EARTHQUAKE ENGINEERING RESEARCH LABORATORY
Division of Engineering and Applied Science
California Institute of Technology

SEISMOLOGICAL FIELD SURVEY
(Formerly U.S. Coast and Geodetic Survey)
National Oceanic and Atmospheric Administration
U.S. Department of Commerce

STRONG-MOTION INSTRUMENTAL DATA ON THE SAN FERNANDO EARTHQUAKE OF FEB. 9, 1971

D. E. HUDSON, EDITOR

September, 1971

A Report Prepared With the Assistance of Grants from the
NATIONAL SCIENCE FOUNDATION
and the
EARTHQUAKE RESEARCH AFFILIATES

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Preface

The San Fernando Earthquake of February 9, 1971 occurred virtually at the center of the Southern California strong-motion earthquake instrumentation network, and provided an unprecedented amount of valuable data on strong earthquake-generated ground motions. This data will be of key significance in interpreting the severe damage to many modern engineering structures which occurred, and marks a major development in the field of earthquake engineering.

It was evident immediately after the event that the problems of recovering field records, of processing the information, and of disseminating the results as quickly and as widely as possible would severely tax the available resources. Fortunately, the close cooperation which had been built up over the years between the Seismological Field Survey of the U. S. Department of Commerce and the Earthquake Engineering Research Laboratory of the California Institute of Technology provided an operating group which could be quickly expanded to meet the challenge.

In the days and weeks following the earthquake, each of these organizations issued numerous preliminary reports aimed at the quickest possible distribution of information. The present report up-dates and brings together a number of these initial releases, along with much new material. It is hoped that in this way a more complete picture of the overall instrumentation results can be presented in one convenient place. The report also makes available for the first time a complete description of the Southern California networks, and a

detailed account of the performance of these networks during the earthquake.

A notable feature of the present report is the reproduction in accurate scale form of the complete set of seismoscope records obtained during the earthquake. These seismoscope records offer an unparalleled picture of the complexity of the pattern of ground shaking throughout the Southern California region.

The primary purpose of the present compilation is to make available the basic data itself, and no attempt has been made to add interpretive material. Many interpretive studies have, of course, already been made, and the full exploitation of this basic data to increase our knowledge of earthquake engineering will no doubt go on for a number of years.

In reporting the accelerograph measurements, numerous examples of accelerograms have been given, and samples of standard data processing procedures leading to digitized print-outs and calculated velocity and displacement curves, and response spectrum curves, have been included. The complete set of accelerograms in computer-plotted form, along with the digital print-outs, are being issued by the Earthquake Engineering Research Laboratory of the California Institute of Technology as a part of the series "Strong-Motion Earthquake Accelerograms - Digitized and Plotted Data." The first volume devoted to the San Fernando earthquake has already been issued as Vol. 1, part C, Report No. EERL 71-20. These volumes of digitized accelerograms will be followed during the next year by additional volumes containing integrated ground velocity and displacement curves, and response spectrum curves, which will be prepared for all of the records obtained during the San Fernando earthquake.

The existence of this unusually complete ground motion data is a tribute to the cooperative efforts of a large number of people over a period of many

years. Many of the individuals involved have been named in the acknowledgements included in the separate sections. Hundreds of individual accelerograph and seismoscope owners have pooled their resources to make the Southern California region the best instrumented area in the world for strong earthquake ground motion investigations. A complete list of organizations, building owners, and others who deserve thanks for making possible the acquisition and the operation of the instruments would be an imposing indication of the extent of the cooperative effort involved. Special mention should be made of the very important contributions of the late John C. Monning, former general manager and superintendent of the Department of Building and Safety of the City of Los Angeles. It was Mr. Monning's vision and foresight, implemented with great energy and patience, which resulted in the code requirements for accelerographs in tall buildings which made this earthquake the most extensive structural dynamic test of full-scale buildings ever carried out. His colleagues and successors in the Department of Building and Safety have carried this work forward in a very effective manner, and have thus played a key role in the development of the accelerograph network.

For the Seismological Field Survey, formerly for many years under the name of the U. S. Coast and Geodetic Survey, and more recently as a part of the National Oceanic and Atmospheric Administration, the present event is the culmination of a forty-year program of pioneering work in the measurement of strong earthquake ground motions. For the group at the California Institute of Technology, it is an opportunity to put to large-scale practical use the results of studies of earthquake accelerogram analysis which began in the 1920's. During recent years this research on accelerogram analysis has been supported by the National Science Foundation, with

important assistance from the Earthquake Research Affiliates program of the California Institute of Technology. The data processing referred to in the present report, and the preparation of the report itself, has been made possible by a special grant from the National Science Foundation. The editorial assistance of Mrs. Phyllis Henderson is much appreciated.

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Strong-Motion Instrumental Data on the

San Fernando Earthquake of February 9, 1971

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Chapter 1

STRONG-MOTION ACCELEROGRAPH RECORDS

R. P. Maley[1] and W. K. Cloud[2]

INTRODUCTION

The epicenter of the February 9, 1971 earthquake, Richter magnitude 6.6, was located in a sparsely populated section of the San Gabriel Mountains 14 km north of San Fernando, California. According to Allen and others (1971), faulting began at a depth of 13 km, progressed southward and upward at approximately 45°, and eventually surfaced in the Sylmar-San Fernando area where displacements greater than two meters were generated by combined upthrusting and left-lateral slippage (Kamb and others, 1971). The discontinuous fault line strikes approximately N 72° W and was responsible for a concentration of particularly heavy damage to structures located on or near the disrupted zone. Total economic losses in the San Fernando-Los Angeles area may approach one-half billion dollars and includes major collapses of structures at the Olive View and Veterans Hospitals, failure of freeway overpasses, and extensive damage to numerous other buildings, streets and public utilities.

At the time of the earthquake the Seismological Field Survey unit of the National Oceanic and Atmospheric Administration's (NOAA) National Ocean Survey was operating, in cooperation with numerous other organizations, a dense network of strong-motion accelerographs in southern California. As a result, 241 accelerograms were recorded during the shock, including more than 175 from the Los Angeles area where a large number of instruments have been installed at various levels of high-rise buildings 21 to 50 km from the epicenter.

[1]Seismological Field Survey, Environmental Research Laboratories-NOAA, Los Angeles, California.

[2]Berkeley Seismograph Station, University of California, Berkeley, California (former Chief of the Seismological Field Survey).

Evaluation of this data will be particularly relevant to the investigation of the dynamic behavior of instrumented buildings under moderate seismic forces, and in a related aspect, it also may provide the best measure of the intensity of ground motion in non-instrumented areas where destruction was the heaviest. Perhaps information obtained from other stations may prove to be equally important in completing the total pattern of strong shaking since accelerations were recorded at several dams, near aqueducts and pumping facilities, and at numerous free-field locations, all essentially outside of Los Angeles. In any event, the total collection of strong-motion records, the largest ever compiled from a single earthquake, has provided more significant data than had been accumulated during the entire 39 year history of the program. The ultimate benefit derived from its application is a highly rewarding payoff for a long-range and patient investment in engineering seismology investigations by the Seismological Field Survey under the National Ocean Survey and its predecessor, the Coast & Geodetic Survey.

THE ACCELEROGRAPH NETWORK

Since late 1932 the Seismological Field Survey* unit of NOAA's National Ocean Survey (formerly the Coast and Geodetic Survey) has operated a strong-motion accelerograph network in the Western United States to record the damaging motions of earthquakes. Following the establishment of a group of stations in the early and middle 1930's, the number of instruments in southern California, some 15 to 20, remained relatively constant until 1963 when the first modern accelerograph was

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* The Seismological Field Survey is now a unit in NOAA's Environmental Research Laboratories.

designed and produced by United ElectroDynamics (later absorbed by Teledyne-Geotech). The introduction of this new instrument stimulated the development of an extensive cooperative network between the Coast and Geodetic Survey and other organizations such as the California Department of Water Resources, Army Corps of Engineers, California Institute of Technology, private building owners subject to seismograph provisions of local building codes, and various other institutions, both public and private, too numerous to mention. From 1963 to the present time the size of the network has increased at an accelerating pace, particularly after 1965 when the City of Los Angeles passed an ordinance requiring three accelerographs in new structures taller than six stories. This requirement became more widespread when it was adopted by many other cities as a result of being included in the appendix of the 1970 Uniform Building Code. Consequently, at the time of the San Fernando earthquake of February 9, 1971, there were well over 200 accelerographs in and near Los Angeles, 185 in Los Angeles and Beverly Hills alone.

STRONG-MOTION RESULTS

Location of the strong-motion accelerograph stations in central and southern California at the time of the San Fernando earthquake, whether or not the instrument was triggered by the ground shaking, is shown in successively greater detail in Figure 1, the region south of Fresno, Figure 2, the extended Los Angeles area, and Figure 3, the zone of heaviest concentration in central Los Angeles.

Since each instrument site is coded with a permanent identification number, one may go directly to the listing of strong-motion instrumental

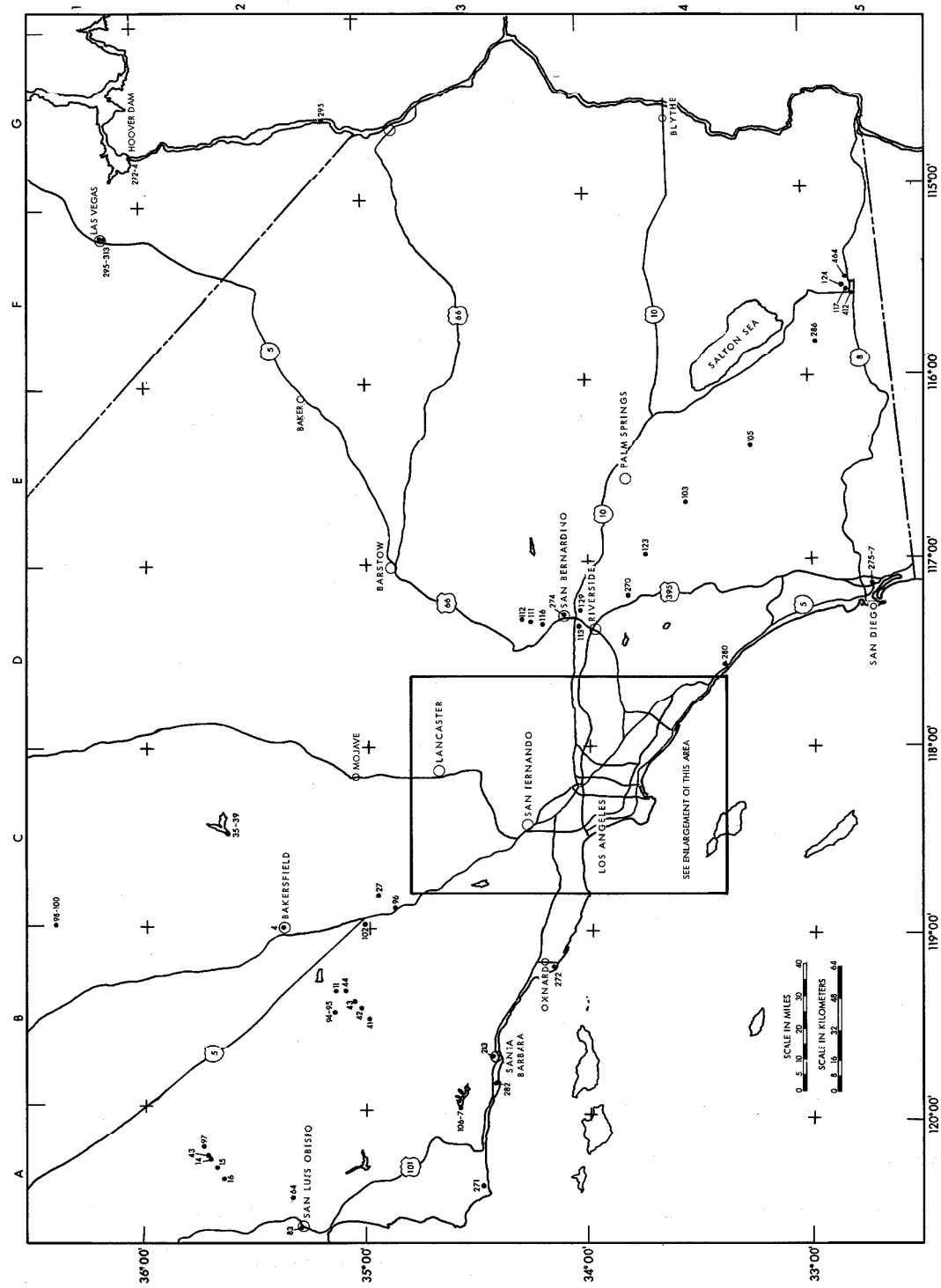

Figure 1 Accelerograph Stations in Central and Southern California during the San Fernando Earthquake.

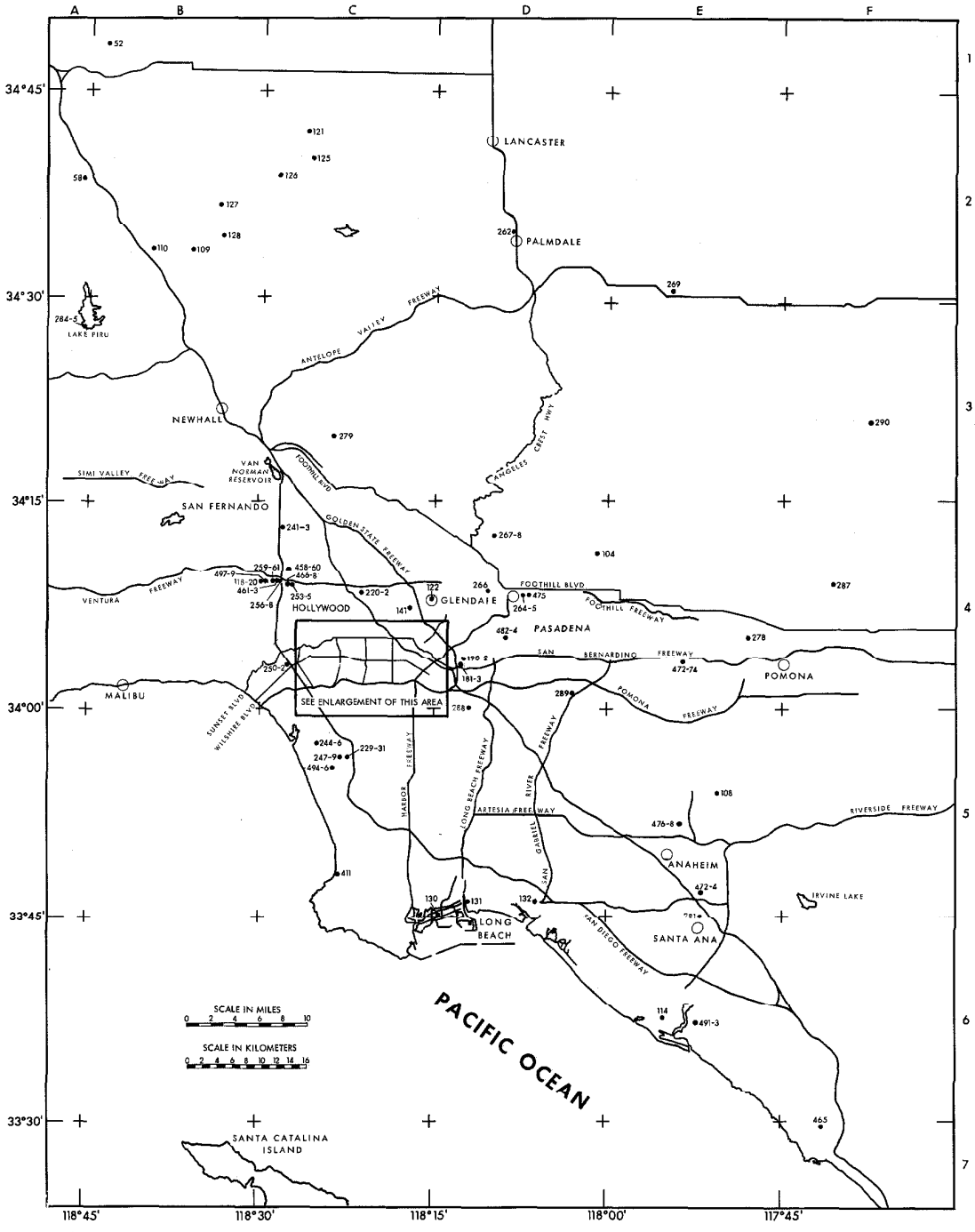

Figure 2 Accelerograph Stations in the Extended Los Angeles Area during the San Fernando Earthquake.

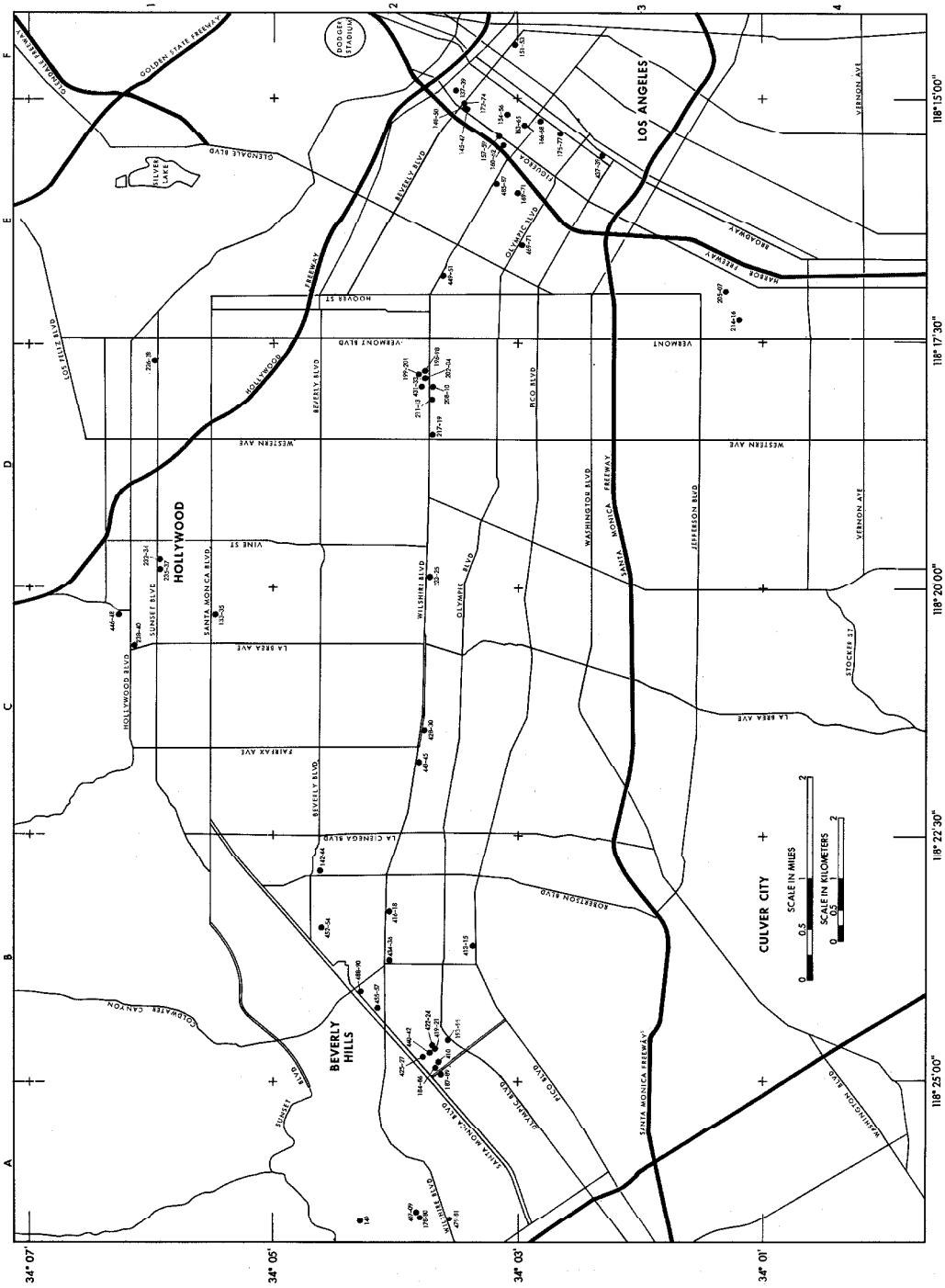

Figure 3 Accelerograph Stations in Central Los Angeles during the San Fernando Earthquake.

data, annually issued by the Seismological Field Survey, to find the geographic coordinates, instrument type, and operating characteristics of that particular accelerograph. Note that each point on the map refers only to the station location whereas the accompanying number or numbers indicates the presence of one or more instruments at that particular site. Table I is an alphabetical listing of the stations keyed to the three maps.

The earthquake was recorded by five different strong-motion accelerographs possessing a variety of natural periods, sensitivities and recording media. See Table II. Four of the five models have been developed and marketed since 1963 and are in a sense largely responsible for the substantial growth in the network, since previous instrumentation was bulky, difficult to maintain, more expensive, and required special housing. Reproductions of typical seismograms collected from three of the newer instruments are shown in Figures 4, 5 and 6, 12 inch paper records from the AR-240, Figure 7, 70 mm film records from the SMA-1, and Figure 8, 35 mm film records from the MO-2. Representative recordings from the RFT-250 are shown in another section of this report by Hudson. Almost 90 percent of the acceleration data were recorded on the newer models including all that were obtained from the 68 multiple instrumented buildings. For more detailed information concerning the characteristics of the various models, refer to Hudson (1970) and Halverson (1969, 1970).

A total of 241 records were recovered from stations located be-

TABLE I

CENTRAL AND SOUTHERN CALIFORNIA STRONG-MOTION ACCELEROGRAPH NETWORK

June 1, 1971

Accelerograph Site	Identification Number*	Map No.	Map Location
Alhambra			
Fremont, 900 S.	482, 483, 484	2	D4
Anza	103	1	E4
Arcadia			
Santa Anita Reservoir	104	2	D4
Bakersfiel d	4	1	B2
Beverly Hills			
Camden Drive, 430**	488, 489, 490	3	B2
Oakhurst, 435 N.	452, 453, 454	3	B2
Roxbury, 450 N.	455, 456, 457	3	B2
Wilshire, 9100	416, 417, 418	3	B2
Wilshire, 9450	434, 435, 436	3	B2
Borrego Springs	105	1	E4
Brea			
Carbon Canyon Dam	108	2	E5
Cachuma Dam	106, 107	1	B3
Castaic			
Castaic	110	2	B2
Castaic Dam	No number		
Cedar Springs			
Cedar Springs-Abutment	112	1	D3
Cedar Springs-Allen Ranch	111	1	D3
Cholame-Shandon Array	13, 14, 15, 16	1	A2
Colton	113	1	D3
Costa Mesa	114	2	E6

Accelerograph Site	Identification Number*	Map No.	Map Location
Devil Canyon	116	1	D3
El Centro			
Substation	117	1	F5
Community Hospital	412	1	F5
Meadows Union School	464	1	F5
El Segundo**			
Sepulveda Blvd., 909	494, 495, 496	2	C5
Fairmont Reservoir	121	2	C2
Fullerton			
Nutwood, 2600	476, 477, 478	2	E5
Glendale			
Broadway, 633 E.	122	2	C4
Grapevine			
Tehachapi Pumping Plant	27	1	C3
Hemet	123	1	E4
Hoover Dam	292, 293, 294	1	G1
Imperial			
Imperial Valley College	124	1	F5
Isabella Dam	35, 36, 37, 38, 39	1	C2
Lake Hughes			
Array No. 1, 4	125, 126	2	C2
Array No. 9, 12	127, 128	2	B2
Loma Linda	129	1	D3
Long Beach			
Long Beach Utility Bldg.	131	2	D5
Long Beach State College	132	2	D5
Terminal Island	130	2	D5
Los Angeles			
Airport Blvd., 9841	247, 248, 249	2	C5
Avenue of Stars, 1900	184, 185, 186	3	B2
Avenue of Stars, 1901	187, 188, 189	3	B2
Beverly Drive, 1177	413, 414, 415	3	B2

Accelerograph Site	Identification Number*	Map No.	Map Location
Los Angeles (continued)			
Century Blvd., 5260	229, 230, 231	2	C5
Century City Ground Station	410	3	B2
Century Park E., 1800	425, 426, 427	3	B2
Century Park E., 1880	440, 441, 442	3	B2
Century Park E., 1888	419, 420, 421	3	B2
Century Park E., 1888 (Ramp)	422, 423, 424	3	B2
Century Park E., 2080	193, 194, 195	3	B2
Figueroa, 222 S.	145, 146, 147	3	E2
Figueroa, 234 S.	148, 149, 150	3	E2
Figueroa, 455 S.	157, 158, 159	3	E2
First, 250 E.	151, 152, 153	3	F2
First, 800 W.	172, 173, 174	3	E2
Fremont, 533 S.	160, 161, 162	3	E2
Garland, 750 S.	169, 170, 171	3	E2
Grand, 420 S.	154, 155, 156	3	E2
Griffith Observatory	141	2	C4
Hilgard, 930	407, 408, 409	3	A2
Hill, 1150 S.	437, 438, 439	3	E3
Hollywood Storage Bldg. (1025 N. Highland)			
Building	133, 134	3	C1
Parking Lot	135	3	C1
Hollywood Blvd., 7080	238, 239, 240	3	C1
Hoover, 3663	214, 215, 216	3	E3
Lankershim, 3838	220, 221, 222	2	C4
L. A. Water & Power (111 S. Hope St.)	137, 138, 139	3	F2
Lincoln Blvd., 8639	244, 245, 246	2	C5
Marengo, 1640	181, 182, 183	2	D4
Normandie, 616 S.	431, 432, 433	3	D2
Olive, 646 S.	166, 167, 168	3	E3
Olive, 808 S.	175, 176, 177	3	E3
Olympic Blvd., 1625 S.	469, 470, 471	3	E3
Orchid Avenue, 1760 N.	446, 447, 448	3	C1
Orion, 8244	241, 242, 243	2	C4
Robertson, 120 N.	142, 143, 144	3	B2
San Vicente, 11661	250, 251, 252	2	C4
Sixth Street, 611 W.	163, 164, 165	3	E3
Sixth Street, 3407 W.	199, 200, 201	3	D2
Sunset, 4867	226, 227, 228	3	D1
Sunset, 6430	232, 233, 234	3	D1
Sunset, 6464	235, 236, 237	3	D1
Tiverton, 945	178, 179, 180	3	A2
U.C.L.A. (Boelter Hall)	140	3	A2
University, 3440 (U.S.C.)	205, 206, 207	3	E3

Accelerograph Site	Identification Number*	Map No.	Map Location
Los Angeles (continued)			
Van Owen, 15107	458, 459, 460	2	C4
Ventura, 14724	253, 254, 255	2	C4
Ventura, 15250	466, 467, 468	2	C4
Ventura, 15433	256, 257, 258	2	C4
Ventura, 15910	461, 462, 463	2	C4
Ventura, 16055	259, 260, 261	2	C4
Ventura, 16633**	497, 498, 499	2	C4
Ventura, 16661	118, 119, 120	2	C4
Wilshire, 1200**	485, 486, 487	3	E2
Wilshire, 2500	449, 450, 451	3	E2
Wilshire, 3345	196, 197, 198	3	D2
Wilshire, 3411	202, 203, 204	3	D2
Wilshire, 3470	208, 209, 210	3	D2
Wilshire, 3550	211, 212, 213	3	D2
Wilshire, 3710	217, 218, 219	3	D2
Wilshire, 4680	223, 224, 225	3	D2
Wilshire, 5900	428, 429, 430	3	C2
Wilshire, 6200	443, 444, 445	3	C2
Wilshire, 10880**	479, 480, 481	3	A2
Zonal, 2011	190, 191, 192	2	D4
Las Vegas	296 - 313 (18)	1	F1
Maricopa Array	41, 42, 43, 44	1	B2
Mohave Generating Plant	295	1	G2
Newport Beach**			
Newport Circle Dr., 620	491, 492, 493	2	E6
Orange			
Chapman, 4000 W.	472, 473, 474	2	E5
Oso Pumping Plant (Gorman)	52	2	B1
Pacoima			
Pacoima Dam	279	2	C3
Palmdale	262	2	D2
Palos Verdes Estates	411	2	C5
Pasadena			
Athenaeum, C.I.T.	475	2	D4
Millikan Library, C.I.T.	264, 265	2	D4
J.P.L.	267, 268	2	D4
Seis. Lab, C.I.T.	266	2	D4

Accelerograph Site	Identification Number*	Map No.	Map Location
Pearblossom	269	2	E2
Perris	270	1	D4
Point Concepcion	271	1	A3
Port Hueneme	272	1	B3
Pyramid	58	2	A2
San Bernardino	274	1	D3
San Diego			
San Diego Light & Power	277	1	D5
San Diego Gas & Electric	275, 276	1	D5
San Dimas			
Puddingstone Reservoir	278	2	E4
San Juan Capistrano	465	2	F7
Salinas Dam	64	1	A2
San Luis Obispo	83	1	A2
San Onofre	280	1	D4
Santa Ana	281	2	E5
Santa Barbara			
County Courthouse	283	1	B3
Univ. of California	282	1	B3
Santa Felicia Dam (Piru)	284, 285	2	A3
Superstition Mountain	286	1	F5
Taft	94, 95	1	B2
Tejon			
Fort Tejon	96	1	C3
Temblor II (Cholame)	97	1	A2
Terminus Dam	98, 99, 100	1	B1

Accelerograph Site	Identification Number*	Map No.	Map Location
Upland San Antonio Dam	287	2	F4
Vernon	288	2	D4
Wheeler Ridge	102	1	C2
Whittier Whittier Narrows Dam	289	2	D4
Wrightwood	290 (+ 1 other temporary Accelerograph)	2	F3

* Permanent Identification Number in Annual List of Stations issued by Seismological Field Survey, NOS-NOAA.

** Not installed during the San Fernando earthquake.

TABLE II

DIFFERENT ACCELEROGRAPH MODELS TRIGGERED

BY THE SAN FERNANDO EARTHQUAKE

Instrument	Earth-quake Records	Sensitivity (cm/g)	Period (sec)	Recording Medium	Manufacturer	Year Introduced
C & GS Standard	28	6 - 17	.04 - .08	6 or 12" photo paper	Coast & Geodetic Survey	1932
AR - 240	75	7.5	.06	12" photo paper	Teledyne-Geotech, Inc.	1963
RFT - 250	58	1.9	.05	70 mm film	Teledyne-Geotech, Inc.	1967
MO - 2	45	1.5 Horizontal 2.2 Vertical	.03	35 mm film	Victoria Engineering, Ltd. New Zealand	1967 (to U.S.)
SMA - 1	35	1.9	.04	70 mm film	Kinemetric, Inc.	1970

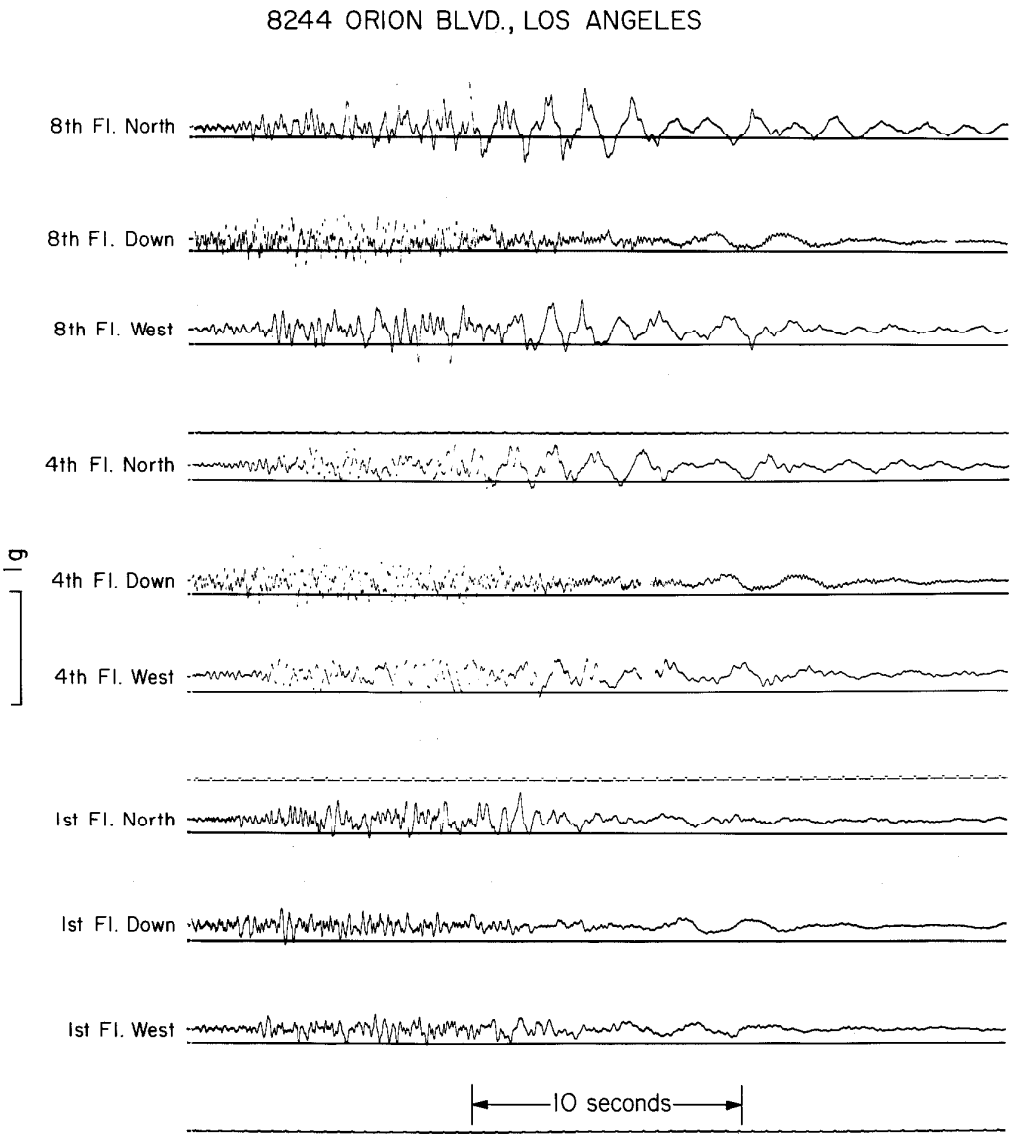

Figure 4 AR-240 Accelerograph record from Holiday Inn, 8244 Orion

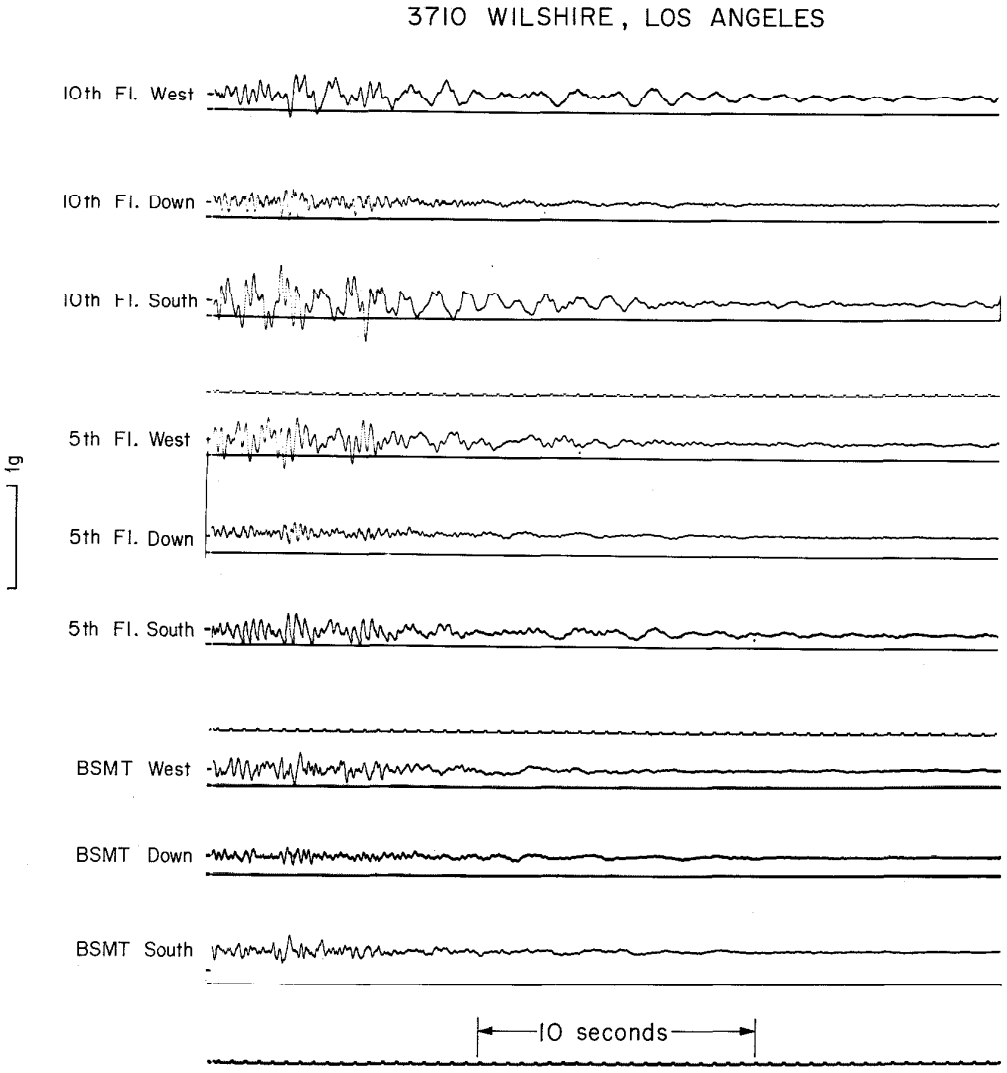

Figure 5 AR-240 Accelerograph record from 3710 Wilshire Blvd., Los Angeles

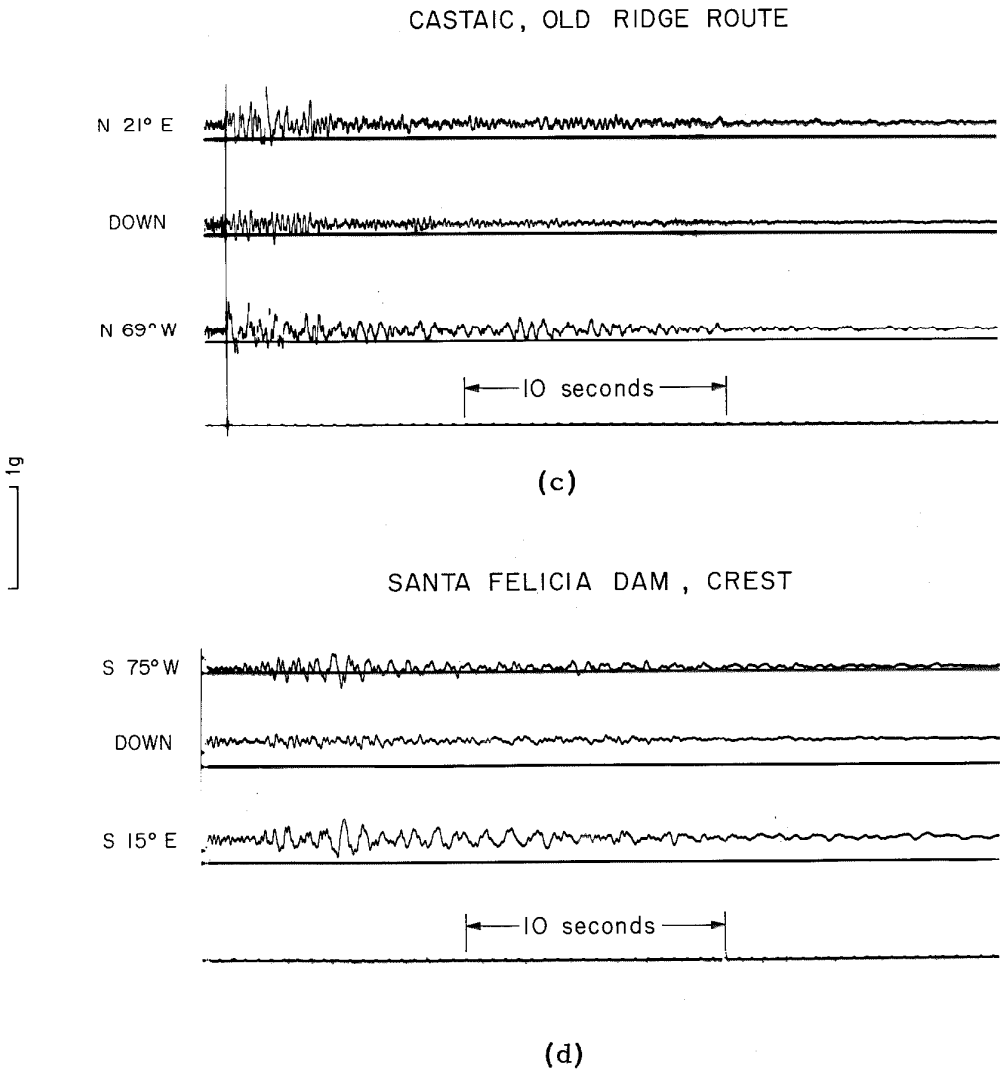

Figure 6 AR-240 Accelerograph records from special sites.

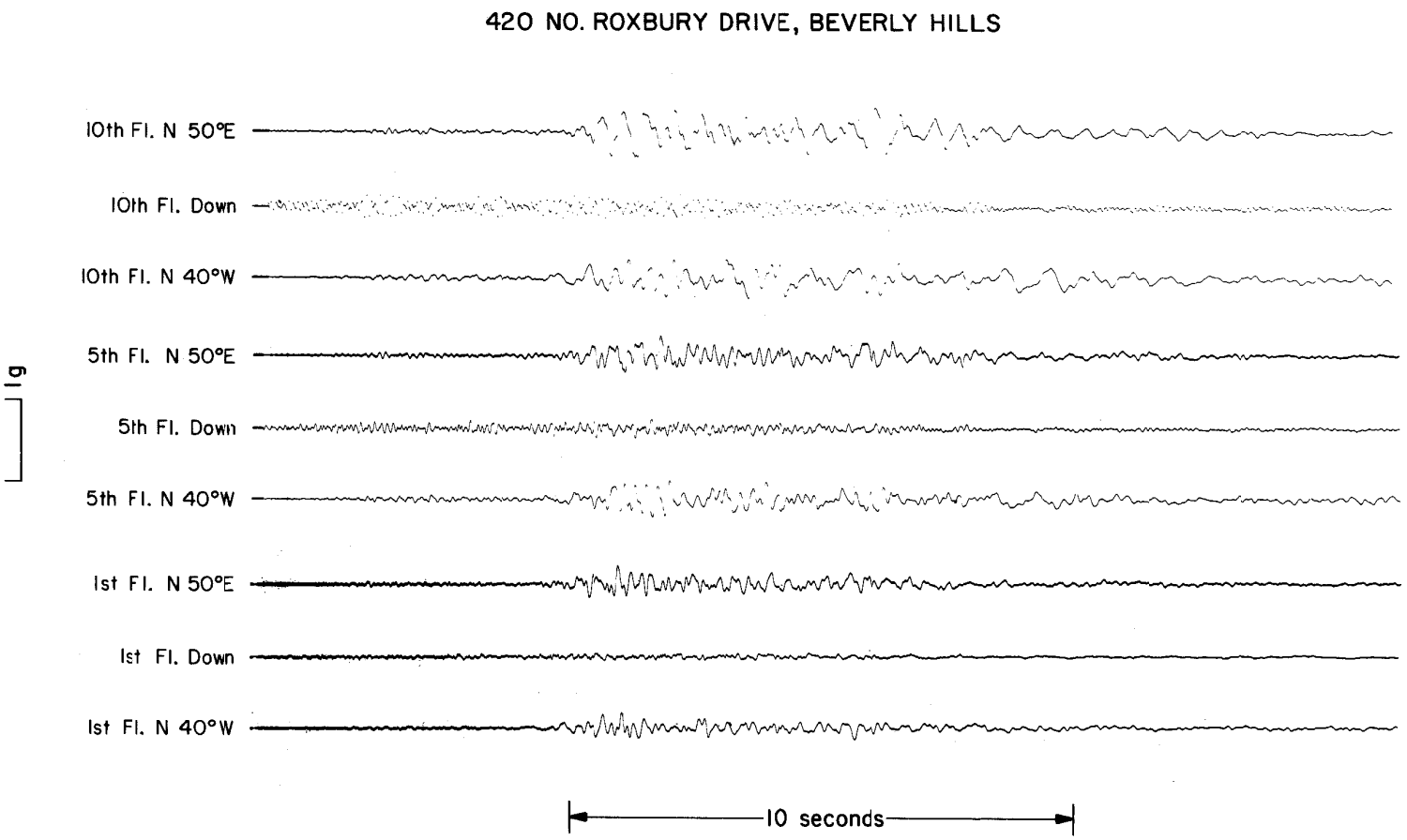

Figure 7 SMA-1 Accelerograph record from 420 N. Roxbury Drive, Beverly Hills.

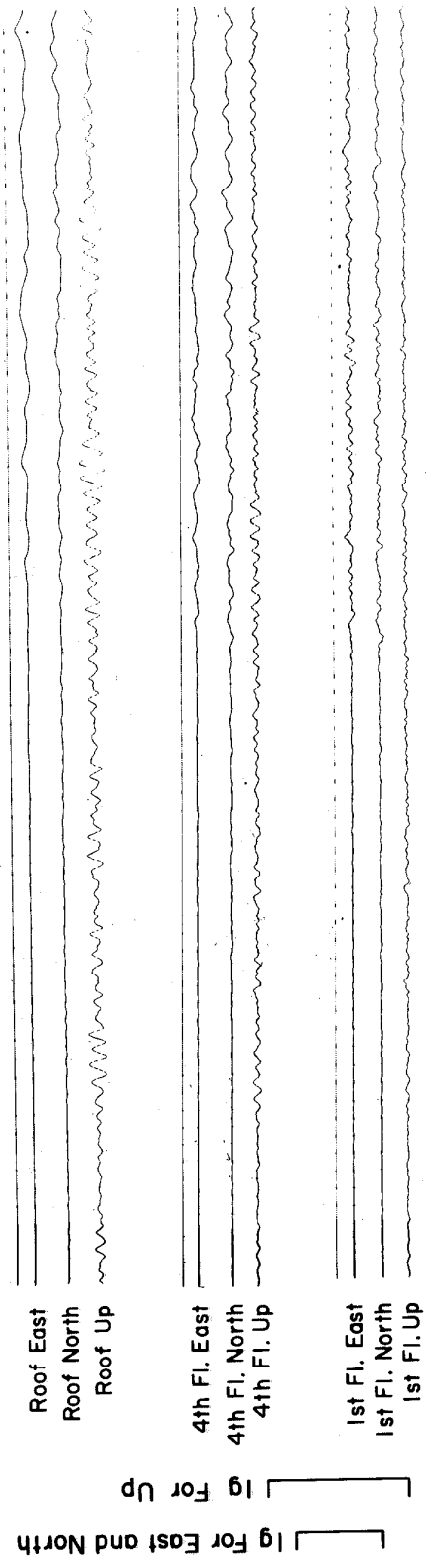

Figure 8 MO-2 Accelerograph record from 3260 Century Blvd., Los Angeles

tween 8 and 369 km of the epicenter, with the majority of them from sites closer than 75 km, primarily in the Los Angeles region. Table III is a list of the maximum accelerations for the three components at each station with locator coordinates for Figures 1, 2 and 3, epicentral distances, instrument identification numbers referenced to the annual strong-motion data table, the type of structure at each site, the specific location of instruments within multi-story buildings and upon dams, and the general geology for each site. Where NR is included in the data column, no record was obtained due to battery failure or equipment malfunction, and where PR is listed, it means only a partial record was obtained and consequently the earliest and strongest motions of the earthquake were not recorded. All instruments within 250 km are included in the table whether or not they were triggered by the earthquake since the mere fact of not receiving sufficient ground motion to activate the instrument's starter is by itself of some importance. Figures 9, 10 and 11 show the maximum horizontal and vertical ground accelerations plotted on maps at their respective station locations.

