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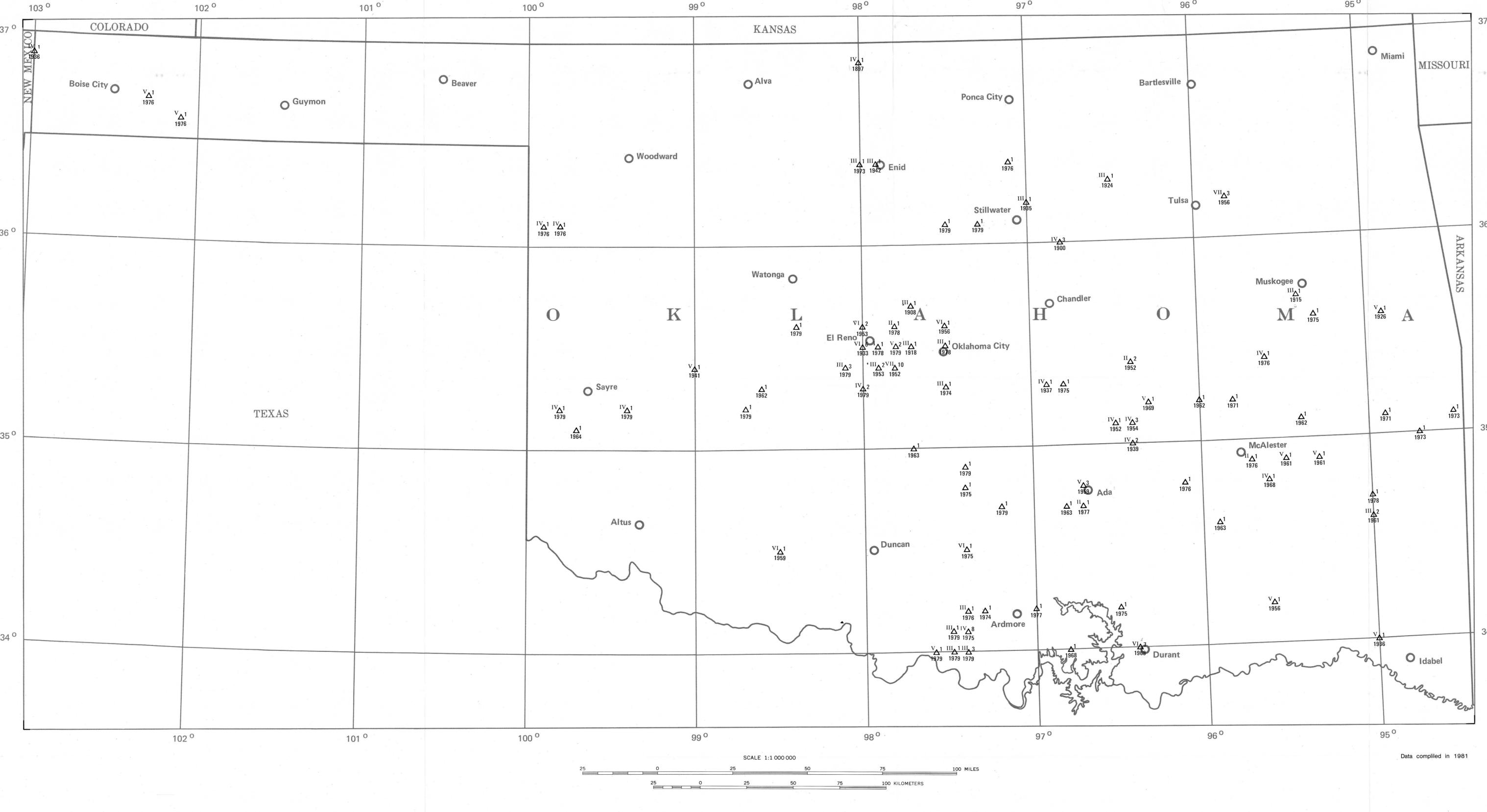
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INTRODUCTION

