6	38.15	77.59	005	B	201	..	3.6DEW 2	V	44
1971	SEP	12	00	09	22.6	38.1	77.4	..	B	193	..	3.2BLA 2	IV	193
1972	MAY	20	19	39	06.9	37.06	82,29x	001	A	201	..	3.9DEW 2	...	..
1972	SEP	05	16	00	01.9	37.6	77.7	..	A	191	..	3.3BLA 2	IV	191
1973	APR	09	23	11	02.7	37.5	77.5 *	..	F	46	..	.. ..	IV	46
1974	MAR	23	09	46	33.8	38.92	77.78	002	B	47	..	2.6BLA 2	...	..
1974	MAY	30	21	28	35.3	37.46	80.54	005	A	201	..	3.6BLA 2	V	47
1974	NOV	07	21	31	04.5	37.75	78.20	..	F	47	..	2.4BLA 2	IV	47
1975	MAR	07	12	45	13.5	37.32	80.48	005	B	48	..	3.0BLA 2	II	48
1975	NOV	11	08	10	37.6	37.22	80.89	001	A	201	..	3.2SLM 2	VI	48
1976	JAN	30	18	58	49.1	39.62	78.25x	000	A	201	..	2.8BLA 2	...	..
1976	SEP	13	18	54	38.0	36.62	80.77	009	A	201	..	3.3BLA 2	VI	49
1977	FEB	27	20	05	34.6	37.90	78.63	005	B	39	..	2.4BLA 2	V	39
1977	OCT	23	07	51	41.0	36.93	82.13	010	B	322	..	2.8BLA 2	...	..
1978	MAR	17	18	26	34.8	36.78	80.73	016	A	322	..	2.8BLA 2	IV	240
1980	NOV	05	21	48	14.7	38.18	79.90	004	B	300	..	2.8BLA 2	F	300

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By

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