The highest earthquake accelerations ever instrumentally measured, high frequency horizontal pulses in the 1 g plus range, were recorded on the east abutment of the Los Angeles County Flood Control District's Pacoima Dam, 8 km south of the epicenter and 4 km north of the surface faulting in the Sylmar-San Fernando area. The station is located on a jointed and fractured granitic ridge, part of a large block of the San Gabriel Mountains that was thrusted up and left laterally at least two meters during the earthquake. Maximum horizontal accelerations of 1.25 g occurred six to eight seconds after instrumental triggering within a

TABLE III

MAXIMUM ACCELERATIONS RECORDED DURING THE

SAN FERNANDO EARTHQUAKE OF 9 FEBRUARY 1971

Station Name	Identification Number *	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
1. Pacoima Dam	279	2	C-3	8	Down S 74 W S 16 E	.72 1.25 1.24		Highly jointed diorite gneiss	Small building	4 kms from surface faulting
2. Los Angeles 8244 Orion	241-3	2	C-4	20	Down North West	.17 .27 .14	4th / 8-roof .23 / .22 .18 / .39 .24 / .31	Alluvium	7-story R C Bldg.	8 kms from surface faulting
3. Los Angeles 15107 Vanowen	458-60	2	C-4	24	Down West South	.12 .11 .12	4th / 8-roof .19 / .17 .23 / .34 .26 / .38	Alluvium 500', watertable at 70'	Circular 7-story R C Bldg.	1¼ kms from surface faulting
4. Lake Hughes #12	128	2	B-2	25	Down N 21 E N 69 W	.18 .37 .28		Eocene sandstone below a shallow (10'±) layer of alluvium	Small building	
5. Los Angeles 14724 Ventura	253-5	2	C-4	28	Up N 78 W S 12 W	.09 .19 .26	6th / 13-roof .11 / NR .27 / .21 .36 / .32	Alluvium	12-story R C Bldg.	
6. Los Angeles 15250 Ventura	466-8	2	C-4	28	Down S 09 W S 81 E	.10 .23 .14	7th / 13-roof .18 / .13 .25 / .26 .21 / .18	Alluvium, water table at 55'	12-story R C building	
7. Los Angeles 15433 Ventura	256-8	2	C-4	28	Up N 12 E N 78 W	NR NR NR	7th / 13th .15 / .07 .24 / .27 .17 / .23	Alluvium	13-story R C building	

* Refers to list in "Strong-Motion Instruments Data" table annually issued by the Seismological Field Survey.

Abbreviations: PR = partial record; NR = no record; RC = reinforced concrete; St.= steel.

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
							9th / 18-roof			
8. Los Angeles 15910 Ventura	461-3	2	C-4	28	Down	.11	.22 / .21	Alluvium, watertable at 35'	17-story St. building	
					S 09 W	.13	.18 / .22			
					S 81 E	.15	.13 / .23			
9. Los Angeles 16055 Ventura	259-61	2	C-4	28		NR	NR / NR	35' of alluvium over siltstone and sandstone, water table at 50'	12-story R C building	Mid-level accelerograph out for repair
10. Los Angeles 16661 Ventura	118-20	2	C-4	28				Alluvium	9-story R C building	Owner did not supply batteries
							10-roof			
11. Pasadena J P L	267-8	2	D-4	29	Down	.13	.26	Sandy-gravel	9-story St. building	
					S 08 W	.17	.21			
					S 82 E	.21	.38			
12. Lake Hughes #4	126	2	C-2	29	Down	.16		Weathered granitic	Small building	
					S 21 W	.16				
					S 69 E	.19				
13. Lake Hughes #9	127	2	B-2	29	Down	.12		Gneiss	Small building	
					N 21 E	.15				
					N 69 W	.16				
14. Castaic	110	2	B-2	29	Down	.18		Sandstone	Small building	
					N 21 E	.39				
					N 69 W	.32				
							11th / 20th			
15. Los Angeles 3838 Lankershim	220-2	2	C-4	30	Down	.09	PR / .23	Interlayered soft sandstone and shale	20-story R C building	
					North	.18	PR / .10			
					West	.13	PR / .21			
16. Lake Hughes #1	125	2	C-2	31	Down	.12		Granitic	Small building	
					N 21 E	.17				
					N 69 W	.13				

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
17. Glendale 633 E. Broadway	122	2	D-4	32	Down	.14		Alluvium	3-story building	
					S 70 E	.28				
					S 20 W	.23				
18. Los Angeles Griffith Park Observatory	141	2	C-4	33	Down	.12		Granitic	Concrete pier on bed rock	
					South	.18				
					West	.16				
19. Palmdale	262	2	D-2	33	Down	.08		Alluvium	Small building	
					S 50 E	.11				
					S 30 W	.13				
						Abutment Crest				
20. Santa Felicia Dam	284-5	2	A-3	33	Down	.09		Sandstone - shale complex	Earth fill dam. Height 200' Crest length 1260'	6 seismoscope records also obtained on and near the dam.
					S 82 W	.24				
					S 08 E	.23				
					Down		.07			
					S 75 W		.18			
					S 15 E		.22			
21. Pasadena Seismological Laboratory	266	2	D-4	34	Down	.08		Weathered granitic	2-story building	
					South	.19				
					East	.11				
							6th / 12-roof			
22. Los Angeles 7080 Hollywood	238-40	3	C-1	34	Down	.06	.16 / .22	Alluvium	11-story R C building	
					East	.11	.19 / .21			
					North	.10	.12 / .12			
							12th / 22nd			
23. Los Angeles 1760 N. Orchid	446-8	3	C-1	34	Up	.08	.14 / .19	Alluvium	22-story R C building	
					South	.16	.08 / .11			
					East	.13	.14 / .20			
							7th / 14th			
24. Los Angeles 6430 Sunset	232-4	3	D-1	34	Up	.09	NR / NR	Alluvium, Water table at 55'	14-story St. building	
					South	.19	NR / NR			
					East	.14	NR / NR			
							6th / 12-roof			
25. Los Angeles 6464 Sunset	235-7	3	D-1	34	Up	.08	PR / .29	Alluvium Water table at 55'	11-story St. building	
					South	.11	PR / .24			
					East	.12	PR / .28			

Table III (continued)

Name	Station Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels		Geology	Structure Type	Comments
							P.E. Lot-Base	Roof			
26. Los Angeles Hollywood Storage	133-5	3	C-1	35	Up	.12	.06	NR	700±' of alluvium	14-story R C building	
					East	.22	.15	NR			
					South	.19	.11	NR			
							3rd level	8th level			
27. Los Angeles 4867 Sunset	226-8	3	D-1	35	Down	.13	.13	.20	Shallow alluvium over Miocene siltstone	8-story R C building	Accelerographs on B and 2 in north wing, on 7 in east wing.
					S 89 W	.17	.30	.45			
					S 01 E	.17	.22	.46			
28. Fairmont Reservoir	121	2	C-2	36	Up	.05			Granitic		
					N 34 W	.10					
					N 56 E	.07					
							5th	11-roof			
29. Beverly Hills 435 N. Oakhurst	452-4	2	C-2	36	Down	.04	.05	.10	Alluvium, Water table at 22'	10-story R C building	
					North	.06	.13	.24			
					West	.09	.14	.25			
							4th	9th			
30. Los Angeles 120 Robertson	142-4	3	B-2	36	Down	.03	NR	.12	Alluvium	9-story R C building	
					S 02 W	.09	.18	.33			
					S 88 E	.09	.18	.28			
							5th	10th			
31. Beverly Hills 450 N. Roxbury	455-7	3	B-2	37	Down	.04	.10	.12	Alluvium	10-story R C building	
					N 50 E	.20	.22	.30			
					N 40 W	.17	.21	.22			
							5th	11-roof			
32. Beverly Hills 9100 Wilshire	416-8	3	B-2	37	Up	.04	.08	PR	Alluvium. Water table at 40'	10-story R C building	
					East	.16	.13	PR			
					South	.12	.15	PR			
33. Beverly Hills 9450 Wilshire	434-6	3	B-2	37		NR	NR	NR	Alluvium. Water table at 40+'	10-story R C building	

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
34. Los Angeles UCLA	140	3	A-2	37	Up North West	.07 .10 .09		70' of alluvium over 5000' of sedimentary rock	7-story building	Instrument adjacent to UCLA reactor
35. Pasadena CIT Athenaeum	475	2	D-4	37	Down East North	.10 .11 .10		Approximately 1000' of alluvium upon granite	2-story building	
36. Pasadena Millikan Library CIT	264-5	2	D-4	37	Down East North	.12 .18 .22	10-roof .14 .34 .33	Approximately 1000' of alluvium upon granite	9-story R C building	
37. Century City Ground Station	410	3	B-2	38		NR		Alluvium	Small building	
38. Los Angeles 1900 Avenue of Stars	184-6	3	B-2	38	Up S 46 E N 44 E	.06 .08 .10	16th / 28-roof PR / .35 PR / .15 PR / .12	Silt and sand layers. Water level at 70'	27-story St. building	
39. Los Angeles 1901 Avenue of Stars	187-9	3	B-2	38	Down N 46 W S 44 W	.07 .12 .17	9th / 21-roof .14 / PR .18 / PR .11 / PR	Silt and sand layers. Water table at 70-80'	19-story St. building	
40. Los Angeles 1800 Century Park East	425-7	3	B-2	38	Down S 36 E N 54 E	.08 .08 .10	5th / 16-roof .16 / .31 .21 / .28 .22 / .28	Silt and sand layers. Water table at 70-80'	15-story R C building	
41. Los Angeles 1880 Century Park East	440-2	3	B-2	38	Down N 54 E N 36 W	.07 .11 .13	7th / 17-roof .12 / .27 .10 / .10 .14 / .12	Silt and sand layers. Water table at 70-80'	16-story St. building	

Table III (continued)

	Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels		Geology	Structure Type	Comments
								14th	20th			
42.	Los Angeles 1888 Century Park East Bldg.	419-21	3	B-2	38	Down	NR	.19	.35	Silt and sand layers. Water table at 70-80'	20-story St. building	
						N 54 E	NR	.14	.15			
						N 36 W	NR	.06	.08			
								Level 5	Level 9			
43.	Los Angeles 1888 Century Park East-Ramp	422-4	3	B-2	38	Down	NR	.09	.11	Silt and sand layers. Water table at 70-80'	6-story (9 levels) R C Parking ramp	Basement accelerograph out for repair
						S 36 E	NR	.18	.38			
						N 54 E	NR	.12	.31			
								10th	19-roof			
44.	Los Angeles 2080 Century Park East	193-5	3	B-2	38	Up	NR	NR	.23	Alluvium	17-story R C building	
						N 50 E	NR	NR	.35			
						N 40 W	NR	NR	.18			
								8th	15th			
45.	Los Angeles 930 Hilgard	407-9	3	A-2	38	Up	PR	PR	.16	Alluvium. Water level at 55'	15-story R C building	Upper 2 instruments in elevator tower structurally separated from the north and south residential towers
						N 76 W	PR	PR	.15			
						N 14 E	PR	PR	.20			
								8th	14th			
46.	Los Angeles 945 Tiverton	178-80	3	A-2	38	Down	NR	.10	.15	Alluvium	14-story R C building	
						N 78 W	NR	.12	.14			
						S 12 W	NR	.23	.18			
								3rd	6th			
47.	Los Angeles 4680 Wilshire	223-5	3	D-2	38	Down	.08	.13	.16	Alluvium	7-story R C building	
						N 15 E	.12	.22	.24			
						N 75 W	.09	.18	.30			
								16th	33-roof			
48.	Los Angeles 5900 Wilshire	428-30	3	C-2	38	Up	.03	.08	.15	Alluvium - asphaltic sands	31-story St. building	
						N 83 W	.07	.12	.17			
						S 07 W	.07	.10	.14			

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
49. Los Angeles 6200 Wilshire	443-5	3	C-2	38	Up	.04	10th .07 / 17th .07	Thin layer of alluvium over asphaltic sands	17-story R C building	
					N 08 E	.13	.28 / .30			
					N 82 W	.13	.15 / .26			
50. Los Angeles 1177 Beverly Dr.	413-5	3	B-2	39	Up	.07	3rd NR / 7th NR	Alluvium	Arcuate shaped 7-story R C building	Accelerograph on 7 was out for repair
					N 31 W	.12	NR / NR			
					N 59 E	.11	NR / NR			
51. Los Angeles 616 S. Normandie	431-3	3	D-2	39	Down	.05	8th .10 / 17-roof .20	Alluvium. Siltstone at 25'	17-story R C building	
					North	.10	.22 / .31			
					West	.11	.14 / .23			
52. Los Angeles 3407 W. Sixth	199-201	3	D-2	39	Down	.06	4th .10 / 8-roof .26	Alluvium	7 stories, 2 St. and 5 R C	
					South	.17	.21 / .29			
					East	.19	.21 / .21			
53. Los Angeles 3345 Wilshire	196-8	3	D-2	39	Down	.07	2nd NR / 12th .12	Alluvium	12-story R C building	
					South	.12	.17 / .21			
					East	.09	.11 / .26			
54. Los Angeles 3411 Wilshire	202-4	3	D-2	39	Up	.07	13th PR / 31st PR	Siltstone. Water table at basement level	31-story St. building	
					South	.11	PR / PR			
					West	.14	PR / PR			
55. Los Angeles 3470 Wilshire	208-10	3	D-2	39	Down	.05	5th .10 / 11th .16	Alluvium	11-story R C building	
					East	.12	.24 / .22			
					North	.15	.21 / .23			
56. Los Angeles 3550 Wilshire	211-3	3	D-2	39	Up	.06	11th NR / 21st NR	Alluvium. Water table at 35'	21-story St. building	
					North	.18	NR / NR			
					West	.12	NR / NR			

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels		Geology	Structure Type	Comments
							5th	11th			
57. Los Angeles 3710 Wilshire	217-9	3	D-2	39	Down	.08	.10	.17	Alluvium	11-story R C building	
					West	.17	.27	.37			
					South	.16	.16	.22			
							8th	14-roof			
58. Los Angeles 2500 Wilshire	449-51	3	E-2	40	Down	.04	.07	.14	Alluvium. Siltstone at 20-30'. Water table at 35'	13-story R C building	
					N 29 E	.10	.13	.20			
					N 61 W	.10	.16	.19			
							7th	15th			
59. Los Angeles Water & Power	137-9	3	F-2	41	Down	.08	.10	.17	Miocene siltstone	15-story St. building	
					N 50 W	.14	.17	.16			
					S 40 W	.20	.13	.12			
							12th	18-roof			
60. Los Angeles 222 S. Figueroa	145-7	3	E-2	41	Up	.04	PR	.09	25' of alluvium over shale. Water at 20'	17-story R C building	Instruments in different bldg sections, G-north tower and 20 - So. tower.
					N 53 W	.15	PR	.40			
					S 37 W	.12	PR	.31			
							12th	18-roof			
61. Los Angeles 234 S. Figueroa	148-50	3	E-2	41	Up	.06	NR	.17	25' of alluvium over shale. Water at 20'	17-story R C building	Instruments in different sections. G-west tower, 12-elevator tower & 20 - east tower.
					S 53 E	.17	NR	.50			
					N 37 E	.20	NR	.44			
							19th	39th			
62. Los Angeles 445 S. Figueroa	157-9	3	E-2	41	Down	.06	.12	NR	Shale	39-story St. building	
					N 52 W	.14	.21	NR			
					S 38 W	.13	.13	NR			
							8th	17-roof			
63. Los Angeles 250 E. First	151-3	3	F-2	41	Down	.04	.07	.21	Alluvium	15-story St. building	
					N 36 E	.09	.21	.16			
					N 54 W	.13	.17	.18			

Table III (continued)

	Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels		Geology	Structure Type	Comments
								16th	32-roof			
64.	Los Angeles 800 W. First	172-4	3	E-2	41	Up N 53 W N 37 E	.06 .15 .09	.15 .18 .11	.22 .28 .18	Pliocene siltstone	31-story St. building	
								6th	11-roof			
65.	Los Angeles 533 S. Fremont	160-2	3	E-2	41	Up N 30 W S 60 W	.08 .25 .22	.16 .34 .31	PR PR PR	Alluvium	10-story R C building	
								2nd	8th			
66.	Los Angeles 750 S. Garland	169-71	3	E-2	41	Down S 30 W N 60 W	PR PR PR	.10 .22 .16	.15 .30 .23	Alluvium	8-story R C building	
							2nd	10th	17th			
67.	Los Angeles 420 S. Grand	154-6	3	E-2	41	Down S 37 W S 53 E	.07 .12 .17	PR PR PR	.23 .23 .32	Shale and siltstone - several 1000'	16-story steel building Note comment	Second floor is ground level. Floor numbers from adjoining building.
								6th	10th			
68.	Los Angeles 1625 Olympic	469-71	3	E-3	41	Down N 28 E N 62 W	.16 .14 .27	.14 .18 .22	.23 .23 .28	Alluvium	10-story R C building	
								24th	43rd			
69.	Los Angeles 611 W. Sixth	163-5	3	E-3	41	Down N 52 W N 38 E	.06 .10 .11	NR NR NR	.11 .11 .18	Alluvium	43-story St. building	
70.	Santa Anita Dam	104	2	D-4	42	Down N 03 E N 87 W	.07 .18 .24			Granite diorite complex	Small building	
								6th	12th			
71.	Alhambra 900 S. Fremont	482-4	2	D-4	42	Down West South	.09 .13 .11	.11 .15 .14	.17 .18 .15	Few 100 feet of alluvium over siltstone	12-story St. building	

Table III (continued)

	Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels		Geology	Structure Type	Comments
								5th	10th			
72.	Los Angeles 1150 S. Hill	437-9	3	E-3	42	Down	.05	.09	.15	500' of gravelly sand over shale	10-story St. building	
						S 53 E	.12	.11	.14			
						N 37 E	.09	.10	.11			
73.	Los Angeles 3663 Hoover	214-6	3	E-3	42		NR	NR	NR	400' of alluvium	7-story R C building	
								4th lev.	7th lev.			
74.	Los Angeles 646 S. Olive	166-8	3	E-3	42	Down	.08	.12	.26	Alluvium	8 level R C parking ramp	
						S 37 W	.22	.25	.38			
						S 53 W	.25	.26	.48			
								4th lev.	8th lev.			
75.	Los Angeles 808 S. Olive	175-7	3	E-3	42	Down	.09	.19	.24	Alluvium	8 level R C parking ramp	
						S 37 W	.14	.16	.25			
						S 53 E	.13	.26	.44			
								4th	8-roof			
76.	Los Angeles 1640 Marengo	181-3	2	D-4	42	Down	.08	.12	.13	Pleistocene alluvium. Water level at 35'	7-story R C building	
						N 38 W	.14	.20	.24			
						S 52 W	.14	.26	.44			
								5th	11-roof			
77.	Los Angeles 11661 San Vicente	250-2	2	C-4	42	Up	NR	.11	.16	Alluvium. Water table at 57'	10-story R C building	
						N 35 W	NR	.08	.10			
						S 55 W	NR	.09	.11			
								5th	13-roof			
78.	Los Angeles 3440 University U S C	205-7	3	E-3	42	Up	.05	.08	.09	400' of alluvium over clay and shale. Water table at 275'	12-story R C building	Roof accelerograph is in top of small elevated penthouse.
						S 61 E	.08	.13	.24			
						N 29 E	.06	.14	.26			
								5th	9th			
79.	Los Angeles 2011 Zonal	190-2	2	D-4	42	Down	.06	.08	.12	Shale at east end of building. 8' of fill at west end.	9-story R C building	
						S 28 W	.08	.16	.20			
						S 62 E	.07	.18	.21			

Table III (continued)

Name	Station	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels		Geology	Structure Type	Comments
80.	Pyramid	58	2	A-2	44		NR			Shale	Small building	
81.	Pearblossom	269	2	E-2	46	Down North West	.06 .10 .15			400' of alluvium over 14,000' of sedimentary rock.	Small building	
82.	Vernon	288	2	D-4	46	Up S 07 W N 83 W	.05 .09 .11			>1000' of alluvium. Water table> 300'	6-story building	
								6th	12th			
83.	Los Angeles 8639 Lincoln	244-6	2	C-5	48	Down S 45 W S 45 E	.04 .04 .04	.05 .10 .10	.06 .12 .12	Terrace deposits-sand	12-story R C building	
								7th	14th			
84.	Los Angeles 9841 Airport Blvd.	247-9	2	C-5	49	Up North West	.01 .03 .03	NR NR NR	.05 .10 .09	Alluvium	14-story R C building	
								4th	8-roof			
85.	Los Angeles 5260 Century	229-31	2	C-5	49	Up East North	.02 .06 .06	.04 .04 .07	.08 .09 .06	Alluvium	7-story St. building	
86.	Whittier Narrows Dam	289	2	D-4	52	Down S 53 W S 37 E	.05 .10 .10			More than 1000' of alluvium	Earthfill dam. Height 56' Crest length 14,960'	
87.	Oso Pump Plant	52	2	B-1	55	Down North West	.06 .05 .05			Alluvium	Small building	
88.	Puddingstone Dam	278	2	E-4	62	Down N 55 E N 35 W	.05 .09 .05			Volcanic clastics and intrusions with associated shales.	Small building	
89.	Palos Verdes Estates	411	2	C-5	67	Down S 25 E N 65 E	.01 .04 .02			Shallow Pleistocene sands over shale--volcanic complex	2-story building	

Table III (continued)

	Station	Identification Number	Location		Distance from Epicenter	Component	Maximum Acceleration (g)		Geology	Structure Type	Comments
							Ground Level	Other Floors/Levels			
Name			Map	Key	(km)						
							#1	#2			
90.	Wrightwood	290	2	F-3	70	Down S 25 W S 65 E	.02 .05 .04	.02 .06 .04	Alluvium veneer on igneous metamorphic complex.	Small building	Both accelerographs at ground level
91.	Tejon	96	1	C-3	71	Down East North	.02 .02 .03		Granitic	Small building	
92.	Long Beach Terminal Island	130	2	D-5	71	Up S 69 W N 21 W	.02 .03 .03		Alluvium. Water table < 20'	Small building	
93.	San Antonio Dam	287	2	F-4	71	Up N 15 E N 75 W	.03 .08 .06		Up to 150' of alluvium over granitics	Earth fill dam. Height 160' Crest length 3850'	
94.	Long Beach Utility Building	131	2	D-5	72	Up North East	.02 .03 .02		Alluvium. Water table at 15'	3-story building	
95.	Long Beach State College	132	2	D-5	73	Down N 76 W S 14 W	.02 .04 .02		Unconsolidated silt-sand-clay	9-story building	
96.	Grapevine Tehachapi Pumping Plant	27	1	C-3	73	Down South East	.02 .05 .07		15' of alluvium over gneiss	Small building	
97.	Carbon Canyon Dam	108	2	E-5	74	Down S 40 W S 50 E	.04 .07 .07		Thin alluvium over poorly cemented siltstone	Earth fill dam. Height 99' Crest length 2610'	
								10-West	10-Center		
98.	Fullerton 2600 Nutwood	476-78	2	E-5	74	Down West South	.02 .04 .04	.04 .11 .13	.02 .09 .15	Alluvium	10-story R C building	Both upper accelerographs on top (10th) floor

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels 10th	Other Floors/Levels 19th	Geology	Structure Type	Comments
99. Port Hueneme	272	1	B-3	78	Up South West	.01 .03 .02			Alluvium > 1000'	Small building	
100. Orange 4000 W. Chapman	472-4	2	E-5	83	Down West South	.01 .02 .02	.04 .09 .08	.08 .15 .11	Alluvium> 300' over shale	19-story R C building	
101. Santa Ana	281	2	E-5	86	Up N 04 E S 86 W	.02 .03 .03			Alluvium	3-story building	
102. Wheeler Ridge	102.	1	C-2	89	Down South East	.01 .02 .03			Alluvium, 200-300'	Small building	
103. Costa Nesa	114	2	E-6	96	Down South East	.01 .02 .04			Terrace deposits	18-story R C building	
104. Cedar Springs Allen Ranch	111	1	D-3	98	Down S 05 W S 85 E	.01 .02 .02			Granitic	Small building	
105. Devil Canyon	116	1	D-3	99					Limestone - gneiss complex	Small building	Two accelerographs were not triggered.
106. Cedar Springs Pump Plant	112	1	D-3	101	Down S 36 W S 54 E	.01 .03 .03			Shallow gravelly alluvium	Small building	
107. Colton	113	1	D-3	104	Up East South	.03 .04 .04			Alluvium >500'	Small building	
108. San Bernardino	274	1	D-3	104	Down East North	.02 .05 .04			Alluvium - 1000'. Water table at 30'	6-story building	

Table III (continued)

	Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
109.	Loma Linda	129	1	D-3	111		PR		Alluvium	10-story building	
110.	Santa Barbara Court House	283	1	B-3	119	Down East North			Boulder alluvium - 700' deep	2-story building	Record not available for scaling.
							#1	#2 #3 #4			
111.	Maricopa Array	41-4	1	B-2	119	Down S 40 W S 50 E	< .01 < .01 < .01	< .01 < .01 .01 < .01 .01 .01 < .01 .01 .01	Poorly cemented sandstone	Small buildings	
112.	San Juan Capistrano	465	2	F-7	120	Down N 33 E N 57 W	.02 .04 .03		Alluvium	Small building	
113.	Bakersfield	4	1	B-2	122	Up South West	< .01 .01 < .01		Alluvium > 500'	Large one story building	
114.	Buena Vista	11	1	B-2	122	Down South East	< .01 .01 .01		Alluvium	Small building	
115.	Perris	270	1	D-4	127				Alluvium veneer over granitic	Small building	Was not triggered
								3-roof			
116.	Taft	94-5	1	B-2	128	Down N 21 E S 69 E	< .01 .02 .01	.02 .01	40' of alluvium over poorly cemented sandstone	One story school building	Vertical component on roof is unreadable
117.	Santa Barbara University of California	282	1	B-3	133	Down East North	.01 .02 .01		Alluvium veneer over sandstone	2-story building	
118.	San Onofre	280	1	D-4	135	Down N 33 E N 57 W	.01 .01 .02		Lightly cemented Pliocene sandstone, > 325' depth	Small building	

Table III (continued)

	Station Name	Identification Number	Location Map	Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels		Geology	Structure Type	Comments
119.	Hemet	123	1	E-4	139	Down S 45 W S 45 E	.03 .05 .04			Alluvium	Small building	
							Spillway	Crest	Aux.Crest			
120.	Isabella Dam	35-9	1	C-2	140	Down N 14 E N 76 W	< .01 .01 .01	< .01 .01 .01	< .01 .01 .01	Main dam on granite. Aux. on granite and alluvium.	Earth fill dam	
							Cont. Tower	Aux. Abut.				
							< .01 .01 .01	< .01 .01 .01				
							Abutment	Crest				
121.	Cachuma Dam	106-7	1	B-3	147		NR	NR		Shale	Earthfill dam	
122.	Anza	103	1	E-4	178	Down N 45 E N 45 W	.01 .03 .04			Alluvium	Small building	
123.	Point Concepcion	271	1	A-3	188					Shale	Small building	Was not triggered
124.	Salinas Dam	64	1	A-2	209					Sedimentary rock	Concrete dam	Was not triggered
125.	San Diego	277	1	D-5	216	Up East South	< .01 .01 .01			Shallow alluvium (50-100') over sedimentary rock	4-story building	
								22nd				
126.	San Diego Gas & Electric	275-6	1	D-5	216	Down East North	< .01 .01 .01	NR		Shallow terrace deposits	22-story St. building	
127.	San Luis Obispo	83	1	A-2	219					5' of clay loam over Franciscan shale	Small building	Was not triggered

Table III (continued)

Station Name	Identification Number	Location Map	Location Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Maximum Acceleration (g) Other Floors/Levels	Geology	Structure Type	Comments
128. Temblor	97	1	A-2	225					Small building	Was not triggered
129. Cholame - Shandon Array	13-16	1	A-2	227	Down N 51 E N 39 W	#5 <.01 .01 .01	#8 <.01 .01 .01	Alluvium	Small buildings	2 & #12 were not triggered
130. Terminus Dam	97-9	1	B-1	229	Down S 81 E N 09 E	Crest All .01	Abutment Other components Cont. Tower .01	Metamorphic complex	Earth fill dam	
131. Borrego Springs	105	1	E-4	230	Down S 45 W S 45 E	<.01 <.01 <.01		Alluvium		
132. Superstition Mountain	286	1	F-5	286				Granitic	Small building	Was not triggered
133. Imperial	124	1	F-5	308					Small building	Was not triggered
134. El Centro	117, 412, 464	1	F-5	318-324	Down S 52 W S 38 E	<.01 .01 .01	Hospital	Alluvium - several 1000'	Small building	Accelerographs at Union Meadows School and the Irrigation District substation were not triggered
135. Las Vegas Landmark Tower	296	1	F-1	348±	Vert. N - S E - W		Top <.01 .01 .01	Alluvium		
136. Las Vegas International Hotel		1	F-1	348±	Vert. N - S E - W		Top <.01 .01 .01	Alluvium		

Table III (continued)

	Station Name	Identification Number	Location Map	Key	Distance from Epicenter (km)	Component	Maximum Acceleration (g) Ground Level	Other Floors/Levels	Geology	Structure Type	Comments
137.	Las Vegas Bank of Nevada	305	1	F-1	348±	Up N 27 E S 63 E		Top <.01 .01 .01	Alluvium		
138.	Las Vegas Univ. of Nevada at Las Vegas	309	1	F-1	348±	Vert. N - S E - W	<.01 .01 .01		Alluvium		
139.	Las Vegas Royal Inn		1	F-1	348±	Vert. N - S E - W		Top <.01 .01 .01	Alluvium		
140.	Las Vegas Stardust	311	1	F-1	348±	Vert. N - S E - W		Top <.01 .01 .01	Alluvium		
141.	Las Vegas Desert Inn	312	1	F-1	348±	Vert. N - S E - W		Top .01 .01 .02	Alluvium		
142.	Las Vegas Dunes Hotel	299	1	F-1	348±	Vert. N - S E - W	.01 .02 .02	Top .01 .02 .02	Alluvium		
143.	Las Vegas Sahara	302	1	F-1	348±	Vert. N - S E - W		Top(200) Top(400) <.01 <.01 .03 .02 .02 .02	Alluvium		
144.	Las Vegas Ground Station	308	1	F-1	348±	Vert. N - S E - W	<.01 .01 .01		Alluvium		
145.	Hoover Dam, Nevada	292-4	1	G-1	369	Up S 45 E S 45 W	Oil House / Gallery / Intake Tower All traces show amplitudes < .01		Several 100' of volcanic breccia over basalt	Concrete dam	Oilhouse is on abutment

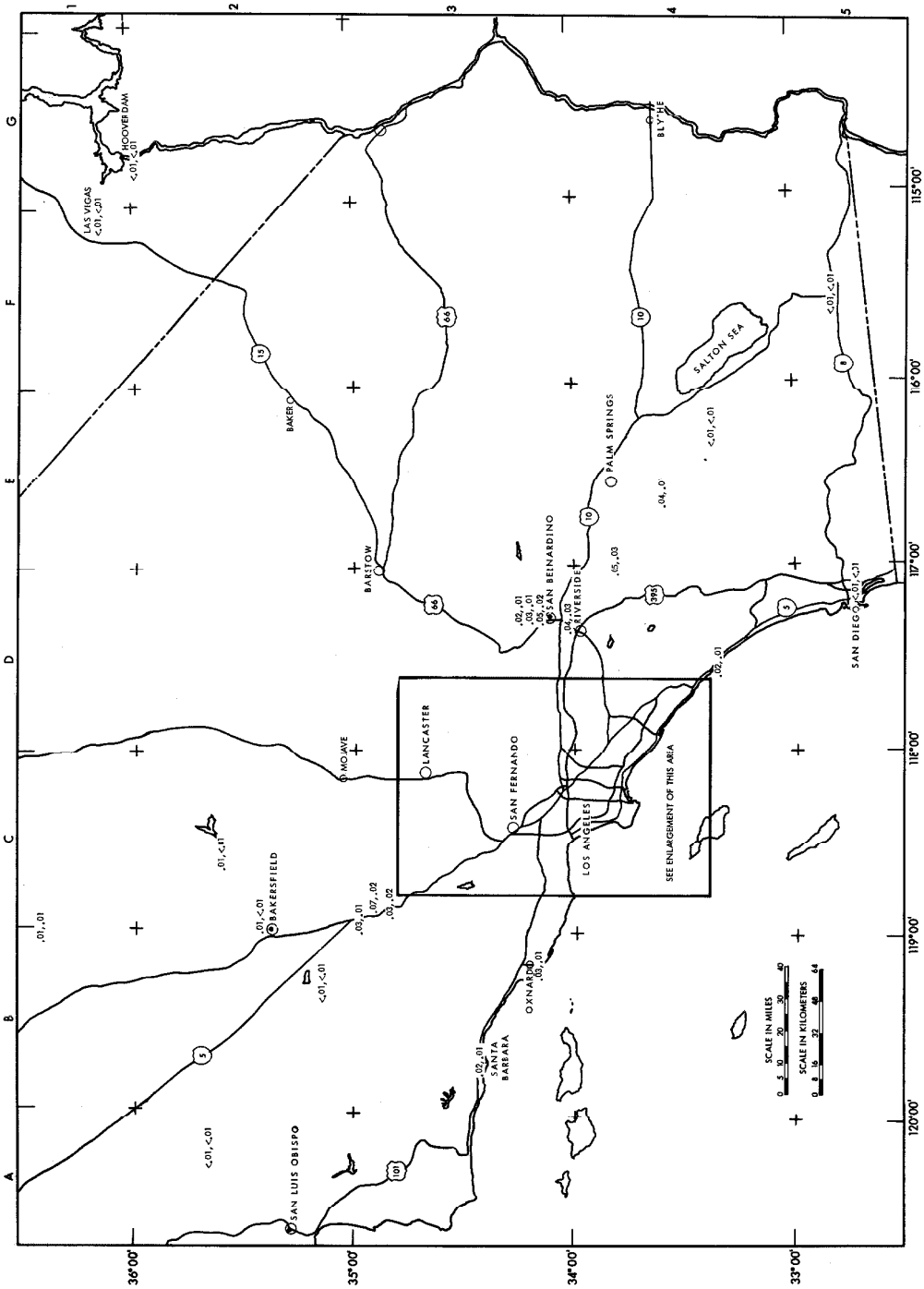

Figure 9 Maximum Horizontal and Vertical Acceleration Values, San Fernando Earthquake, Central and Southern California.

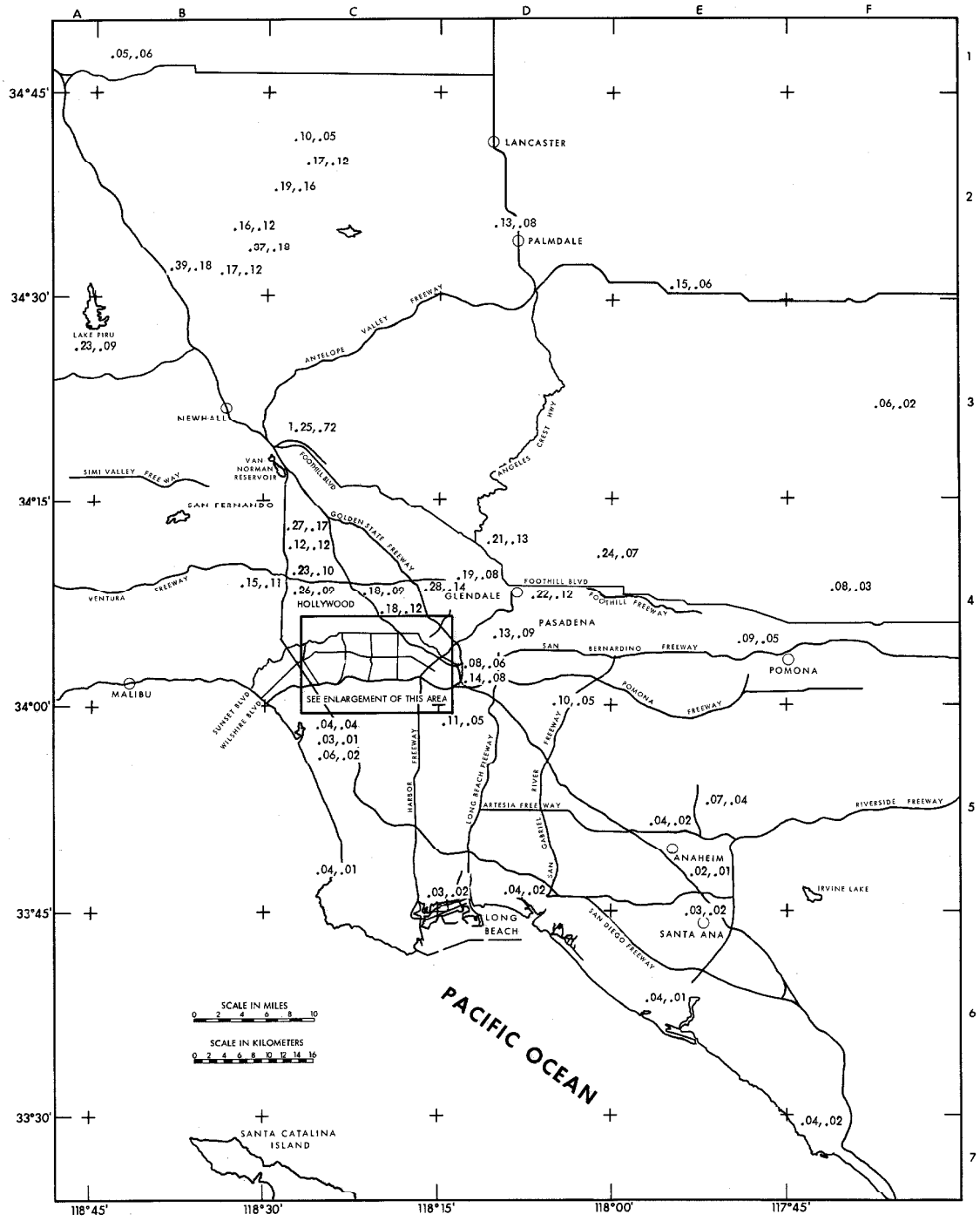

Figure 10 Maximum Horizontal and Vertical Acceleration Values, San Fernando Earthquake, Extended Los Angeles Area.

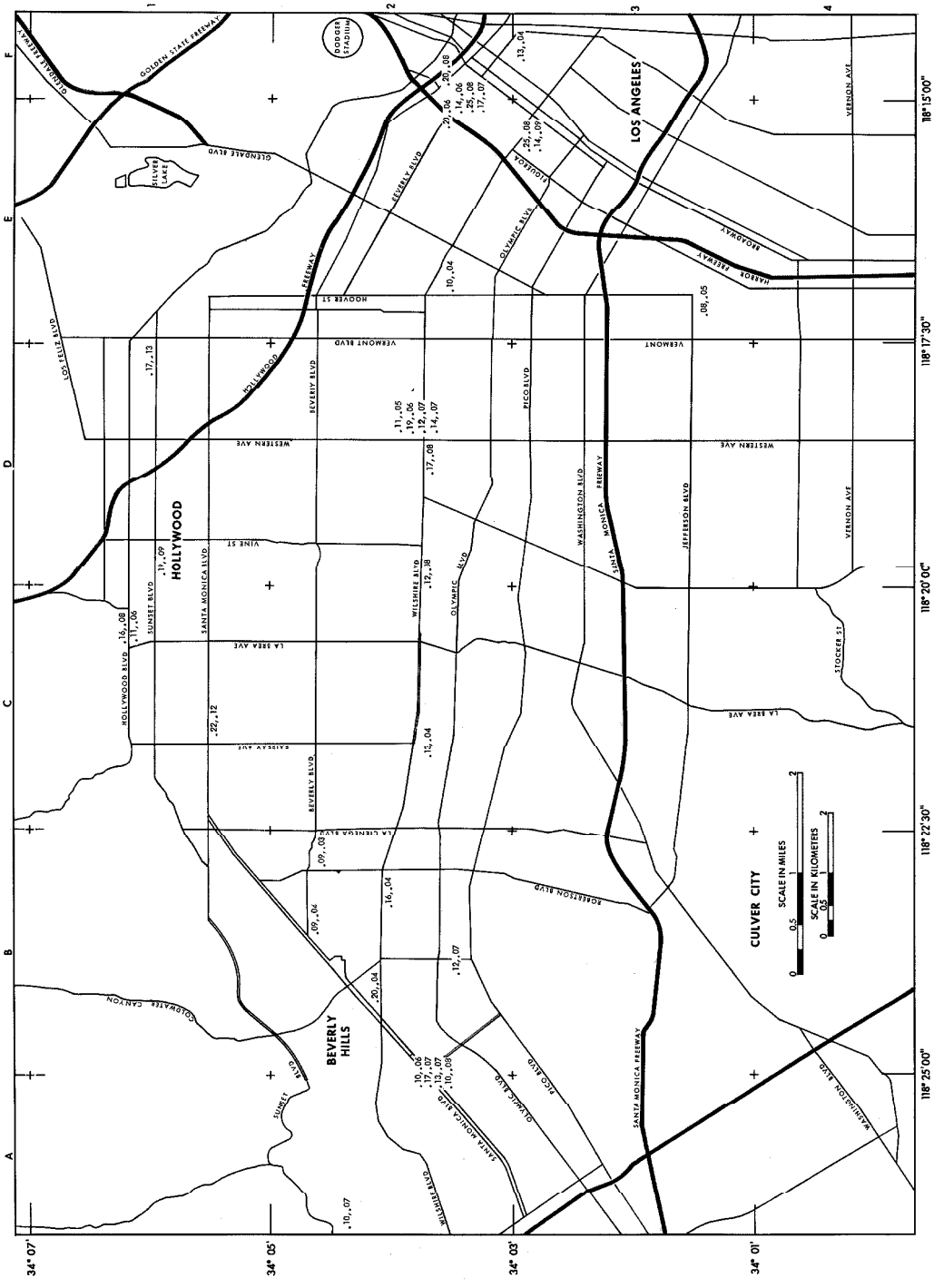

Figure 11 Maximum Horizontal and Vertical Acceleration Values, San Fernando Earthquake, Central Los Angeles Area.

seven-second envelope of the heaviest ground shaking where acceleration values generally ranged from 0.50 to 0.75 g (see Chapter 6 of this report). A peak vertical acceleration of 0.72 g was recorded at the same time during an average background level of 0.4 to 0.5 g. The highest ground accelerations measured in the past were 0.3 g recorded at El Centro eight km from the Imperial fault during the magnitude 7.1 earthquake of 1940, and later 0.5 g recorded only 75 meters from breakage that occurred on the San Andreas fault during the magnitude 5.3 Parkfield earthquake of 1966. A comprehensive analysis of the Pacoima dam record is included in another section of this report by Trifunac and Hudson.

The next highest horizontal accelerations, slightly less than 0.4 g, were measured at two stations 25 to 29 km northwest of the epicenter in the Castaic area. By contrast nearby instruments of the Lake Hughes array, at 29 to 31 km, recorded maximum accelerations of 0.16 to 0.19 g, one-half or less than those at Castaic (refer to 4, 12, 13, 14 and 16 of Table III). A superficial inspection of these results suggests that geological conditions had a considerable effect upon the amplitudes, since the lower values were recorded on crystalline rock and the higher values on Tertiary sandstones. Perhaps future examination of spectra will cast more light upon the character of this apparent amplification.

An interesting set of records were obtained at United Water Conservation District's Santa Felicia dam located on Piru Creek, 33 km northwest of the epicenter where two accelerographs and six seismoscopes were installed on the crest and at various surrounding sites. The dam is an earth-filled structure with a 1260 foot long crest rising 200 feet

above the stream bed. Figure 6 shows the accelerograph record from the crest station where the maximum acceleration was slightly greater than 0.2 g, approximately the same as that measured at the outlet structure below the dam. The relatively long period waves recorded at the crest, 0.6 to 0.9 second, caused the adjacent seismoscope with a natural period of 0.75 second to go off scale, while at the outlet structure the dominant period was near 0.1 second, and consequently comparatively small amplitudes were recorded on the seismoscope at that site (see Chapter 3 of this report by Morrill). The difference in frequencies is attributed to the longer period response of the earthfill dam contrasted to that of a small concrete structure with an integral 30 foot stilling well imbedded in a sandstone and shale complex.

Maximum horizontal ground accelerations recorded during the San Fernando earthquake are plotted against epicentral distance in Figure 12. Superimposed on the graph are the acceleration attenuation curves developed by Cloud and Perez (1970) using data gathered from 19 different earthquakes between 1933 and 1969. It is evident the more conservative attenuation curve, $\log (a/g) = 3.5 - 2 \log (D + 80)$, where D is the distance to the epicenter or to observed faulting, agrees well with the data from this earthquake except for the unexpectedly high values at Pacoima dam and smaller deviations noted at 25 and 29 km in the Castaic area. The Pacoima dam anomaly may be difficult to assess since the instrument is located on a fractured granitic ridge, part of a regional block that was thrusted up and laterally a few meters during the earthquake. Note the data at distances greater than 45 km are consistent with the less conservative of the two curves, $\log (a/g) = 3.0 - 2 \log (D + 43)$, and

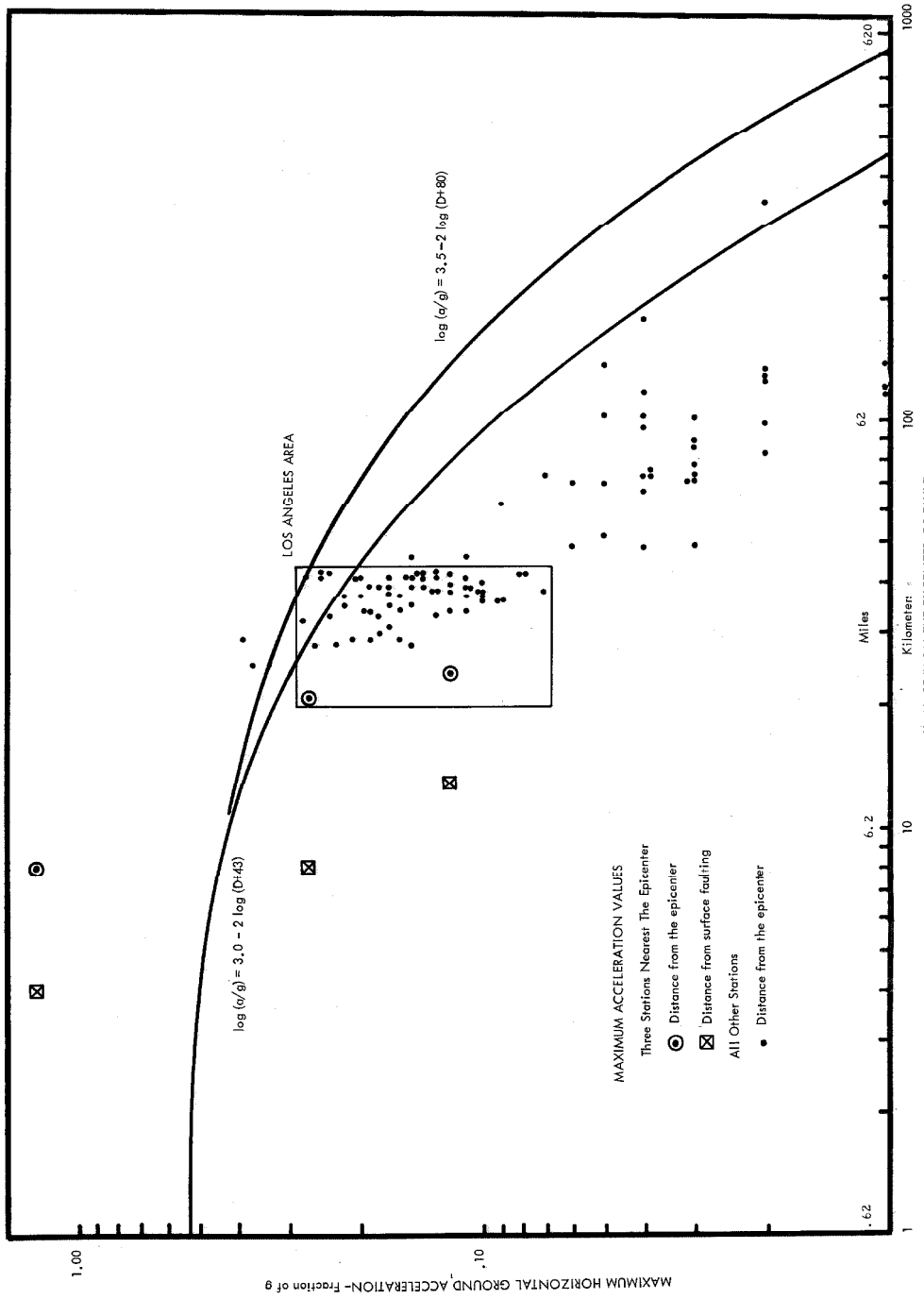

FIGURE 12

MAXIMUM HORIZONTAL GROUND ACCELERATIONS RECORDED DURING THE SAN FERNANDO EARTHQUAKE OF 2-9-71 (VALUES ≥ 0.01g)

although some of the values between 30 and 45 km do fall above that limit, these represent only 10 percent of the large number of points in that interval.