The earthquake data shown on this map and listed in table I 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 1979. These data have been reexamined which resulted in some revisions of epicenters and intensities as well as assignment of intensities to earthquakes that previously had none assigned. Only earthquakes located within the boundary of the State are listed in table I even though earthquakes in bordering states or countries may have been felt or caused damage in the state. 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 I are estimates of the most accurate epicenter, magnitude, and intensity of each earthquake, on the basis of historical and current information. Much of the more recent data was taken from a comprehensive study of Oklahoma earthquakes by Lawson and others (1979). 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

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 l 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 l 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. If no magnitude was computed and the earthquake was felt it was included in the earthquake list. 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:
- Leaders (..) indicate information not available.
 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 l. 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°

F 0.0°-0.5°

G 0.5°-1.0°

H 1.0°-2.0°

- 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:
- 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).
- listed below:

 PAS Seismological Laboratory, California Institute of Technology, Pasadena, Calif.

 SLM St. Louis University, St. Louis, Mo.

 TUL Oklahoma Geophysical Observatory, Oklahoma Geological Survey, Leonard, Okla.

 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.

and 5 = mbLg modified, 6 = mbeus (Evernden, 1967), and 7 = Zollweg, 1974). The source codes are

- 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
- 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,

from breaking. Damage considerable to concrete irrigation ditches.

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

Table 1.—Chronological listing of earthquakes for the State of Oklahoma

cases). Distorted lines of sight and level. Threw objects upward into the air.

D	ATE		ORIGI	[N]	IME (UTO	E(UTC) LAT.	LONG.	DEPTH	HYPOCENTER		MAGNITUDE		INTENSITY	
	MONTH	DAY	Н		S	(N.)	(W.)	(KM)	QUAL	REF	USGS	OTHER	MM	REF
007	DEC	na				36.9	98.0		I	105			T V*	105
897	DEC	02	• • •	••	• •			••	H	237	• •		IV	237
900	DEC	••	• •	• •	• •	36.0	96.8	• •			• •			
901	APR	01	• •	••	• •	36.0	96.8	• •	Н	237	• •	• • • • •	• • •	• •
901	APR	08	13	30	• •	36.0	96.8	• •	Н	237	• •		***	0.4
908	JUL	19	• •	• •	• •	35.7	97.7	• •	G	105	• •	• • • •	III	84
910	• • •	• •		• •	• •	35.5	98.0	• •	G	235	• •		III*	
915	OCT	08	16	50	• •	35.7	95.4	• •	G	105	• •	•• ••	III	105
918		••		• •	• •	35.5	97.7	• •	G	105	• •	• • • • •	III*	
918	SEP	10	16	30		35.5	98.0	• •	G	38			V	38
918	SEP	11	06	30		35.5	98.0	• •	G	105			IV*	105
918	SEP	11	09	00		35.5	98.0		G	105			III*	105
924	JUN	03	00	40		36.3	96.5		G	105	• •.		III	84
926	JUN	20	14	20		35.6	94.9		G	105			V	-105
929	DEC	28	00	30		35.5	98.0		F	2			VI	38
933	AUG	19	19			35.5	98.0		G	38			VI	38
935	NOV	29				36.2	97.0		G	235			III*	236
936	MAR	14	17	20		34.0	95.0		G	105			V	38
936	JUL	12	00			36.9	103.0		G	105				105
937	JUN	08		26		35.3	96.9		G	105			IV	105
939	JUN	01	07		• •	35.0	96.4		Н	105		10.0	IV	12
				00	• •	35.0	96.4		Н	236	• •			
939	JUN	01			• •	35.4	99.0		G	105	••	•• ••	V	105
941	OCT	18	07	10.000	• •			• •			••	•• ••	III	105
942	JUN	12	04			36.4	97.9		G	105	• •	 F FDAG /		
952	APR	09			33.7	35.4	97.8	005	C	228	• •	5.5PAS 4	VII	25
952		11		30	• •	35.4	97.8	••	G	105	• •	• • • •	III*	
952	APR	11	20	30	• •	35.4	97.8	• •	G	105	• •		IV.	25
952	APR	16		• •	• •	35.4	97.8	• •	G	238	• •	• • • •	III*	
952	APR	16		58	• •	35.4	97.8	• •	G	105	• •	•• ••	III*	
952	APR	16		05	• •	35.4	97.8	• •	G	38	• •		V	38
952	APR	16		30		35.4	97.8		G	235	• •		III*	
952	MAY	01	11	40		35.4		*	. G	236				236
952	MAY	02	01	55		35.4	96.4	*	G	236	• •		II*	236
952	JUL	17	00	30		35.4	97.8		G	105			III*	
952	JUL	17	02	00		35.4	97.8		G	105			III*	25
952	AUG	14	21	40		35.4	97.8		G	105			IV	25
952	OCT	08	04	15	• •	35.1	96.5		G	105			IV	25
953	MAR	16		50	.\.	35.4	97.9		G	105			III	105
953	MAR	17		12	- 11	35.6	98.0		G	105			V	105
953	MAR	17		25		35.6	98.0		G	105			VI	105
953	JUN	06		40	· • · · · ·	34.8.	96.7	• • • • • • • • • • • • • • • • • • • •	G	105	• ::		IV	26
954	APR	11	••	••		35.1	96.4	• • • • • • • • • • • • • • • • • • • •	G	105	••		IV	2