The ground accelerations recorded in various localities throughout the Los Angeles area, between 21 and 42 km of the epicenter, show a surprisingly similar range of values regardless of where the individual instrument clusters were located. Refer to Table IV. For instance, the maximum ground accelerations in San Fernando Valley at 21 to 28 km ranged from 0.11 to 0.27 g while those in downtown Los Angeles at 41 to 42 km ranged from 0.09 to 0.27 g. Although there are considerably more records available from downtown Los Angeles, it should be pointed out that the average of all maximum ground accelerations was 0.17 g in the San Fernando Valley compared to 0.15 g in the downtown area. Of additional interest, the highest amplitudes in the San Fernando Valley were predominantly in a north-south direction, nearly 90° to the trend of faulting. Similar strongly polarized amplitudes were observed on some seismoscope records recovered from the same area (Chapter 3 of this report). Beyond 45 km, the apparent attenuation of peak acceleration fell off sharply as indicated by the highest values near Los Angeles airport, 48 to 49 km, of only 0.03 to 0.06 g and at Long Beach, nominally 70 km, where the maximum accelerations were 0.02 to 0.04 g.

Strong-motion seismograms were recorded on the top floors of 57 high-rise buildings in the Los Angeles area including six reinforced concrete structures where upper level accelerations exceeded 0.4 g; an eight-story hospital in Hollywood, two eight-level parking ramps and two

TABLE IV

THE RANGE OF MAXIMUM HORIZONTAL GROUND

ACCELERATIONS AT VARIOUS LOS ANGELES LOCALITIES

Locality	Distance from the Epicenter (Km)	Maximum Horizontal Ground Acceleration (g)	Number of Measurements
San Fernando Valley	21 - 28	.11 - .27	10
Hollywood	34	.10 - .22	12
Pasadena (CIT)	37	.10 - .22	4
Beverly Hills - West Los Angeles	36 - 38	.06 - .20	24
Wilshire District	38 - 39	.09 - .19	18
Downtown Los Angeles	41 - 42	.09 - .27	26
Los Angeles Airport	48 - 49	.03 - .06	6
Long Beach	67 - 72	.02 - .04	8

17-story towers in downtown Los Angeles, and a seven-story hotel three km east of downtown (respectively 27, 74, 75, 60, 61 and 76 in Table III). A maximum acceleration of 0.50 g, the highest observed in any building during the San Fernando earthquake, was measured in one of the 17 story towers. Horizontal accelerations greater than 0.3 g occurred in 14 other structures, all but two of reinforced concrete frame construction. Vertical accelerations exceeded 0.3 g on the top floor of only three buildings, all located in Century City adjacent to Beverly Hills (38, 40 and 42 in Table III).

Where ground amplitudes in buildings were equal to or greater than 0.10 g, the ratio of peak horizontal accelerations, top to bottom, ranged from 1.1 to 2.3 in 80 percent of the comparisons. A few buildings showed ratios as high as 3.5, and at five other sites they were less than 1.0 (0.6 - 0.9), thus showing an apparent reduction of seismic forces at the top of the structures. These latter buildings were all 15 to 22 stories in height with fundamental periods of vibration between 1.5 and 2.7 seconds (15, 23, 41 - both directions, and 59 in Table III).

As in past earthquakes, accelerograms from the upper floors of high-rise buildings showed the structures responded in a manner related to their fundamental and other modes of vibration. See Figures 4, 5, 7 and 8. Ambient vibrations were measured in numerous buildings prior to the San Fernando earthquake, thus making it possible to compare these values with the periods induced by seismic forces and with the natural periods following the earthquake. Table V, a selected sampling of measurements before, during and after the earthquake, shows there was a considerable lengthening of building periods during the interval of

TABLE V

SELECTED BUILDING PERIODS MEASURED BEFORE, DURING,

AND AFTER THE SAN FERNANDO EARTHQUAKE

Building	Stories	Frame	Epicentral Distance (km)	Direction	Maximum Ground Acceleration (g)	Pre-Earthquake Period (sec)	Approximate Earthquake Period	Post-Earthquake Period (sec)	Change of Post-Earthquake Period (percent)
8244 Orion	7	R-C	21	N	0.27	0.48	1.7	0.65	+35
				W	0.14	0.52	1.6	0.70	+35
3838 Lankershim	20	R-C	30	N	0.18	1.22	1.8	1.40	+13
				W	0.13	1.26	1.8	1.53	+21
7080 Hollywood	11	R-C	34	N	0.10	0.90	1.4	1.02	+13
				W	0.11	1.03	1.5	1.14	+11
3710 Wilshire	11	R-C	39	N	0.16	0.98	1.4	1.07	+ 9
				W	0.17	0.76	1.1	0.87	+12
1640 Marengo	7	R-C	42	NW	0.14	0.53	1.0	0.65	+23
				NE	0.14	0.49	1.2	0.64	+31
5260 Century	7	Steel	49	N	0.06	1.24	1.5	1.25	+ 1
				W	0.06	1.26	1.6	1.33	+ 8

strong shaking, and from the follow-up studies it is apparent there was a permanent increase in the fundamental modes. Of particular interest are two identical seven-story reinforced concrete hotels located at 8244 Orion and 1640 Marengo, respectively 21 and 41 km from the epicenter, where preliminary evaluations show period lengthening in the order of 23 to 35 percent. If this brief table is truly representative, it should be expected that most structures in the Los Angeles now have longer fundamental periods than prior to the earthquake.

A summary of the types of structures existing at accelerograph sites reveals that nearly 80 percent (189) of the 241 records were obtained at various levels of taller buildings. See Table VI. Another 29 records were from hydraulic structures, principally dams, where one to five accelerographs had been installed in various cofigurations on the dam and its appurtenances and at the abutments. The remaining 23 records are from accelerographs in small buildings, chiefly along the San Andreas and San Jacinto fault zones. Perhaps the most notable deficiency in network coverage is the lack of free-field instruments in the Los Angeles area, i.e., there were only three operating accelerographs in buildings small enough to be called free-field stations and just one of these was near the major clusters of tall buildings (Hollywood Storage lot, #26 in Table III). In an engineering sense, the distribution of accelerographs was relatively inequitable since there were no recorders in single-family residential dwellings, moderate sized apartment units, at bridges or along freeways, in industrial plants or major utility sites (other than high-rise buildings) or at the numerous harbors and marinas.

TABLE VI

TYPES OF STRUCTURES WHERE RECORDS WERE OBTAINED

Large Buildings*

Number of Stories	Number of Records from Different Levels		
	Lowest	Middle	Top
Large 1	2	0	1
2 - 4	8	0	0
5 - 10	24	22	23
11 - 20	28	22	29
21 - 30	4	1	2
> 30	5	3	3
	71	48	58

* Excludes 12 Las Vegas stations.

Small Buildings

Hydraulics Structures

Crest of earthfill dams	7
In concrete dam	1
Intake towers	3
Abutments or near dams	12
Other existing or planned structures	6
	29

Other sites

Arrays across the San Andreas fault	10
Other fault line stations	7
Miscellaneous	6
	23

SUMMARY

Strong-motion accelerograph records were obtained from 241 instruments operated as part of the NOAA--National Ocean Survey cooperative network between 8 and 369 km of the San Fernando earthquake epicenter. More than 175 of these came from the Los Angeles area where building codes in a number of cities have required the installation of accelerographs at three levels of new buildings taller than six stories.

Among the more significant results are the following:

1. The highest earthquake accelerations ever measured, 1.25 g horizontally and 0.72 g vertically, were recorded on the abutment of Pacoima dam eight km from the epicenter.
2. Except for the anomalously high Pacoima dam results, attenuation of maximum horizontal ground accelerations from all recording sites is for the most part consistent with the equation, $\log (a/g) = 3.5 - 2 \log (D + 80)$, calculated by Cloud and Perez (1970) for past earthquakes.
3. The range of maximum ground accelerations recorded at different localities in the Los Angeles area were relatively similar, generally about 0.10 g to 0.25 g, although the measured values fell off rapidly beyond 45 km.
4. Peak accelerations exceeding 0.3 g were recorded on the top floors of 20 different high-rise buildings, including a 17-story tower 41 km from the epicenter where a maximum of 0.5 g was observed.

5. In 80 percent of the buildings where the base accelerations were 0.10 g or greater, the top floor accelerations were 1.1 to 2.3 times those recorded at the ground level.
6. Ambient vibration measurements in buildings before and after February 9 have revealed a large temporary shift in the fundamental periods recorded during the earthquake and a tendency for a permanent lengthening of these periods to a lesser degree after the earthquake.
7. It is apparent the distribution of accelerographs in southern California is far from equitable both geographically and in an engineering sense, since about 85 percent of the instruments are in the Los Angeles area and nearly all of these are in high-rise buildings.

The unprecedented number of accelerographs records obtained from the San Fernando earthquake provides such a large volume of instrumental strong-motion data that scientists and engineers will require many years of investigation and research to utilize it in entirety. Since 1940, the El Centro record with a maximum acceleration of 0.3 g has been a prime tool for use in earthquake engineering. Now ground accelerations have been recorded in excess of 1.0 g at a site near Los Angeles, and from 0.2 to 0.4 g at 14 other nearby stations. The ultimate evaluation of this data will unquestionably have a large influence upon the design and construction of buildings and other critical facilities, the zoning of potentially high seismic risk areas, and upon a host of other related problems. The saturation of strong-motion accelerographs in the Los

Angeles area, though far from optimum, has resulted in excellent dividends, particularly in view of the short-term existence of this concentrated network.

ACKNOWLEDGMENTS

The authors appreciate the substantial contributions provided by their co-workers from the Seismological Field Survey-NOAA in the collection and handling of records including C. F. Knudson, B. J. Morrill, E. C. Etheredge, P. N. Mork, L. J. Foote, B. L. Silverstein, and Virgilio Perez, who completed the painstaking task of scaling the records. R. J. Dielman of the California Institute of Technology supplied extensive assistance during field investigations, in the recovery and processing of records and in the production of maps and tables used in this report. J. West of the National Oceans Survey's Special Projects Party in Las Vegas participated in the collection of records and directed the post-earthquake building period measurements. K. W. King of the Special Projects Party and M. R. Mulhern of the Seismological Field Survey furnished the subsequent reduction of the building vibration data. J. D. Patterson of the Jet Propulsion Laboratory drafted the fine set of instrument location maps.

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Chapter 2

A Statistical Summary of Accelerograph Performance During the Earthquake of February 9, 1971

Richard P. Maley[1]

The magnitude 6.6 San Fernando earthquake of February 9, 1971, triggered 272 accelerographs in California and Nevada, thus providing an authentic test of a large portion of the strong-motion network cooperatively operated by the Seismological Field Survey in the western United States. Since this was the first earthquake ever recorded by such a large number of instruments, it is particularly relevant to examine the success achieved in maintaining the concentrated group of instruments that now exist in southern California.

The first half of Table I, a summary of gross instrumental performance, shows that 43 records were lost from approximately 16% of the 272 accelerographs triggered during the San Fernando event.

The second half of the table, arbitrarily divided into "code stations" for accelerographs installed because of building code requirements and "non-code stations" for all other instruments regardless of their locations, reveals the 43 records lost were disproportionately divided between the code stations with 36 lost or 19% of the total versus only 7 lost or 9% of the total for the non-code stations. The chief reasons for this discrepancy are the existence of a large number of slightly less reliable accelerographs in the code network and the additional attention given to the non-code stations in terms of service interval and comprehensive maintenance. There is a greater emphasis on the

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TABLE I

GENERAL ACCELEROGRAPH PERFORMANCE

Summary of Accelerograph Performance

Accelerographs triggered	272
Records obtained	229
Records lost	43 (16%)

Accelerograph Performance of Code & Non-Code Stations

	Code Stns	Non-Code Stns
Accelerographs triggered	186	86
Records obtained	150	79
Records lost	36 (19%)	7 (9%)

maintenance of non-code stations because this portion of the network is geographically far less dense and consequently supplies data at key structures, free field ground sites including those along important fault lines, and generally provides the seismic information needed to interpret the variation in strong-motion response characteristics over a broad range of geologic environments.

The accelerographs at Las Vegas were excluded from consideration in this report since they are operated by the National Ocean Survey's Special Projects Party primarily to monitor the nuclear detonations at the Nevada Test Site.

Table II lists the specific reasons for instrumental failures. It is obvious from these statistics that two-thirds of the failures resulted from inadequacies of the power supply. Although perhaps 25% of these cases were essentially unavoidable, the remaining three-fourths of the battery failures (23 instruments) resulted almost exclusively from an excessively long servicing interval, a direct consequence of the lack of technicians necessary to support a proper maintenance schedule. More detailed reference is made to this point later in the report.

Five types of accelerographs were operating in southern California at the time of the San Fernando earthquake and are briefly described as follows:

(1) STandard Coast & Geodetic Survey strong-motion seismograph, developed in 1931 and operating today with some modifications. Requires a trickle charger and greater maintenance than any modern accelerograph.

(2) AR - 240. Compact accelerograph developed with external calibration capability, was simply maintained but still required a trickle charger.

TABLE II

CAUSE OF ACCELEROGRAPH FAILURES

Battery discharged	*30
Film transport failure	6
Relay failure	3
Miscellaneous	4
	43

*Includes normal battery degradation	(23)
Trickle charger plug pulled out	(1)
Battery disconnected	(1)
Battery case broken	(1)
Wrong type batteries	(3)
Corrosion	(1)

(3) RFT - 250. Followed the AR - 240, was more compact, easily maintained and contained rechargeable batteries without a trickle charger.

(4) MO - 2. Compact with no charger needed but without capability of calibration after installation. Difficult to effectively service and subsequently with a reduced reliability.

(5) SMA - 1. Very compact, operated off disposable batteries thereby eliminating a trickle charger or periodic battery recharging. Easily serviced and maintained.

Table III summarizes the performance of the various accelerograph models during the San Fernando earthquake.

It is readily apparent, ignoring the character of maintenance and the respective servicing intervals, that the failure rate is relatively low for 4 types of accelerographs and inordinately high for the fifth type, the MO - 2. Although the MO - 2 is generally somewhat less reliable than the other instruments, it is only fair to point out that its failures were more often marked by exceptionally long inspection intervals (Table IV), and one might expect a success ratio more comparable to the other instruments had personnel been available to adequately service the equipment. The MO - 2's have been relegated by a priority system to that of the least important of the current instrumentation because of a number of recurring and as yet unsolved functional problems as well as the lack of calibration capability after installation. Table IV shows the MO - 2 inspection interval averaged 7 months and that the code stations generally had a much longer inspection interval than the non-code stations. Under optimum conditions the accelerographs should be serviced every two months and in any event at a maximum of every three months if a nominal success is

TABLE III

ACCELEROGRAPH PERFORMANCE BY INSTRUMENT TYPE

	Accelerographs	Records	Records Lost	Loss Rate
STnd C & G S	19	16	3	16%
AR - 240	82	75	7	9%
RFT - 250	66	58	8	12%
MO - 2	67	45	22	33%
SMA - 1	38	35	3	8%
	272	229	43	

TABLE IV

INSPECTION INTERVAL PRIOR TO THE EARTHQUAKE

Code Stations	Months
MO - 2	7
AR - 240	6
RFT - 250	4
SMA - 1	2-1/2
Average for all four	5-1/2

Non-Code Stations	Months
Average of all stations	3-1/2

Replaceable Battery Age on 2 - 9 - 71

Code Stations	Months
MO - 2	8-1/2
RFT - 250	4-1/2
SMA - 1	2-1/2

Non-Code Stations	Months
Average of all stations	3-1/2

to be achieved in obtaining earthquake records.

The second section of the table shows why the relatively large loss ratio occurred among the MO - 2 accelerographs; that is, the replaceable batteries had been in use on an average of 8-1/2 months, 2-1/2 months longer than desirable. Neglecting the SMA -1's that had short term batteries because of the recency of installations, it may be noted the average age of replaceable batteries in the code stations was nearly double that of the non-code stations.

No reference was made to the standard accelerographs or AR - 240's since both instruments have trickle chargers and consequently batteries are not exchanged on a routine basis.

The following comments summarize the general results of strong-motion accelerograph performance during the San Fernando earthquake.

(1) Approximately 16% of the potential data from 272 instruments were lost, while in contrast during the Borrego Mountain earthquake of April, 1968, less than 1% of the data from 115 accelerographs were lost. The difference in these two performance rates is directly attributed to poor servicing schedules necessitated by the lack of sufficient personnel to adequately maintain the network. One may well assume the loss ratio will be significantly higher in the next earthquake.

(2) Since a greater importance is attached to the inspection and up-keep of the non-code instruments, a considerably larger fraction of records were obtained from them than from the code instruments.

(3) Seventy percent of the 43 records lost were the result of power supply failures, in most instances due to the normal degradation

of rechargeable batteries. With this fact in mind, it is recommended that all future instrumentation include trickle chargers to maintain the batteries whenever a convenient 110 volt supply is available at the station.

(4) Although there appears to be a large difference in the performance of the various accelerograph models, this more than likely is the consequence of the priority system of maintenance instituted because of the shortage of field technicians. Had the support program been optimum for all equipment, perhaps the success ratios for the different instruments would have been more nearly equivalent.

(5) A final comment refers to information included in Table V, a comprehensive summary of accelerograph performance for all strong-motion stations in the nominal operational area. Redundancy of time and starting systems among accelerographs in multiple installations is highly desirable since it provides individual timing and starting capabilities to each instrument in event of the malfunction one or more accelerographs within the group. A few total failures and numerous records without a time base were observed during the San Fernando event due to lack of such compensating systems. The Seismological Field Survey has for a number of years recommended inclusion of alternate time systems on all instruments as well as back-up starters in multiple installations. Had there been no redundant starters in Los Angeles buildings, an additional 14 records would have been lost.

Since future earthquakes in California in the 6 to 7 magnitude range

will probably trigger several hundred strong-motion accelerographs, it is to be hoped that at least the instrumentally related comments in this report will provide some beneficial contribution to the cooperative network.

TABLE V

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Los Angeles Building Code Stations	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Airport Blvd 9841	MO	3	2	1	7	Battery corrosion	7	7	
Ave of Stars 1900	MO	3	2	1*	16	Battery failure	8	8	No time
" 1901	AR	3	2	1	21	" "	NA	10	
Beverly Dr 1177	MO	2	1	1	3	" "	10	10	1 acc. out for con-struction
Century Blvd 5260	MO	3	3				7	7	
Century Pk. E 1800	SMA	3	3				4	4	
" " 1880	SMA	3	3				6	6	
" " 1888	RFT	3	2	1	G	Battery failure	5	5	No time
" " 1888 Pkng Ramp	RFT	2	2				6	6	1 acc. out for repair
Century Pk E 2080	MO	3	1	2	G 10	Battery Failure	9	9	No time
Figueroa 222 S	MO	3	2	1*	12	" "	8	5	
" 234 S	MO	3	2	1	15	Battery discon-nected	?	8	
" 445 S	AR	3	2	1	39	Paper ran out	NA	5	
First 250 E	AR	3	3				NA	8	
" 800 W	MO	3	3				7	5	
Fremont 533 S	MO	3	2	1*	11	Battery failure	7	7	
Garland 750 S	RFT	3	2	1*	G	" "	7	5	No time
Grand 420 S	RFT	3	2	1*	10	" "	3	3	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Los Angeles Building Code Stations	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Hilgard 922	MO	3	1	2	G 8	Battery failure	7	5	No time
Hill 1150 S	RFT	3	3				4	4	
Hollywood Blvd 7080	AR	3	3				NA	3	
Hoover 3663 S	AR	3	0	3	G 4 7	Relay failure	NA	8	Connection of redundant starters would have provided records on 4 and 7
Lankershim 3838	RFT	3	2	1*	11	Battery failure	3	3	Double time pulse
Lincoln Blvd 8639	RFT	3	3				8	5	
Marengo 1640	AR	3	3				NA	5	
Normandie 616 S	SMA	3	3				5	5	
Olive 646 S	AR	3	3				NA	3	
Olive 808 S	AR	3	3				NA	5	Double time pulse
Olympic Blvd 1625 S	SMA	3	3				1	1	
Orchid 1760 N	MO	3	3				8	6	No time
Orion 8244	AR	3	3				NA	4	
Robertson 120 N	AR	3	3				NA	3	
San Vicente 11661	MO	3	2	1	G	Battery pack open	7	7	No time
Sixth Street 611 W	RFT	3	2	1	24	Battery failure	5	5	
" " 3407 W	AR	3	3				NA	6	
Sunset Blvd 4867	AR	3	3				NA	6	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Los Angeles Building Code Stations	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Sunset Blvd 6430	MO	3	1	2	7 15	Take - up failure	7	5	1 acc. out for repair
" " 6464	MO	3	2	1	6	" "	7	5	
Tiverton 945	AR	3	2	1	G	Charger plug out		5	No time
University 3440	MO	3	3				13	5	" 5th fl. only
Van Owen 15107	RFT	3	3				3	3	
Ventura Blvd 14724	MO	3	3				8	8	
" " 15250	SMA	3	3				1	1	
" " 15433	MO	3	2	1	G	Battery failure	7	7	No time
" " 15910	SMA	3	3				2	2	
" " 16055	MO	2	0	2	G 18	" "	8	8	1 acc. out for repair
" " 16661	AR	3	0	0		Owner did not supply batteries	NA		
Wilshire Blvd 2500	SMA	3	3				1	1	
" " 3345	AR	3	3				NA	8	"V" (2nd fl) undamped
" " 3411	MO	3	1	2	13 31	Film transp. failure	13?	11	Partial records
" " 3470	AR	3	3				NA	8	
" " 3550	MO	3	1	2	11 21	(1 Battery failure (1 film transp (failure	7	7	
" " 3710	AR	3	3				NA	4	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Los Angeles Building Code Stations	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Wilshire Blvd 4680	AR	3	3				NA	8	
" " 5900	MO	3	3				4	4	Poor film transp.
" " 6200	MO	3	3				8	8	No time
Zonal Ave 2011	AR	3	3				NA	7	
		165	133	32					
Non-Los Angeles Building Code Stations									
Alhambra									
Fremont 900 S	SMA	3	3				1	1	
Beverly Hills									
Oakhurst 435 N	SMA	3	3				1	1	
Roxbury 420 N	SMA	3	3				3	3	
Wilshire 9100	MO	3	2	1	11	Battery failure	10	10	No time
" 9450	SMA	3		3		" "	3	3	Wrong battery type
Fullerton									
Nutwood 2600	SMA	3	3				1	1	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Non-Los Angeles Building Code Stations	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Orange									
Chapman 4000 W	RFT	3	3				1	1	
		21	17	4					
Non-Code Stations Los Angeles Area									
Athenaeum, CIT	SMA	1	1				1	1	
Carbon Canyon Dam	RFT	1	1				7	5	
Century City Ground	AR	1		1	G	Take - up failure	NA	5	
Costa Mesa	AR	1	1				NA	5	
Glendale	AR	1	1				NA	5	
Griffith Observatory	RFT	1	1				7	7	
Hollywood Storage	STD	3	2	1	15	Unknown	NA	5	Erratic time (8)
J. P. L.	RFT	2	2				1	1	
Long Beach	STD	1	1				NA	6	No time
Long Beach St. Coll.	RFT	1	1				7	7	
L. A. Water & Power	AR	3	3				NA	5	
Millikan Library CIT	RFT	2	2				1	1	
Pacoima Dam	AR	1	1				NA	4	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Non-Code Stations Los Angeles Area	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Palos Verdes Estates	RFT	1	1				6	5	
Puddingstone	AR	1	1				NA	5	
Santa Ana	STD	1	1				NA	1	
Santa Anita Dam	AR	1	1				NA	5	
San Antonio Dam	RFT	1	1				7	5	
Seism. Lab., CIT	RFT	1	1				1	1	
Terminal Island	STD	1	1				NA	6	Erratic time
U. C. L. A.	STD	1	1				NA	4	
Vernon	STD	1	1				NA	5	
Whittier Narrows Dam	RFT	1	1				7	5	
		29	27	2					
Southern California Stations Outside of the Los Angeles Area									
Anza	RFT	1	1				2	2	
Borrego Springs	RFT	1	1				2	2	
Cachuma Dam	STD	2	0	2	G crest	(Charger plug out (Fuses blown (Switches off (Starter broken		8	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Southern California Stations Outside of the Los Angeles Area	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Castaic	AR	1	1					5	
Cedar Springs	AR	2	2					1	
Colton	STD	1	1					2	
Devil's Canyon									Was not triggered
El Centro Comm. Hosp.	RFT	1	1				2	2	
Fairmont	STD	1	1					3	30 sec. motor rise time
Hemet	RFT	1	1				2	2	
Imperial									Was not triggered
Lake Hughes Array	3 AR 1RFT	4	4				5	5	
Loma Linda	RFT	1		1*	G	Battery failure	2	2	
Palmdale	RFT	1	1				5	5	
Pearblossom	AR	1	1					2	
Perris									Was not triggered
Point Concepcion									" " "
Port Hueneme	STD	1	1					5	No time - 1st 9 sec.
San Bernardino	RFT	1	1				2	2	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Southern California Stations Outside of the Los Angeles Area	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
San Juan Capistrano	RFT	1	1				1	1	
San Diego	STD	1	1					2	
San Diego Gas & Electric	RFT	2	1	1	22	Battery failure	2	2	
San Onofre	AR	1	1					1	
Santa Barbara	STD	1	1					5	
Santa Felicia Dam	AR	2	2					5	
Superstition Mtn.									Was not triggered
U. C. Santa Barbara	RFT	1	1				13	5	
Wrightwood	RFT/SMA	2	2				2	2	
		31	27	4					
Central California Stations									
Bakersfield	STD	1	1					5	
Buena Vista	AR	1	1					3	
Cholame-Shandon Array	AR	2	2					2	
Isabella Dam	RFT	5	5					3	
Maricopa Array	RFT	4	4					3	
Oso Pumping Plant	AR	1		1				1	

STATISTICAL TABLE OF ACCELEROGRAPH PERFORMANCE

Earthquake of 9 February 1971

Central California Stations	Accelero-graph Model	Number Installed	Records Recovered	Records Lost	Floor level	Malfunction cause	Battery Age (months)	Service interval (months)	Comments
Pyramid	RFT	1		1	G	Battery failure	3	3	
Taft	SID/AR	2	2					3	
Tehachapi	AR	1	1					1	
Tejon	AR	1	1					5	No time
Terminus	RFT	3	3					3	
Wheeler Ridge	AR	1	1					1	Time failure after 2 sec. (Batt.)
		23	22	1					
Nevada Stations									
Hoover Dam	STD	3	3	0				9?	
		3	3	0					

* Accelerographs triggered but battery was initially too low and first part of motion (maximum amplitudes) was not recorded.

NA = Not applicable, since the instruments have trickle charged batteries.

G = Ground level or basement location.

(Excludes records obtained from NOS Special Projects Party in Las Vegas.)

Chapter 3

SEISMOSCOPE RESULTS - SAN FERNANDO EARTHQUAKE OF 9 FEBRUARY 1971

by

B. J. Morrill

Seismological Field Survey

* * * *

Introduction: At the time of the earthquake the Seismological Field Survey of the National Ocean Survey, NOAA (formerly Coast and Geodetic Survey) had 150 seismoscopes throughout the affected area along with over 250 strong-motion accelerographs. The present report presents the basic data obtained from the seismoscopes.

Of the 150 seismoscopes in the shaken area, 96 percent produced useable records, and provided a body of information that will be of great value to earthquake engineers. Considering that the total cost of the installed seismoscope system is less than $30,000, the cost-benefit ratio of this type of instrumentation is seen to be unusually favorable.

The seismoscopes in the network were purchased by many different agencies, both private and governmental, and were installed and maintained by the Seismological Field Survey. Included were the group of 50 Southern California seismoscopes originally developed in cooperation with the California Institute of Technology with support from the National Science Foundation.

Description of the Seismoscope: The seismoscope was designed by the Coast and Geodetic Survey and developed by the California Institute of

Technology in the late 1950's and the first two hundred were installed in 1960. At present there are 375 in the field scattered from Fairbanks, Alaska to El Centro, California. The seismoscope was designed as a simplified, low cost instrument supplemental to the more expensive recording strong-motion accelerograph.

The seismoscope "consists of a free conical pendulum which can move in any horizontal direction. The wire flexure pivot support point of the pendulum moves with the ground, and the resulting angular deflections relative to the instrument frame are recorded by a scriber on a smoked spherical watch glass. Eddy current damping is provided by an aluminum disk in the form of a segment of a spherical shell, which moves between the poles of a permanent magnet system. This aluminum segment is a principal contributer to the moment of inertia of the compound pendulum. Since the motion in a horizontal plane is traced out as a permanent record, the sequence of events can be followed even though no time-recording is employed. In this way much more information than would be obtained from an indication of maximum displacements alone can be secured by a very simple means." (Cloud and Hudson - 1961)

The instrument is shown in Figure 1. Seismoscopes are usually installed under "free-field" conditions. A typical installation is shown in Figure 2. There are two types or manufactures of seismoscopes now in use, the Wilmot and the Sprengnether. Characteristics of each are given in Table I. In the tabulations for this report the particular type may be recognized by the serial number.

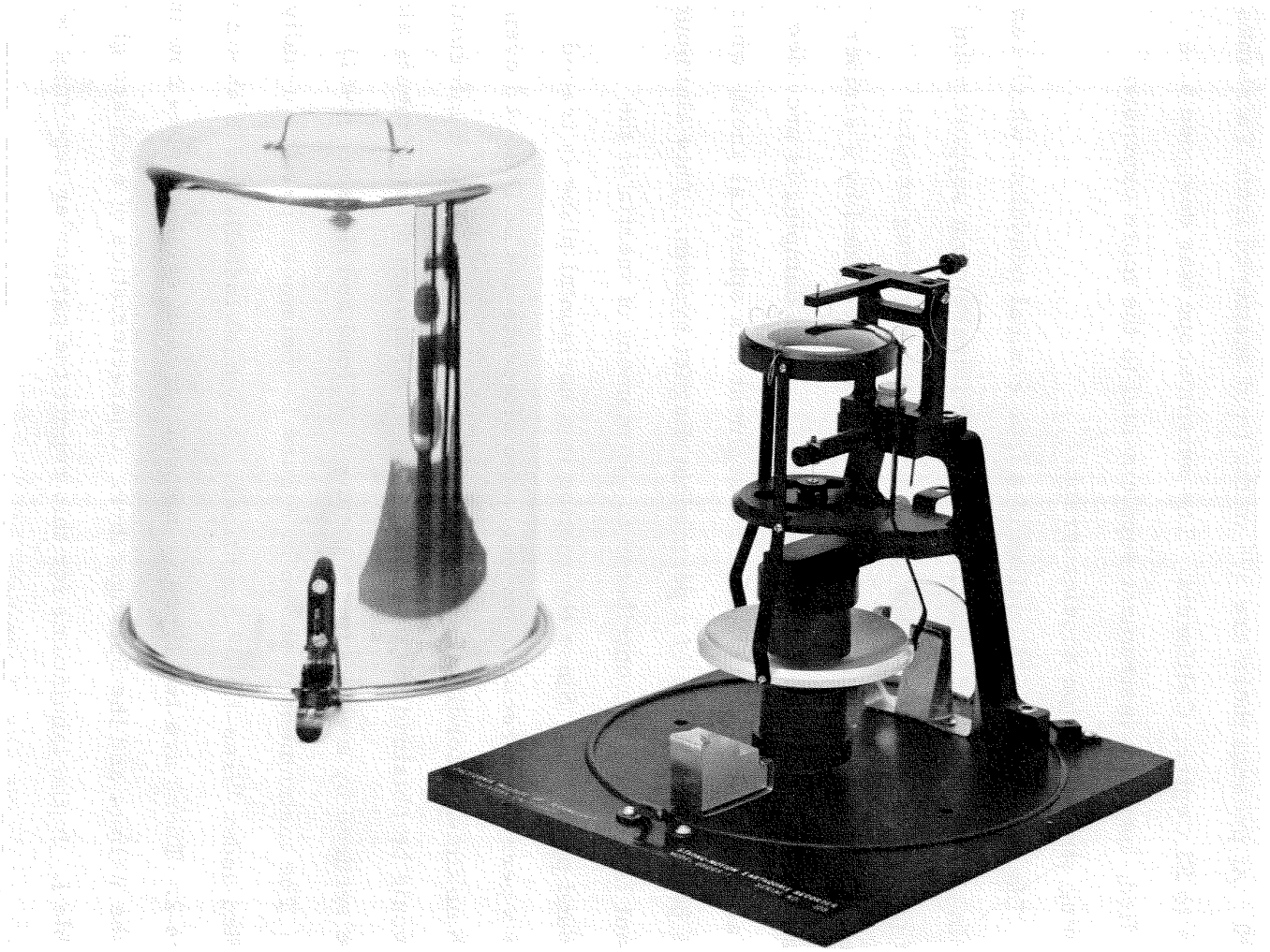


Figure 1. The seismoscope is a relatively low-cost instrument which measures directly one point on the response spectrum.

Figure 2. Typical seismoscope field installation, showing concrete base and external protective cover.

Table I. Seismoscope Characteristics

	Wilmot	Sprengnether
Serial No.	100, 200, and 500	2800
Sensitivity (cm/rad)	5.45	6.00
Period (seconds)	0.75	0.78
Damping (see Figure 4)		

Status of Seismoscope Record Recovery: At the time of occurrence of the 9 February 1971 earthquake, there were 150 seismoscopes in the felt area. Of the possible records, 144 useable records were obtained, resulting in 96 percent successful recording of the event. The six failures were due to moisture and vandalism damage. Two records (Pacoima and Dry Canyon) were partly destroyed when the earthquake motion exceeded the design limits of the instruments and the recording plates were dislodged. These incomplete records will, however, provide useful information on the nature of the motion during the first few seconds of the motion. Extraction of such valuable information from a damaged record was demonstrated by Trifunac and Hudson, 1970 and by Murray, 1970, in the analysis of the Parkfield earthquake.

Seismoscope Data: Figure 3 is a map showing the seismoscope sites in the Southern California network. The site location numbers shown on the map are listed in Table II. This is the site identification number used in the "Annual List of Stations" issued by the Seismological Field Survey. Included in Table II is the seismoscope instrument serial number, which

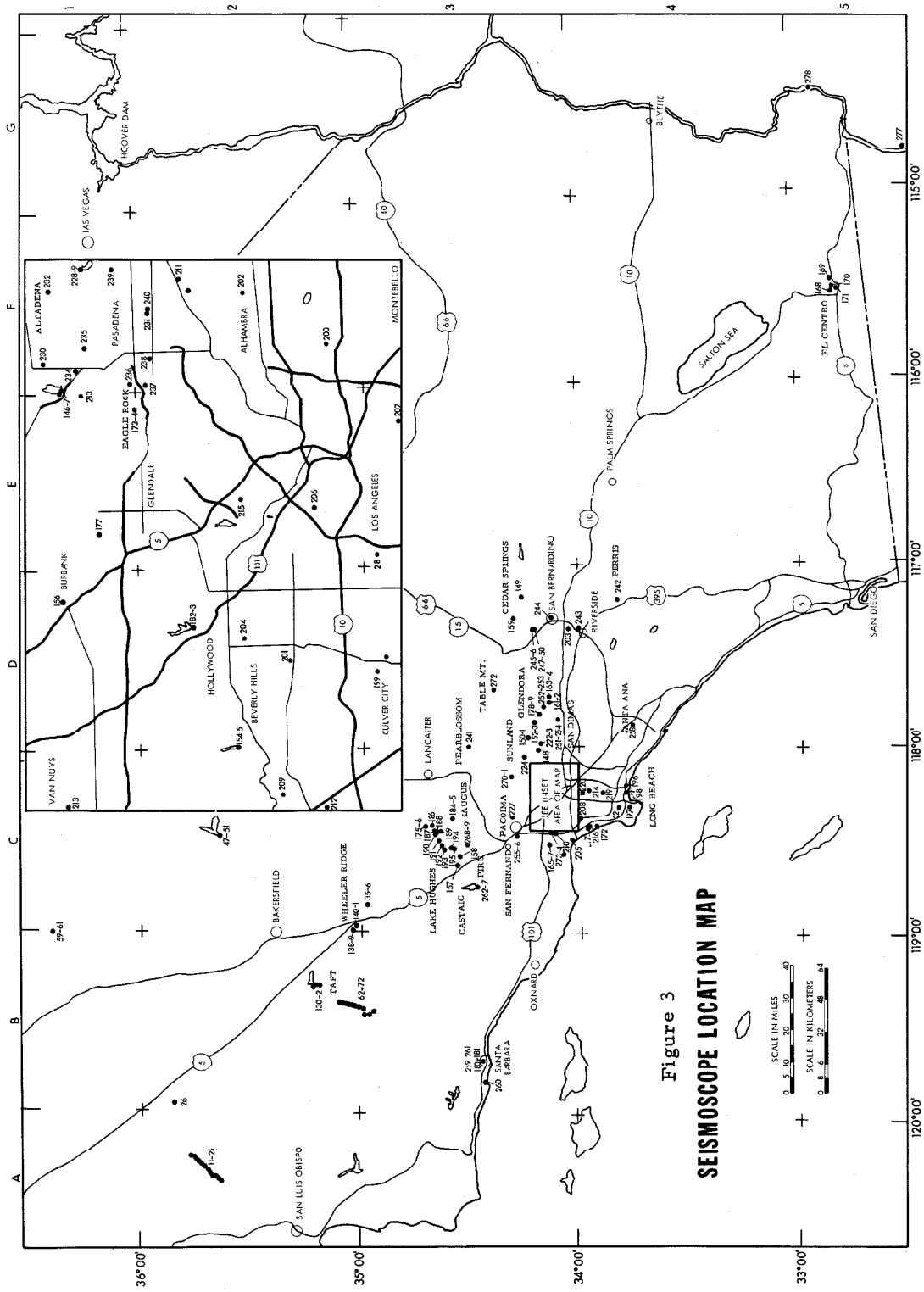

SEISMOSCOPE LOCATION MAP
SCALE IN MILES
SCALE IN KILOMETERS
SEE INSET AREA OF MAP
LAS VEGAS
HOOVER DAM
BLYTHE
SALTON SEA
EL CENTRO
PALM SPRINGS
SAN DIEGO
BAKERSFIELD
TAFT
WHEELER RIDGE
LAKE HUGHES
CASTAIC
SAN FERNANDO
PACOIMA
SUNLAND
GLENDORA
SAN DIMAS
POMONA
ANAHEIM
LONG BEACH
SANTA BARBARA
OXNARD
SAN LUIS OBISPO
LANCASTER
PEARBLOSSOM
TABLE MT.
CEDAR SPRINGS
SAN BERNARDINO
RIVERSIDE
PERRIS
ALTADENA
PASADENA
EAGLE ROCK
GLENDALE
ALHAMBRA
MONTEBELLO
BURBANK
HOLLYWOOD
BEVERLY HILLS
CULVER CITY
LOS ANGELES
VAN NUYS
120°00'
119°00'
118°00'
117°00'
116°00'
115°00'
36°00'
35°00'
34°00'
33°00'

Figure 3

also appears on each glass record plate, and is reproduced on the photographs.

Table II lists by geographical area all recovered seismoscope records from the February 9, 1971 San Fernando earthquake. Included in this table is the distance of the station from the epicenter, in kilometers, and the direction in degrees from North clockwise.

For each record, the maximum displacement on the plate measured from the initial zero point was measured. From the sensitivity of the seismoscope in cm/rad, the maximum angular motion of the pendulum φ_{max} was determined. The maximum relative displacement response spectrum value S_d was then calculated from:

$$S_d = \frac{gT^2}{4\pi^2} \varphi_{max} \sqrt{\frac{n}{10}} \qquad \text{(Hudson and Cloud, 1967)}$$

where: T = period (sec)

n = damping (% critical)

φ_{max} - trace amplitude/sensitivity .

In addition to the seismoscope magnetic damping, dry friction between the stylus and the glass record plate introduces some amplitude-dependent damping. The S_d values were thus corrected by the $\sqrt{\frac{n}{10}}$ term, where the percent critical damping n was taken corresponding to the maximum trace amplitude from the damping curve of Figure 4. This damping curve is an average curve obtained from some 450 observations on 12 different glass record plates. From the damping values for specific plates shown in Figures 10a, b it can be judged that the use of the average damping curve would introduce negligible errors in the final corrected S_d values.

TABLE II. SOUTHERN CALIFORNIA SEISMOSCOPE STATIONS
AND DATA FROM SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971

City / Building or Site	Site No.*	Inst. No.	Map Location	Location from Epicenter		Max. Rel. Displacement	
				Direction (N-C.W.-Deg.)	Distance (km)	Direction (N-C.W.-Deg.)	Sd (cm)
Altadena							
Devils Gate Reservoir (crest)	146	566	E-1	135	31.4	047	1.22
Devils Gate Reservoir (left bank)	147	568	E-1	139	31.4	074	1.29
Residence, 1972 Skyview Drive	232	117	E-1	131	35.0	359	2.72
Arcadia							
Santa Arita Reservoir	148	565	C-3	124	42.1	230	0.66
Arrowhead							
U.S. Forest Service	149	107	D-3	103	105.9	360	0.78
Azusa							
Cogswell Reservoir (crest)	150	507	D-3	113	43.6	088	1.12
Cogswell Reservoir (right bank)	151	530	D-3	113	43.6	303	0.79
San Gabriel Reservoir (crest)	152	506	D-3	114	54.4	331	3.27
San Gabriel Reservoir (left bank)	153	545	D-3	114	54.4	358	0.16
Beverly Hills							
Lower Franklin Canyon Reservoir (West Abut.)	154	207	D-2	182	33.4	172	1.06
Lower Franklin Canyon Reservoir (main crest)	155	206	D-2	182	33.4	174	2.63
Burbank							
Burbank High School	156	125	D-1	164	24.9	278	4.85

*Permanent Identification Number in Annual List of Stations Issued by Seismological Field Survey, NOAA

TABLE II (cont)

City / Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter: Direction (N-C.W.- Deg.)	Location from Epicenter: Distance (km)	Max. Rel. Displacement: Direction (N-C.W.- Deg.)	Max. Rel. Displacement: S_d (cm)
Castaic							
North Station	157	229	C-3	310	23.3	195	3.72
Old Ridge Route	158	2874	C-3	306	29.8	360	3.88
Cedar Springs							
Strong Motion Station	159	2867	D-3	098	99.6	0.22	0.29
Cholame							
Cholame Array No. 2	15	2855	A-2	310	208.1	240	0.08
Cholame Array No. 5	18	2858	A-2	310	208.1	315	0.08
Cholame Array No. 8	21	2896	A-2	310	208.1	115	0.16
Claremont							
Live Oak Reservoir (crest)	161	524	D-3	115	68.0	010	0.24
Live Oak Reservoir (left bank)	162	514	D-3	115	68.0	232	0.38
Thompson Creek Reservoir (crest)	163	560	D-3	114	69.6	026	0.75
Thompson Creek Reservoir (left bank)	164	515	D-3	114	69.6	030	0.35
Encino							
Encino Reservoir (crest)	165	199	C-3	201	30.2	185	1.59
Encino Reservoir (West Abut.)	166	217	C-3	201	30.2	178	0.51
Encino Reservoir (tower)	167	200	C-3	201	30.2	140	1.94
El Centro							
Imperial Valley Irrig. Dist. Accel. Site	168	132	F-5			Negligible	
El Centro High School	169	158	F-5			"	

TABLE II (cont)

City	Building or Site	Site No	Inst. No.	Map Location	Location from Epicenter		Max. Rel. Displacement	
					Direction (N-C.W.-Deg.)	Distance (km)	Direction (N-C.W.-Deg.)	S_d (cm)
El Centro (cont)								
	El Centro Steam Plant	170	164	F-5			Negligible	
	El Centro Water Works	171	124	F-5			"	
El Segundo								
	Hyperion Treatment Plant	172	102	C-4	183	52.6	090	0.62
Eagle Rock								
	Eagle Rock Reservoir (West Abut.)	173	208	E-2	147	36.2	276	4.17
	Eagle Rock Reservoir (main dam crest)	174	209	E-2	147	36.2	300	4.93
Glendale								
	Herbert Hoover High School	177	141	E-1	156	28.2	Off-center (vandalized)	
Glendora								
	Big Dalton Reservoir (crest)	178	520	D-3	115	60.0	100	0.35
	Big Dalton Reservoir (left bank)	179	567	D-3	115	60.0	174	0.32
Grapevine								
	Tehachapi Pumping Plant (north site)	35	2851	C-3	327	72.7	187	0.35
	Tehachapi Pumping Plant (accel.site)	36	2954	C-3	327	72.7	240	0.51
Hollywood								
	Hollywood Reservoir (West Abut.)	182	205	D-2	168	31.8	320	1.05
	Hollywood Reservoir (main dam crest)	183	198	D-2	169	31.8	275	0.66
	Hollywood Reservoir (crest)	—	221	D-2	160	36.6	112	3.44
	Hollywood Reservoir (right abut.)	—	212	D-2	168	36.6	360	2.40

TABLE II (cont)

City	Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter: Direction (N-C.W.- Deg.)	Location from Epicenter: Distance (km)	Max. Rel. Displacement: Direction (N-C.W.- Deg.)	Max. Rel. Displacement: S_d (cm)
Lake Hughes	Lake Hughes Array No. 1 (never installed)	——	——	C-3	——	——	——	——
	" " " No. 2	186	2824	C-3	349	30.5	160	1.56
	" " " No. 3	187	2887	C-3	347	29.4	080	1.44
	" " " No. 4	188	2891	C-3	345	29.1	326	1.91
	" " " No. 4a	189	2889	C-3	343	29.2	330	2.37
	" " " No. 5	190	2894	C-3	347	29.6	338	1.32
	" " " No. 6(station removed)	——	——	C-3	——	——	——	——
	" " " No. 7	191	2822	C-3	331	29.3	313	1.13
	" " " No. 8	192	2890	C-3	329	29.0	vandalized	
	" " " No. 9	193	2892	C-3	326	28.0	160	0.91
	" " " No. 10(never installed)	——	——	C-3	——	——	——	——
	" " " No. 11	194	2819	C-3	324	25.0	134	1.04
	" " " No. 12	195	2893	C-3	322	24.4	120	1.82
Lancaster	Fairmont Reservoir (South Abut.)	175	211	C-3	356	34.2	213	1.46
	Fairmont Reservoir (main dam crest)	176	216	C-3	356	34.2	010	2.04
Long Beach	Municipal Building (accel. site)	196	147	C-4	164	72.6	146	0.64
	San Pedro High School	197	122	C-4	174	71.8	350	1.83
	Terminal Island (accel. site)	198	149	C-4	167	73.0	095	0.66

TABLE II (cont)

City	Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter		Max. Rel. Displacement	
					Direction (N-C.W.-Deg.)	Distance (km)	Direction (N-C.W.-Deg.)	S_d (cm)
Los Angeles								
	Baldwin Hills Reservoir (East Abut.)	199	192	D-3	176	43.4	140	3.52
	East L. A. Jr. College	200	104	F-2	150	46.5	278	2.92
	Hancock Park	201	140	D-2		vandalized		
	Taylor Residence	202	110	F-2	144	44.2	357	2.10
	Colton (accel. site)	203	143	D-4	121	107.0	004	0.35
	Hollywood Storage (accel. site)	204	146	D-2	170	35.4	345	3.08
	Tauxe Residence	205	156	C-4	196	42.3	015	2.29
	Edison Building (accel. site)	206	150	E-2	160	41.0	280	3.10
	Vernon (accel. site)	207	148	E-3	158	48.2	138	2.17
	Leeds Residence	208	123	C-4	179	48.5	146	1.02
	UCLA (accel. site)	209	137	F-2	187	37.8	080	1.29
	Duke Residence	210	109	C-3	197	24.1	220	0.73
	West L.A. Public Library	212	113	C-2	181	39.2	203	1.39
	Van Nuys High School	213	139	C-1	192	24.1	060	3.35
	Southgate High School	214	129	C-4	160	52.8	037	1.10
	Elysian Heights School	215	162	E-2	144	42.6	070	1.46
	Playa Del Rey School	216	127	C-4	181	46.5	049	2.06
	Windsor Hills School	217	154	C-4	174	45.4	081	2.06
	Museum of Science and Industry	218	157	E-2	166	43.9	152	2.17
	Compton School Adm. Bldg.	219	163	C-4	166	58.3	110	2.04
	Huntington Park City Hall	220	120	C-4	160	49.6	198	1.39
	Narbonne High School	221	134	C-4	173	67.8	090	0.35

TABLE II (cont)

City / Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter: Direction (N-C.W.-Deg.)	Location from Epicenter: Distance (km)	Max. Rel. Displacement: Direction (N-C.W.-Deg.)	Max. Rel. Displacement: S_d (cm)
Maricopa							
Station B	63	629	B-3	309	117.8	Negligible	
Monrovia							
Sawpit Canyon Reservoir (right bank)	222	505	D-3	123	45.0	040	1.00
Sawpit Canyon Reservoir (crest)	223	569	D-3	123	45.0	043	0.81
Mount Wilson							
Caltech Seismograph Station	224	114	C-3	121	37.0	—	1.06
Pacoima							
Pacoima Dam	227	525	C-3	180	6.9	Plate thrown off	
Pasadena							
Eaton Wash Reservoir (base)	228	508	F-1	131	38.2	008	2.10
Eaton Wash Reservoir (crest)	229	517	F-1	131	38.2	122	2.76
Gilman Residence	230	133	F-1	134	31.0	226	2.24
Caltech Campus, Millikan Lib.(accel.site)	231	166	F-2	140	38.4	214	2.40
Caltech Campus, Athenaeum	240	138	F-2	139	38.6	247	1.94
Motta Residence	233	151	E-1	141	32.2	015	2.69
Muir High School	234	108	F-1	139	33.0	255	3.77
Washington Junior High School	235	100	F-1	138	34.6	205	1.22
Seismological Laboratory	236	152	F-2	143	35.0	083	2.24
San Raphael School	237	126	F-2	144	35.4	Damaged by water	
Garfield School	238	124	F-2	141	35.9	136	2.42
Hale School	239	128	F-1	134	38.3	Damaged by water	

TABLE II (cont)

City	Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter		Max. Rel. Displacement	
					Direction (N-C.W.-Deg.)	Distance (km)	Direction (N-C.W.-Deg.)	S_d (cm)
Pearblossom								
	Pearblossom Pumping Plant	241	2847	D-3	074	47.4	072	0.82
Perris								
	Accelerograph Station	242	249	D-4	118	129.0	016	0.08
Piru								
	Santa Felicia Dam (toe, S-1)	262	590	C-3	282	33.4	290	2.10
	" " " (outlet works, S-2)	263	588	C-3	282	33.4	295	1.24
	" " " (right abut. S-3)	264	586	C-3	282	33.4	288	1.82
	" " " (right crest, S-4)	265	589	C-3	282	33.4	302	5.63
	" " " (dam crest, S-5)	266	587	C-3	282	33.4	305	6.28
	" " " (left abut. S-6)	267	585	C-3	282	33.4	303	2.30
Riverside								
	Caltech Seismograph Station	243	142	D-4	114	105.0	Negligible	
San Bernardino								
	Post Office	244	144	D-3	108	106.0	004	0.35
	Devils Canyon - Site No. 1	245	233	D-3	102	100.0	340	0.44
	" " Site No. 2	246	231	D-3	102	100.0	157	0.46
	" " Site No. 3 (removed)	—	—	—	—	—	—	—
	" " Site No. 4	247	227	D-3	102	100.0	355	0.29
	" " Site No. 5	248	241	D-3	102	100.0	009	0.38
	" " Site No. 6	249	237	D-3	102	100.0	017	0.16
	" " Site No. 7	250	232	D-3	102	100.0	345	0.65

TABLE II (cont)

City	Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter		Max. Rel. Displacement	
					Direction (N-C.W.-Deg.)	Distance (km)	Direction (N-C.W.-Deg.)	S_d (cm)
San Dimas								
	Puddingstone Reservoir (crest)	251	529	D-3	122	64.4	318	4.17
	Puddingstone Reservoir (accel. site)	254	521	D-3	122	64.4	136	1.29
	San Dimas Reservoir (crest)	252	531	D-3	115	63.4	270	0.41
	San Dimas Reservoir (left bank)	253	509	D-3	115	63.4	200	0.58
San Fernando								
	Lower San Fernando Dam (East Abut.)	255	213	C-3	208	14.9	287	6.70
	Lower San Fernando Dam (main dam crest)	256	210	C-3	208	14.9	110	7.72
San Marino								
	San Marino City Hall	211	115	F-2	138	41.4	248	3.08
	Crotty Residence, Shenandoah Road	—	651	F-2	140	41.9	150	2.58
Santa Ana								
	Accelerograph Site	258	159	D-4	145	87.6	260	0.62
Santa Barbara								
	Accelerograph Site	259	500	B-3			Negligible	
	University of California	260	145	B-3	271	143.8	335	0.35
	Santa Barbara Museum	261	116	B-3			Negligible	
	Goleta - Food Fair Market	180	135	B-3	271	143.8	048	0.57
	Goleta - Sylvester Residence	181	155	B-3	271	143.8	270	0.19
Santa Monica								
	Santa Ynez Dam (right abut.)	—	193	C-3	279	144.9	360	0.66
	Santa Ynez Dam (crest)	—	195	C-3	279	144.9	269	0.95

TABLE II (cont)

City	Building or Site	Site No.	Inst. No.	Map Location	Location from Epicenter		Max. Rel. Displacement	
					Direction (N-C.W.-Deg.)	Distance (km)	Direction (N-C.W.-Deg.)	S_d (cm)
Saugus								
	Bouquet Canyon Reservoir (West Abut.)	184	201	C-3	008	20.6	Damaged by water	
	Bouquet Canyon Reservoir (main dam crest)	185	202	C-3	008	20.6	080	3.84
	Dry Canyon Reservoir (East Abut.)	268	194	C-3	307	14.9	268	4.75
	Dry Canyon Reservoir (main dam crest)	269	196	C-3	307	14.9	Plate thrown off	
Sunland								
	Big Tujunga Reservoir (crest)	270	528	C-3	119	22.5	275	2.78
	Big Tujunga Reservoir (left bank)	271	513	C-3	119	22.5	317	2.17
Table Mountain								
	Tiltmeter Station	272	131	D-3	091	70.4	188	0.29
Taft								
	Buena Vista - Accel. Site	130	260	B-2	309	117.8	Negligible	
	Buena Vista - North	131	235	B-2	309	117.8	Negligible	
	Buena Vista - South	132	228	B-2	309	117.8	Negligible	
Westwood								
	Lower Stone Canyon Reservoir (East Abut.)	273	204	C-3	189	32.2	162	0.73
	Lower Stone Canyon Reservoir (main dam crest)	274	203	C-3	189	32.2	190	1.47
Wheeler Ridge								
	Accelerograph Station	138	2955	C-2	319	90.4	065	0.22
	Wheeler Ridge Pumping Plant	139	2897	C-2	319	90.4	162	0.29
	Wind Gap Pumping Plant	140	2850	C-3	319	90.4	107	0.32
	Tiltmeter No. 2	141	2849	C-3	319	90.4	080	0.48

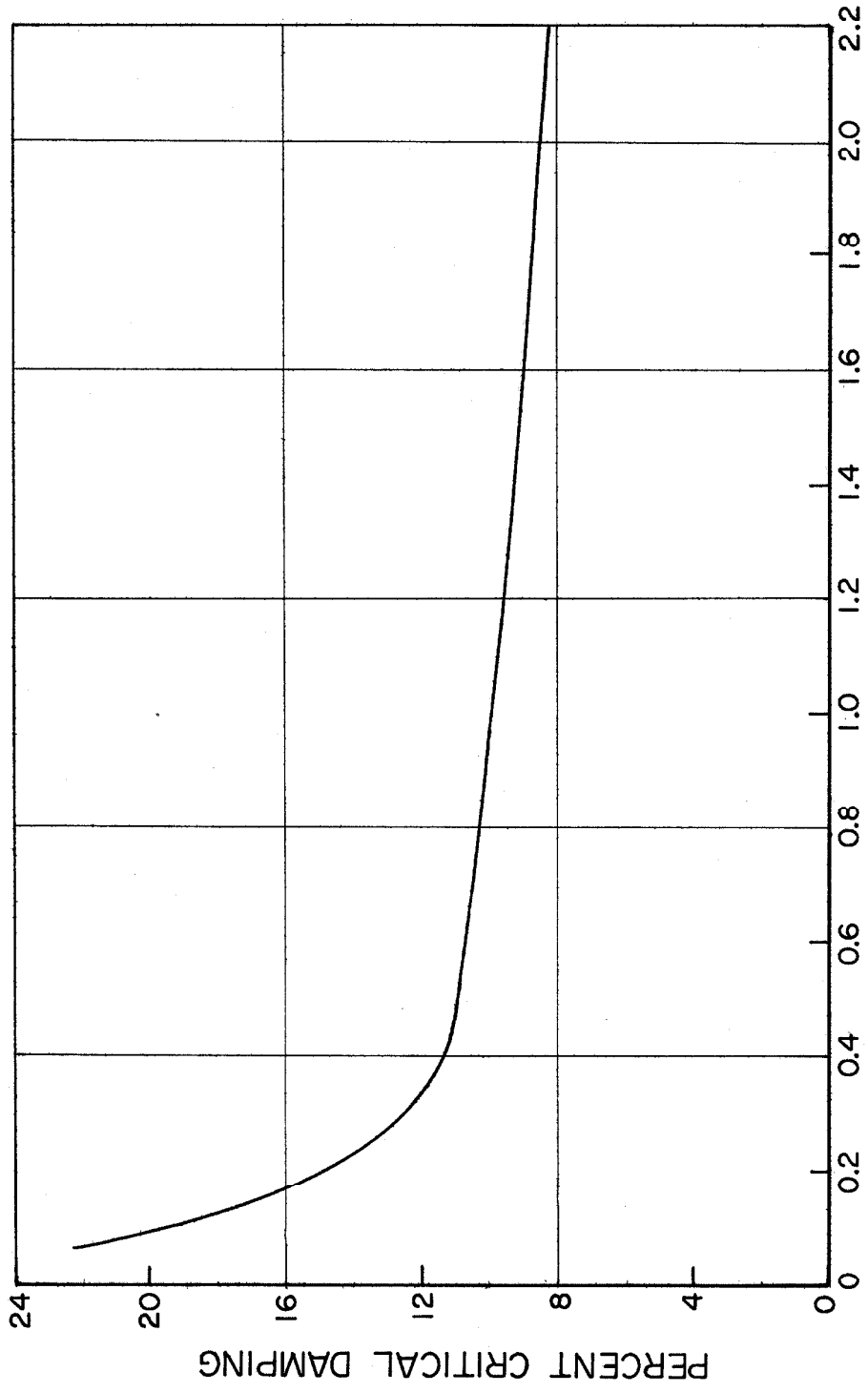


FIGURE 4. STANDARD SEISMOSCOPE DAMPING CURVE
BASED ON AVERAGE CONDITIONS

For each maximum S_d value given in Table II, the corresponding direction is shown in degrees measured from North clockwise.

The map of Figure 5 shows in graphical form the magnitude and direction of the maximum seismoscope response at each station. The length of the line segment centered on the station point is proportional to the S_d value, and the direction is that of the corresponding maximum relative displacement. Two line segments indicate that there are two seismoscopes at the station, as on the abutment and crest of a dam.

In Figure 6, accurate scale photographic copies of all recovered seismoscope plates are shown. On each page a line segment indicates the scale from which the S_d values can be checked as described above. On each photograph of the record plate, a reference direction line is drawn at N67W, which is an overall average of the strike of the fault as reported by several investigators in the joint Department of Commerce-Department of the Interior report on the San Fernando Earthquake (1971). The North direction arrow orients the glass record plate as viewed from above.

Some Records of Special Interest: Of particular importance are the records of Figure 6T, nos. 255 and 256 which were obtained from the east abutment and crest of the San Fernando Dam at the lower Van Norman Reservoir. These seismoscopes recorded the motion before and during the failure of the dam. The crest instrument miraculously escaped damage as it rode down under water with the face of the dam. Figure 7 shows the instrument housing as it appeared after the level of the reservoir had been pumped below the level of the seismoscope. Figure 8 is a sketch showing the maximum height of the water inside the protective cover during submergence, which indicates how air trapped in the instrument cover protected the seismoscope itself from submergence. Figure 9 shows the

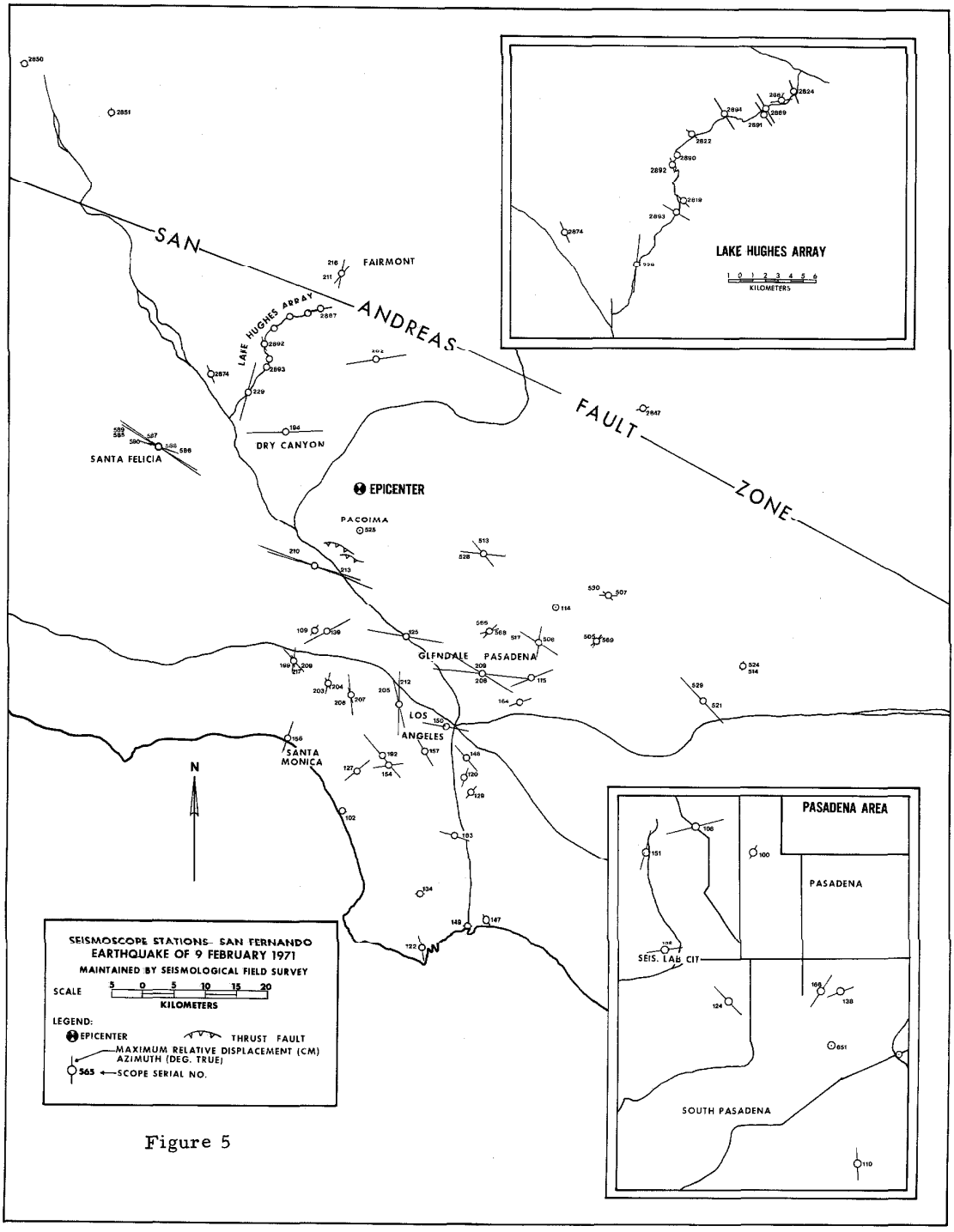
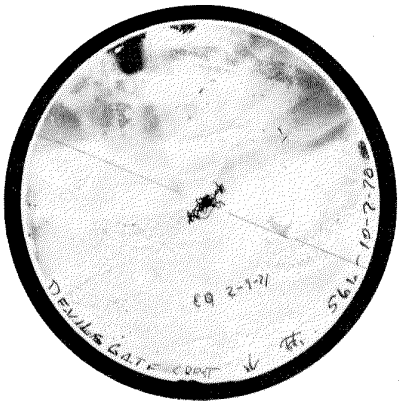

SAN ANDREAS FAULT ZONE
LAKE HUGHES ARRAY
KILOMETERS
FAIRMONT
DRY CANYON
SANTA FELICIA
EPICENTER
PACOIMA
GLENDALE
PASADENA
LOS ANGELES
SANTA MONICA
N
PASADENA AREA
SEIS. LAB CIT
SOUTH PASADENA
SEISMOSCOPE STATIONS- SAN FERNANDO
EARTHQUAKE OF 9 FEBRUARY 1971
MAINTAINED BY SEISMOLOGICAL FIELD SURVEY
SCALE 5 0 5 10 15 20
KILOMETERS
LEGEND:
EPICENTER
THRUST FAULT
MAXIMUM RELATIVE DISPLACEMENT (CM)
AZIMUTH (DEG. TRUE)
565 ← SCOPE SERIAL NO.

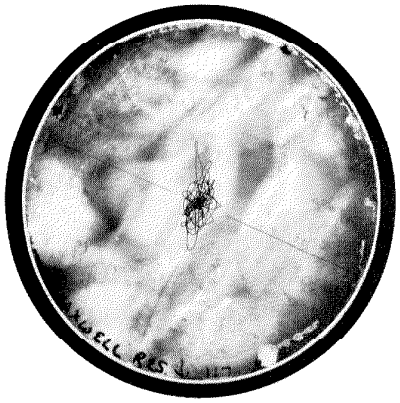
Figure 5



146 DEVIL'S GATE RESERVOIR CREST

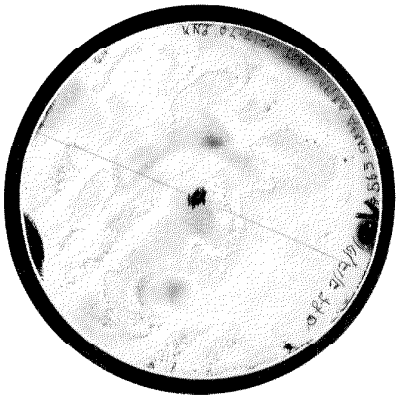
NORTH

147 DEVIL'S GATE RESERVOIR – LEFT BANK

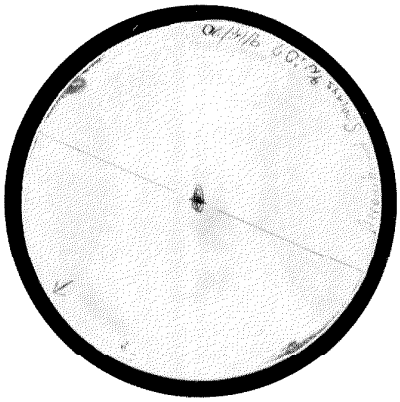


232 RESIDENCE – ALTADENA

2 CM

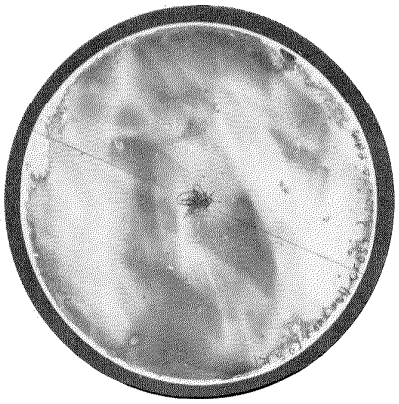


148 SANTA ANITA RESERVOIR



149 ARROWHEAD

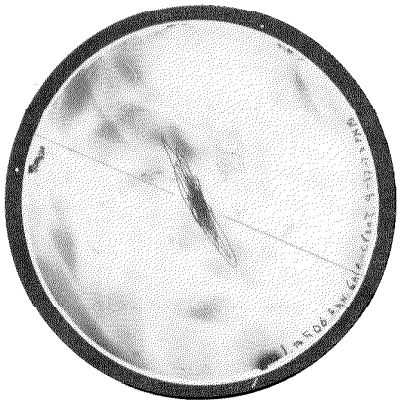
FIGURE 6-A



150 COGSWELL RESERVOIR - CREST

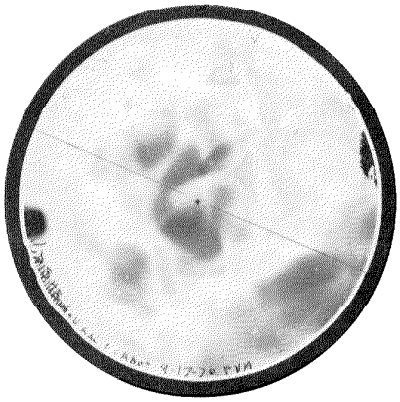
151 COGSWELL RESERVOIR - RIGHT BANK

NORTH



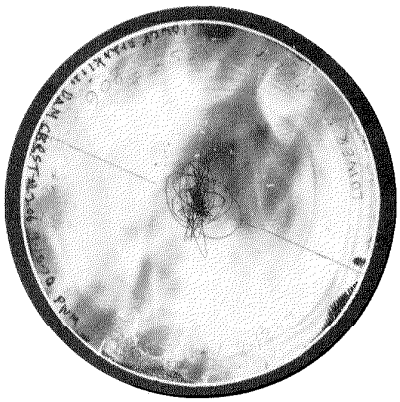
152 SAN GABRIEL RESERVOIR - CREST

2 CM



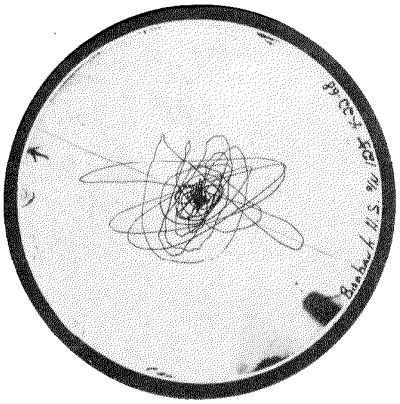
153 SAN GABRIEL RESERVOIR - LEFT BANK

154 LOWER FRANKLIN CANYON RES.-WEST ABUT.



155 LOWER FRANKLIN CANYON RES.-MAIN CREST

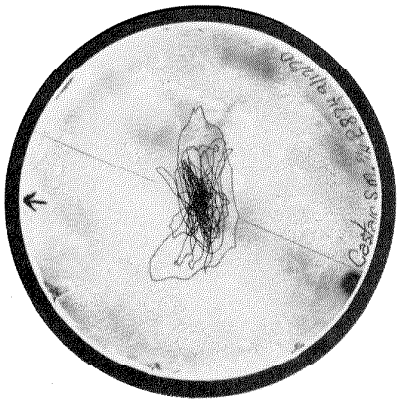
FIGURE 6-B



156 BURBANK HIGH SCHOOL

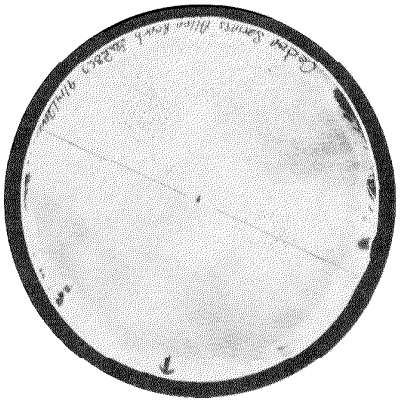
NORTH

157 CASTAIC - NORTH STATION

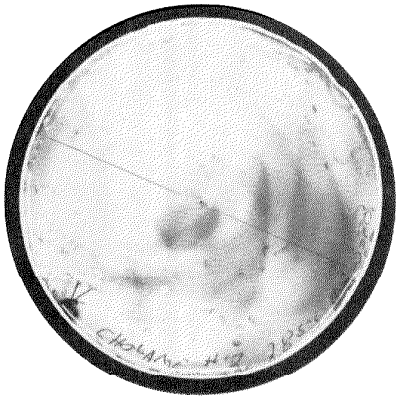


158 CASTAIC - OLD RIDGE ROUTE

2 CM

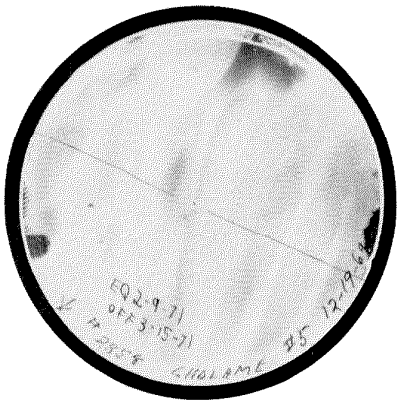


159 CEDAR SPRINGS



15 CHOLAME ARRAY NO.2

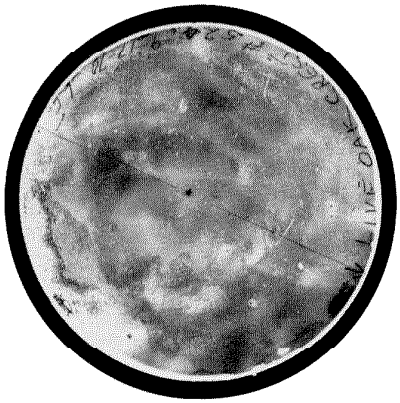
FIGURE 6-C



18 CHOLAME ARRAY NO.5

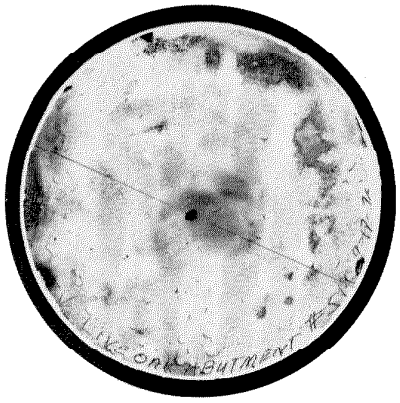
NORTH

21 CHOLAME ARRAY NO.8

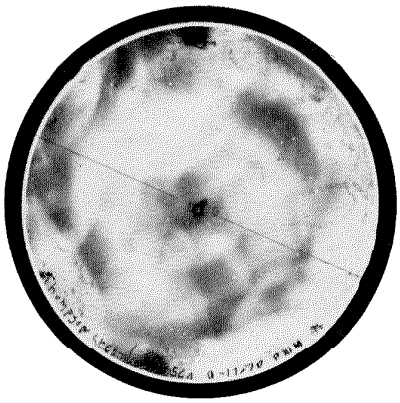


161 LIVE OAK RESERVOIR - CREST

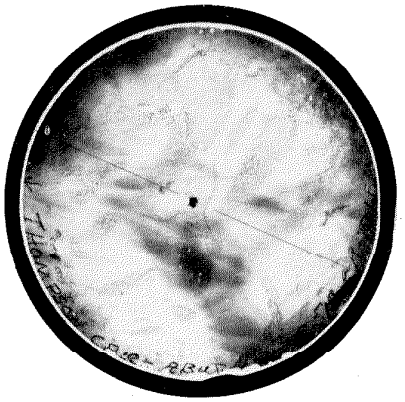
2 CM



162 LIVE OAK RESERVOIR - LEFT BANK

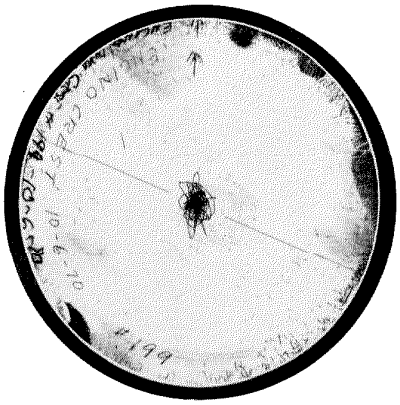


163 THOMPSON CREEK RES.-CREST



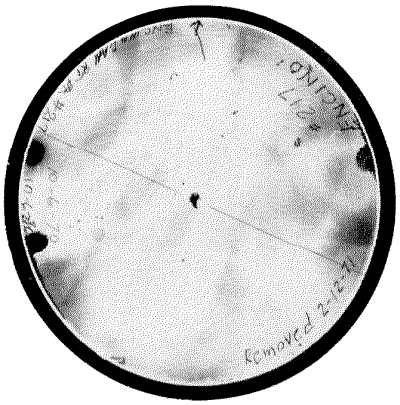
164 THOMPSON CREEK RES.-LEFT BANK

FIGURE 6-D

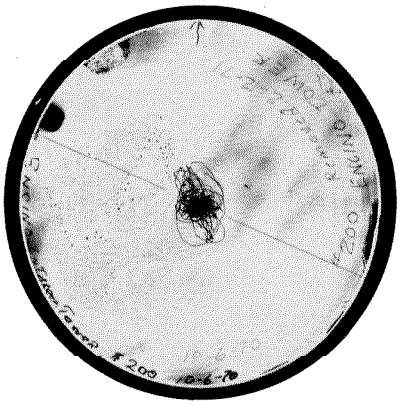


165 ENCINO RESERVOIR - CREST

NORTH



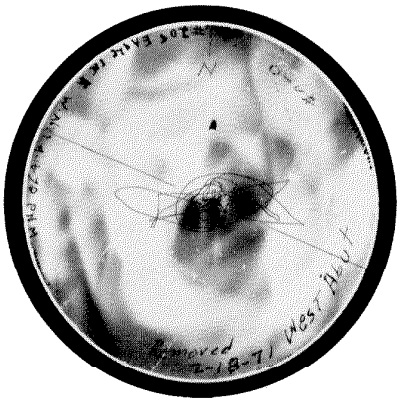
166 ENCINO RESERVOIR - WEST ABUT.



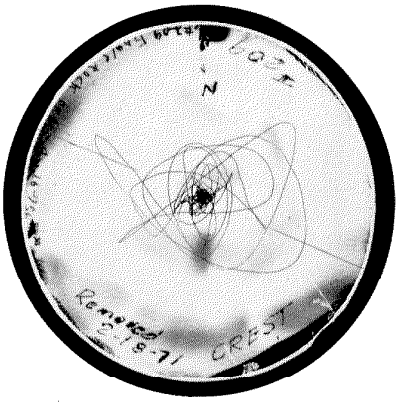
167 ENCINO RESERVOIR - TOWER

2 CM

172 HYPERION TREATMENT PLANT

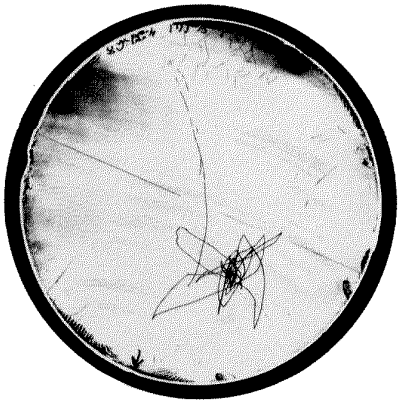


173 EAGLE ROCK RESERVOIR - WEST ABUT.



174 EAGLE ROCK RESERVOIR - MAIN DAM CREST

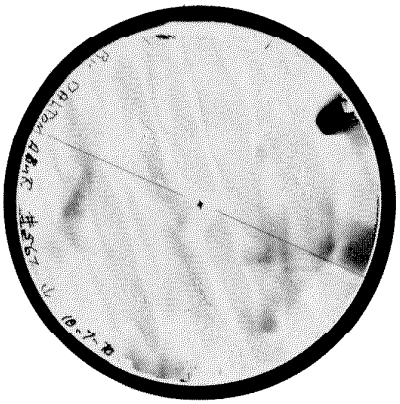
FIGURE 6-E



177 HERBERT HOOVER HIGH SCHOOL

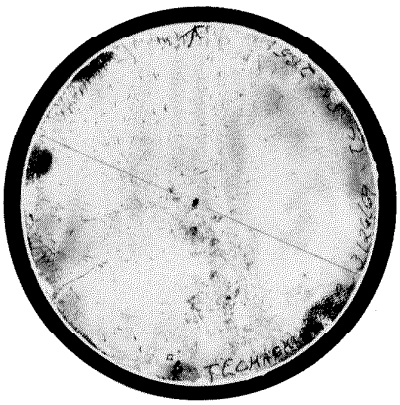
NORTH

178 BIG DALTON RESERVOIR - CREST

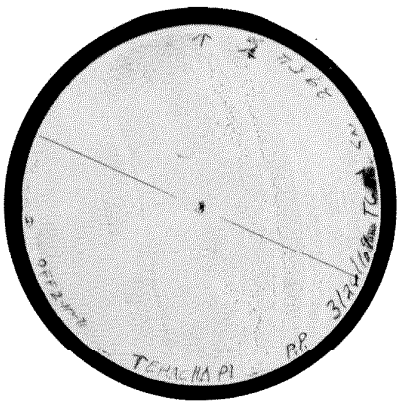


173 BIG DALTON RESERVOIR - LEFT BANK

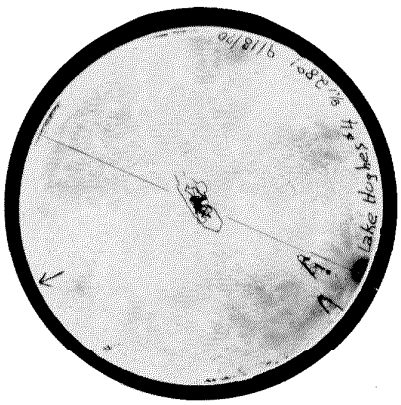
2 CM



35 TEHACHAPI PUMPING PLANT - NORTH SITE



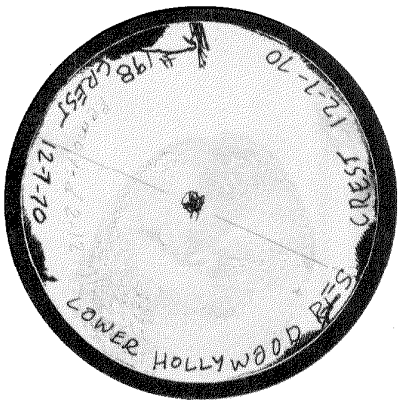
36 TEHACHAPI PUMPING PLANT - ACCEL.SITE



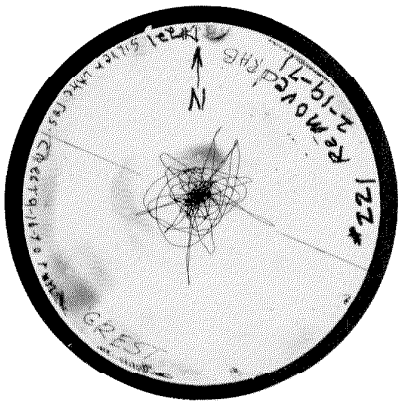
188 LAKE HUGHES ARRAY NO.4

FIGURE 6-F

182 HOLLYWOOD RESERVOIR - WEST ABUT.

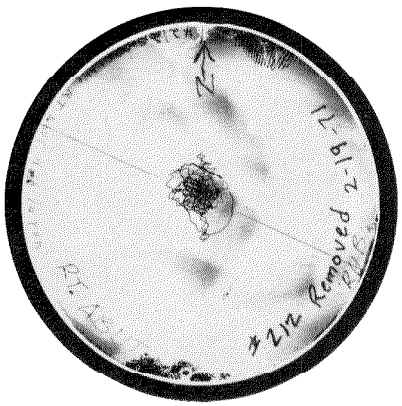


183 HOLLYWOOD RESERVOIR - MAIN DAM CREST



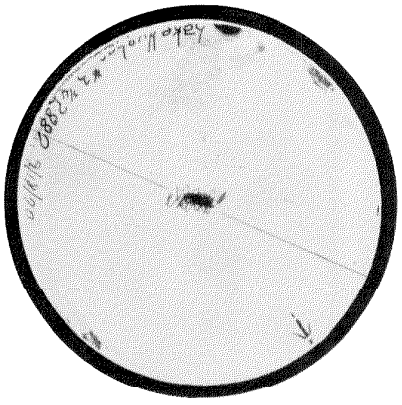
SILVER LAKE RESERVOIR - CREST

2 CM



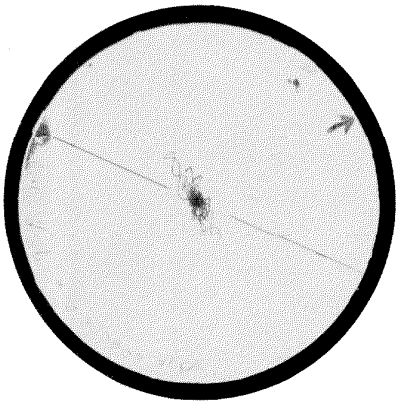
SILVER LAKE RESERVOIR - RIGHT ABUT.