1954 APR 12 23 05 .. G 105 35.1 96.4 1954 APR 13 18 48 .. 35.1 96.4 .. G 105 35.6 97.5 .. G 105 1956 FEB 16 23 30 .. 1956 APR 02 16 03 18 34.2 95.6 .. G 105 1956 OCT 30 10 36 21 34.8 96.7 .. G 105 V 32 1959 JUN 15 12 45 .. 1959 JUN 17 10 27 07 34.5 98.5 .. D 32 1960 MAR 18 21 30 .. 36.2 95.8 .. G 235 III* 236 1960 MAR 18 23 30 .. 36.2 95.8 .. G 235 III* 236 1961 JAN 11 01 40 .. 34.9 95.5 .. G 105 1961 APR 27 03 34.6 95.0 .. H 105 III 105 III 105 1961 APR 27 05 34.6 95.0 .. H 105 1961 APR 27 07 30 .. 34.9 95.3 .. G 105 35.3 98.6 .. C 235 .. 3.3TUL 1 1962 APR 28 06 09 11 35.1 95.4 .. C 235 .. 2.6TUL 1 1962 MAY 18 02 40 29.3 1962 AUG 10 20 47 19.0 34.8 97.4 x .. C 235 .. 3.2TUL 1 1962 SEP 01 02 09 56.1 35.2 96.0 .. C .. 2.8TUL 1 1962 SEP 07 22 53 44.0 34.7 98.4 x .. C 235 .. 3.2TUL 1 1962 OCT 23 17 55 58.0 35.0 98.5 x .. C 235 .. 2.9TUL 1 1963 FEB 02 16 57 39.0 34.7 98.2 x .. C 235 .. 2.8TUL 1 1963 MAR 13 09 33 34.0 34.6 95.9 .. C 235 .. 3.1TUL 1 1963 MAY 07 20 03 29 34.3 96.4 x .. C 235 .. 3.0TUL 1 1963 JUN 05 17 02 08.0 34.7 96.8 x .. C 235 .. 2.5TUL 1 1963 JUN 12 16 38 52.0 34.7 96.8 .. C 235 .. 2.6TUL 1 1963 JUL 14 08 10 27.0 35.0 97.7 .. C 235 .. 2.6TUL 1 1964 FEB 02 08 22 44.1 35.1 99.7 033 C 74 .. 2.8TUL 6 1968 JAN 04 22 30 .. 34.85 95.55 .. C 237 34.0 96.4 .. D 237 .. 2.3TUL 7 III* 41 1968 OCT 11 02 25 55 1968 OCT 11 02 40 42 34.0 96.4 .. D 237 34.0 96.4 .. D 237 .. 2.8TUL 7 III* 41 1968 OCT 11 08 55 42 .. 2.4TUL 7 III* 41 1968 OCT 11 09 33 37 34.0 96.4 34.0 96.4 .. D 237 .. 2.6TUL 2 1968 OCT 12 21 46 44 34.0 96.4 .. D 237 34.0 96.4 .. D 237 .. 2.8TUL 2 1968 OCT 18 21 14 10 1968 NOV 15 10 41 25 1969 MAY 02 11 33 19.8 35.2 96.3 033 C 74 4.6 3.6TUL 6 V 42 .. 2.5TUL 6 1971 MAR 01 19 27 32.1 35.1 94.9 .. C 237 1971 MAR 13 19 22 15.3 35.2 95.8 .. C 237 1973 JAN 10 16 38 15.3 36.4 98.0 .. C 237 1973 NOV 18 10 03 52.7 35.0 94.7 .. C 237 .. 3.1TUL 2 1973 DEC 25 04 11 32.0 35.1 94.5 .. C 237 .. 2.8TUL 2 1974 MAY 10 01 15 17.8 34.2 97.3 .. C 237 .. 