186 LAKE HUGHES ARRAY NO.2



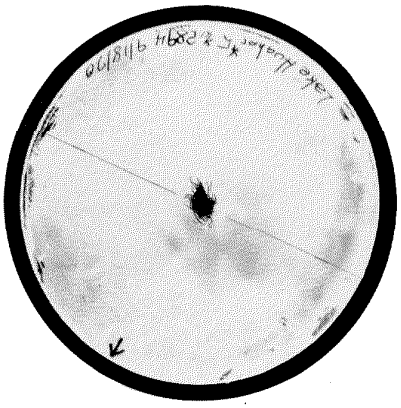
187 LAKE HUGHES ARRAY NO.3

FIGURE 6-G

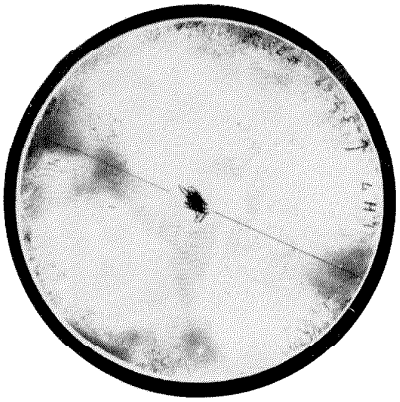


189 LAKE HUGHES ARRAY NO.4A

NORTH

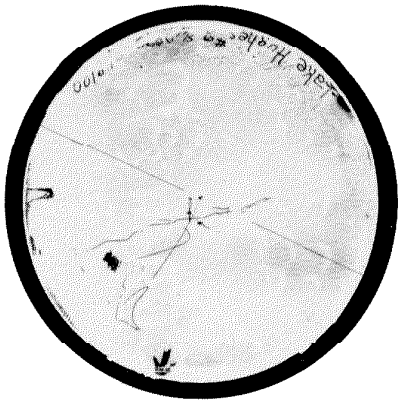


190 LAKE HUGHES ARRAY NO.5

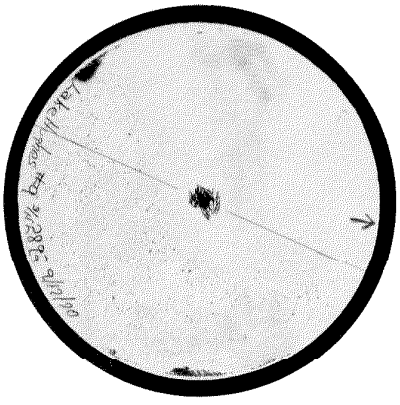


191 LAKE HUGHES ARRAY NO.7

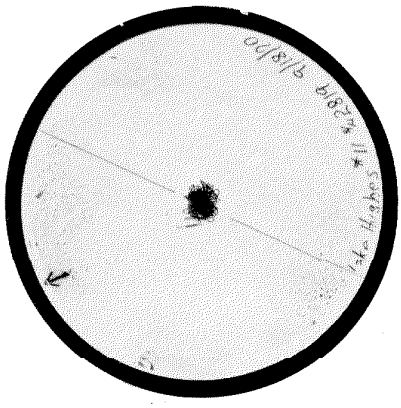
2 CM



192 LAKE HUGHES ARRAY NO.8



193 LAKE HUGHES ARRAY NO.9

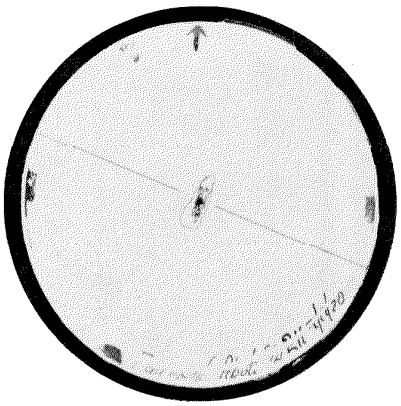


194 LAKE HUGHES ARRAY NO.11

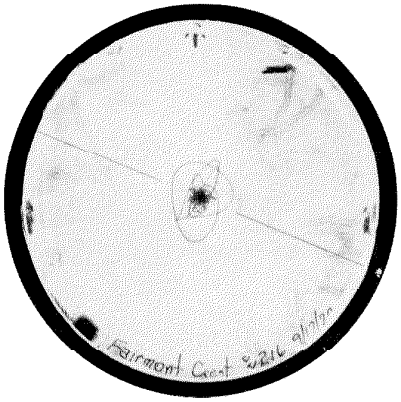
FIGURE 6-H

195 LAKE HUGHES ARRAY NO.12

NORTH



175 FAIRMONT RESERVOIR - SOUTH ABUT.

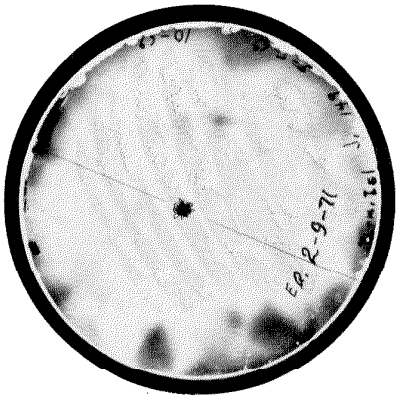


176 FAIRMONT RESERVOIR - MAIN DAM CREST

2 CM

196 LONG BEACH MUNICIPAL BUILDING

197 SAN PEDRO HIGH SCHOOL

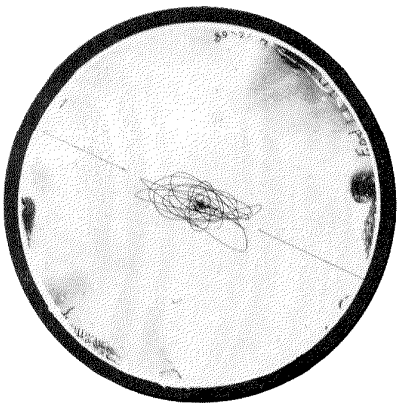


198 TERMINAL ISLAND

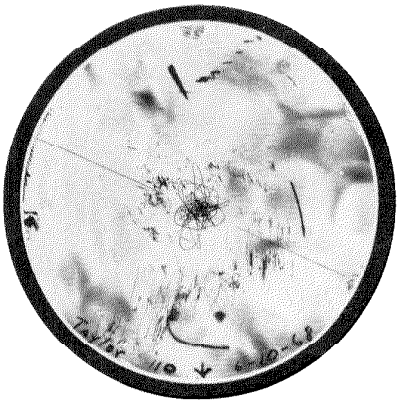
FIGURE 6-I

199 BALDWIN HILLS RESERVOIR

NORTH

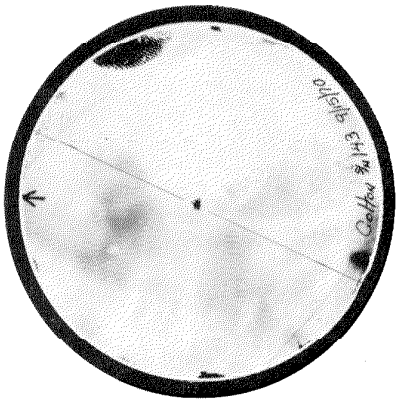


200 EAST LOS ANGELES JUNIOR COLLEGE



202 TAYLOR RESIDENCE

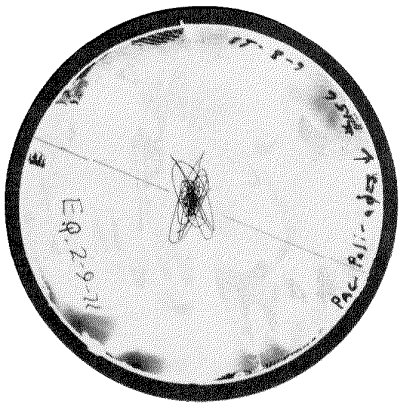
2 CM



203 COLTON

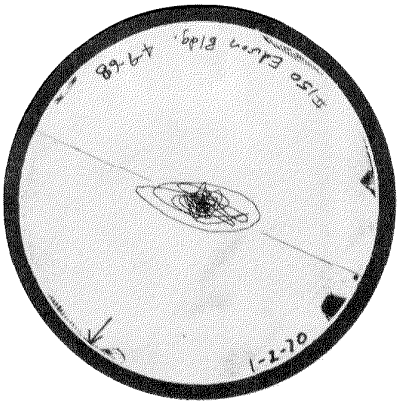
204 HOLLYWOOD STORAGE BUILDING

FIGURE 6-J

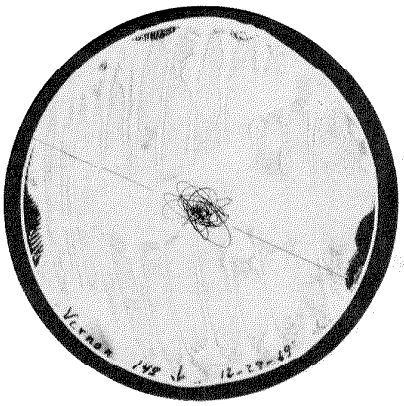


205 TAUXE RESIDENCE

NORTH

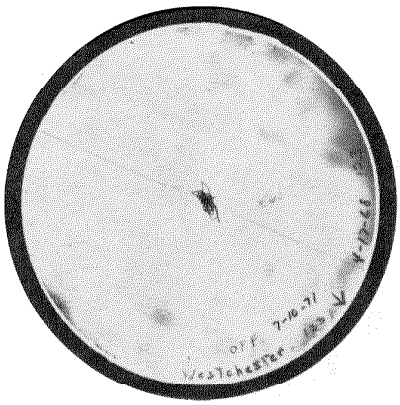


206 EDISON BUILDING

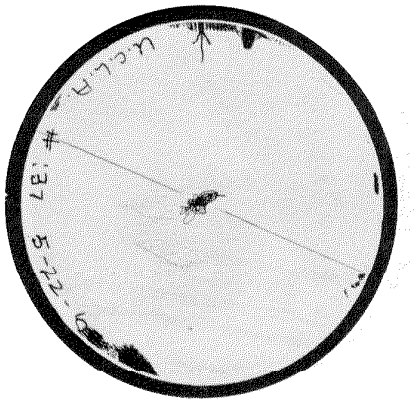


207 VERNON

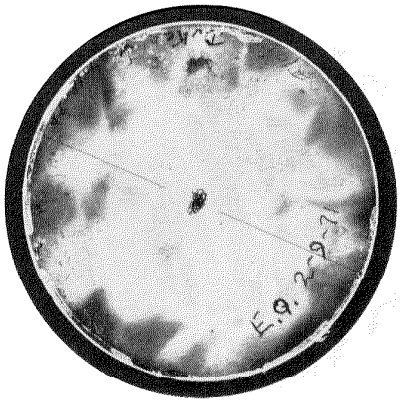
2 CM



208 LEEDS RESIDENCE

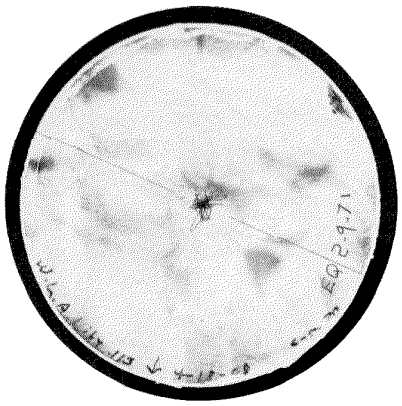


209 UCLA ACCEL. SITE



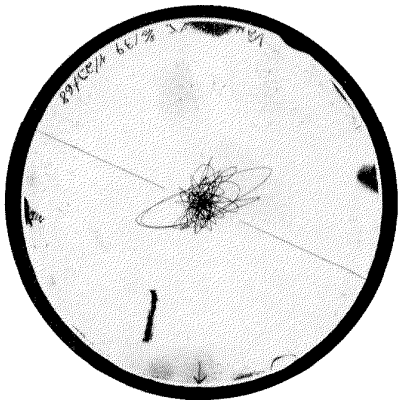
210 DUKE RESIDENCE

FIGURE 6-K



212 WEST LOS ANGELES PUBLIC LIBRARY

NORTH

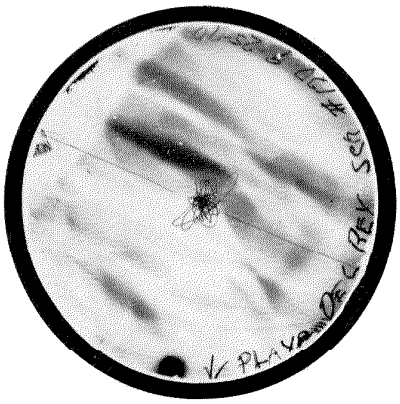


213 VAN NUYS HIGH SCHOOL

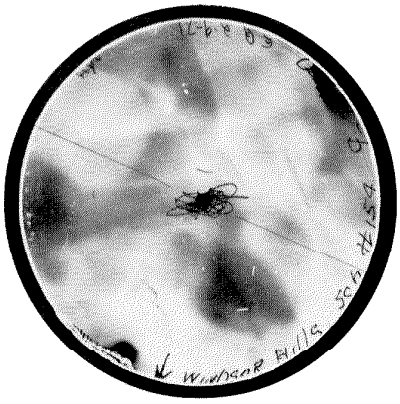
214 SOUTHGATE HIGH SCHOOL

2 CM

215 ELYSIAN HEIGHTS SCHOOL



216 PLAYA DEL REY SCHOOL

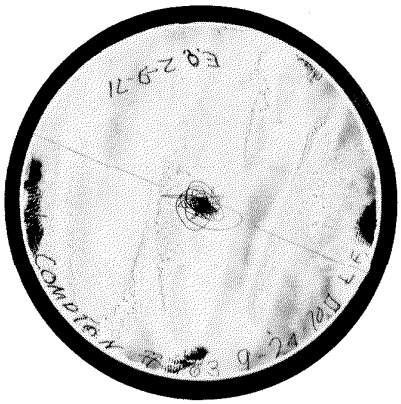


217 WINDSOR HILLS SCHOOL

FIGURE 6-L

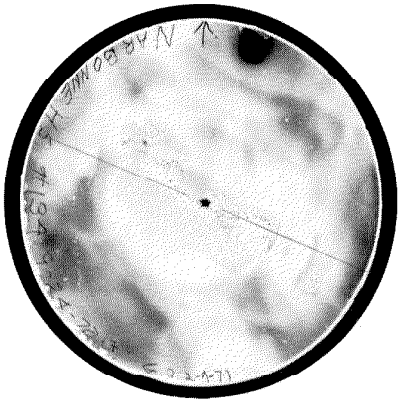
218 MUSEUM OF SCIENCE AND INDUSTRY

NORTH



219 COMPTON SCHOOL

220 HUNTINGTON PARK CITY HALL



221 NARBONNE HIGH SCHOOL

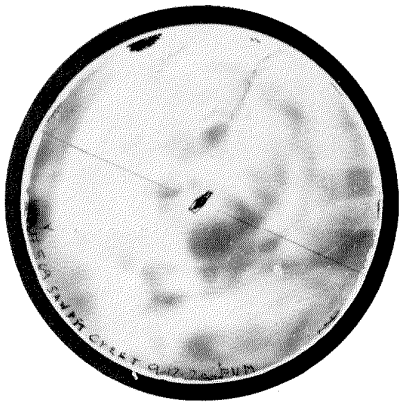
2 CM

63 MARICOPA STATION B

FIGURE 6-M

222 SAWPIT CANYON RESERVOIR - RIGHT BANK

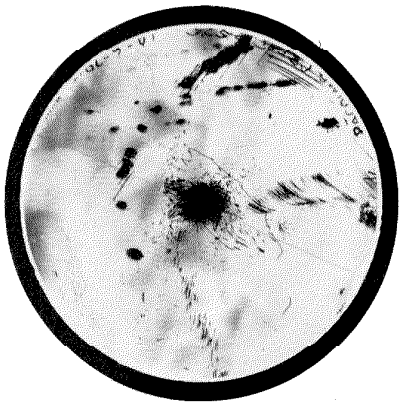
NORTH



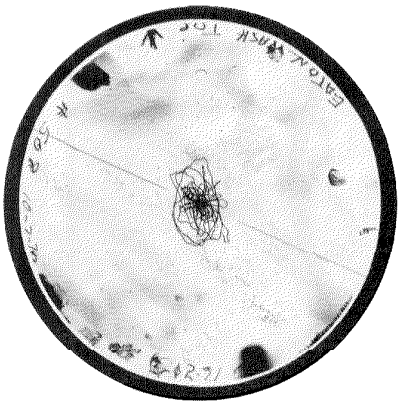
223 SAWPIT CANYON RESERVOIR - CREST

224 MOUNT WILSON

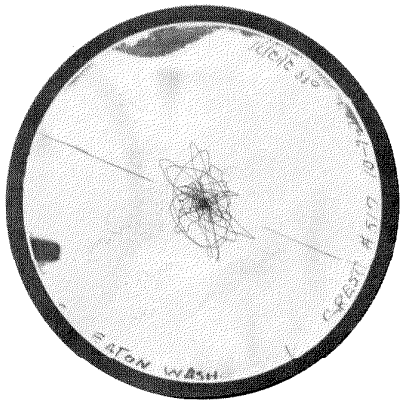
2 CM



227 PACOIMA DAM - CREST

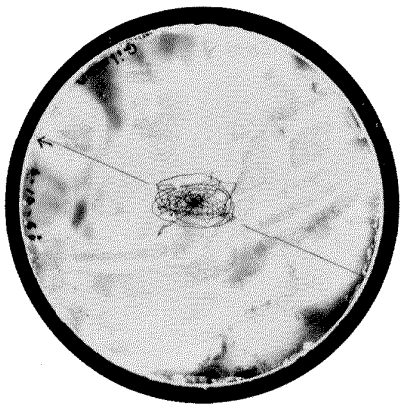


228 EATON WASH RESERVOIR - BASE



229 EATON WASH RESERVOIR - CREST

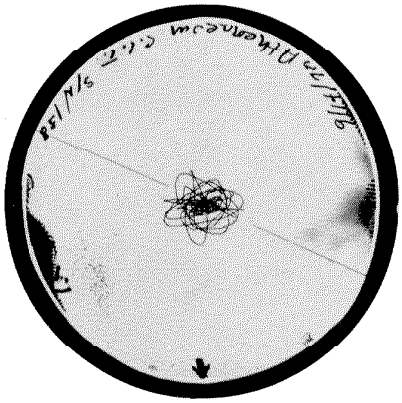
FIGURE 6-N



230 GILMAN RESIDENCE

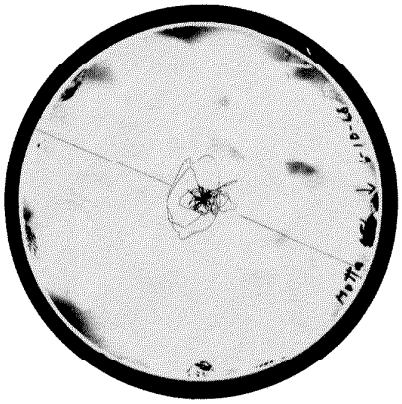
NORTH

231 MILLIKAN LIBRARY - CALTECH CAMPUS

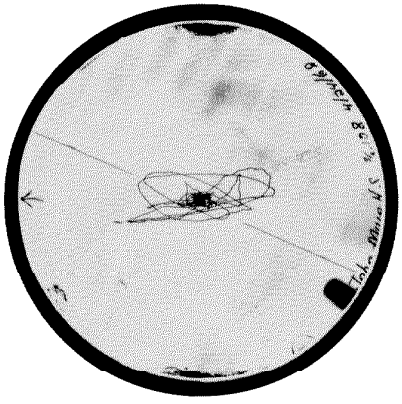


240 ATHENAEUM - CALTECH CAMPUS

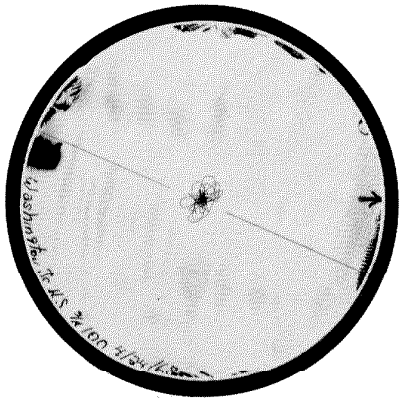
2 CM



233 MOTTA RESIDENCE



234 MUIR HIGH SCHOOL



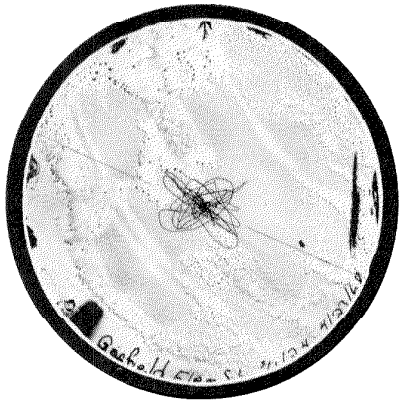
235 WASHINGTON JUNIOR HIGH SCHOOL

FIGURE 6-O

236 CALTECH SEISMOLOGICAL LABORATORY

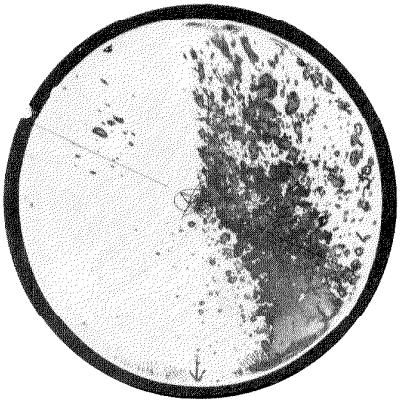
NORTH

237 SAN RAPHAEL SCHOOL

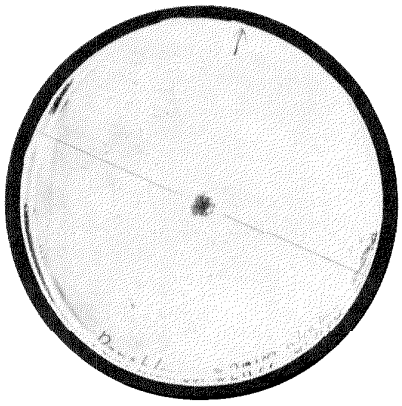


238 GARFIELD SCHOOL

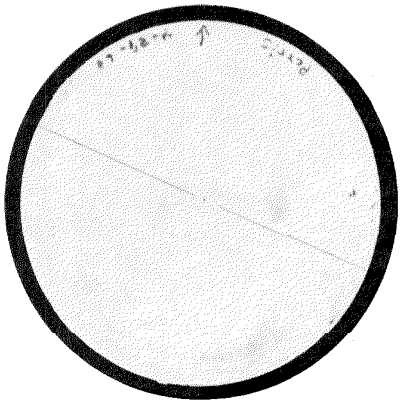
2 CM



239 HALE SCHOOL

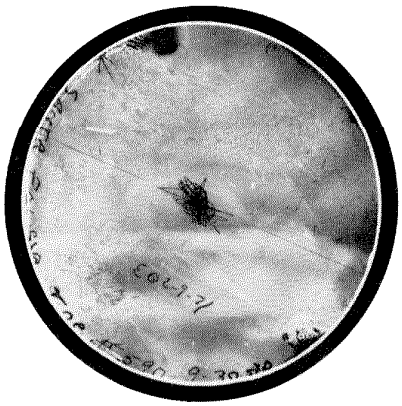


241 PEARBLOSSOM PUMPING PLANT

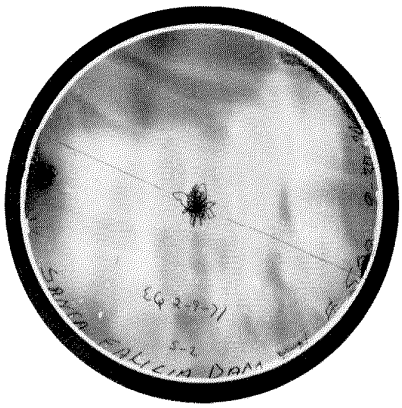


242 PERRIS ACCELEROGRAPH STATION

FIGURE G-P



262 SANTA FELICIA DAM - TOE, S-1

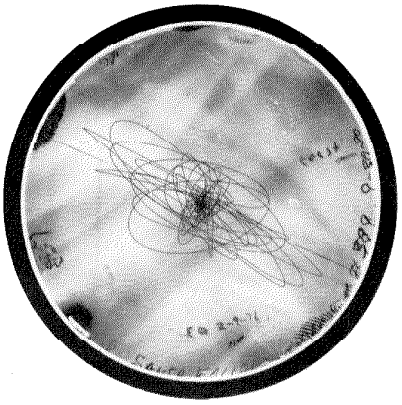


263 SANTA FELICIA DAM - OUTLET WORKS, S-2

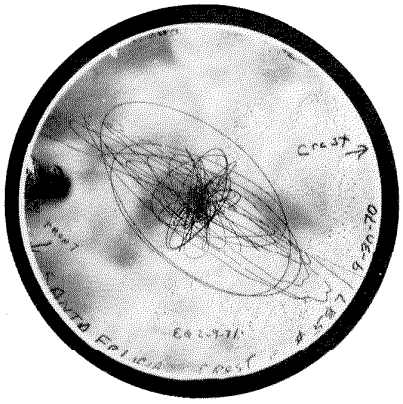
NORTH

264 SANTA FELICIA DAM - RIGHT ABUT., S-3

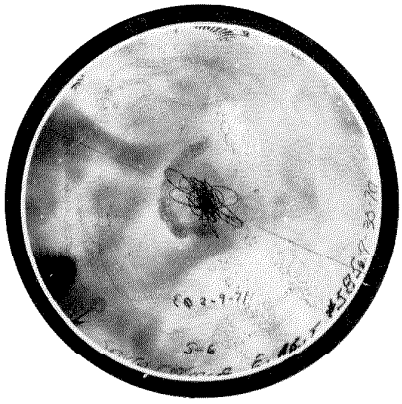
2 CM



265 SANTA FELICIA DAM - RIGHT CREST, S-4

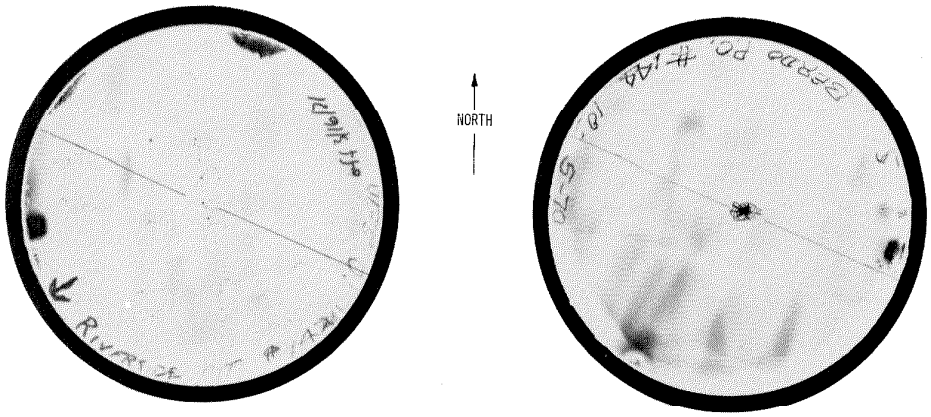


266 SANTA FELICIA DAM - CREST, S-5



267 SANTA FELICIA DAM - LEFT ABUT., S-6

FIGURE 6-Q

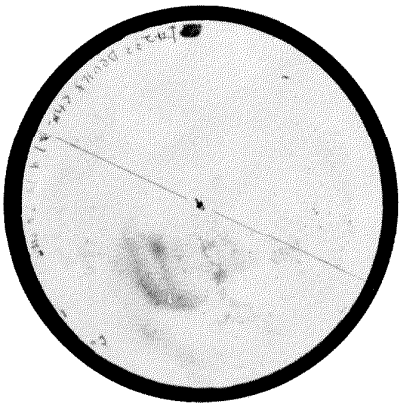


243 RIVERSIDE

2 CM

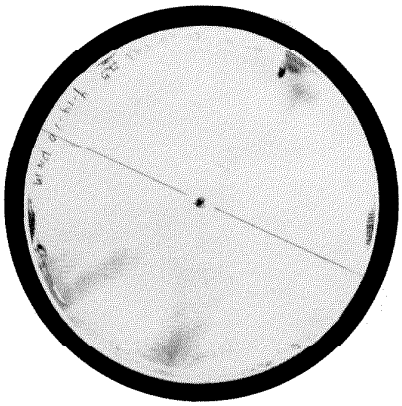
244 SAN BERNARDINO POST OFFICE

FIGURE 6-R



245 DEVIL'S CANYON - SITE NO.1

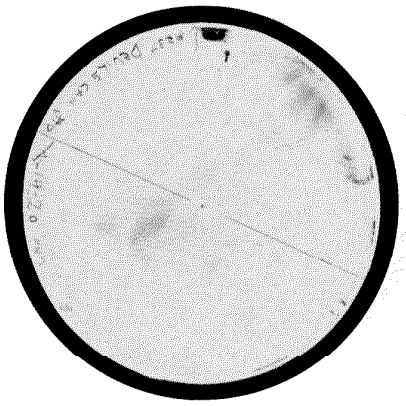
246 DEVIL'S CANYON - SITE NO.2



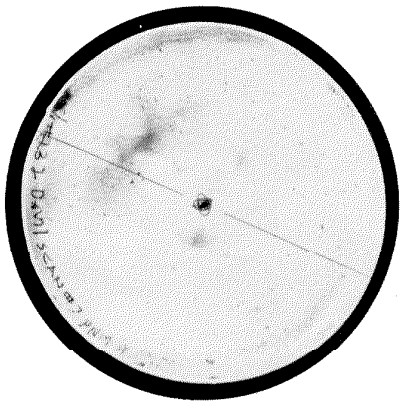
248 DEVIL'S CANYON - SITE NO.5

247 DEVIL'S CANYON - SITE NO.4

2 CM



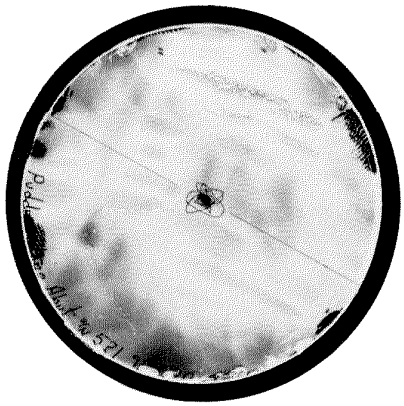
249 DEVIL'S CANYON - SITE NO.6



250 DEVIL'S CANYON - SITE NO.7

FIGURE 6-S

251 PUDDINGSTONE RESERVOIR - CREST



254 PUDDINGSTONE RESERVOIR - ACCEL.SITE

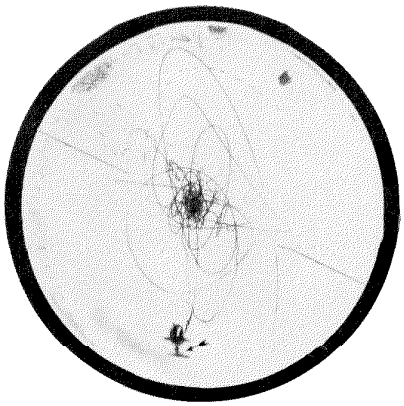
NORTH

252 SAN DIMAS RESERVOIR - CREST

253 SAN DIMAS RESERVOIR - LEFT BANK

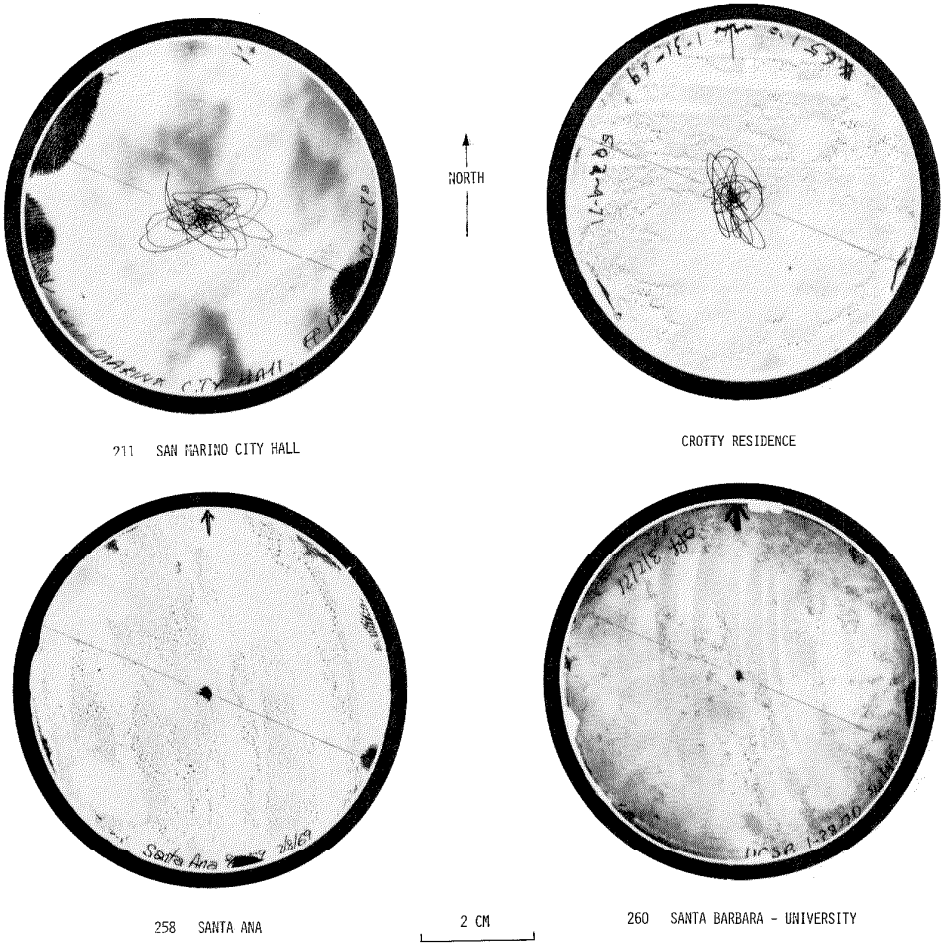
2 CM

255 LOWER SAN FERNANDO DAM - EAST ABUT.



256 LOWER SAN FERNANDO DAM - CREST

FIGURE 6-T



211 SAN MARINO CITY HALL

CROTTY RESIDENCE

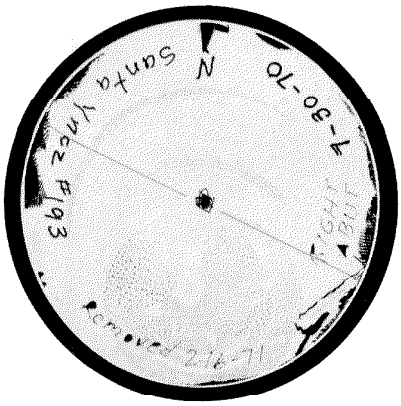
258 SANTA ANA

260 SANTA BARBARA - UNIVERSITY

180 GOLETA - MARKET

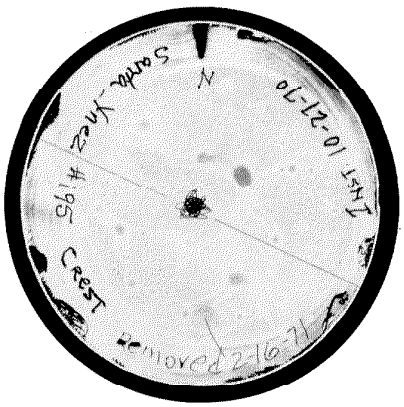
181 GOLETA - RESIDENCE

FIGURE 6-U

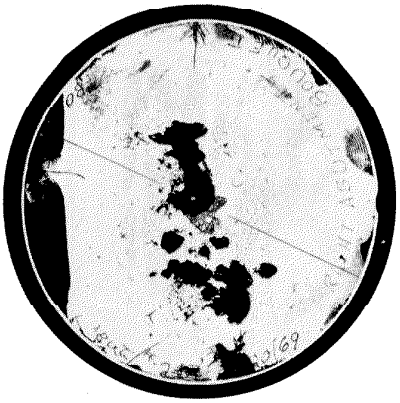


SANTA YNEZ DAM - RIGHT ABUT.

NORTH

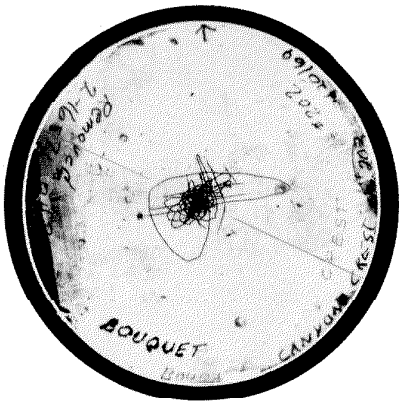


SANTA YNEZ DAM - CREST

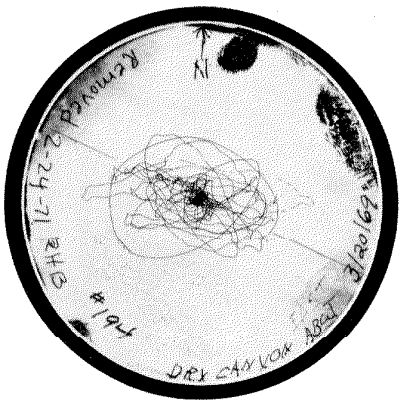


184 BOUQUET CANYON RESERVOIR - WEST ABUT.

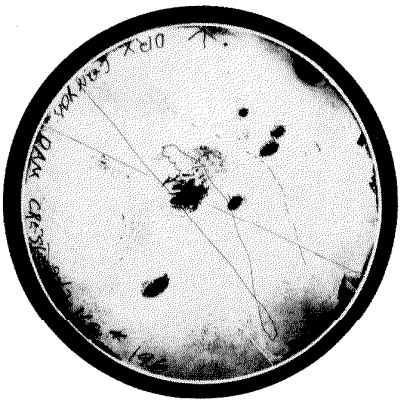
2 CM



185 BOUQUET CANYON RESERVOIR - CREST

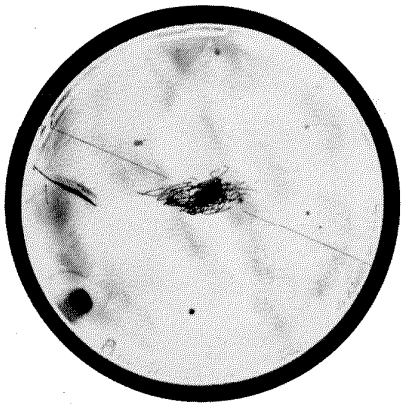


268 DRY CANYON RESERVOIR - EAST ABUT.



269 DRY CANYON RESERVOIR - CREST

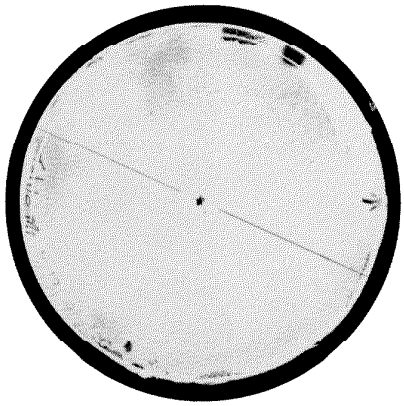
FIGURE 6-V



270 BIG TUJUNGA RESERVOIR - CREST

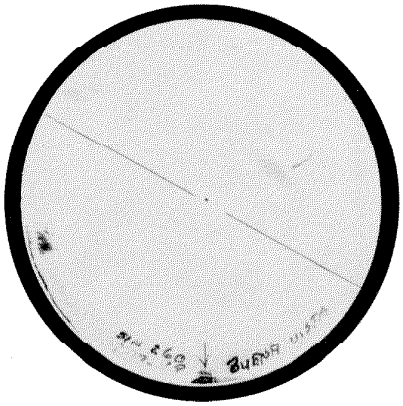
NORTH

271 BIG TUJUNGA RESERVOIR - LEFT BANK



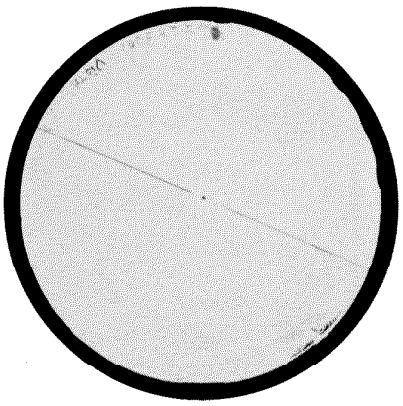
272 TABLE MOUNTAIN

2 CM



130 BUENA VISTA - ACCEL.SITE

131 BUENA VISTA - NORTH

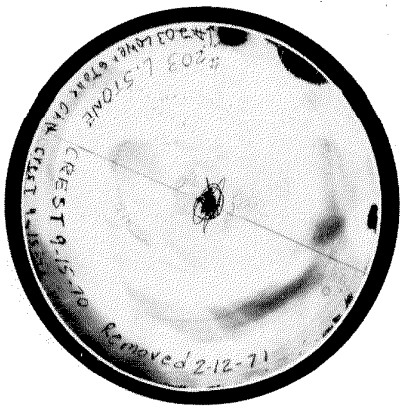


132 BUENA VISTA - SOUTH

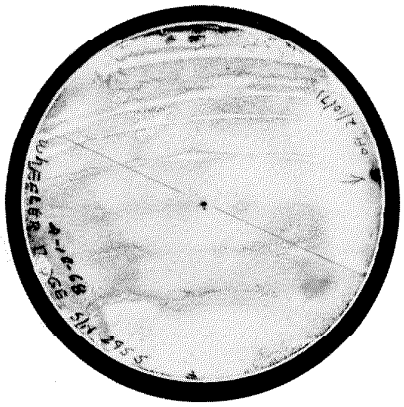
FIGURE 6-W

273 LOWER STONE CANYON RES.-EAST ABUT.

NORTH

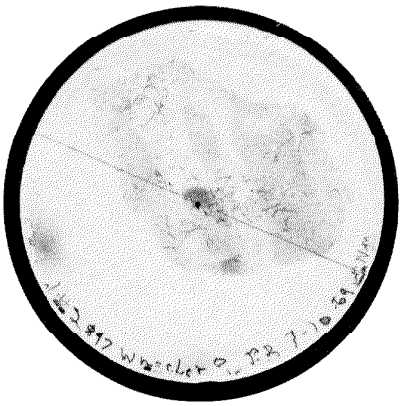


274 LOWER STONE CANYON RES.-CREST

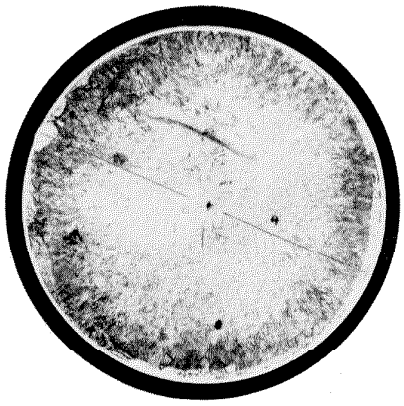


138 WHEELER RIDGE ACCEL. STATION

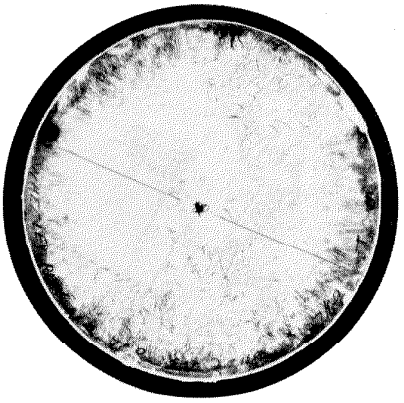
2 CM



139 WHEELER RIDGE PUMPING PLANT



140 WIND GAP PUMPING PLANT



141 WHEELER RIDGE - TILTMETER NO.2

FIGURE 6-X

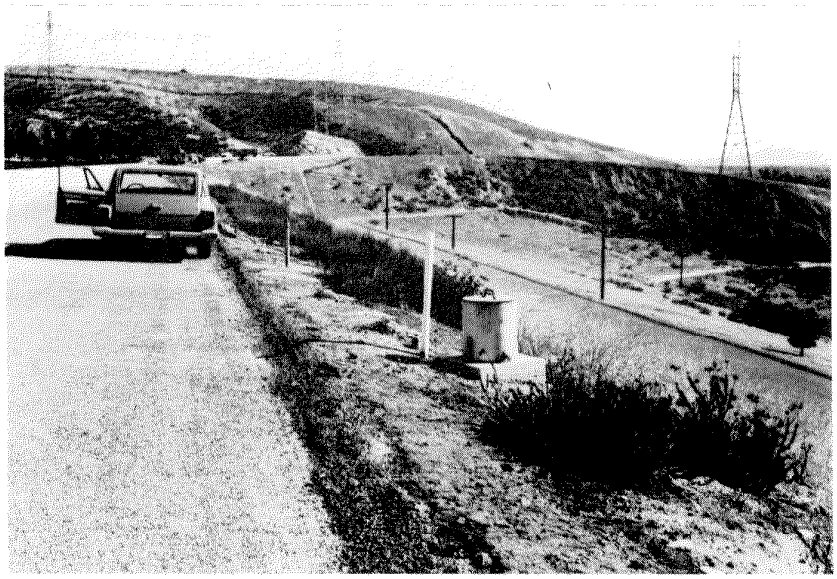


Figure 7(a). Seismoscope Site 256 at crest of Lower San Fernando Dam before earthquake.

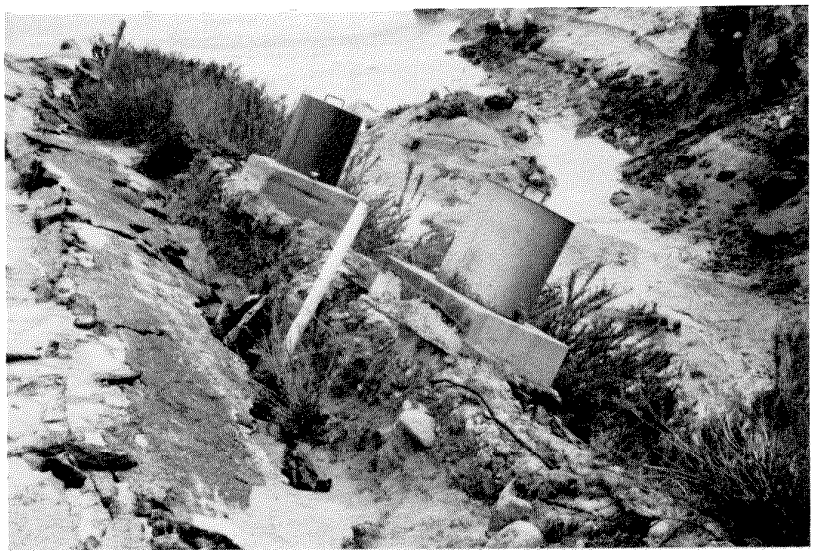


Figure 7(b). Seismoscope Site 256 at crest of Lower San Fernando Dam after earthquake and lowering of reservoir level. The instrument at the left is a Peak Reading Accelerometer installed after the photograph of Figure 7(a).

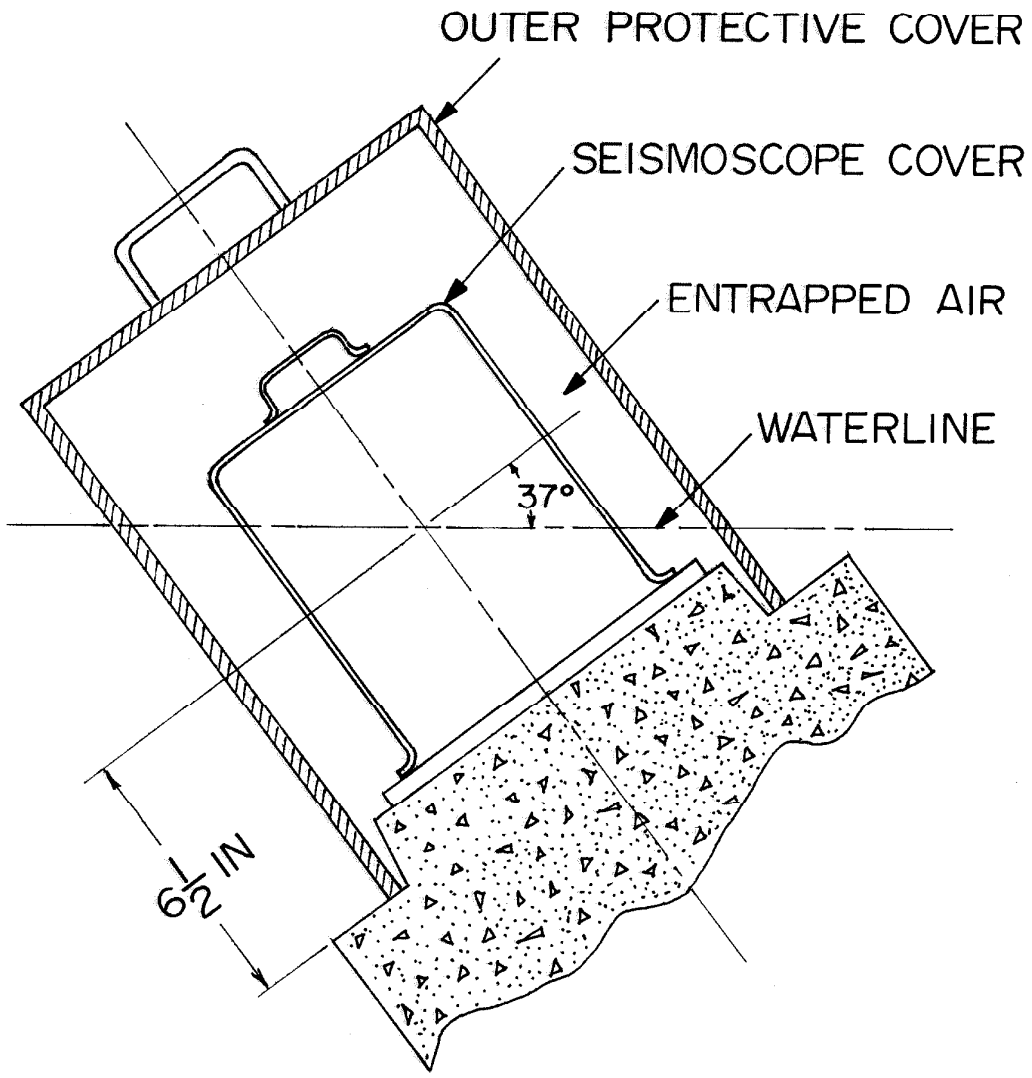


FIGURE 8. SEISMOSCOPE AT LOWER SAN FERNANDO DAM AFTER EARTHQUAKE

seismoscope on its tilted foundation after the protective cover was removed. Note that at the angle of permanent tilt of 37° the pendulum was caught on the magnet support arm. The position of the stylus on the record plate while the instrument was tilted at this angle is indicated by the barbed arrow in Figure 6 T, no. 256. The small transverse line and the portion of the record between that position and the black blob just above it probably represents motion of the scope near the end of the sliding, and the black blob perhaps represents the motion during the initial part of the sliding. Probably the remainder of the record represents motion of the crest of the dam prior to failure. Close examination of the seismoscope installation during recovery indicated that the seismoscope foundation probably did not fail until the actual instant of dam failure. A detailed analysis is being made which should result in an approximate reconstruction of the acceleration-time curve. Figure 10a, b shows damping and tilt test records made on the instruments immediately after recovery. Table III gives the instrumental constants of both instruments.

Table III. Seismoscope Characteristics at Van Norman Reservoir

	Crest	Abutment
Serial No.	210	213
Sensitivity (cm/rad)	5.52	5.52
Period	0.75	0.75
Single Amplitude at 10% Damping (cm)	0.73	1.27

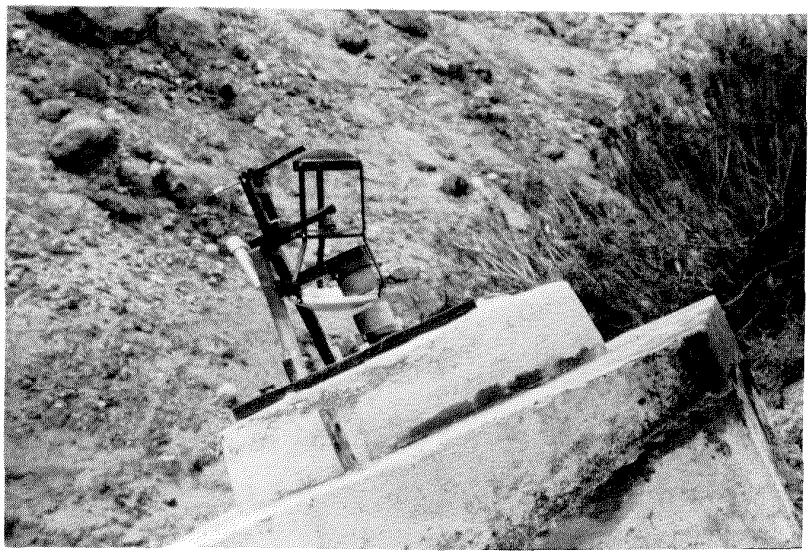


Figure 9. Seismoscope SN 210 at Site 256 at crest of Lower San Fernando Dam in final position after earthquake and lowering of water level.