2.6TUL 2 1974 NOV 10 06 19 18.6 34.8 96.7 .. C 237 .. 2.7TUL 7 1974 DEC 16 02 30 21.4 35.3 97.5 010 D 74 .. 2.6TUL 7 III 47 1975 MAR 31 09 52 06.0 35.6 95.3 .. C 237 .. 2.9TUL 7 1975 JUN 16 01 59 28.2 34.2 96.5 .. C 237 .. 2.9TUL 7 34.14 97.37 005 .. 3.4TUL 2 1975 OCT 12 02 58 11.2 34.82 97.41 020 C 1975 OCT 30 00 37 14.1 35.3 96.8 .. C 237 1975 NOV 29 14 29 40.9 34.52 97.35 005 B 74 1975 DEC 19 05 29 25.0 34.1 97.4 .. C 237 1976 MAR 16 07 39 45.3 35.43 95.60 .. C 237 1976 MAR 30 06 53 16 36.68 102.25 .. C 237 .. 2.1TUL 2 1976 MAR 30 09 27 01.0 36.61 102.08 005 C 74 .. 2.7TUL 2 V 91 .. 3.4TUL 2 1976 APR 16 18 59 44.2 36.11 99.88 005 B 74 1976 APR 17 02 48 05.7 34.1 97.4 .. D 237 .. 2.4TUL 2 1976 APR 19 04 42 42.2 36.13 99.84 005 C 1976 JUN 23 08 21 17.8 34.1 97.4 .. C 237 1976 JUN 24 08 02 39.5 34.1 97.4 .. C 237 .. 1.4TUL 7 II 237 .. 2.1TUL 2 1976 SEP 20 09 40 16.2 34.16 97.40 .. C 237 1976 OCT 20 04 05 39.8 34.75 96.12 .. C 237 1976 OCT 22 17 15 50.5 36.38 97.06 .. C 237 1976 DEC 19 08 26 36.7 34.92 95.73 005 B 237 .. 2.9TUL 2 II 85 1977 JAN 06 16 19 54.0 34.70 96.73 005 B 208 .. 2.2TUL 2 II 208 1977 FEB 04 20 52 29.3 34.06 97.37 005 B 208 .. 1.9TUL 2 1977 FEB 10 01 28 16.3 34.06 97.37 005 B 208 1977 MAR 26 21 37 12.6 34.06 97.37 005 B 208 34.04 97.36 005 B 208 1977 JUN 16 02 02 46.6 1977 JUN 30 23 03 22.0 34.19 96.96 005 B 239 34.70 95.00 007 A 239 .. 2.9TUL 2 1978 MAR 05 14 46 50.5 34.01 97.38 005 A 239 1978 MAR 09 06 30 50.8 1978 MAY 17 23 11 15.7 35.53 97.91 005 A 239 1978 MAY 18 00 19 22.4 33.50 97.50 005 A 230 .. 2.7TUL 2 III 230 1978 MAY 18 00 32 17.6 35.60 97.83 005 A 230 .. 2.1TUL 2 II 230 1979 MAR 18 20 44 19.5 35.38 98.12 005 A 231 .. 2.9TUL 2 III 231 1979 JUN 07 07 39 35.6 35.19 99.81 005 A 232 .. 3.0TUL 2 IV 232 1979 SEP 13 00 49 23.0 35.22 99.36 015 A 233 .. 3.4TUL 2 IV 233 1979 SEP 16 15 57 20.8 35.34 98.00 005 A 233 .. 2.5TUL 2 IV 233

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