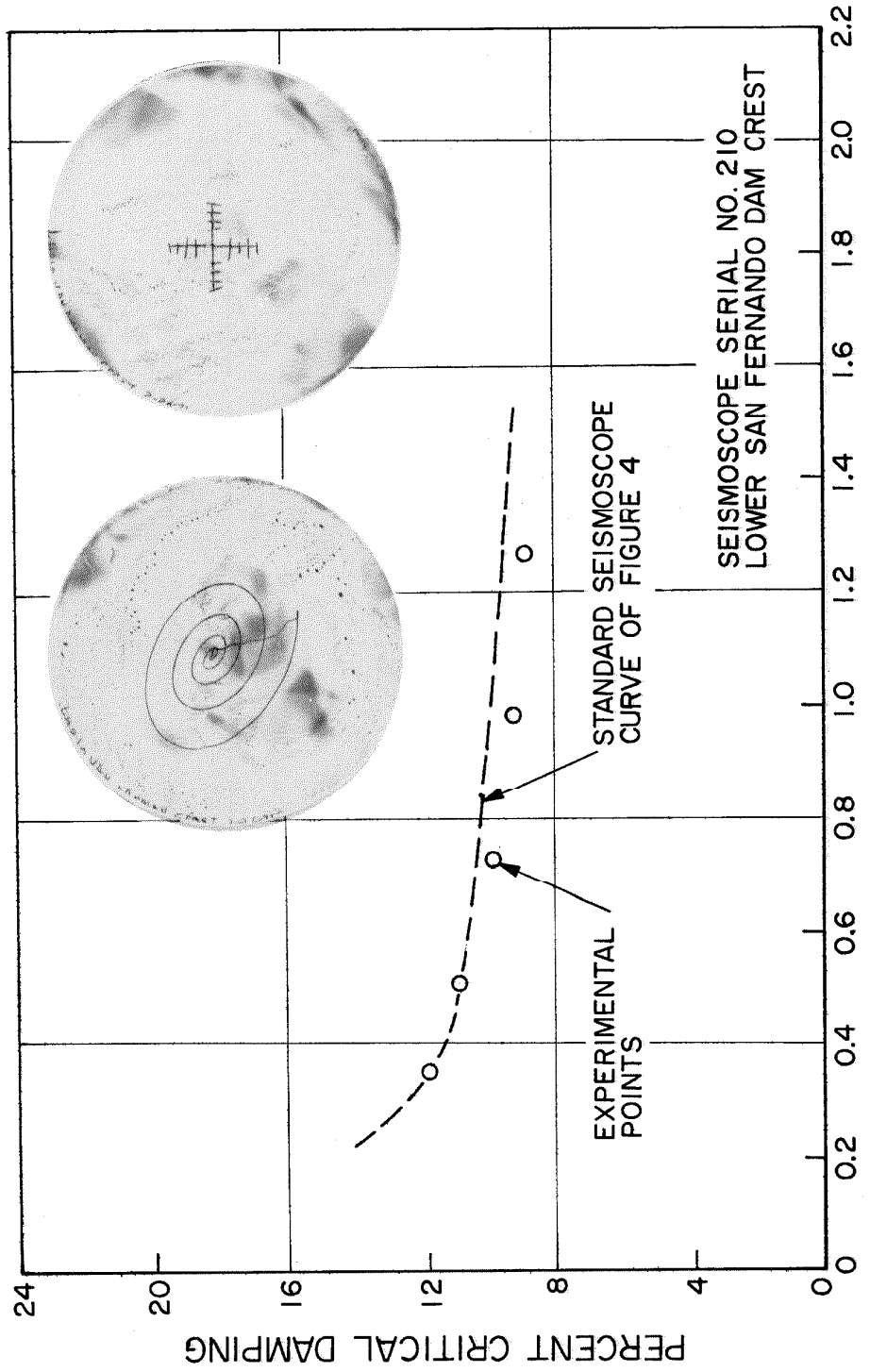


FIGURE 10a. DAMPING AND TILT TEST RECORDS - AFTER EARTHQUAKE

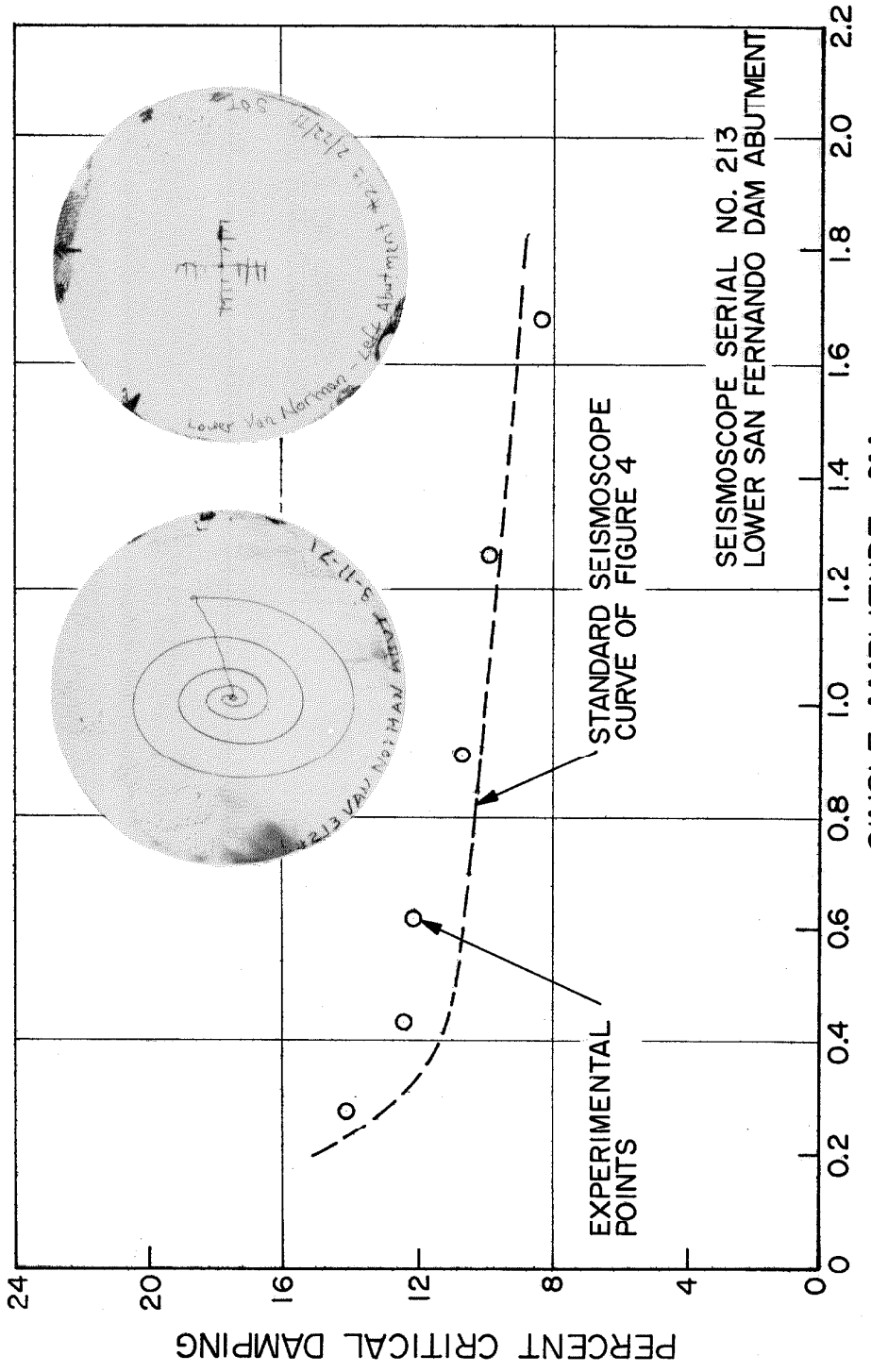


FIGURE 10b. DAMPING AND TILT TEST RECORDS - AFTER EARTHQUAKE

Figure 11 is an aerial photo of the dam with arrows indicating location of the instruments.

Another set of records of major interest are those obtained at Santa Felicia Dam. Figure 12 shows the array of instruments at Santa Felicia. The six records are shown in Figure 6 Q, nos. 262-267. The large variations in the amplitudes of the records made at this site are striking.

Acknowledgments

Many agencies and individuals, both private and government, have provided both instruments and space for instruments. This support down through the years is appreciated. Technicians of the Seismological Field Survey carried out an efficient and speedy recovery operation with extremely low record loss. Special recognition should be given Leroy Foote, Pete Mork, and Barry Silverstein for recovering seismoscope records. Virgilio Perez, SFS, provided most of the computer analysis. C. F. Knudson, SFS, edited the manuscript. Appreciation is extended to Richard Dielman of the California Institute of Technology for assistance with the preparation of the maps, tables, and illustrations.

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W. K. Cloud and D. E. Hudson (1961), "A Simplified Instrument for Recording Strong-motion Earthquakes", Bull. Seis. Soc., 51, 159-174.

M. D. Trifunac and D. E. Hudson (1970), "Analysis of the Station No. 2 Seismoscope Record - 1966, Parkfield, California Earthquake", Bull. Seis. Soc., 60, 785-794.

Figure 11. Aerial view of Lower San Fernando Dam after earthquake of February 9, 1971. Arrows indicate seismoscope sites. Crest Site 256 completely submerged.

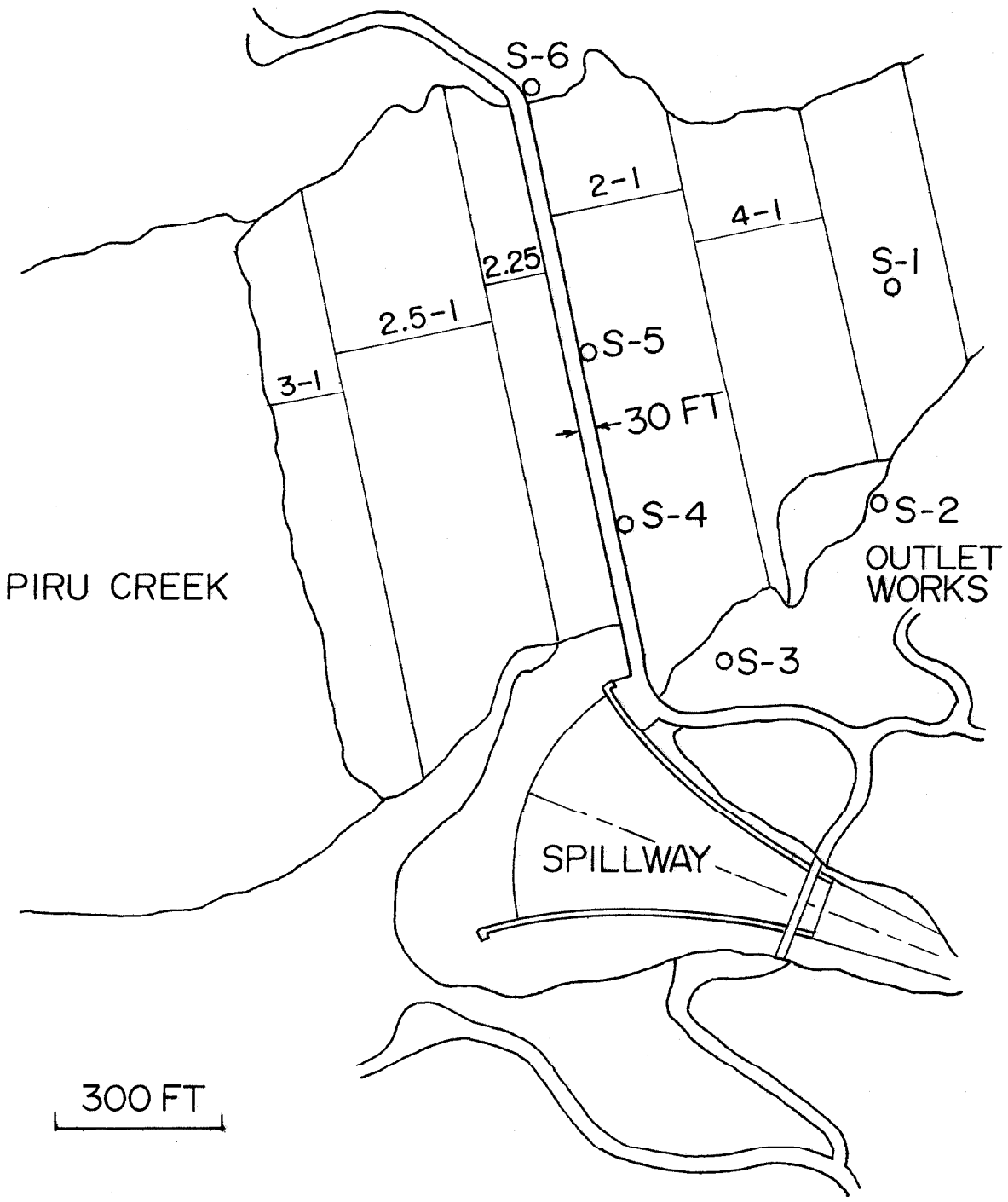

FIGURE 12. SEISMOSCOPE ARRAY-
SANTA FELICIA DAM

W. K. Cloud (1967), "Seismoscope Results from Three Earthquakes in the Hollister, California Area", Bull. Seis. Soc., 57, 1445-1448.

G. E. Murray (1970), Personal Communication re Analysis of Parkfield Earthquake Seismoscope Records.

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"The San Fernando, California, Earthquake of February 9, 1971", Geological Survey Professional Paper 733, U. S. Geological Survey and the National Oceanic and Atmospheric Administration, Washington, D. C., 1971.

Chapter 4

PRELIMINARY REPORT ON FELT AREA AND INTENSITY

By Nina H. Scott[1]

The main shock of the San Fernando, California, earthquake series occurred on February 9, 1971, at 06:00:41.6 Pacific Standard time. The epicenter was located at 34°24.0' north, 118°23.7' west, about 7 miles east of Newhall, in Soledad Canyon. The magnitude of this death-dealing and devastatingly damaging earthquake was moderate, 6.6. The shock was felt over approximately 80,000 square miles. A preliminary map of the affected area showing Modified Mercalli intensities is displayed in figure 1, and was primarily determined from almost 2,000 reports received through the questionnaire card (Form NOS-680) canvass conducted by the National Ocean Survey. Intensities ranging from VIII-XI occurred over approximately a 150-square-mile area, encompassing the towns and adjacent areas of San Fernando, Sylmar, Newhall, and Saugus of northern Los Angeles County, with the maximum structural damage and ground surface faulting occurring in the San Fernando-Sylmar area, where portions of hospitals collapsed and other large major public buildings damaged beyond repair and evacuated; school buildings severely damaged, some condemned; numerous commercial buildings, and single-family dwellings and apartment houses damaged beyond repair, some demolished; one dam practically demolished and others damaged; highway overpasses totally collapsed and many bridges

1 Seismological Field Survey, National Ocean Survey, National Oceanic and Atmospheric Administration.

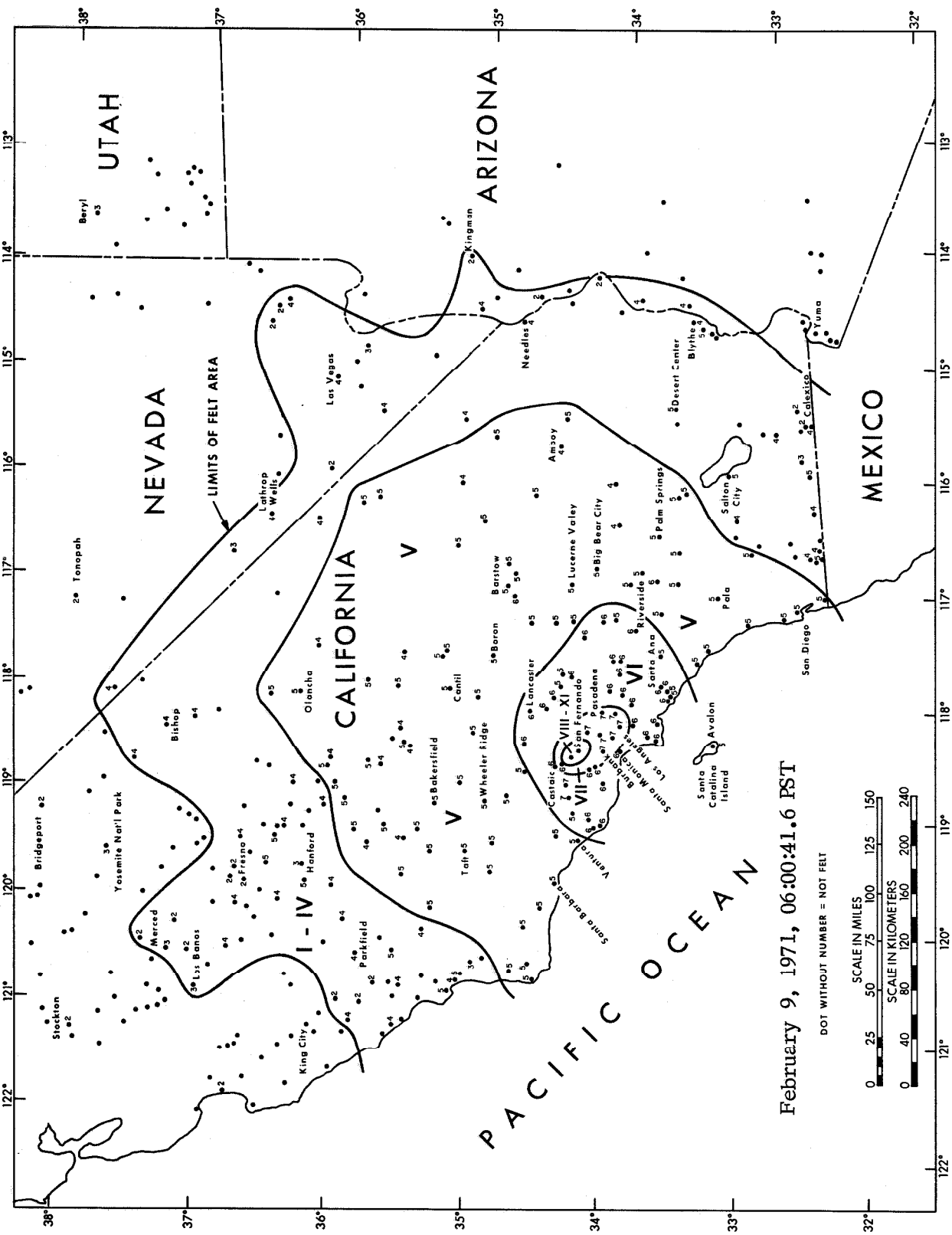

Fig. 1. Area affected by the southern California earthquake of February 9.

MODIFIED MERCALLI INTENSITY SCALE OF 1931
(Abridged)

I. Not felt except by a very few under especially favorable circumstances. (I Rossi-Forel Scale.)

II. Felt only by a few persons at rest, especially on upper floors of buildings. Delicately suspended objects may swing. (I to III Rossi-Forel Scale.)

III. Felt quite noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motorcars may rock slightly. Vibration like passing truck. Duration estimated. (III Rossi-Forel Scale.)

IV. During the day felt indoors by many, outdoors by few. At night some awakened. Dishes, windows, and doors disturbed; walls make creaking sound. Sensation like heavy truck striking building. Standing motorcars rocked noticeably. (IV to V Rossi-Forel Scale.)

V. Felt by nearly everyone; many awakened. Some dishes, windows, etc., broken; a few instances of cracked plaster; unstable objects overturned. Disturbance of trees, poles, and other tall objects sometimes noticed. Pendulum clocks may stop. (V to VI Rossi-Forel Scale.)

VI. Felt by all; many frightened and run outdoors. Some heavy furniture moved; a few instances of fallen plaster or damaged chimneys. Damage slight. (VI to VII Rossi-Forel Scale.)

VII. 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 Rossi-Forel Scale.)

VIII. 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. (VIII+ to IX Rossi-Forel Scale.)

IX. 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. (IX+ Rossi-Forel Scale.)

X. Some well built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from river banks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks. (X Rossi-Forel Scale.)

XI. 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. Damage total. Waves seen on ground surfaces. Lines of sight and level distorted. Objects thrown upward into the air.

extensively damaged; roads and streets cracked, buckled, and displaced; severe damage to gas, water, sewage, and power facilities; railroad tracks bent and broken; major ground effects--faulting, cracking, heaving, lurching, compression-ridging, vertical and horizontal displacements, and numerous landslides and rockfalls.

A press report of March 3, 1971, stated fatalities from this earthquake had risen to 65 with the death of a man who had been a patient at the Olive View Hospital which is about 1-1/2 miles west of the Sylmar Veterans Hospital where the major loss of life occurred. It was reported at least a thousand persons were injured.

INTENSITY VIII-XI:

San Fernando, Sylmar, Granada Hills, Mission Hills, Newhall, Saugus and vicinities.

* * * * * *

Editor's Note: At this point the original report described conditions in the epicentral region, mainly geological, by extensive quotations from papers which have now been collected and published in the report "The San Fernando, California, Earthquake of February 9, 1971", A preliminary report by the U. S. Geological Survey and the National Oceanic and Atmospheric Administration; Geological Survey Professional Paper 733, Washington, D. C., 1971 (Superintendent of Documents, $2.25). Since this comprehensive report is now readily available, the material will not be reprinted here.

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The majority of the following reports were obtained through the questionnaire card canvass conducted by the National Ocean Survey:

Granada Hills:

16834 Bircher St.--"Our tract (wood floors, lath, plaster, and stucco; 1-and 2-story homes) suffered minimal damage. However, newer dwellings to north and northwest (slab, wallboard construction) sustained major damage, many condemned. Holy Cross Hospital is 2-1/2 miles east and the Van Gogh School is 1-1/2 miles north of our home. Many commercial markets had major to minor damage; many business buildings marked 'unsafe.' Minor ground cracks north of our tract. Block fences fell. China cabinet overturned. Damage slight at my home."

17201 Courbet (about 3/4 mile west of Upper Van Norman Reservoir).--Twisting and fall of chimneys, columns, and monuments. Damage great to masonry and concrete. Dishes, windows, and furniture broken. Plaster, windows, walls, chimneys, and ground cracked.

Granada Hills (cont.)

10518 Encino Ave.--Ground cracked, landslides, water disturbed. Chimneys, tombstones, elevated water tanks, etc., cracked, twisted, and overturned. (This observer also reports only slight damage.)

17608 Blackhawk St.--"No observed fissures, faults, or landslides. Most 4-inch-thick concrete block walls in neighborhood (running north-south) are down. East-west walls seem pretty good. All cupboards on east-west walls emptied. Thirty-gallon water tank shifted 3 inches S.70°W. Several 1/8-inch-thick cracks at attachment of garage to house and around bottom plate. Damage moderate."

12038 Bambi Place.--Ground cracked. Chimneys in neighborhood damaged. Water and power off. Bookcases moved 6 to 8 inches.

12817 Neon Way.--Ground cracked. Cement and plaster cracked. Furniture broken. "Everything affected." Damage slight to moderate.

16939 Colven Road.--Block walls cracked and broken. Plaster cracked and broken. Chimney and concrete block wall cracked and knocked over. Toilet bowl broken. Furniture overturned. "Damage slight."

16329 San Jose.--Chimneys overturned. Two feet of water slopped from swimming pool. Plaster cracked. "There was quite a lot of vertical movement during the first part of the shock. It was almost impossible to walk for the first few seconds. I tried to walk and felt as if I were walking uphill." Damage slight.

15832 Chatsworth St.--Foundation, driveway, and water pipes cracked. Chimney broke at roof line. Two ceilings of tile fell. One light fixture and all pictures and mirrors down; emptied shelves and cupboards. "Outside damage limited to west side. Our biggest bother was sorting and returning several thousand books to shelves. The shelves (fastened to the walls) were not damaged, just emptied. The later additions to house were finished with wallboard--all seams cracked and must be redone. All the plumbing in one bathroom broke."

10342 Odessa Ave.--Block wall collapsed. Driveway cracked. Rock facing in decorative chimney cracked. "Our home and community is located about 3-5 miles from the hardest hit areas of Sylmar and San Fernando. The house faces a northwesterly direction, and during the shock seemed to move north-south. Our driveway break (minor) is also from north to south. The block wall which collapsed in yard runs east-west. Our neighbor also commented about the north-south movement, although their home faces south and runs east-west. Based upon the condition of the interior of house (fallen lamps, books, and dishes, etc.) it seemed that the front side (west) of house moved more than the back side. There was little displacement of objects on eastern side, but much on west side. Aftershocks have also seemed to move the house north-south, with only occasional east-west shocks. Although the aftershocks have decreased considerably in the 3 weeks since the main shock, I find the most

Granada Hills (cont.)

disconcerting problem now is the continual popping sounds in walls and cabinets, sometimes very loud, and the creaking and springy feeling of the floors. I do believe so many homes in our area came through the earthquake so well because of our wallboard interior walls. Many of our friends who have lath and plaster did not come through the shock nearly so well."

11729 Stranwood Ave.--(This report is from the reservoir keeper of Lower Van Norman Reservoir, Robert E. Noel.) "We live on the reservoir at the bottom of the dam on the west end. No ground cracks around house. Chimney badly damaged; one crack in foundation. Stove, refrigerator, and dresser shifted. No broken plaster; no broken windows. Damage slight. My wife and child were up, getting ready for school. She heard the shock coming. I was asleep. I tried to get out of bed but couldn't, until the worst of it was over. I made a quick check on the family and a quick check of the house, then dressed and went to check the dam. When I got to the main road going to the top of the dam, I could see, through the dust an irregularity of the crest of the structure below, looking to the top. I drove to the top of the dam and around the west abutment and saw the damage to the face. It was hard to believe what I saw."

(There were also 5 reports of intensity VI from the Granada Hills area.)

Mission Hills.--Ground cracked; landslides; water disturbed. Chimneys, tombstones, elevated water tanks, cracked and overturned. Plaster cracked, broke, and fell. Windows cracked. Furniture broken. Damage great. At 10222 Norwich Ave.: Heavy objects (30 pound tape recorder and large outside planter) were thrown 3-4 feet and overturned. Six-year-old boy thrown out of bed. Light objects were not moved. "Noticed high-frequency, low-amplitude vertical motion at beginning of shock; low-frequency, high-amplitude lateral motion at end."

Newhall-Valencia and Saugus-Honby areas:

Newhall.--Four old buildings in downtown Newhall were condemned by the City Engineer. He estimated 90 percent of the fireplaces and chimneys on two-story houses were damaged in the area. One concrete wall was knocked down; most homes sustained only superficial damage. (From Earthquake Information Bulletin, National Earthquake Information Center, National Ocean Survey.) There was also damage to oil storage tanks and pipelines at the Newhall refinery located about 2 miles southeast of Newhall. The bottom of one jet-fuel storage tank buckled, and there were scattered leaks elsewhere in the plant. The chief problem for the refinery was lack of water. Both sides of a booster pump on the water line leading to the refinery were ruptured. Minor damage was done to testing equipment in the laboratory. (From Oil and Gas Journal, February 15, 1971.)

Newhall, Soledad and entire area.--Water supply cut off. Some

Newhall-Valencia and Saugus-Honby areas (cont.)

chimneys loosened from homes, cracks in walls, concrete slabs, etc. China closet overturned. Many windows broken in stores. Damage great. (From observer at 18909 Scenic Estates Dr.)

Newhall (from observer at 24522 Walnut).--Ground cracked, landslides, water disturbed, nearby. Chimneys, tombstones, elevated water tanks, cracked, twisted, and overturned. Plaster cracked. Furniture broken. Moderate damage to house.

Newhall Ranger Station, about 1 mile south of Newhall.--Ground cracked. Pipelines broken. Chimneys cracked and bricks rearranged. Plaster cracked. "Cracks in plaster and paneling of not much significance. Damage slight. This site is a 1-acre area housing compound of the U.S. Forest Service administrative buildings. The structures, two offices, one 6-bay garage, one barracks, several small outbuildings, and one residence were constructed in 1934, and of wood; very well built. All doors and cabinets in the residence and offices were thrown open and contents spilled to floor. Direction of thrust appeared to be to south. No furniture of any appreciable size was knocked over, but very heavy pieces were shifted several inches. Electricity, phone, and water were knocked out at impact. Hairline cracks are apparent in and on all buildings, but appear to be the result of aftershocks."

Newhall (24736 Walnut).--"We were not at home during the earthquake, but when we returned home we found beds, heavy bookcases, the stove, dressers, etc., had all shifted. One bookcase overturned. The top of the chimney, about 4 feet below the roof line, broke off and fell, and made a dent in the lawn about a foot deep. All rooms except the kitchen have cracks in walls. Outside concrete slab is cracked. No windows broken."

Newhall (26961 B Avenue of the Oaks, northeast Newhall area, just north of Highway 14).--Ground cracks; water disturbed. Side walls lifted and shifted; retaining walls tilted. Dry walls--few cracks. Furniture shifted and overturned. "Shock was like a dropping motion, then a shift from northeast-southwest. Large, 19-inch, T.V. thrown off 3-foot-high stand. Bookshelves and books on floor; lamps thrown to floor; kitchen cupboards emptied of all contents, canned goods, dishes, etc. Refrigerator doors thrown open and contents slid out to floor. Large dresser (on short legs) and full of materials shifted about 9 inches on carpeted floor. Had to leave premises due to my wife being disturbed."

Newhall (23405 La Glorita Circle).--Patio block walls loosened. Piano and refrigerator moved. Plaster cracked over windows and doors, but very little. Market 2 blocks away lost windows. Damage slight.

Newhall (Lyons Ave.).--Gasline broke. An observer from Honby reported the Newhall phone plant was flooded due to a broken water main.

Newhall-Valencia and Saugus-Honby areas (cont.)

Valencia: (Valencia is a northerly adjacent community of Newhall)

24200 Lyons Ave., in shopping center (east of Golden State Freeway).--Suspended ceiling collapsed. Nearly all glass in wall was broken. (From USGS-NOAA report.)

25310 Via Calinda.--Chimneys cracked, twisted, and overturned. Water disturbed. Chandelier fell. T.V. overturned. Small amount of plaster cracking. Windows cracked in nearby houses. "In the city of Newhall block walls were knocked over." Damage moderate.

25349 N. Ave. Ronanda).--Chimneys cracked, twisted, and overturned. Garden walls down. Furniture shifted and overturned. "Sensation of violent rotary motion."

25657 Avenida Jolita.--Chimney separated from house. Some plaster cracking. Furniture shifted, overturned, and broke. Damage slight.

Honby area, about 3-1/2 miles east by north of Saugus, in Soledad Canyon Road area:

19419 and 19407 Soledad Canyon Road, in North Oaks Shopping Center.--Roofs collapsed. Cracks in nearby parking lot. (From USGS-NOAA report)

27327 Camp Plenty Road, just north of Soledad Canyon Road.--Overturned 600-pound transmitter to south. Bookcase overturned and other moved. Plaster cracked. "All plasterboard joints show cracks. Some vertical cracks in foundation. No ground cracks here, but shopping centers close by (300 yards) have cracks in blacktop parking lots. W. T. Grant Building had roof collapse on north side of building. Fifty to 70 percent of store windows broken. Highway bridges need repairs to approaches. Electricity off instantly, but came back on again in about 20 minutes."

27430 Fairport Ave.--"All I have spoken with said it felt as if their building would topple. We have a 16-foot trailer parked in driveway and it twisted or jumped over a foot around. Block walls fell. In community, streets cracked, curbs broken, many buildings condemned. I teach at the Honby School (1-story building; 6 classrooms)--over 1-inch-wide floor crack across center of slab; section dropped about 1-1/2 inches; some doors will not open and some will not close. New blacktop broken and cracked. At my home a front door latch (locked) broke off. Front of house faces west. The door was opened but held by safety catch. Many people have asked for transfers for their children and are leaving the community."

27416 Dewdrop.--Ground cracked. Chimneys, tombstones, elevated water tanks, etc., cracked, twisted, and overturned. Many cracks in swimming pool. Plaster cracked. Furniture broken. Damage moderate.

28189 Hot Springs Ave., north Honby area.--Block walls flattened. Chimneys cracked and twisted. Stucco cracked. Small (1/4 inch) ground cracks. Building bounced in all directions. Locked doors swung open and closed. Slight damage to building.

Newhall-Valencia and Saugus-Honby areas (cont.)

10511 Soledad Canyon Road (in area about 7 miles east by north of Honby, near Soledad).--Ground cracked, landslides, water disturbed. Chimneys cracked, twisted, and overturned. Roof split (wooden building). Furniture shifted, overturned, and broken. Water heater torn loose. Damage slight to house.

Saugus.--Ground cracked. Trailer foundations cracked. Most light fixtures fell. Furniture shifted, overturned, and broke. Plaster cracked, broke, and fell. Windows broken. "There were eight people working in the post office at the time. Everyone got out just in time to avoid falling light fixtures. Equipment was tossed around more in our trailer complex (seven trailers placed together) than it was in our main office (brick building). The crew maintained their composure, as far as I could see, but it was the general consensus that if the shock had lasted much longer, panic would have resulted."

SAN FERNANDO, SYLMAR AND NEARBY AREAS:

As stated previously, devastating damage occurred to buildings and facilities of all kinds in various parts of these areas. The most spectacular damage was the destruction of portions of the Olive View and the San Fernando Veterans Hospitals (45 people were killed at the San Fernando Veterans Hospital); the failure of the Lower Van Norman Dam; and the collapse of highway overpasses along Highway 5.

San Fernando:

2043 Phillippi St., northwest corner of San Fernando, and about 1-3/4 miles southeast of Olive View Hospital.--"No one sound could be distinguished. The building and everything in it shook so violently that the combined sounds were deafening. In my block, streets split and were displaced in about 10 places; one place in street was buckled. Other streets in the area were split, cracked, twisted, and buckled far worse than my street. My chimney top shot straight up, then fell on roof. It was pulled straight up with its reinforcement rods left in main body of chimney and pulled a segment of the inside tile out of the main body of chimney. Swimming pools in area lost 5,000 gallons or more of water. One pool, 2 blocks away, was pushed under decking nearly to the house foundation. Water in toilet tank splashed all over the bathroom. Every surface in house was cleared of contents. All bedroom furniture in 3 bedrooms, except beds, was overturned. Every bottle lid was screwed off or loosened, even new bottles. Eighty-five percent of glass and pottery broken, including 'melmac.' Moderate to severe plaster cracks in walls and ceilings of every room. Ninety-nine percent of block walls down, including reinforced walls. I have only slight damage to my house, but half a block away, every other house

San Fernando, Sylmar and Nearby Areas (cont.)

is condemned; one block away, 90 percent of the houses are condemned. All the waterpipes and many of the gaspipes had to be replaced in a 36-block area of San Fernando where I live."

1942 Chivers St., northwest corner of San Fernando, northeast of Glenoaks Blvd., and about 2 miles southeast of Olive View Hospital.--"Fractures in earth. According to the U.S. Geological Survey, the lot was shortened by about 1 foot. Water and gas lines in street broken. Most concrete block fences knocked down."

About 1/2 mile east of San Fernando Airport, at Foothill Blvd. and Vaughn St.--"Building about 6 months old. Floor is up and down 12 inches in a rolling manner. Vaughn Street is raised at least 12 inches near rear of the building. Side walls torn loose from glu-lam beams. Rear lintel broken. Front wall (S-W) looks good. Waterpipe in street (24-inch diameter) broken."

About 1/2 mile northeast of San Fernando Airport, northeast of Foothill Blvd.--"Building (concrete-tilt-up) at 12300 Gladstone moved 12 inches into building at 12314 Gladstone, ground and all, at west corner. This was possible because it sat back about 12 inches behind adjoining building. The 12314 Gladstone building (concrete block) was only moved 4 inches off footings at west corner. Floor badly distorted. Compression lines in rear yard running north-south. Building about 3 years old. Street buckled. Building at 12424 Gladstone, about 1 year old: Northeast rear wall failed because nails pulled through 1/2-inch plywood roof diaphragm. Nails also pulled through plywood on southwest wall. Southwest block wall supported by frame and stucco office in front did not fail, but front block corners completely broken. Building leaning 3 inches to west. Diagonal east-west cracks in floor 1 inch wide. At Arroyo Ave. and Borden Ave. (just south of San Fernando Airport, and northeast of Glenoaks Blvd.), no damage to an 80 by 240 foot concrete block building (built in 1961), at south corner of Arroyo and Borden."

About 1 mile southeast of San Fernando Airport, 12401 Fillmore, Fillmore and Foothill Blvd., and northeast of Glenoaks Blvd.--Ground cracked, landslides, water disturbed. Chimneys overturned. Furniture broken. Damage great. "Mobile home, 60 by 20 feet, weight 11 tons (with wheels off), moved 4 feet and was broken apart. Water and gas pipes in ground were twisted and broken. Noise was overwhelming. Personal feeling was one of resignation to the inevitable--surprised to be alive after shock was over. Also felt complete panic after the shock was over due to no communication. Learned later that a fault was located about 200 feet from our home."

Sylmar:

12939 Gladstone Ave.--Ground cracked, landslides, water disturbed. Chimneys, water tanks, cracked, twisted, and overturned. Plaster and windows cracked. Furniture broken. Damage moderate to great. "Landslides in the hills."

San Fernando, Sylmar and Nearby Areas (cont.)

Sylmar:

13972 Sayre St., between Borden Ave. and Foothill Blvd., near Phillippi Ave., southwest of Foothill Blvd.--Ground cracked, landslides, water disturbed. Houses off foundations; cement slabs cracked in half and spread. Damage moderate to observer's home.

14141 Foothill Blvd., about 3/4 mile southeast of Olive View Hospital.--Ground cracked, landslides, water disturbed. Pipes broke. Hot water heater torn from wall. Wall moved. Plaster cracked, broke, and fell. Furniture overturned. Small objects thrown. "All animals panicked; horses broke corrals. The earthquake shook, rolled, and heaved. Fires broke out everywhere. All birds left at dawn before the shock hit."

13477 Bradley, northwest Sylmar area, between Roxford and Foothill.--"Limbs on my trees were shaken off. My block wall fell. Vehicle moved about 2 feet. In the community there were many chimneys down and some houses were off foundations. Little plaster cracking in my home and no windows in home were cracked. Damage to my home was slight."

15445 Cobalt, west Sylmar area, near San Fernando Road, and south of Roxford St.--Ground cracked, water disturbed. Chimneys and tombstones overturned. Damage slight at residence (mobile home). "I was never so frightened in all my life. I have never been a nervous person, but during these last two months I get scared at the least little movement."

13597 Simshaw Ave., about 6 blocks south of the southeast boundary of the Sylmar Veterans Hospital grounds.--(Excerpted from a letter to Robert D. Nason, Earthquake Mechanism Laboratory, NOAA). "The first shock was sudden; no warning rumble. I thought it was an explosion. We went up and down, with the noise and jolts accelerating. I can recall four very hard up-and-down motions, the last one being the hardest. The sound seemed earsplitting--I thought my eardrums would burst. It was impossible to hear anyone, so we just didn't bother. My daughter said she was screaming but not one of us heard her. My husband, a large strong man, tried to force himself up from the bed but was slapped down each time. Five times he tried, straining with every muscle, until he was exhausted. I had trouble hanging onto the bed. We could hear nothing but the noise of the earthquake. The slapping motion of the earth seemed to be in an east-west direction, with the last slap ending in a hard motion to the west, towards Olive View Hospital. We were shaking between the up-and-down motions. Now we started to roll. I was holding onto the bed for 'dear life' to keep from being thrown into the furniture. I could see the clock glide across the room. I looked out the window from the bed. The window starts at 5 feet from the floor and goes to about 1-1/2 feet from the ceiling. I could clearly see the outline of the trees against the sky (it is a 360-acre area, rather open), the tops of the trees, the sky, the dark area of growth, and the very dense area--I expected to

San Fernando, Sylmar and Nearby Areas (cont.)

see the ground any minute. This was repeated with every roll. At one point I thought the house would go over with the next roll as each roll was worse than the last. That, I believe, was the end of the major motion, as my husband and I jumped out of bed almost simultaneously. It was when we were in the rolls, north-south direction, that I could hear everything falling and breaking. The 'slaps' felt as if one were being blown around and up in the air, then coming down hard, like being in the center of a big explosion. The concussion was unbearable. During the rolls the sound was much more bearable. When we got to the bedroom door we found it was jammed with furniture, including the dresser, which weighs about 250 pounds, and the sewing machine, which was upside down. The minute I could get a few inches gap in the door, I yelled to my children to get outside, and not to wait for us. My husband had the door cleared in seconds. My four children were huddled in the hall. We were now in the aftershocks. The hall was leaning in first one way, then another. We pushed the children down the hall. We were thrown against each side of the wall all the way to the front door. The came another hard aftershock, and my husband could not get the door open. As it eased up, he was able to jerk the door open, bending the middle hinge badly. We were the first ones out on our street. We stood on the lawn and watched Pacoima Dam light up with a hazy glow and then fade. The light came from behind the front of the dam and was a steady light, not a flash, and there were lots of slides and dust. We could hear lots of large rocks rolling down off the dam area, and thought the dam was breaking. We left the children in the car, which was bouncing up and down with every shake. By now, people were starting to come out of their houses. I just sat in the middle of the yard, I was so dizzy and dazed. The ground was bumping up gently, and I noticed that I was sitting on one of the cracks in the yard but I just didn't care. I saw people who looked simply frightened 'out of their lives' and some who looked absolutely blank. We felt as though we had been through an explosion. It wasn't until we were in the aftershocks (in the hall) that I suspected it was an earthquake. We returned to the house a minute or two at a time to gather shoes and robes. It took us 2-1/2 hours to find my husband's glasses even though he knew where he had left them. At daylight, we were amazed to find the house structurally intact, as we had been thinking it would be totally ruined. Inside, however, it was a mess, taking us over three weeks to straighten it up. The house has a slab floor and dry walls, and stood up well. We had about $181.00 in structural glass damage, even the shower doors were broken. Our neighbors on both sides of us were not so lucky. In general, things were scattered in a very even pattern throughout the house. I took a straight pin, which was embedded about half way in, out of my bedroom wall. I have written down most of the details as I remember them and given a lot of thought to them, trying to be as exact as possible, if anyone could be exact through it. I asked my doctor how Pacoima Luthern Hospital was and he said 'Bombed!'. Somehow that just explains things perfectly."

San Fernando, Sylmar and Nearby Areas (cont.)

Sylmar:

13284 Hubbard St., about 1 mile south of Veterans Hospital.--"I had just gotten out of bed, and was immediately thrown to the floor. No warning at all--one minute I was standing and the next minute I was on the floor. I couldn't have gotten up if I had wanted to. I don't remember any ground noises, just the sound of furniture and glass falling and breaking. Almost everything of glass in the house was broken. Cupboard doors opened and all dishes fell out. Our heavy kitchen refrigerator was moved nearly 1-1/2 feet; television tipped over; heavy gun cabinet tipped over. All the furniture was moved a foot or more from the walls. Our fish pond, 7 by 8 feet and 18 inches deep, was almost emptied. I don't know what kind of ground we are on, but it must be pretty solid because the only damage to our house was a few hairline cracks on the outside plaster and one very small crack in the kitchen ceiling. We didn't even have a broken window. Our big pickup truck, with a big camper on it, was moved about 2-3 feet. All the chimneys in the area were shaken down and all the block walls were down. Some houses just across the street were damaged and declared unsafe. I would say the ground here is level. There was no ground cracking on my property, but the street in front has cracks in the asphalt and all the street corner curbs seem to be cracked or broken. I wouldn't go back in the bedroom for about two weeks because when the shock was going on I felt trapped in there. The people in the community are still being frightened by the aftershocks."

About 3 miles northwest of Sylmar, in canyon on Highway 14 at the Los Angeles city limits.--"I was reading the morning paper when the shock hit. All other earthquakes that I have experienced were of a rolling motion, but this one felt as if the bottom fell out of everything. I felt a falling sensation, and jumped up to try and get out, but I was knocked down to my knees. I was sitting at the kitchen table when it struck. Everything began to fall; all dishes and glassware crashed to the floor; then in about 5 seconds the lights went out, and for 30 seconds I couldn't move. I put my hands over the back of my head and stuck it under the table because bottles and everything else were falling and hitting me on the head. I thought it was the end of the world. My wife hadn't gotten out of bed yet, and she began to yell that 'all the windows are breaking and the house is falling down.' I finally got to my feet, after about 30 seconds, and yelled to my wife to hurry down so we could get outside. If we had been sitting on a big vibrator, it couldn't have shaken us any harder. There was no rolling or horizontal motion. It was a straight-up-and-down motion. A big bookcase and a large commode upstairs fell towards the east. We have two large china closets in the dining room and there was not even a dish or glass broken in them during the whole thing. This old house was built in 1915 and is on pretty solid ground. There was no noise as in other earthquakes I have experienced. This

San Fernando, Sylmar and Nearby Areas (cont.)

one hit without warning. My service station across the street from me was not damaged either. About 1/2 mile south of me, near that new freeway that was being built and where so many bridges were lost, there is a mountain that is torn all to pieces--looks like it went through a grinder. The north side of my place didn't seem to get hit as hard as the south side."

Kagel Canyon Area:

Los Angeles Fire Station No. 74, 12587 N. Dexter Park Road; Sec. 32, T.14W., R.3N., about 3 miles southeast of Veterans Hospital.--Ground cracked, landslides, water disturbed. Chimneys, tombstones, elevated water tanks, etc., cracked, twisted, and overturned. Gas mains broken. Power off. Furniture overturned and broken. Violent motion in all directions; also strong vertical motion. Damage great. "This building was moved off foundation approximately 12 inches and had to rise over sill at least 4-1/2 inches to settle down without damage to the shingles." The following is an excerpt from a report by B. J. Morrill, National Ocean Survey, NOAA, appearing in the joint preliminary report by the U.S. Geological Survey and the National Oceanic and Atmospheric Administration: "Firemen were resting in the wood frame quarters building. Mr. J. White, duty fireman, stated that he was tossed out of bed onto the floor, and the bed landed on top of him. Every object in the building was upset, even the handset of a standard wall phone came off its hook. Loud cracking and thunderlike noises added to the general confusion. The building was shifted off its foundation. Outside, rocks were thrown off the ground, and large cracks appeared in both soil and rock. . . . many ground cracks appeared throughout the area. The surface of a hill adjacent to the building exhibited the 'shattered earth' effect (R. Nason, USGS-NOAA joint report) a few miles to the west. A nearby rock roadcut appeared to have exploded, and the adjacent road was offset in many places. A 20-ton fire truck enclosed in the garage moved 6 to 8 feet fore and aft, 2 to 3 feet sideways without leaving visible skid marks on the garage floor. The truck was in gear, and the brakes were set. Damage to the truck was a bent rear step, broken windshield, shattered red light, and siren broken off. Also, a ladder and a hook were broken. Marks which appear to have been made by the right rear tire were found on the door frame 3 feet above the floor, while the metal fender was not damaged. The fender extends several inches out beyond the upper portion of the tire. Four feet above the floor the hose rack was broken by the rear step of the truck. The step was bent up while the hose rack was broken downward. The rear of the garage was pushed outward 6 to 8 inches, and the final position of the truck was about 4 feet out the front of the garage, with the garage door resting on the cab." Mr. Morrill also suggests that the building accelerated upward, with respect to the ground, at a rate of at least 1 g for about 0.1 second.

San Fernando, Sylmar and Nearby Areas (cont.)

Kagel Canyon Area (cont.)

Kagel Canyon.--(From a letter by Doreen Russell, Secretary, Kagel Canyon Civic Association) " . . . many of our homes have been totally destroyed, while others just next door had no real structural damage. For example, our home had very slight damage, but two of our immediate neighbors, one a very new house and the other a much older structure, lost their homes. Severe ground scarp at Glen Haven Cemetery."

11825 West Trail, southern Kagel Canyon.--"We were too busy to be scared, until later. We were already up. Husband heard the shock coming and thought it was a low-flying jet. Hard rattle first, then in 1-2 seconds I was thrown from chair and my husband was dumped into the tub; then back-and-forth motion. I was able to reach the hall and get the children into a doorway until things slowed down, then we went outside. Lights went out in the first movement. Water out but gas and telephone were O.K. Ground seemed to keep moving. We have three acres (San Gabriel Range, first mountain by valley), with three houses. Lower house had little damage; no landslides or broken pipes. The second house, about 125 feet or so higher up, had cracked foundation; 1-foot-thick walls cracked 1 to 4 inches; four deep ground cracks, two under the house. Third house, about another 100 feet higher up than the second house, had cement floors buckled and cracked; deep ground cracks; pipes separated; new garage (side room) separated from house and slightly askew; 3/4-inch floor crack in cement; door wedged closed; everything dumped from cabinets, and lots of stored glass windows broken. Garage was a mess. Water main in front of this third house was broken, separated 6 inches in five places, as it curves around the corner."

13706 N. Kagel Canyon Road.--"Water tank off foundation. Natural stone wall (no mortar) fell. Ground cracked. My husband was awake and was thrown from north to south. Furniture was overturned from north to south, east to west, and west to east. Refrigerator was out of position from south to north about 18 inches. Kitchen cabinets, from both north and south shelves, were almost emptied. In living room articles on north end of room slid off tables toward north, and on south end of room all books were dumped onto floor from west to east. Most violent action seemed to be from east to west, from final position of furniture."

12371 N. Little Tujunga Road, about 1 mile east of Dexter Park (Kagel Canyon); Little Tujunga Ranger Station.--(Report from Hugh E. Masterson, District Fire Control Officer) "Ground heavily fractured. Water tank twisted. Concrete cesspool, waterlines, and pavement damaged. Everything upside down. All crockery and china broken. Very heavy damage to all the buildings on the station. Many inspectors have been on the station but no final estimate made of the damage; however, it will probably exceed $1 million."

San Fernando, Sylmar and Nearby Areas (cont.)

Little Tujunga Road-Bear Canyon Area (Bear Divide Ranger Station, about 2 miles north-northeast of Pacoima Dam; NW 1/4, Sec. 7, T.3N., R.14W).--"Rockslides on road up to 500,000 cubic yards. Many ground cracks. Block wall broken. Mobile home dead-manned from concrete to 1/2-inch cable to 3/8-inch eyebolts--eyebolts straightened out. Water sloshed out of toilet bowls. Many cracks in fill ground and solid ground. A giant up-and-down motion, changing to a north-south side motion."

INTENSITY VII:

Aqua Dulce (about 14 miles northeast of Saugus).--Ground cracked. Some jacks under trailer fell over and skirting buckled. Some furniture overturned.

Alhambra.--Chimneys overturned. "Earthquake appeared to have long duration, about 10-15 minutes, due to aftershocks. Noticeable up-and-down motion. Damage was light, except to old buildings in business district where some (very few) plate glass windows were broken; one old brick building lost parapet walls and front." "Damage was slight in the Alhambra area. In wood frame buildings, damage was limited to cracked plaster and windows, broken dishes and knickknacks. Store buildings suffered broken plate glass windows. Chimneys pulled away from some buildings. Several unreinforced brick parapets fell." Press reported powerlines down. (Also from the Alhambra area there were six reports of intensity VI and four reports of intensity V.)

Altadena. Chimneys fell. "Almost solid aftershocks for half an hour. Couldn't distinguish other noises due to general falling, crashing of objects. Power failure in a few minutes was worse than aftershocks. Everything tall fell, lamps, etc. Left for work at 6:58 a.m. No evidence of shock as I drove south on Lake Avenue. However, in Board of Education building, library shelves had fallen west from against east wall. Books from south shelves were also tossed every which way. Things in cupboards in hall fell. General problem. Big window at Bullocks, Pasadena, shattered. I was on phone to report 'schools open' as fast as calls came in. General alarm reflected in phone calls but no panic of any kind. Everything swung and teetered and crashed if unstable. Some people were afraid to come to work. Aftershocks came with regularity every few minutes after the initial bump which definitely preceded the sway in Altadena. I would say we had between 10 and 20 small aftershocks--sometimes no more than a queasy vertigo--after the initial shock. At least four were of fair violence." "One piano in neighborhood escaped caster cups." "Water in pool splashed violently north-south." Plaster cracked. Press reported powerlines down. (16, VI's; 6, V's)

Burbank.--Chimneys cracked, twisted, and overturned. "Great damage to

unreinforced brick." Electricity and phones out. Plaster cracked. Windows broken. Heavy furniture moved. "I have checked approximately 12 homes in my area (807 E. Andover Drive) and found no structural damage. Only items of interest were the movement of furniture, windows broken, and items falling out of cabinets, off tables, dressers, etc. Damage slight." "The earthquake once it was over didn't seem so bad. We were alive and had suffered very little damage in comparison to others. The most frightening part was the aftershocks--not knowing when they would come or how strong they would be. We lived in continual fear for the next few days." (7, VI's; 4, V's)

Canoga Park.--Building wall cracked. Windows broken. Plaster cracked. "The building is a small shopping complex. One of the stores sells liquor and groceries. Damage to the bottles was extensive--40 percent of the stock fell off the shelves, even though there were wires to prevent this. The outside walls of the building cracked and separated about 3/4 inch at some places." "Movement seemed to be north-south and west-east." "Our home was shifting so violently that it was difficult to walk." "Water escaped from street hydrants. Electricity off 1 hour. Awakened by mild rolling shock of several seconds' duration, pause of a few seconds, then a sharp jolt followed by violent shaking in all directions, both lateral and vertical. The intensity appeared to increase in a continuous manner, with a continuous increase in 'thumping-type' noise, and was followed by the steadily increasing noise from falling books, then louder crashing noise of objects falling. The intensity built up during a period of 30 to 60 seconds, then abruptly stopped; then after a short pause was followed by more, milder, rolling shocks. Electric power went out at the end of the violent shock period. Flashes of light observed during shocks. I lost all sense of direction during violent shaking. It was difficult to locate exit door in dark bedroom. Immediately after the shock a check was made for gas leaks, water leaks, broken electric cords or wires both inside and outside--none were found. No neighbors observed outside. Power failure apparently general in the neighborhood. No structural damage noted. Many books fell from tops of bookcases and from a shelf in one closet. Bookcases did not overturn. One table lamp, 3 feet tall, in corner of living room, was found in middle of room about 10 feet from its original position. Other table lamp simply toppled over. All fallen objects were from locations on inside walls. Nothing along outside walls of house fell or moved. Water from aquarium spilled out and water from neighbor's swimming pool sloshed out." "Brick wall fell on neighbor's car. Store windows broken. Lost 2-1/2 feet of pool water." "I heard a rumbling noise just prior to feeling the shock; then it hit. Predominately east-west vibration with some north-south motion. Felt more like several quick vibrations, then a little slower, then several quick motions, with a total response effort similar to a boat action in water." "No dishes, glasses in cupboards broken or noticeably moved. No books from bookcase fell. Lost about 1-1/2 inches to water from 7-gallon fish tank; light hood on fish tank bounced out of place but did not fall off. Many pictures on walls did not move or shift. The large, heavy, hanging lamp over dining table swung

more than moderately but not violently in an east-west direction. During the first aftershock, a half hour or so later, the lamp swung in a north-south direction but not as hard this time." "Shock was felt for a considerable length of time. Noises of rattling, creaking, etc., were continuous. Telephone and power out. Water was running but during the day it became contaminated and remained so for about one day." (9, VI's; 5, V's)

Encino.--Two palm trees knocked over. Flagstone and concrete driveway cracked; concrete and flagstone pool deck raised 1/2 inch above pool tile; steel support column of porch roof shifted 1-1/2 inches out of concrete base; 4 by 12 by 20 garage roof support timber shifted about 1 inch on north end. Damage about $4,000." Waterlines broken. Plaster cracked. Block garden walls broken. Yard swamped with water from pool. Electricity out. (3, VI's)

Fillmore.--"We lost one building in town, a dress shop, when the roof caved in. Two other business buildings were damaged. One furniture store lost part of the roof in the rear of the building and a hardware store lost part of the brick fire wall on the north side of the building. All of the grocery and liquor stores in town suffered losses when canned and bottled goods fell off shelves and display counters. Electrical service was out in the surrounding rural areas for a short time, about 5 to 15 minutes." "I was awakened by a terrific shaking of the bed and a terrible noise. Seemed as if the house would fall to pieces, but the only damage to the structure was an outside brick chimney which was separated from the house by about 3/4 inch. About 2-1/2 city blocks away, the side of a 2-story brick building fell on a 1-story frame roof and demolished the smaller building. There was some damage to an orange packing house. The lights were out for a few minutes."

Glendale.--Ground cracked. Chimneys overturned. Plaster and windows cracked. Furniture broken. Electricity out; street lights flashing. Press reported the Glendale Presbyterian Church, built in 1923, was severely damaged. The First Methodist Church was not damaged, but in the 54-year-old former sanctuary behind it, towers fell through the roof. "There was a complete mess inside the apartment. Bookcases fell. Refrigerator moved about 3 inches from wall. Bookcase on west wall; refrigerator on south wall. One brick from the brick bookcase, quite heavy, was thrown about 7 feet." (12, VI's; 6, V's)

La Canada.--Chimneys overturned. Low, false ceiling bent and fell. Plaster, windows, walls cracked; plaster fell. Slab in patio raised and cracked. Heavy objects moved. Pool water sloshed violently. Press reported powerlines down. "There was a distinct feeling of significant vertical acceleration during the early moments of the shock." (9, VI's; 7, V's)

La Crescenta.--Many false fronts of buildings badly damaged. Unreinforced parapet failures. Some old stone walls cracked. Chimneys overturned. Water and furnace pipes broken. Many windows cracked in old and new buildings. "Cracked concrete pool deck and dislocated concrete and stone supporting wall." One observer estimated damage to house and contents at $3,000. "We had very little

breakage from dishes and knickknacks (5542 Pine Glen Road), probably due to the bedrock foundation. Other friends living out in the center of the canyon or on deeper alluvial deposits had considerable glass and dish breakage. One friend on third floor of wood frame apartment building had a wall-mounted A.C. unit fly half-way across the room to the east. I tried to analyse direction of motion at my house from swinging of lamps and displacement of objects and finally decided it had to be east-west, even though swag lights in bedroom were swinging north-south." (2, VI's; 2, V's)

Los Angeles.--Moderate damage occurred in downtown Los Angeles, especially to older-type buildings with brick and masonry facings. Portions of an old building, the Mission Inn, collapsed, killing one person. Extensive damage occurred to some of the old historic buildings on Olvera Street. Press reported "unsafe" and "potentially unsafe" signs were posted at some buildings in "Little Tokyo" and along Main and Los Angeles Streets. Considerable damage occurred to some of the larger buildings and to some high-rise buildings--walls cracked; fall of plaster and tile; windows broken; elevators knocked out of service.

Abbey Hotel, 825 W. 8th St.--"Old, poorly built, 4-story building. Section about 5 by 8 feet fell away from lobby wall, with water pipe damage at this break. Primary shock was moderate shaking for first 5-10 seconds, then grew in intensity rapidly. Stayed at maximum about 40 seconds, with immediate aftershocks of strong rolling motion, floating feeling, and building noise almost ceased during this period, only slight creaking noises. It seemed that during these aftershocks ground noises could be heard, resembling large masses of rock, at great depth, being shifted against one another. Some damage: Cracks, 1/4 to 3/8 inch in width, opening on wall corners adjacent to stairway entrances on each floor; on ground floor (lobby), plaster fell from ceiling above last flight of stairs and adjacent ceiling of area where wall fill and plaster fell out. Lights in room flickered on and off during the main shake, with floor lamp in great agitation. Damage slight to building. Much window breakage and masonry facing damage on taller buildings."

May Company Store.--(From "Headlines," a May Company publication) "The Downtown Store was closed to storemembers early Tuesday morning while building inspectors, store security and engineers checked every area of the store. The building was considered structurally sound and safe for entry; but because of the damages to the interior the store remained closed to customers. The 'back' stairwell, escalators and elevator wells seemed to have suffered the most damage. Walls surrounding the back stairs and the walls in the adjacent halls sustained much surface damage in cracked and fallen plaster, and in some cases, holes in walls and at corners were visible. Main wall supports were in good condition and were not damaged. The escalators were extensively damaged. Exterior damage to the store was confined to display windows and decorative treatment on the building. Well over 60 percent of the plate glass windows were shattered. Some slight damage was noticeable on cornices and ornamental trim."

Los Angeles (cont.)

Olympic and Alameda (about 2 miles south by east of Civic Center).--"The building in which I work (Olympic and Alameda) sustained approximately 400 broken windowpanes, 14 by 20 inch, all steel sash. Almost 100 percent of these were on the north and south sides of the building. One or two freight-type elevators were inoperative due to guide tracks warping and permitting counterbalance weights to swing free."

127 S. Serrano Ave. (in area about 1-1/4 miles southwest of Los Angeles City College).--Almost all nearby chimneys badly fractured. Many new plaster cracks in all 8 rooms of house. Bookcase fell; dresser moved. Pool water splashed 20 feet horizontally.

3812 Terry St. (in area about 3/4 mile northwest of Silver Lake).--Small objects flew through the air. Vehicles rocked (cracked water hose to radiator). Plaster cracked and fell; ceramic tile cracked. "Everything in front apartment that was movable shifted. Heavy chest of drawers moved 12 to 15 inches away from wall. I attempted to walk across room but was unable to do so. Most dreaded element was the sound--as though every nail in the building were being wrenched out at once. Damage moderate."

932 Maltman Ave. (Silver Lake area, about 1/2 mile from southwest shore).--Chimneys cracked and overturned. Some plaster cracking; window cracked. Damage slight to observer's home.

4411 Los Feliz Blvd. (south of Griffith Park).--Chimneys cracked, twisted, and overturned. "Older masonry buildings generally damaged." Damage moderate.

2835 Sunset Place (about 2-1/4 miles west by north of Civic Center).--"Chimneys in same block fell; some cracked and will be removed. Powerlines in rear flashing. There were reports of broken dishes in area. We live in 4-family flat (old wooden building). We had nothing broken; one small mirror fell."

Hollywood area.--Sidewalks buckled. Windows broke. "When we were awakened, it sounded and felt as if a truck had hit the motel. It also felt as if the furnace were about to explode." "After earthquake, people were outside on sidewalks and would not go back inside because of aftershocks. I thought building would disintegrate. Part of brick wall on roof fell. Arch over building entrance cracked, creating danger. Brick buildings seemed more damaged than single structure cement." "At 6 a.m., heavy earthquake. For first 2 or 3 seconds thought it would be the usual shake; then intensity increased suddenly. Thought all 'hell' was going to break loose. Bolted out of bed and stood under doorway. All thoughts blank except when would the shock end--seemed to last forever. Lights out almost immediately and things overturned. Saw flashes of light from shorted telephone pole transformers--thought the whole city was ablaze. Got dressed and went outside, sat in car, as I thought there would be

Los Angeles (cont.)

aftershocks, and there were. Went back inside about 45 minutes later; then went to work. Noted some traffic lights were inoperative. People went outside after the shock, then tried or attempted to go back inside, but aftershocks kept them outside for about 25 minutes. Cars were driven and parked irregularly." From observer at 1627 N. Normandie Ave.: "Older brick buildings received the most damage. Chimneys cracked. Heavy objects moved. Water sloshed from toilet bowls. This area where I live was apparently jolted heavier than other sections of Hollywood. Perhaps adobe soil is responsible." "Chimneys fell at Hollywood-Wilshire area." "Husband had parked car at work. Saw lightning in sky and over mountains and heard loud rumble before shock. Car shook strongly, got out of car, earth moving up and down, got back in car. People were running out of houses. My husband drove back home and left for work later. At home, 519-1/2 N. Heliotrope Dr. (near Los Angeles City College), people were also frightened and ran from houses. So many aftershocks, so close together, too many to count. Mostly sharp jerks on house, from east-west, some north-south shakes."

2457 Hyperion Ave. (in area west of Silver Lake).-- "Heavy chimney sheared off at roof line. Plaster cracked throughout interior. Minimum cracking of exterior stucco. Roof tiles shifted and broken. Very little displacement, horizontal or vertical, at right angles to direction of wave travel (bookshelves at right angles to maximum displacement line were emptied, those parallel were not; same for shelves and cabinets). Torsion of building visually observed. Interior wood and lath and plaster failed (both horizontally and diagonally) in shear, and vertically in tension. Also some compression parallel to wave travel. Wall damage was extensive; ceilings moderate."

5238 College View Ave. (south of Ventura Freeway and just southeast of southeast corner of Glendale city limits).--Observer reported there was no damage to his 60-year-old, 1-story home, but that most neighbors' chimneys were cracked, twisted, and overturned.

5415 Wameda Ave. (Eagle Rock Area).-- "Damage considerable. Plaster fell. Furniture moved. Dishes flew out of cupboards and shattered. Air raid siren short-circuited. Whole house shook violently--had to 'hold on.' Chimney at school and bell tower at Presbyterian Church damaged. My car fell off jack stands in garage."

5151 State College Drive (California State College, just northeast of northeast Monterey Park city limits).--"On the California State College Campus, the new 8-story Administration Building is built on about 7 pairs of reinforced concrete columns (no first floor). Column pairs 1 and 7 exhibit tension cracks. No other colums show any damage. Plaster cracks, 45° diagonal, only in east-west walls. Corners of rooms and steel door frames show separation cracks. Bookcases fell if facing east-west; generally did not fall if facing north-south."

Los Angeles (cont.)

3566 Lowry Road (in area about 1/2 mile southeast of Griffith Park, west of Golden State Freeway.--"Chimneys on older homes cracked and overturned. Considerable glass damage in vicinity. Many pre-1933 masonry buildings severely damaged, some beyond repair, within 2 mile radius of my house." No damage to observer's new, well built, 2-story wooden building.

(Also from the Los Angeles area there were approximately 66 reports of intensity VI; 122 reports of intensity V.)

North Hollywood.--Water mains broken. Chimneys fell. Large plate glass windows broken. Outdoor block walls cracked and dislocated. File cabinet overturned. The following is from observer at 7262 Farmdale, about 5 blocks northwest of Burbank Airport): "I was awakened at 6:00 a.m. The house shook and rolled, and there were rumbling noises but not extremely loud. Climbing out of bed during the shaking, I was able to walk to my daughter's room. She was awake and was not terrified. Oven and refrigerator displaced 4 inches. Flat steel plates (25 pounds each) were moved on uncarpeted surface of floor. General disruption in all rooms. No readily observable cracks in ceilings or walls. Cement block wall in yard cracked at cemented joints, displacement about 1 inch. Immediately after shock subsided (lasted about 20-30 seconds), I checked lights and phone--they still worked. Water O.K. I felt about 5 or 6 aftershocks between about 6:09 and 6:19 a.m. Then I sat down to record more aftershocks." This observer reported he felt 34 shocks to 1:30 p.m., with the strongest at 6:35, 6:44, 8:00, 8:30, 10:57, 10:59, and at 12:57 p.m. Stopped keeping track after 1:45 p.m. (11, VI's; 4, V's)

Northridge.--Power out. No water for 4 days. Exterior block walls down. Holes in stucco walls and doors. Windows broken. "The severe shaking seemed to last for a period of about 2-3 minutes. Multistory wood frame stucco buildings in neighborhood (9723 Rathburn Ave.) suffered extreme damage in shear walls but little damage in horizontal elements, such as floors and ceilings. Modern reinforced masonry buildings all seem damaged around corners at roof level." "Ground motion was very violent--seemed rippling--causing the house to tilt about 5^{o}. Little or no structural damage or plaster cracking in the residences in our immediate vicinity (10027 Wish Ave.). Considerable damage to concrete block walls in the area, particularly those oriented on an east-west axis. Approximately 100 feet of wall totally destroyed on my property. Floor lamps and table lamps were all tipped over; considerable breaking of dishes and bric-a-brac." Near Chatsworth St. and Reseda Blvd.: Chimneys, cracked, twisted, and overturned; furniture shifted, overturned, and broke; 5-drawer steel file cabinet overturned. At 8419 Yolanda Ave.: Block wall cracked; above-ground pool damaged. Upright piano moved 8 inches east; refrigerator moved 3 feet southeast. Damage slight. At 10306 Sylvia Ave.: Block walls toppled and weakened; driveway cracked;

portable planters moved; T.V. overturned; bed moved 6 inches. Damage slight. At 17527 Burton St.: Water disturbed and dirty. Electricity off 30 minutes; phone out 2 hours. Trailer fell off jacks. Chest of drawers fell south. Movement difficult. Many aftershocks felt for the first 2 days; several thereafter. At 10952 Etiwanda Ave., near Chatsworth and Reseda: Chimneys cracked, twisted, and overturned. Pool water down 2 feet. Huge bookshelves broken loose; 5-drawer steel file cabinet overturned. Damage moderate. At 18822 Chase St.: Patio cement cracked and old cracks widened. Chimney toppled next door. Block walls weakened and ready to topple. Plaster cracked. Water cooler broken; shower glass cracked. No structural damage. At 19530 Pine Valley Ave.: Chimneys cracked, twisted, and overturned in vicinity. Wrought-iron fence broke. Plaster fell. Small overhang roof (tile) sagged and must be replaced. Damage moderate. (8, VI's; 2, V's)

Pacoima (excluding the more strongly shaken areas of northern Pacoima, southeast and east of San Fernando).--Ground cracked. Gaslines broken. Chimneys overturned. Outside block walls knocked down. Crack in floor the length of the building (post office). Furniture overturned. Damage moderate. (Report from postmaster. Post office located at Van Nuys Blvd., near Telfair Ave.) In the Arleta District, south of Pacoima, in area just east of Panorama City: "In our house the refrigerator opened and everything fell out, also most things from the cupboards. Our next door neighbor's cupboards face the same direction as ours, with only a driveway separating the two houses, but she lost only one bottle of catsup. Our kitchen had to be cleaned out with a shovel. Most of the furniture in the family room moved at least 6 to 8 inches from the walls, including a large player piano. We couldn't tell in which direction it was shaking--seemed to be bouncing and swaying too. We tried to walk through the house to get the children, and had to hold onto walls to keep from falling. Our block wall fences are all cracked but still standing. We have many cracks outside, but few cracks inside. Furniture broken. Water disturbed. Plaster and windows cracked. Damage slight." (2, VI's)

Panorama City.--Building at 14545 Lanark Street reported as very badly damaged, and a building at 8155 Van Nuys Avenue was also damaged. At 14861 Lorne St., damage was reported as slight: Stucco cracks; waterline broke between meter and house. "Vertical motion of house very pronounced as well as lateral movement. Did not awaken 3-year-old girl." Electricity went off over entire area. At another location, furniture shifted; plaster cracked. (1, V)

Pasadena.--At the Jet Propulsion Laboratory, 4800 N. Oakgrove Ave., an estimated $200,000 in minor damage to the Laboratory was reported. An engineer at the Laboratory reported: "I arrived at work about 7:50 a.m., and made numerous surveys of buildings on the Laboratory grounds to assess structural damage. Structural damage was superficial. Some spalling of concrete columns and concrete block walls. Some cracking of concrete walls. Considerable damage

to architectural finishes (plaster, suspended ceilings, lighting fixtures). Expansion joints and seismic joints had worked and caused buckling of threshold strips and buckling and displacement of metal water stops at joints. Some waterlines broken." Observers in several areas reported chimneys cracked, twisted, and overturned. Many windows broken in business district. Cracking and fall of plaster reported at a number of locations. Heavy sloshing of water from swimming pools. One observer at 1355 Daveric Dr., northeast Pasadena, north of Foothill Boulevard, reported ground cracked. (12 reports of intensity VI; 20 reports of intensity V)

Piru.--Chimneys overturned. Plaster cracked in several buildings in town. Damage reported as slight.

Reseda.--Block garden walls fell. Some roofs buckled. Plaster cracked and fell. Heavy furniture shifted and overturned. Water sloshed from swimming pools. "Our fallen 6-foot block wall was not reinforced by steel. Aftershocks widened stucco cracks. Asphalt driveways cracked and some new sidewalk was cracked around power poles. Doors facing north or south on cupboards and on furniture flew open. On shelves running north-south nothing fell, even from those near the ceiling. Windows in house are all aluminum-framed and did not break, though quite large. Some roofs in area buckled." (5, VI's; 1, V)

Sepulveda.--At 9037 Burnet Ave.: "Telephone pole tilted east-west (across street). Chimney cracked vertically where it lies against house. Huge crack on cement foundation of garage floor, running east-west across floor. Small chicken shed tilted south. The house was a mess inside. Anything on top of furniture (mantle, tables, etc.) was thrown down and broken. Stove and icebox moved in kitchen. In the garage, a 6 by 6 foot bookcase, full of books, overturned. Garage had to be 'dug through' to put things back in place. It suffered worse than the house. We inspected the house and did not see any new cracks, but since the aftershocks, we have found many new cracks, running south-north, about the thickness of a razon blade. There are many old cracks running in the same direction. All of our cement porches (3) have shifted 1 to 1/2 inch away from the house. We have found cracks outside both garage and house since aftershocks. In our house, all objects on north-south walls fell; in neighbor's house (across street), all objects on their east-west wall fell, none on north-south walls." At 10108 Gloria Ave.: Sixty feet of outside block wall fell and 150 feet cracked; some inside and outside plaster cracking; damage moderate. At 9752 Marklein Ave.: Garden wall cracked; furniture shifted; stucco slightly cracked; minor kitchen counter tile cracking. "Earth motion was definitely north-south. Heavy books on north-south shelves fell sideways--not off shelves. Portable T.V. against north wall fell to floor. Kitchen and both bathroom floors littered with broken glass. Hot water tank connections loosened, water leaking. China cabinet and refrigerator on east-west walls shifted 6 inches from walls. No structural damage." Postmaster at Sepulveda reported slight, nonstructural damage to post office; ground cracked; landslides, water disturbed; chimneys cracked; plaster and windows cracked. Other observers reported: "Water and gas service

disturbed. Many windows cracked in area, including a furniture store." "One-third of water emptied from swimming pool." "Slight spalling of sidewalk at pool joints." (3, VI's)

Sherman Oaks.--It was reported the Union Bank Building, northeast corner of Sepulveda and Ventura, sustained some structural damage and considerable nonstructural damage (USGS-NOAA joint report). At 3817 Cody Road: Unreinforced chimneys cracked, twisted, and overturned. Ground cracked slightly. Plaster cracked. Damage slight. "Major ground motion appeared to be east-west. The major shock lasted ablut 60 seconds. Very little damage to hillside houses on rock in general vicinity. Houses on softer substrata at lower elevations appeared to sustain larger accelerations and damage." (6, VI's; 8, V's)

South Pasadena.--It was reported 100 chimneys were down and at least 100 were damaged. Large plate glass windows in several stores broken. Some old brick parapets fell in commercial area. "One or two buildings of unreinforced masonry construction showed severe cracking." Ground crack observed on Monterey Road. Community water tower leaked. Water sloshed 6 feet on each side of swimming pool. (4, VI's; 2, V's)

Sunland.--At 8632 Le Berthon St.: Block walls thrown down. "Our heavy plate glass mirror in bedroom was ripped off the wall, taking some plaster off the wall. Built-in oven was sprung from the cabinet. The hutch in dining room was thrown down, breaking all contents, and landed on the dining room table, badly damaged." At 10734 Nassau: Rocks in garden rolled. Damage to furniture and dishes was in excess of $900. At 10114 McBroom St.: Shock was violent enough to knock one off his feet if not holding onto something solid. (2, VI's)

Sun Valley.--Chimneys cracked, twisted, and overturned. Outside concrete reinforced wall cracked. Heavy furniture moved east-west. Water in street due to sloshing of swimming pools. "I was standing at the time; motion was a violent northwest-southeast shaking. Dining room fixture (4-foot chain) swung to the ceiling. Glass and crystal fell from every china closet in neighborhood." "Many people thought it was a bomb." (3, VI's; 1, V)

Tarzana.--At 18525 Linnet St.: House foundation cracked. Water pipe broken. Plaster and windows cracked. Toilet and bathtub line damaged. Damage moderate. "There are still (March 9) numerous strong aftershocks." Other observers reported: Plaster cracked and fell. Cracks widened in pavement and asphalt drives. Pool water sloshed. (3, VI's; 3, V's)

Topanga.--The following is an excerpt from "Headlines," a May Company publication, reporting on damage at the May Company store in Topanga Plaza: "Twenty-five plate glass windows in the escalator well shattered. Approximately 50 percent of merchandise and display fixtures damaged or destroyed in the China Department. The bedding and linen stockrooms were a tangle of toppled shelving and merchandise. Ceiling tiles and complete light casings fell. On the roof, four 4-ton fans were sheared from their bolts, and the fans moved 2-9

inches out of position. The Lamp, Mirror, Picture, and Television Departments also received extensive damage to merchandise. The Lower Level and Middle Level also received damage. The major problem was water. Three inches of water had seeped into these levels by mid-morning as the result of damaged water pipes in an adjacent department store in the shopping mall. The building was carefully inspected by engineers and building inspectors before storemembers were permitted to enter. Damage to the structure was only surface damage, and the building was found to be in good condition." Other observers reported: Rockslides; one chimney reported broken; dry rock walls dislodged (minor); planter box (on casters), weight 250 pounds, moved 4 inches north; some settlement of foundation of house, about 1/2 inch. (3, VI's)

Tujunga.--Ground cracked. Minor cracking of pavement. Chimneys cracked, twisted, and overturned. Plaster and windows cracked. Electrical wires down. "Most of the dwellings in the area suffered only minor damage. Some older dwellings suffered moderate to major damage, but these were very few. Many commercial buildings had broken plate glass windows. A few commercial buildings suffered moderate damage." Many aftershocks felt. (1, VI; 1, V)

Van Nuys.--Ground cracked. Chimneys cracked, twisted, and overturned. Water muddy for about 5 days. Outside block walls cracked. Slab floor cracked. Plaster cracked. Heavy furniture shifted. Pool water sloshed over top of house. "People here were very frightened, but kept control. In our general area, 8183 Lesner Avenue, loss was mostly to dishes and personal items. Parts of block walls came down; water heaters moved, some off elevated stands, and most were inside of houses in service porch area. Some people were thrown out of bed. Some cars rolled out of driveways or garages. Traffic became a major problem." (7, VI's; 16, V's)

Woodland Hills.-- Cement pool decking severely cracked. Cement block fence loosened. Tree leaning. Plaster cracked. Half of pool water sloshed out. Damage moderate. "No electricity for 1 hour and 15 minutes. Electric power went out within seconds after start of shock. Gas and water supply remained O.K. No telephone communication for 7 hours." "Aftershocks seem to be, in general, a rolling, wavy motion, causing a good shake. However, about one out of four aftershocks seem like a roll at first, then a big thud and dropping sensation. Personally, I feel as if the ground and building are waving and moving all the time." (5, VI's; 7, V's)

INTENSITY VI:

Agoura, Anaheim, Azusa, Baldwin Park, Beverly Hills, Camarillo, Carson, Castaic and vicinity, Cerritos, Chatsworth, Compton, Costa Mesa, Crestline, Culver City, Downey, Elizabeth Lake area (about 3-1/4 miles southeast of Lake Hughes Post Office), El Monte, Fairmont Reservoir (about 2 miles north by east of Lake Hughes), Fullerton, Gardena, Glendora, Hacienda Heights,

Hawthorne, Highland, Huntington Beach, Huntington Park, La Habra, Lake Hughes, Lakewood, La Mirada, Lancaster, La Puente, Lenwood area (about 7 miles southwest of Barstow), Littlerock, Lomita, Long Beach, Lytle Creek area, Malibu, Manhattan Beach, Marina Del Rey, Maywood, Mission Viejo (about 9 miles inland from Laguna Beach), Monrovia, Monterey Park, Moorpark, Mt. Baldy area, Newbury Park (4 miles southwest of), Ontario, Oxnard, Palmdale, Palos Verdes Peninsula, Placentia, Point Mugu, Port Hueneme, Quartz Hill, Redondo Beach, Riverside, Rosemead, Roubidoux (near Riverside), San Gabriel, San Marino, Santa Ana, Santa Fe Springs, Santa Monica, Santa Susana, Sierra Madre, South Gate, Studio City, Thousand Oaks, Torrance, Tustin, Twin Peaks, Upland, Valinda (La Puente area), Valyermo and vicinity, Verdugo City, Vernon, Walnut, West Covina, and Whittier.

INTENSITY V:

Acton and 4 miles northwest of, Adelanto and vicinity, Alta Loma, Anza, Apple Valley, Arroyo Grande, Artesia, Arvin, Avalon, Avila Beach, Bakersfield, Banning, Barstow, Beaumont, Bell, Bellflower, Bell Gardens, Big Bear City, Big Bear Lake, Bloomington, Bonsall, Boron, Brea, Bryn Mawr, Buellton, Buena Park, Buttonwillow, Cachuma Village and Cachuma Dam, Cadiz, Calabasas, Caliente, California City, California Hot Springs, California Valley (formerly Simmler), Calimesa, Camp Pendleton, Cantil, Capistrano Beach, Carlsbad, Carpinteria, Cartago, Casmalia, Cathedral City, Cedar Glen, Cedarpines Park, Charter Oak, Cherry Valley, China Lake, Chino, City of Industry, Claremont, Coachella, Colton, Corona, Corona Del Mar, Coronado, Covina, Crest Park, Cucamonga, Cuyama, Daggett, Dana Point, Death Valley Junction, Delano, Delkern, Del Mar, Desert Center, Desert Hot Springs, Diamond Bar (Pomona area), Di Giorgio, Duarte, Ducor, Dunn Siding (about 30 miles northeast of Yermo), East Los Angeles, Edison, Edwards Air Force Base, El Cajon, Elsinore, El Segundo, El Toro and Marine Corps Air Station, Encinitas, Escondido, Essex, Etiwanda, Fallbrook and vicinity, Farmersville, Fawnskin, Fellows, Fontana and 5 miles north of, Forest Falls, Fort Irwin, Fort Tejon State Historical Park (Lebec), Fountain Valley, Frazier Park and Chuchupate Ranger Station (near Frazier Park), Garden Grove, Gaviota, George Air Force Base, Gilman Hot Springs, Glennville, Goleta, Gorman, Grover City, Halcyon, Harbor City, Havilah (about 5 miles south by west of Bodfish), Helendale, Hemet and 5 miles east of, Hermosa Beach, Hesperia, Highgrove, Hinkley, Homeland, Homestead (about 4 miles northwest of Inyokern on Highway 6), Huron, Idyllwild, Imperial, Indio, Inglewood, Irvine, Irwindale, Johannesburg, Johnsondale, Keene, Kelso, Kettleman City, Kern Canyon Power Plant No. 1 (about 10 miles east-northeast of Bakersfield), Kernville, Laguna Beach, Laguna Hills, La Jolla, Lake Arrowhead, Lake Isabella, Lakeview, La Mesa, Lamont, La Quinta, Laton, La Verne, Lawndale, Lebec and vicinity, Lemoore, Leucadia, Lincoln Acres, Little Lake, Llano, Loma Linda, Lompoc, Lone Pine, Los Alamitos, Los Olivos, Los Prietos Ranger Station (about 10 miles northwest of Santa Barbara), Lost Hills, Lucerne Valley, Ludlow, Lynwood,

McFarland, McKittrick, March Air Force Base, Maricopa, Mecca, Meiners Oaks, Midway City, Mira Loma, Mojave, Monolith, Montclair, Montebello, Moreno, Morongo Valley, Mt. Baldy, Mt. Wilson, Murrieta, National City, Newberry Springs, New Cuyama, Newport Beach, Norco, North Palm Springs, Norton Air Force Base, Norwalk, Nuevo, Oak Grove Ranger Station (about 10 miles southeast of Aguanga), Oak View, Oceano, Oceanside, Ocotillo, Desert Ironwoods Motel (about 3 miles west of Ocotillo Wells), Oildale, Ojai, Olancha, Orange, Oro Grande, Ozena Guard Station (near junction of Highway 33 and Lockwood-Ozena Road), Pacific Palisades, Pala, Palm Desert, Palm Springs, Palos Verdes Estates, Paramount, Pattiway (Hudson Ranch), Pearblossom and about 5 miles south of), Pedley, Perris, Phelan, Pico Rivera, Pinon Hills, Pioneertown, Pixley, Pomona, Porterville, Poway, Pumpkin Center (about 16 miles south of Bakersfield), Ramona, Rancho Mirage, Rancho Santa Fe, Randsburg, Redlands, Red Mountain, Rialto, Ridgecrest, Rimforest, Ripley, Rolling Hills Estates, Rosamond, Running Springs, Sage Fire Control Station (about 12 miles southeast of Hemet), Salton City (west shore of Salton Sea), San Bernardino, San Clemente, Sandberg (Sandberg Ranch), San Diego, San Dimas, San Juan Capistrano, San Pedro, Santa Barbara, Santa Maria, Santa Paula, Santa Ynez and 4 miles southeast of, Santa Ysabel, Santee, San Ysidro, Seal Beach, Seeley, Shandon, Shafter, Shoshone, Signal Hill, Silverado, Simi, Solana Beach, Solvang, South Laguna, South San Gabriel, Springville, Stanton, Sugarloaf, Sultana, Summerland, Sun City, Sunnymead, Sunnyside, Sunset Beach, Surfside, Taft, Tecate, Tecopa, Tehachapi, Temecula, Temple City, Terra Bella, Thermal, Thousand Palms, Tipton, Trabuco Canyon, Traver, Trona, Ventucopa area (Reyes-Wegis Cattle Ranch, about 6 miles west of Ventucopa in Santa Barbara Canyon), Ventura, Victorville, Vista, Westend, Westlake Village (west of Malibu Junction), Westminster, Wheeler Ridge, White Water, Wildomar, Wilmington, Winchester, Wrightwood, Yermo, Yorba Linda, and Yucaipa.

INTENSITY IV:

Alpaugh, Amboy, Armona, Atascadero, Avenal (near), Baker, Big Pine, Bishop, Blythe, Bodfish, Borel Powerhouse (13.5 miles south by south-southwest of Kernville Powerhouse No. 3 (35°47' N., 118°26' W.), Borrego Springs, Boulevard, Brawley (Wieman Ranch, about 7 miles west of Brawley), Burrel, Cabazon and about 10 miles east of in San Gorgonio Pass), Calexico, Cambria, Camp Nelson, Cardiff By The Sea, Cholame and Bitterwater Pumping Station about 18 miles southeast of Cholame, Chula Vista, Cima, Corcoran, Creston, Darwin, Death Valley (Furnace Creek Inn and Furnace Creek Ranch), Delano, Del Rey, Dinuba, Dulzura area (Barrett Dam), Eagle Mountain, Earlimart, East Highlands, Exeter, Firebaugh, Five Points, Fowler, Guadalupe, Guatay, Helm, Herndon, Imperial Beach, Independence, Inyokern (4.5 miles west of, Beckman Ranch), Ivanhoe, Jacumba, Jamul, Joshua Tree, Keeler, Kern River Powerhouse No. 3 (near Kernville, 35° 47' N., 118°26' W.), Kingsburg, Kings Canyon National Park, Lakeside, La Panza (about 25 miles east of Santa Margarita, on Highway 58), Lemongrove, Lindsay,

Long Valley Dam (about 25 miles northwest of Bishop, Lake Crowley), Loraine (about 10 miles east of Caliente), Los Alamos, Miracle Hot Springs, Miramar Naval Air Station, Miramonte, Mountain Center, Mount Laguna, Needles, Nestor, Nipomo, Nipton, Orosi, Parkfield, Paso Robles, Pauma Valley, Piedra and 7 miles south of, Pine Valley, Pismo Beach, Poplar, Posey, Potrero, San Marcos, San Onofre Nuclear Generating Plant (near San Clemente), Selma, Spring Valley, Strathmore, Surf, Templeton, Three Rivers area (Ash Mountain), Three Rivers, Tulare, Twentynine Palms, Valley Center, Vandenberg Air Force Base, Warner Springs, Wasco, Weldon, Woody, Woodville, Yettem, and Yucca Valley.

INTENSITY I-III:

Biola, Bridgeport, Bryson area (Weferling Ranch), Caruthers, Clovis, Control Gorge Power Plant (about 13 miles northwest of Bishop), Earp, El Nido, Fresno, Hanford, Heber, Holtville, Hornitos, June Lake, Kaweah, Le Grand, Lockwood, London (Dinuba area), Los Banos, Los Osos, Merced, Milo (5 miles northeast of, near Springville), Moss Landing PG&E Steam Plant (no motion actually felt, but considerable float movement on water tank), Palomar Mountain, Palo Verde, Parker Dam, Piute Mountain area (about 13 miles southeast of Bodfish), Pinedale, Plaster City, Point Arguello, Red Top, Riverdale, San Ardo, San Miguel, Snelling, Stockton, Strawberry, Wofford Heights, and Yosemite National Park.

ARIZONA:

INTENSITY IV:

Bullhead City, Ehrenberg, and Poston.

INTENSITY I-III:

Kingman and Topock.

NEVADA:

INTENSITY IV:

Dyer, East Las Vegas, Goodsprings, Las Vegas, Lathrop Wells, and Overton.

INTENSITY I-III:

Beatty, Boulder City, Loganvale, Moapa, Pahrump, and Tonapah.

UTAH:

INTENSITY I-III:

Beryl.

REPORTED NOT FELT IN CALIFORNIA: Acampo, Adelaida (12 miles west of Paso Robles), Ahwahnee, Alpine, Altaville, Amador City, Angels Camp, Antelope, Arnold, Aromas, Arroyo Seco Guard Station (about 12 miles southwest of Greenfield), Atwater, Auberry, Avenal, Avery, Badger, Balch Camp, PG&E (36°55' N., 119°05' W.), Ballico, Banta, Bar B Ranch (about 8 miles southwest of Idria), Bard, Bass Lake, Bear Valley, Benton, Big Creek, Big Oak Flat, Bonita, Burson, Camp Connell, Campo, Campo Seco, Camp Roberts, Cantua Creek, Capitola, Castle Air Force Base (Merced), Cayucos, Ceres, Choice Valley area (near Choice Valley School, south of Cholame), Cholame (Alley Ranch, about 3 miles southeast of Cholame), Chowchilla, Clements, Coalinga, Coarsegold, Columbia, Copperopolis, Corralitos, Coulterville, Cressey, Crows Landing, Cutler, Deep Springs, Delhi, Denair, Descanso, Desert Center area (Julian Hinds Pumping Plant, about 10 miles west of Desert Center), Dos Palos, Douglas Flat, Drytown, Dulzura, Dunlap, Easton, El Cajon, El Centro, El Dorado, Elk Grove, El Portal, Empire, Escalon, Exeter (Exeter Fauver Ranch), Farmington, Fiddletown, Fish Camp, Friant, Galt, Glencoe, Gold Rock Ranch (32°53' N., 114°52' W.), Gonzales, Goshen, Greenacres, Greenfield, Groveland, Gustine, Harmony, Hathaway Pines, Havasu Lake, Herald, Hickman, Hilmar, Hollister and south of, in Cienega District, at Harris Ranch (7 miles south of Hollister) and at 13150 Cienega Road), Holt, Hughson, Huntington Lake, Idria, Ione, Jackson, Jamesburg (south of Carmel Valley, Search Ranch), Jamestown, Jolon, Julian, Kerckhoff Powerhouse (vicinity of Auberry; NW 1/4, Sec. 2 and NE 1/4 Sec. 3, T.10S., R.22 E.), Kerman, Keyes, King City, Knights Ferry, La Grange, Lakeshore, Lathrop, Lee Vining, Linden, Livingston, Lockeford, Lodi, Lone Pine (12 miles south of), Long Barn, Lonoak area (Mee Ranch, intersection of Highway 198 and 25), Los Banos (San Luis Dam), Lucia and Circle M Ranch (on coast, about 20 miles south of Big Sur), Madera, Mammoth Lakes, Manteca, Mariposa, Martell, Mendota, Midpines, Moccasin, Modesto and South Modesto, Mokelumne Hill, Monterey, Morro Bay, Mountain Ranch, Murphys, Newman, Niland, North Fork, Oakdale, Oakhurst, O'Neals, Orange Cove, Pacheco (Martinez area), Panoche (36°36' N., 120°50' W.), Paicines and vicinity (Bear Valley Fire Control Station, 25820 Airline Highway, and Mulberry), Parlier, Patterson, Pine Canyon (about 8 miles southwest of King City), Pinecrest, Pine Grove, Pinnacles National Monument (Pinnacles), Pioneer, Planada, Pozo (about 15 miles southeast of Santa Margarita), Plymouth, Prather, Priest Valley (36°11' N., 120°42' W.), Railroad Flat, Raisin, Ranchita, Raymond, Reedley, Richgrove, Ripon, Riverbank, Sacramento area (Florin and Parkway), Salida, Salinas, San Andreas, San Francisco International Airport (San Bruno), Sanger, San Joaquin, San Jose, San Juan Bautista, San Lucas, San Luis Obispo, San Simeon and Hearst Ranch, Santa Margarita and 2 miles southwest of, Santa Nella, Santa Rita, Saticoy, Sequoia National Park, Shaver Lake, Sheepranch, Slack Canyon (36°05' N., 120°40' W.), Soledad, Sonora, Soulsbyville, South Dos Palos, Squaw Valley, Standard, Stevinson, Stovepipe Wells Village (Death Valley National Monument) Sutter, Terra Bella, Three Rivers Power Plant No. 1 (36°28' N., 118°52' W.), Thornton, Tinemaha Reservoir (about 18 miles north of Independence),

Tollhouse, Tom's Place (about 20 miles northwest of Bishop, just below Crowley Lake), Tracy, Tranquillity, Tres Pinos, Tuolumne, Turlock, Twain Harte, Vallecito (Calaveras County), Valley Home, Valley Springs, Victor, Vidal, Visalia, Volcano, Volta, Wallace, Walnut Grove, Waterford, Westley, Westmorland, West Point, White Pines, Wilton, Wilseyville, Winterhaven, Winters, Winton, Wishon, Woodbridge, and Woodlake.

REPORTED NOT FELT IN ARIZONA: Bagdad, Bouse, Dateland, Gadsden, Hackberry, Lake Havasu City, Oatman, Quartzsite, Roll, Salome, San Luis, Somerton, Tacna, Temple Bar, Valentine, Wellton, Yucca, and Yuma.

REPORTED NOT FELT IN NEVADA: Arden, Bunkerville, Caliente, Carp, Goldfield, Henderson, Hiko, Indian Springs, Luning, Mercury, Mesquite, Mina, Panaca, Pioche, and Searchlight.

REPORTED NOT FELT IN UTAH: Cedar City, Central, Enterprise, Gunlock, Hurricane, Ivins, Kanarraville, La Verkin, Leeds, Milford, Modena, New Castle, New Harmony, Pintura, Rockville, Saint George, Santa Clara, Springdale, Toquerville, Virgin, and Washington.

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Chapter 5

Strong-Motion Accelerogram Processing

by

D. E. Hudson

Accelerogram Collection and Reproduction. The simultaneous triggering of 272 strong-motion accelerographs in the Southern California region over distances of several hundred miles presented an unprecedented problem of record collection and data handling.

After the earthquake, an immediate decision was made in the Los Angeles office of the Seismological Field Survey (NOAA) that in the interests of minimizing the risks of losing records, only the regular experienced staff members connected with the office would pick up the photographic records from the field instruments. It was felt that the existing film supplies in the accelerographs would be adequate to record the important aftershocks, and that the time delay in collecting the records would entail no practical disadvantage, in view of the fact that preliminary reports had indicated that there had been no significant structural damage in any of the buildings housing the accelerographs.

By February 10, 1971, one day after the earthquake, the first group of accelerograms had been collected from the buildings nearest the epicentral region, and had been developed and scaled for approximate peak acceleration values. The Los Angeles Department of Building and Safety was immediately notified of the availability of these records for inspection by engineers and building owners. By this time it was also evident that there had in fact been no significant structural damage to any of the

buildings housing the strong-motion accelerographs, so that no special system was necessary for the rapid communication of accelerograph readings to building owners. The large values of acceleration measured on the first records, however, made it clear that a major effort should be made to ensure a rapid and wide distribution of the results.

During a period of some two to three weeks after the earthquake, all of the photographic records were brought in to the Los Angeles office of the Seismological Field Survey where they were developed and a preliminary labeling and scaling of peak accelerations was carried out. This was done on a priority basis, with the records nearest the epicentral region being collected and processed first, because of the intense interest of all earthquake investigators. The accelerographs themselves were all checked for proper operation and left with a full film supply in readiness for the next earthquake.

The Pacoima Dam accelerograph, located virtually at the epicenter of the earthquake, could not be reached for several days after the earthquake because of large rock slides which blocked the access road, and which rendered visits to the sites on foot hazardous. The precipitous nature of the steep canyon location precluded the use of helicopters.

The records from the five accelerograph types making up the network were in the following forms: Standard U. S. Coast and Geodetic and AR-240, 12 in. wide photographic paper; RFT-250 and SMA-1, 70-mm. film: and the MO-2, 35-mm. film. The record lengths varied from a few feet to 30 feet, with several records as long as 80 feet. The total set of 229 usable records from the total 241 records obtained consisted of 103 paper records, 93 70-mm. records, and 45 35-mm. records.

Accelerogram Processing and Analysis Program. To render assistance to the Seismological Field Survey with immediate problems of record reproduction and dissemination, and to provide for eventual complete data analysis, the Engineering Division of the National Science Foundation and the Earthquake Engineering Research Laboratory at the California Institute of Technology developed a data handling and processing program immediately following the earthquake. The main objectives of this special NSF program in the data processing phase were:

(1) To produce accurate archival copies of all records, as well as copies suitable for digitization and data processing.

(2) To produce multiple copies of a form suitable for immediate display and distribution to all interested parties, and to arrange for such distribution.

(3) To carry out an accurate digitization of all useable records, in a form compatible with past accelerogram analysis.

(4) To prepare for all records in a standard form corrected accelerogram data, integrated velocity and displacement curves, and Fourier and response spectrum curves in various standard forms.

Record Reproduction. After preliminary labeling and checking in the Los Angeles office of the Seismological Field Survey, all originals were taken to the Jet Propulsion Laboratory in Pasadena where permanent photographic labels were made for each record, including all pertinent instrumental information. These labels were spliced on all records for future reproduction.

An accurate one-to-one film copy was then made at the Jet Propulsion Laboratory Photographic Department of the initial strong-motion portion of each record. A standard grid was photographed along with each record to check any distortions in the processing. One negative and one positive were made of each record on a stable film base. These short film copies than became the basis for reproduction of multiple copies for immediate distribution.

For distribution copies of the 12-inch paper accelerograms, the short film positive was used in a regular black-line print machine. In this way records could be reproduced economically in numbers of a dozen or so to follow demand. Part of this copying was done at the Jet Propulsion Laboratory, and part was done in the Aeronautics Department at the California Institute of Technology.

For distribution copies of the 70-mm. and 35-mm. short film records, the short negative copies were sent to the Rapid Blue Print Company in Los Angeles for full-size photographic prints. This resulted in accurate black-line-on-white copies for distribution, which were also suitable for direct Xerox copying for preliminary work. The Xerox copying was carried out in the Mechanical Engineering Department at the California Institute of Technology.

To make the records available for public inspection as soon as possible, a room was established on the campus of the California Institute of Technology in which copies of all accelerograms were posted as soon as available, along with additional information on instrument location, aftershock epicenters, etc. Wide publicity was given to the availability of this information through press and television coverage. In the weeks following the earthquake several thousand visitors availed themselves of

this opportunity, including more than a hundred earthquake experts from Japan. Sets of multiple copies were also delivered to the Los Angeles Office of the Seismological Field Survey for distribution to building owners through the Los Angeles Department of Building and Safety, and to the Earthquake Engineering Research Institute - NOAA group at the University of California at Los Angeles.

To produce archival copies of the complete 12-inch paper records, the original records were taken in small lots to the Continental Graphics Company in Los Angeles, where one negative and two positives were produced of the entire length of each original record. Since many of the records were 20 feet long, and several were as long as 80 feet, this involved special processing facilities. As an additional control on the accuracy of the reproductions, technicians from the Jet Propulsion Laboratory measured and recorded a set of standard lengths on the original records and on the photographic copies.

To produce the archival full-length copies of the 35-mm. and 70-mm. records, a negative and two positives were produced by Yale Laboratories in Los Angeles. Special control of this process was required to produce suitable records for automatic image processing digitization.

In addition to the above standard records, certain extra editions were produced of several accelerograms having special interest. Three hundred copies were printed in accurate full-scale format of the Pacoima Dam accelerogram, and a similar set was produced for the basement and roof records at Millikan Library as an example of building response measurements. Considering all of the above processes, within a few weeks of the earthquake several thousand accelerograms had been distributed very widely around the world.

Along with the above record reproduction process, the Jet Propulsion Laboratory staff prepared a code number and tabulation listing for all accelerograms, and location maps for the instrument installations. In addition, the Jet Propulsion Laboratory arranged through a temporary leave of absence system for the transfer of a number of professional data processers and technicians to the campus of the California Institute of Technology for assistance with record processing and digitization. With this assistance, the accelerograph constants were checked from the calibration runs included on the accelerograms.

Digitization Program. In view of the large number of acclerograms it was immediately realized that record digitization would be a major task. Since a good deal of experience with accuracy evaluation and with the training of operators had been obtained on the Benson-Lehner 099D Datareducer*, it was decided that this "semi-automatic" method of digitization would be started immediately, but that in addition an intensive investigation of more automatic systems based on digital imaging processing techniques would be initiated.

During the past few years, several digital imaging processes have been developed for special applications. Such systems have been applied to the digitization of space photographs, and to the digitization of bubble-chamber tracks for particle physics investigations. It appeared

*Hudson, D. E., Nigam, N. C., and Trifunac, M. D., "Analysis of Strong-Motion Accelerograph Records", Proc. 4th World Conference on Earthquake Engineering, Santiago, Chile, 1969.

Trifunac, M. D., "Low Frequency Digitization Errors and a New Method for Zero Baseline Correction of Strong-Motion Accelerograms", Report EERL 70-07, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, 1970.

that several of these systems would be directly applicable to accelerograph digitization, but that a considerable computer programming job would be involved. In addition, it was clear that the problem of accuracy evaluation would take a different form and would require a detailed investigation. Since all of the available automatic systems required that the record be in the form of a 35-mm. or 70-mm. film strip, it was decided that the 12-inch paper records would be digitized semi-automatically with the hope that by the time they were finished, the automatic system would be in successful operation.

To assist with the semi-automatic digitization, time was made available on a second 099 Datareducer through the courtesy of the Shell Oil Company in Los Angeles. A staff of some twelve operators consisting of Jet Propulsion Laboratory technicians and part-time students from the California Institute of Technology was trained and checked for accuracy. With this staff and the two 099 Datareducers, all 90 paper accelerograms were digitized compatible with past accuracy standards within three months of the earthquake.

At the time of completion of the paper records, it was evident that the automatic digitization process would be feasible, and that the bulk of the film accelerograms could be digitized in this new way. It was also clear that some of the film records were not of a quality for automatic digitization, but would require the individual attention possible with the semi-automatic method. It was accordingly decided to carry out automatic processing for all suitable records, and to finish up the others with the 099 Datareducer.

In retrospect, it appears that the system of semi-automatic digitization used on the paper accelerograms was an effective way of

dealing with the problem. The success of the approach depended on the availability of a group of experienced part-time operators from the Jet Propulsion Laboratory and from the Caltech student group. This is an essential feature since no one person can engage in the digitization for more than two or three hours without an inevitable degradation of accuracy. Given the relatively infrequent nature of strong earthquakes, such semi-automatic digitization is a feasible though laborious approach.

As a check on the fully automatic digitization process, a 35-mm. record of average quality was sent to Information International Incorporated in Los Angeles, where the digitization was carried out and supplied on magnetic tape. This tape was then processed at the Computing Center of the California Institute of Technology, and a large scale 8X plot of a selected portion of the record was plotted on the Calcomp plotter. This computer plotted accelerogram was then superimposed directly on an 8X enlargement of the original 35-mm. accelerogram. The excellent agreement obtained for this direct comparison indicated that a satisfactory accuracy had been achieved in the automatic digitization process.

The Accelerograph Network. The location of all of the accelerographs triggered by the earthquake is shown on the set of maps included with a location index in Chapter I. Table I is the basic list of accelerograms including the code number and pertinent information on the record.

TABLE I
NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.001	Pacoima Dam	Pacoima Dam	AR-240	179	S 74° W S = 7.55 cm/g	Down S = 7.62 cm/g	S 16° E S = 7.60 cm/g	12"	28'
71.002	Los Angeles 8244 Orion Blvd.	4th Floor	AR-240	210	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	10'
71.003	Los Angeles 1901 Avenue of the Stars	9th Floor	AR 240	283	N 460 W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 44° W S* = 7.6 cm/g	12"	8'
71.004	Wheeler Ridge	Wheeler Ridge	AR-240	112	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	5'
71.005	Los Angeles 250 E. First St.	Basement	AR-240	287	N 36° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 54° W S* = 7.6 cm/g	12"	10'
71.006	Los Angeles 1901 Avenue of the Stars	Sub-basement	AR-240	278	N 46° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 44° W S* = 7.6 cm/g	12"	7'
71.007	Castaic	Old Ridge Route	AR-240	124	N 21° E S = 8.1 cm/g	Down S = 7.9 cm/g	N 69° W S* = 7.6 cm/g	12"	14'
71.008	Los Angeles 8244 Orion Blvd.	1st Floor	AR-240	190	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	10'
71.009	Lake Hughes	Array Sta. 12	AR-240	217	N 21° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 69° W S* = 7.6 cm/g	12"	5'
71.010	Los Angeles 1640 S. Marengo St.	8th Floor	AR-240	230	N 38° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 52° W S* = 7.6 cm/g	12"	14'
71.011	Los Angeles 250 E. First St.	8th Floor	AR 240	294	N 36° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 54° W S* = 7.6 cm/g	12"	9'
71.012	Lake Hughes	Array Sta 9	AR-240	162	N 21° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 69° W S* = 7.6 cm/g	12"	5'
71.013	Los Angeles 1640 S. Marengo St.	1st Floor	AR-240	235	N 38° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 52° W S* = 7.6 cm/g	12"	15'
71.014	Los Angeles 8244 Orion Blvd.	8th Floor	AR-240	199	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	10'
71.015	Los Angeles 1640 S. Marengo St.	4th Floor	AR-240	229	N 38° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 52° W S* = 7.6 cm/g	12"	13'
71.016	Los Angeles 250 E. First St.	17th Floor	AR-240	295	N 36° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 54° W S* = 7.6 cm/g	12"	8'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.017	Los Angeles 1901 Avenue of the Stars	21st Floor	AR-240	275	N 46° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 44° W S* = 7.6 cm/g	12"	10'
71.018	Pasadena Caltech	Seismological Laboratory	RFT-250	193	South S* = 1.9 cm/g	Down S* = 1.9 cm/g	East S* = 1.9 cm/g	70 mm	16'
71.019	Pasadena Caltech	Athenaeum	SMA-1	124	East S = 1.82 cm/g	Down S = 1.95 cm/g	North S = 1.79 cm/g	70 mm	3'
71.020	Maricopa	Array Sta. 4	RFT-250	162-A	S 40° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 50° E S* = 1.9 cm/g	70 mm	3'
71.021	Maricopa	Array Sta. 3	RFT-250	194-A	S 40° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 50° E S* = 1.9 cm/g	70 mm	4'
71.022	Pasadena Caltech	Millikan Library Basement	RFT-250	198	East S* = 1.9 cm/g	Down S = 1.9 cm/g	North S* = 1.9 cm/g	70 mm	16'
71.023	Pasadena Caltech	Millikan Library 10th Floor	RFT-250	200	East S* = 1.9 cm/g	Down S* = 1.9 cm/g	North S* = 1.9 cm/g	70 mm	16'
71.024	Los Angeles 15250 Ventura Blvd.	Basement	SMA-1	185	N 11° E S = 1.95 cm/g	Down S = 1.70 cm/g	N 79° W S = 1.78 cm/g	70 mm	4'
71.025	Los Angeles 15250 Ventura Blvd.	Roof	SMA-1	183	N 11° E S = 1.92 cm/g	Down S = 1.91 cm/g	N 79° W S = 1.70 cm/g	70 mm	4'
71.026	Los Angeles 15250 Ventura Blvd.	7th Floor	SMA-1	184	N 11° E S = 1.80 cm/g	Down S = 1.71 cm/g	N 79° W S = 1.88 cm/g	70 mm	4'
71.027	Los Angeles 15107 Vanowen St.	Basement	RFT-250	267	West S = 1.87 cm/g	Down S* = 1.90 cm/g	South S = 1.91 cm/g	70 mm	82'
71.028	Los Angeles 15107 Vanowen St.	4th Floor	RFT-250	270	West S = 1.89 cm/g	Down S* = 1.90 cm/g	South S = 1.84 cm/g	70 mm	53'
71.029	Los Angeles 3838 Lankershim Blvd.	21st Floor	RFT-250	150	North S* = 1.9 cm/g	Down S* = 1.9 cm/g	West S* = 1.9 cm/g	70 mm	6'
71.030	Los Angeles 15107 Vanowen	Roof	RFT-250	254	West S = 1.96 cm/g	Down S* = 1.90 cm/g	South S = 1.97 cm/g	70 mm	86'
71.031	Pasadena Jet Propulsion Laboratory	9th Floor	RFT-250	199	S 8° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 82° E S* = 1.9 cm/g	70 mm	16'
71.032	Pasadena Jet Propulsion Laboratory	Basement	RFT-250	195	S 8° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 82° E S* = 1.9 cm/g	70 mm	16'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.033	Los Angeles 1150 S. Hill St.	10th Floor	RFT-250	276	S 53° E S = 1.88 cm/g	Down S* = 1.90 cm/g	N 37° E S = 1.81 cm/g	70 mm	9'
71.034	Los Angeles 1150 S. Hill St.	5th Floor	RFT-250	271	S 53° E S = 1.85 cm/g	Down S* = 1.90 cm/g	N 37° E S = 1.85 cm/g	70 mm	8'
71.035	Los Angeles 1150 S. Hill St.	Sub-basement	RFT-250	277	S 53° E S = 1.89 cm/g	Down S* = 1.90 cm/g	N 37° E S = 1.89 cm/g	70 mm	8'
71.036	Los Angeles 3838 Lankershim Blvd.	Sub-basement	RFT-250	155	North S* = 1.9 cm/g	Down S* = 1.9 cm/g	West S* = 1.9 cm/g	70 mm	6'
71.037	Los Angeles 8639 Lincoln Ave.	6th Floor	RFT-250	170	S - W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S - E S* = 1.9 cm/g	70 mm	6'
71.038	Los Angeles 611 W. Sixth St.	Basement	RFT-250	139	N 52° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 38° E S* = 1.9 cm/g	70 mm	5'
71.039	Los Angeles 8639 Lincoln Ave.	Basement	RFT-250	169	S - W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S - E S* = 1.9 cm/g	70 mm	5'
71.040	Los Angeles 611 W. Sixth St.	42nd Floor	RFT-250	122	N 52° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 38° E S* = 1.9 cm/g	70 mm	5'
71.041	Los Angeles 8639 Lincoln Ave.	12th Floor	RFT-250	168	S - W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S - E S* = 1.9 cm/g	70 mm	6'
71.042	Los Angeles 3838 Lankershim Blvd.	11th Floor	RFT-250	154	North S* = 1.9 cm/g	Down S* = 1.9 cm/g	West S* = 1.9 cm/g	70 mm	5'
71.043	Los Angeles 611 W. Sixth St.	24th Floor	RFT-250	146	N 52° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 38° E S* = 1.9 cm/g	70 mm	3'
71.044	Los Angeles 3710 Wilshire Blvd.	10th Floor	AR-240	220	West S* = 7.6 cm/g	Down S* = 7.6 cm/g	South S* = 7.6 cm/g	12"	7'
71.045	Los Angeles 3710 Wilshire Blvd.	5th Floor	AR-240	219	West S* = 7.6 cm/g	Down S* = 7.6 cm/g	South S* = 7.6 cm/g	12"	6'
71.046	Los Angeles 3710 Wilshire Blvd.	Basement	AR-240	221	West S* = 7.6 cm/g	Down S* = 7.6 cm/g	South S* = 7.6 cm/g	12"	7'
71.047	Los Angeles 4680 Wilshire Blvd.	6th Floor	AR-240	279	N 15° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 75° W S* = 7.6 cm/g	12"	11'
71.048	Los Angeles 4680 Wilshire Blvd.	Basement	AR-240	268	N 15° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 75° W S* = 7.6 cm/g	12"	10-1/2'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.049	Los Angeles 4680 Wilshire Blvd.	3rd Floor	AR-240	284	N 15° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 75° W S* = 7.6 cm/g	12"	10'
71.050	Los Angeles 7080 Hollywood Blvd.	Basement	AR-240	269	East S* = 7.6 cm/g	Down S* = 7.6 cm/g	North S* = 7.6 cm/g	12"	5-1/2'
71.051	Los Angeles 7080 Hollywood Blvd.	6th Floor	AR-240	270	West S* = 7.6 cm/g	Down S* = 7.6 cm/g	South S* = 7.6 cm/g	12"	5-1/4'
71.052	Los Angeles 7080 Hollywood Blvd.	12th Floor	AR-240	267	East S* = 7.6 cm/g	Down S* = 7.6 cm/g	North S* = 7.6 cm/g	12"	6'
71.053	Los Angeles 4867 Sunset Blvd.	Basement	AR-240	260	S 89° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 01° E S* = 7.6 cm/g	12"	6-1/2'
71.054	Los Angeles 4867 Sunset Blvd.	2nd Floor	AR-240	286	S 01° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 89° E S* = 7.6 cm/g	12"	6'
71.055	Los Angeles 4867 Sunset Blvd.	7th Floor	AR-240	282	S 89° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 01° E S* = 7.6 cm/g	12"	5-1/2'
71.056	Los Angeles 3470 Wilshire Blvd.	Sub-basement	AR-240	248	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	9-1/2'
71.057	Los Angeles 3470 Wilshire Blvd.	5th Floor	AR-240	246	East S* = 7.6 cm/g	Down S* = 7.6 cm/g	North S* = 7.6 cm/g	12"	9'
71.058	Los Angeles 3470 Wilshire Blvd.	11th Floor	AR-240	297	East S* = 7.6 cm/g	Down S* = 7.6 cm/g	North S* = 7.6 cm/g	12"	7'
71.059	Los Angeles Water and Power Bldg.	Basement	AR-240	152	N 50° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 40° W S* = 7.6 cm/g	12"	14-1/2'
71.060	Los Angeles 445 Figueroa St.	Sub-basement	AR-240	208	N 52° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 38° W S* = 7.6 cm/g	12"	22-1/2'
71.061	Grapevine Tehachapi Pumping Plant	C.N.R. Site	AR-240	167	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	2-1/2'
71.062	Santa Felicia Dam	Outlet Works	AR-240	242	S 82° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 08° E S* = 7.6 cm/g	12"	6-1/2'
71.063	Santa Felicia Dam	Crest	AR-240	241	S 75° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 15° E S* = 7.6 cm/g	12"	7-3/4'
71.064	Palmdale Fire Sta.	Storage Room	RFT-250	189	S 60° E S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 30° W S* = 1.9 cm/g	70 mm	3'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.065	Lake Hughes Array	Station 4	RFT-250	164	S 21° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 69° E S* = 1.9 cm/g	70 mm	2-3/4'
71.066	Carbon Canyon Dam	Carbon Canyon Dam	RFT-250	131	S 40° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 50° E S* = 1.9 cm/g	70 mm	2-3/4'
71.067	Whittier Narrows Dam	Whittier Narrows Dam	RFT-250	130	S 53° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 37° E S* = 1.9 cm/g	70 mm	3-3/4'
71.068	San Antonio Dam	San Antonio Dam	RFT-250	132	N 75° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 15° E S* = 2.0 cm/g	70 mm	2-1/2'
71.069	Los Angeles Griffith Park Observatory	Moon Room	RFT-250	158	South S* = 1.9 cm/g	Down S* = 1.9 cm/g	West S* = 1.9 cm/g	70 mm	5-1/4'
71.070	Los Angeles 616 S. Normandie Ave.	Basement	SMA-1	117	North S = 1.61 cm/g	Down S = 1.72 cm/g	West S = 1.66 cm/g	70 mm	4-3/4'
71.071	Alhambra 900 S. Fremont Ave.	Basement	SMA-1	179	West S = 1.60 cm/g	Down S = 1.75 cm/g	South S = 1.78 cm/g	70 mm	4'
71.072	Los Angeles 1625 Olympic Blvd.	Ground Floor	SMA-1	146	N 28° E S = 1.92 cm/g	Down S = 1.70 cm/g	N 62° W S = 1.80 cm/g	70 mm	6-1/4'
71.073	Los Angeles 616 S. Normandie Ave.	Roof	SMA-1	119	North S = 1.60 cm/g	Down S = 1.82 cm/g	West S = 1.76 cm/g	70 mm	8'
71.074	Los Angeles 616 S. Normandie Ave.	8th Floor	SMA-1	118	North S = 1.80 cm/g	Down S = 1.62 cm/g	West S = 1.62 cm/g	70 mm	4-1/2'
71.075	Los Angeles 1625 Olympic Blvd.	6th Floor	SMA-1	147	N 28° E S = 1.93 cm/g	Down S = 1.72 cm/g	N 62° W S = 1.82 cm/g	70 mm	5-1/4'
71.076	Los Angeles 420 S. Grand Ave.	2nd Floor	RFT-250	125	S 37° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 53° E S* = 1.9 cm/g	70 mm	8-1/4'
71.077	Los Angeles 420 S. Grand Ave.	10th Floor	RFT-250	124	S 37° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 53° E S* = 1.9 cm/g	70 mm	4-1/2'
71.078	Los Angeles 420 S. Grand Ave.	17th Floor	RFT-250	126	S 37° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 53° E S* = 1.9 cm/g	70 mm	7-1/2'
71.079	Los Angeles 750 Garland Ave.	Ground Floor	RFT-250	153	S 30° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 60° W S* = 1.9 cm/g	70 mm	7'
71.080	Los Angeles 750 Garland Ave.	2nd Floor	RFT-250	152	S 30° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 60° W S* = 1.9 cm/g	70 mm	9-1/2'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.081	Los Angeles 750 Garland Ave.	6th Floor	RFT-250	151	S 30° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 60° W S* = 1.9 cm/g	70 mm	9-1/4'
71.082	Alhambra 900 S. Fremont Ave.	12th Floor	SMA-1	165	West S = 1.70 cm/g	Down S = 1.75 cm/g	South S = 1.80 cm/g	70 mm	4'
71.083	Alhambra 900 S. Fremont Ave.	6th Floor	SMA-1	187	West S = 1.80 cm/g	Down S = 1.75 cm/g	South S = 1.70 cm/g	70 mm	5'
71.084	Los Angeles 1880 Century Park East	Parking 1st Level	SMA-1	121	N 54° E S = 1.92 cm/g	Down S = 1.64 cm/g	N 36° W S = 1.82 cm/g	70 mm	12-1/2'
71.085	Los Angeles 1880 Century Park East	7th Floor	SMA-1	115	N 54° E S = 1.85 cm/g	Down S = 1.74 cm/g	N 36° W S = 1.87 cm/g	70 mm	13-1/2'
71.086	Los Angeles 1880 Century Park East	Penthouse	SMA-1	111	N 54° E S = 1.85 cm/g	Down S = 1.68 cm/g	N 36° W S = 1.53 cm/g	70 mm	12'
71.087	Los Angeles 435 Oakhurst Ave.	Basement	SMA-1	109	North S = 1.66 cm/g	Down S = 1.58 cm/g	West S = 1.69 cm/g	70 mm	4-1/2'
71.088	Los Angeles 435 Oakhurst Ave.	5th Floor	SMA-1	105	North S = 1.70 cm/g	Down S = 1.70 cm/g	West S = 1.60 cm/g	70 mm	3-1/2'
71.089	Los Angeles 435 Oakhurst Ave.	Roof	SMA-1	107	North S = 1.71 cm/g	Down S = 1.56 cm/g	West S = 1.76 cm/g	70 mm	4'
71.090	Los Angeles 1625 Olympic Blvd.	10th Floor	SMA-1	145	N 28° E S = 1.82 cm/g	Down S = 1.81 cm/g	N 62° W S = 1.91 cm/g	70 mm	7-1/2'
71.091	Los Angeles 445 Figueroa St.	19th Floor	AR-240	231	N 52° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 38° W S* = 7.6 cm/g	12"	29'
71.092	Los Angeles Water and Power Bldg.	7th Floor	AR-240	150	N 50° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 40° W S* = 7.6 cm/g	12"	22'
71.093	Los Angeles Water and Power Bldg.	15th Floor	AR-240	151	N 50° W S* = 7.6 cm/g	Down S = 7.6 cm/g	S 40° W S* = 7.6 cm/g	12"	20-1/2'
71.094	Los Angeles 945 Tiverton Ave.	8th Floor	AR-240	244	N 78° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 12° W S* = 7.6 cm/g	12"	70'
71.095	Los Angeles 945 Tiverton Ave.	14th Floor	AR-240	243	N 78° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 12° W S* = 7.6 cm/g	12"	68'
71.096	Los Angeles 3407 Sixth St.	Basement	AR-240	225	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	10'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.097	Los Angeles 3407 Sixth St.	4th Floor	AR-240	223	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	11'
71.098	Los Angeles 3407 Sixth St.	Penthouse	AR-240	233	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	9'
71.099	San Onofre Southern Calif. Edisor	Nuclear Power Plant	AR-240	153	N 33° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 57° W S* = 7.6 cm/g	12"	8'
71.100	Vernon	CDM Bldg.	Standard	41-A	Up S = 12.9 cm/g	S 07° W S = 13.2 cm/g	N 83° W S = 13.2 cm/g	12"	13'
71.101	Santa Ana	Orange County Engineering Bldg.	Standard	11-M	Up S = 11.5 cm/g	S 86° W Mag. = .94 S 04° E** S = 11.9 cm/g	N 04° W Mag. = .96 S 86° W*** S = 11.7 cm/g	12"	12'
71.102	Glendale 633 E. Broadway	Muricipal Service Bldg.	AR-240	216	S 70° E S* = 15.2 cm/g	Down S* = 15.2 cm/g	S 20° W S* = 15.2 cm/g	12"	7'
71.103	Los Angeles 808 S. Olive St.	4th Level	AR-240	226	S 53° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 37° E S* = 7.6 cm/g	12"	17'
71.104	Los Angeles 808 S. Olive St.	8th Level	AR-240	206	S 37° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 53° E S* = 7.6 cm/g	12"	17'
71.105	Los Angeles 2011 Zonal Ave.	Basement	AR-240	296	S 28° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 62° E S* = 7.6 cm/g	12"	6'
71.106	Los Angeles 2011 Zonal Ave.	5th Floor	AR-240	292	S 28° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 62° E S* = 7.6 cm/g	12"	7'
71.107	Los Angeles 2011 Zonal Ave.	9th Floor	AR 240	302	S 28° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 62° E S* = 7.6 cm/g	12"	6'
71.108	Los Angeles 3345 Wilshire Blvd.	Basement	AR-240	300	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	7'
71.109	Los Angeles 3345 Wilshire Blvd.	2nd Floor	AR-240	298	South S = 7.6 cm/g	Down S = 7.6 cm/g	East S = 7.6 cm/g	12"	7'
71.110	Los Angeles 3345 Wilshire Blvd.	12th Floor	AR-240	299	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	7'
71.111	Los Angeles 120 N. Robertson Blvc.	Sub-basement	AR-240	239	S 02° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 88° E S* = 7.6 cm/g	12"	12'

*Nominal Sensitivity
**Identifying Number, 4.
***Identifying Number, 5.

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Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.112	Los Angeles 120 N. Robertson Blvd.	4th Floor	AR-240	237	S 02° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 88° E S* = 7.6 cm/g	12"	13'
71.113	Los Angeles 120 N. Robertson Blvd.	9th Floor	AR-240	238	S 02° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 88° E S* = 7.6 cm/g	12"	12'
71.114	Los Angeles 646 S. Olive Ave.	Basement	AR-240	262	S 37° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 53° E S* = 7.6 cm/g	12"	13'
71.115	Los Angeles 646 S. Olive Ave.	4th Level	AR-240	266	S 37° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 53° E S* = 7.6 cm/g	12"	13'
71.116	Los Angeles 646 S. Olive Ave.	Roof	AR-240	265	S 37° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 53° E S* = 7.6 cm/g	12"	13'
71.117	Los Angeles 1888 Century Park East	14th Floor	RFT-250	269	N 54° E S = 1.87 cm/g	Down S = 1.90 cm/g	N 36° W S = 1.86 cm/g	70 mm	7'
71.118	Los Angeles 1888 Century Park East	21st Floor	RFT-250	268	N 54° E S = 1.87 cm/g	Down S = 1.90 cm/g	N 36° W S = 1.89 cm/g	70 mm	9'
71.119	Palos Verdes Estates	2516 Via Tejon	RFT-250	138	S 25° E S* = 3.8 cm/g	Down S* = 3.8 cm/g	N 65° E S* = 3.8 cm/g	70 mm	5'
71.120	Beverly Hills 420 N. Roxbury Dr.	5th Floor	SMA-1	153	N 50° E S = 1.81 cm/g	Down S = 1.86 cm/g	N 40° W S = 1.69 cm/g	70 mm	9'
71.121	Beverly Hills 420 N. Roxbury Dr.	1st Floor	SMA-1	151	N 50° E S = 1.83 cm/g	Down S = 1.80 cm/g	N 40° W S = 1.80 cm/g	70 mm	8'
71.122	Beverly Hills 420 N. Roxbury Dr.	10th Floor	SMA-1	152	N 50° E S = 1.66 cm/g	Down S = 1.84 cm/g	N 40° W S = 1.81 cm/g	70 mm	8'
71.123	Orange 4000 W. Chapman Ave.	Basement	RFT-250	272	West S = 1.83 cm/g	Down S = 1.77 cm/g	South S = 1.83 cm/g	70 mm	8'
71.124	Orange 4000 W. Chapman Ave.	10th Floor	RFT-250	274	West S = 1.76 cm/g	Down S = 1.84 cm/g	South S = 1.89 cm/g	70 mm	9'
71.125	Orange 4000 W. Chapman Ave.	19th Floor	RFT-250	266	West S = 1.84 cm/g	Down S = 1.90 cm/g	South S = 1.80 cm/g	70 mm	8'
71.126	Los Angeles 1800 Century Park East	Basement (P-3)	SMA-1	141	S 36° E S = 1.98 cm/g	Down S = 1.80 cm/g	N 54° E S = 1.30 cm/g	70 mm	7'
71.127	Los Angeles 1800 Century Park East	5th Floor	SMA-1	140	S 36° E S = 1.85 cm/g	Down S = 1.78 cm/g	N 54° E S = 1.78 cm/g	70 mm	8'

*Nominal Sensitivity

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Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.128	Los Angeles 1800 Century Park East	Penthouse	SMA-1	135	S 36° E S = 1.73 cm/g	Down S = 1.82 cm/g	N 54° E S = 1.69 cm/g	70 mm	7'
71.129	Los Angeles 2500 Wilshire Blvd.	Basement	SMA-1	130	N 29° E S = 1.96 cm/g	Down S = 1.83 cm/g	N 61° W S = 2.00 cm/g	70 mm	6'
71.130	Los Angeles 2500 Wilshire Blvd.	8th Floor	SMA-1	129	N 29° E S = 2.02 cm/g	Down S = 2.00 cm/g	N 61° W S = 1.90 cm/g	70 mm	8'
71.131	Los Angeles 2500 Wilshire Blvd.	Roof	SMA-1	131	N 29° E S = 1.92 cm/g	Down S = 1.90 cm/g	N 61° W S = 2.04 cm/g	70 mm	4'
71.132	Fullerton 2600 Nutwood Ave.	Penthouse West Wing	SMA-1	110	West S = 1.76 cm/g	Down S = 1.68 cm/g	South S = 1.68 cm/g	70 mm	4'
71.133	Fullerton 2600 Nutwood Ave.	Basement	SMA-1	113	West S = 1.69 cm/g	Down S = 1.72 cm/g	South S = 1.69 cm/g	70 mm	4'
71.134	Fullerton 2600 Nutwood Ave.	Penthouse (center)	SMA-1	116	West S = 1.74 cm/g	Down S = 1.36 cm/g	South S = 1.90 cm/g	70 mm	4'
71.135	Los Angeles 15910 Ventura Blvd.	Basement	SMA-1	182	S 09° W S = 2.00 cm/g	Down S* = 1.95 cm/g	S 81° E S = 2.09 cm/g	70 mm	17'
71.136	Los Angeles 15910 Ventura Blvd.	9th Floor	SMA-1	181	S 09° W S = 1.74 cm/g	Down S* = 1.9 cm/g	S 81° E S = 1.93 cm/g	70 mm	20'
71.137	Los Angeles 15910 Ventura Blvd.	19th Floor	SMA-1	180	S 09° W S = 1.87 cm/g	Down S* = 1.95 cm/g	S 81° E S = 1.67 cm/g	70 mm	19'
71.138	Los Angeles 1888 Century Park East	Parking Ramp 9th Floor	RFT 250	275	S 36° E S = 1.84 cm/g	Down S = 1.90 cm/g	N 54° E S = 1.89 cm/g	70 mm	6'
71.139	Los Angeles 1888 Century Park East	Parking Ramp 5th Floor	RFT-250	265	S 36° E S = 1.87 cm/g	Down S = 1.90 cm/g	N 54° E S = 1.86 cm/g	70 mm	8'
71.140	San Juan Capistrano	San Juan Capistrano	RFT-250	180	N 33° E S = 1.99 cm/g	Down S = 1.9 cm/g	N 57° W S = 1.91 cm/g	70 mm	7'
71.141	Long Beach Long Beach State College	Ground Level	RFT-250	184	N 76° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 14° W S* = 1.9 cm/g	70 mm	11'

*Nominal Sensitivity

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Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.142	Colton	Edison Company	Standard	38-A	Up S = 13.1 cm/g	East S = 14.0 cm/g	South S = 13.4 cm/g	12"	4'
71.143	Tejon	Ft. Tejon	AR-240	115	East S = 7.6 cm/g	Down S = 7.6 cm/g	North S = 7.6 cm/g	12"	2'
71.144	Pearblossom	Pumping Plant	AR-240	215	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	4'
71.145	Cedar Springs	Pumping Plant	AR-240	187	S 36° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 54° E S = 7.6 cm/g	12"	4'
71.146	Gorman	Oso Pumping Plant	AR-240	194	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	6'
71.147	Los Angeles	UCLA Reactor Laboratory	Standard	62-S	Up S = 21.0 cm/g West** Magnification 1.0	South S = 21.0 cm/g South*** Magnification 1.0	East S = 22.0 cm/g	12"	21'
71.148	Costa Mesa 666 W. 19th St.	Ground Floor	AR-240	184	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	15'
71.149	Long Beach 215 W. Broadway	Utilities Bldg.	Standard	4-M	Up S = 13.0 cm/g East** Magnification .9	North S = 13.1 cm/g South*** Magnification .9	East S = 13.2 cm/g	12"	7'
71.150	Arcadia Santa Anita	Reservoir	AR-240	240	N 03° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 87° W S* = 7.6 cm/g	12"	5'
71.151	Port Hueneme	Navy Laboratory	Standard	1-A	Up S = 19.6 cm/g West** Magnification .95	South S = 19.5 cm/g North*** Magnification .95	West S = 19.8 cm/g	12"	12'
71.152	Lake Hughes	Array Sta. 1	AR-240	132	N 21° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 69° E S* = 7.6 cm/g	12"	6'

*Nominal Sensitivity
**Identifying Number, 4
***Identifying Number, 5

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.153	San Dimas Puddingstone	Reservoir	AR-240	178	N 55° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 35° W S* = 7.6 cm/g	12"	7'
71.154	Long Beach	Terminal Island	Standard	13-D	Up S = 14.2 cm/g	S 69° W S = 14.1 cm/g	N 21° W S = 13.3 cm/g	6"	12'
71.155	Los Angeles Hollywood Storage	P. E. Lot	Standard	1-D	Up S = 12.9 cm/g	East S = 12.1 cm/g	South S = 13.2 cm/g	6"	43'
71.156	Los Angeles Hollywood Storage	Basement	Standard	22-D	Up S = 12.8 cm/g	East S = 13.3 cm/g	South S = 12.4 cm/g	6"	11'
71.157	Wrightwood 6047 Park Dr.	Wrightwood	SMA-1	232	S 25° W S = 1.66 cm/g	Down S = 1.80 cm/g	S 65° E S = 1.79 cm/g	70 mm	3'
71.158	San Bernardino	Hall of Records	RFT-250	140	East S* = 1.9 cm/g	Down S* = 1.9 cm/g	North S* = 1.9 cm/g	70 mm	4'
71.159	Wrightwood 6074 Park Dr.	Wrightwood	RFT-250	186	S 25° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 65° E S* = 1.9 cm/g	70 mm	3'
71.160	Los Angeles 9341 Airport Blvd.	Basement	MO-2	88	North S* = 1.65 cm/g	West S* = 1.72 cm/g	Up S* = 2.35 cm/g	35 mm	7'
71.161	Los Angeles 9341 Airport Blvd.	15th Floor	MO-2	98	North S* = 1.60 cm/g	West S* = 1.60 cm/g	Up S* = 2.40 cm/g	35 mm	8'
71.162	Los Angeles 14724 Ventura Blvd.	1st Floor	MO-2	165	S 12° W S* = 1.51 cm/g	N 78° W S* = 1.53 cm/g	Up S* = 2.36 cm/g	35 mm	15'
71.163	Los Angeles 14724 Ventura Blvd.	6th Floor	MO-2	129	S 12° W S* = 1.57 cm/g	N 78° W S* = 1.57 cm/g	Up S* = 2.42 cm/g	35 mm	16'
71.164	Los Angeles 14724 Ventura Blvd.	Penthouse	MO-2	188	S 12° W S* = 1.52 cm/g	N 78° W S* = 1.53 cm/g	Up S* = 2.34 cm/g	35 mm	16'
71.165	Hollywood 1760 N. Orchid Ave.	Ground Floor	MO-2	152	South S = 1.47 cm/g	East S = 1.52 cm/g	Up S = 2.34 cm/g	35 mm	13'
71.166	Hollywood 1760 N. Orchid Ave.	12th Floor	MO-2	135	East S = 1.55 cm/g	South S = 1.54 cm/g	Up S = 2.26 cm/g	35 mm	12'
71.167	Hollywood 1760 N. Orchid Ave.	23rd Floor	MO-2	132	East S = 1.57 cm/g	South S = 1.54 cm/g	Up S* = 2.42 cm/g	35 mm	13'
71.168	Beverly Hills 9100 Wilshire Blvd.	Basement		148	East S = 1.49 cm/g	South S = 1.54 cm/g	Up S* = 2.44 cm/g	35 mm	8'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.169	Beverly Hills 9100 Wilshire Blvd.	5th Floor	MO-2	133	East S = 1.51 cm/g	South S = 1.42 cm/g	Up S* = 2.30 cm/g	35 mm	6'
71.170	Los Angeles 800 W. First St.	1st Floor	MO-2	59	N 37° E S = 1.59 cm/g	W 53° W S = 1.60 cm/g	Up S = 2.36 cm/g	35 mm	12'
71.171	Los Angeles 800 W. First St.	16th Floor	MO-2	60	N 37° E S* = 1.57 cm/g	N 53' W S* = 1.59 cm/g	Up S* = 2.39 cm/g	35 mm	13'
71.172	Los Angeles 800 W. First St.	33rd Floor	MO-2	81	N 37° E S* = 1.61 cm/g	N 53' W S* = 1.56 cm/g	Up S* = 2.36 cm/g	35 mm	12'
71.173	Los Angeles 222 Figueroa St.	20th Floor	MO-2	160	S 37° W S* = 1.55 cm/g	N 53' W S* = 1.54 cm/g	Up S* = 2.44 cm/g	35 mm	5'
71.174	Los Angeles 222 Figueroa St.	1st Floor	MO-2	110	S 37° W S* = 1.51 cm/g	N 53' W S* = 1.53 cm/g	Up S* = 2.32 cm/g	35 mm	6'
71.175	Fairmont Reservoir	Reservoir	Standard	79-M	Up S = 16.6 cm/g S 56° W** Static Mag. = 1	N 34' W S = 17.4 cm/g N 34' W*** Static Mag. = 1	N 56° E S = 16.7 cm/g	12"	7'
71.176	Santa Barbara	University of California	RFT-250	183	N 42° E S* = 1.9 cm/g	Up S* = 1.9 cm/g	S 48° E S* = 1.9 cm/g	70 mm	5'
71.177	Los Angeles 6200 Wilshire Blvd.	17th Floor	MO-2	127	N 08° E S = 1.50 cm/g	N 82' W S = 1.57 cm/g	Up S = 2.32 cm/g	35 mm	6'
71.178	Los Angeles 6200 Wilshire Blvd.	Ground Floor	MO-2	175	N 08° E S = 1.49 cm/g	N 82' W S = 1.57 cm/g	Up S = 2.33 cm/g	35 mm	7'
71.179	Los Angeles 6200 Wilshire Blvd.	10th Floor	MO-2	185	N 08° E S = 1.50 cm/g	N 82' W S = 1.49 cm/g	Up S = 2.34 cm/g	35 mm	7'
71.180	Los Angeles 3440 University Ave.	5th Floor	MO-2	89	S 61° E S* = 1.55 cm/g	N 29' E S* = 1.57 cm/g	Up S* = 2.42 cm/g	35 mm	3'
71.181	Los Angeles 3440 University Ave.	Basement	MO-2	97	S 61° E S* = 1.63 cm/g	N 29' E S* = 1.57 cm/g	Up S* = 2.42 cm/g	35 mm	4'
71.182	Los Angeles 3440 University Ave.	Roof	MO-2	105	S 61° E S* = 1.62 cm/g	N 29' E S* = 1.53 cm/g	Up S* = 2.62 cm/g	35 mm	4'
71.183	Los Angeles 1177 Beverly Dr.	Basement	MO-2	170	N 31° W S = 1.54 cm/g	N 59° E S = 1.57 cm/g	Up S = 2.38 cm/g	35 mm	9'

*Nominal Sensitivity
**Identifying Number, 4
***Identifying Number, 5

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.184	Los Angeles 5900 Wilshire Blvd.	16th Floor	MO-2	161	S 07° W S = 1.55 cm/g	N 83° W S = 1.49 cm/g	Up S = 2.37 cm/g	35 mm	3'
71.185	Los Angeles 5900 Wilshire Blvd.	"B" Parking Lot	MO-2	112	S 07° W S = 1.52 cm/g	N 83° W S = 1.50 cm/g	Up S = 2.39 cm/g	35 mm	4'
71.186	Los Angeles 5900 Wilshire Blvd.	Penthouse	MO-2	178	S 07° W S = 1.50 cm/g	N 83° W S = 1.47 cm/g	Up S = 2.30 cm/g	35 mm	6'
71.187	Los Angeles 3411 Wilshire Blvd.	5th Basement	MO-2	61	West S* = 1.64 cm/g	South S* = 1.59 cm/g	Up S* = 2.30 cm/g	35 mm	4'
71.188	Los Angeles 3550 Wilshire Blvd.	Basement	MO-2	194	West S = 1.52 cm/g	North S = 1.58 cm/g	Up S = 2.35 cm/g	35 mm	6'
71.189	Los Angeles 5260 Century Blvd.	Roof	MO-2	63	East S* = 1.57 cm/g	North S* = 1.58 cm/g	Up S* = 2.45 cm/g	35 mm	41'
71.190	Los Angeles 5260 Century Blvd.	1st Floor	MO-2	72	East S* = 1.63 cm/g	North S* = 1.61 cm/g	Up S* = 2.31 cm/g	35 mm	3'
71.191	Los Angeles 5260 Century Blvd.	4th Floor	MO-2	76	East S* = 1.63 cm/g	North S* = 1.61 cm/g	Up S* = 2.31 cm/g	35 mm	4'
71.192	Los Angeles 6464 Sunset Blvd.	Basement	MO-2	123	East S* = 1.52 cm/g	South S* = 1.49 cm/g	Up S* = 2.40 cm/g	35 mm	15'
71.193	Los Angeles 6464 Sunset Blvd.	12th Floor	MO-2	116	East S* = 1.51 cm/g	South S* = 1.57 cm/g	Up S* = 2.44 cm/g	35 mm	16'
71.194	Los Angeles 6430 Sunset Blvd.	1st Floor	MO-2	56	South S* = 1.57 cm/g	East S* = 1.54 cm/g	Up S* = 2.43 cm/g	35 mm	14'
71.195	Los Angeles 930 Hilgard Ave.	15th Floor	MO-2	158	N 76° W S = 1.54 cm/g	N 14° E S = 1.57 cm/g	Up S = 2.28 cm/g	35 mm	18'
71.196	Los Angeles 1900 Avenue of the Stars	Basement	MO-2	121	N 44° E S* = 1.58 cm/g	S 44° E S* = 1.58 cm/g	Up S* = 2.30 cm/g	35 mm	5'
71.197	Los Angeles 1900 Avenue of the Stars	29th Floor	MO-2	197	N 44° E S* = 1.54 cm/g	S 44° E S* = 1.54 cm/g	Up S* = 2.37 cm/g	35 mm	5'
71.198	Los Angeles 234 Figueroa St.	Basement	MO-2	54	S 53° E S* = 1.61 cm/g	N 37° E S* = 1.62 cm/g	Up S* = 2.46 cm/g	35 mm	3'
71.199	Los Angeles 234 Figueroa St.	Roof	MO-2	62	S 53° E S* = 1.65 cm/g	N 37° E S* = 1.62 cm/g	Up S* = 2.36 cm/g	35 mm	3'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address		Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.200	Los Angeles 533 S. Fremont Ave.	Basement	MO-2	73	N 30° W S* = 1.58 cm/g	S 60° W S* = 1.56 cm/g	Up S* = 2.40 cm/g	35 mm	4'
71.201	Los Angeles 533 S. Fremont Ave.	6th Floor	MO-2	93	N 30° W S* = 1.57 cm/g	S 60° W S* = 1.63 cm/g	Up S* = 2.44 cm/g	35 mm	4'
71.202	Los Angeles 11661 San Vicente Blvd.	5th Floor	MO-2	172	S 55° W S* = 1.53 cm/g	N 35° W S* = 1.58 cm/g	Up S* = 2.38 cm/g	35 mm	13'
71.203	Los Angeles 11661 San Vicente Blvd.	11th Floor	MO-2	198	S 55° W S* = 1.55 cm/g	N 35° W S* = 1.55 cm/g	Up S* = 2.41 cm/g	35 mm	13'
71.204	Los Angeles 15433 Ventura Blvd.	7th Floor	MO-2	104	N 12° E S* = 1.57 cm/g	N 78° W S* = 1.53 cm/g	Up S* = 2.48 cm/g	35 mm	8'
71.205	Los Angeles 15433 Ventura Blvd.	13th Floor	MO-2	86	N 12° E S* = 1.60 cm/g	N 78° W S* = 1.63 cm/g	Up S* = 2.37 cm/g	35 mm	19'
71.206	Los Angeles 2080 Century Park East	Roof	MO-2	199	N 40° W S* = 1.55 cm/g	N 50° E S* = 1.54 cm/g	Up S* = 2.43 cm/g	35 mm	9'
71.207	Los Angeles 3550 Wilshire Blvd.	Roof	MO-2	193	West S = 1.54 cm/g	North S = 1.49 cm/g	Up S = 2.40 cm/g	35 mm	12'
71.208	Los Angeles 3550 Wilshire Blvd.	11th Floor	MO-2	186	West S = 1.51 cm/g	North S = 1.58 cm/g	Up S = 2.32 cm/g	35 mm	7'
71.209	Los Angeles 3411 Wilshire Blvd.	Penthouse	MO-2	32	West S = 1.65 cm/g	South S = 1.54 cm/g	Up S = 2.47 cm/g	35 mm	3'
71.210	Los Angeles 3411 Wilshire Blvd.	13th Floor	MO-2	68	West S = 1.61 cm/g	South S = 1.59 cm/g	Up S = 2.48 cm/g	35 mm	4'
71.211	Los Angeles 533 S. Fremont Ave.	11th Floor	MO-2	77	N 30° W S = 1.57 cm/g	S 60° W S = 1.58 cm/g	Up S = 2.50 cm/g	35 mm	7'
71.212	Los Angeles 222 Figueroa St.	12 Floor	MO-2	192	S 37° W S = 1.48 cm/g	N 53° W S = 1.52 cm/g	Up S = 2.36 cm/g	35 mm	6'
71.213	Los Angeles 930 Hilgard Ave.	8th Floor	MO-2	200	N 76° W S = 1.50 cm/g	N 14° E S = 1.55 cm/g	Up S = 2.38 cm/g	35 mm	13'
71.214	Los Angeles 930 Hilgard Ave.	Basement	MO-2	166	N 76° W S = 1.51 cm/g	N 14° E S = 1.53 cm/g	Up S = 2.34 cm/g	35 mm	23'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.215	Los Angeles 9100 Wilshire Blvd.	Roof Level	MO-2	107	East S = 1.58 cm/g	South S = 1.56 cm/g	Up S = 2.39 cm/g	35 mm	7'
71.216	Los Angeles 1900 Avenue of the Stars	16th Floor	MO-2	144	N 44° E S = 1.52 cm/g	S = 46° E S = 1.53 cm/g	Up S = 2.31 cm/g	35 mm	8'
71.217	Maricopa	Array Sta. 1	RFT-250	191	S 40° W S = 1.9 cm/g	Down S = 1.9 cm/g	S 50° E S = 1.9 cm/g	70 mm	3'
71.218	Maricopa	Array Sta. 2	RFT-250	192	S 40° W S = 1.9 cm/g	Down S = 1.9 cm/g	S 50° E S = 1.9 cm/g	70 mm	3'
71.219	Isabella Dam	Gallery	RFT-250	108	N 14° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 76° W S = 1.9 cm/g	70 mm	3'
71.220	Isabella Dam	Auxiliary Abutment	RFT-250	112	N 14° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 76° W S = 1.9 cm/g	70 mm	3'
71.221	Isabella Dam	Auxiliary Crest	RFT-250	110	N 14° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 76° W S = 1.9 cm/g	70 mm	3'
71.222	Isabella Dam	Control Tower	RFT-250	111	N 14° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 76° W S = 1.9 cm/g	70 mm	3'
71.223	Isabella Dam	Crest	RFT-250	109	N 14° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 76° W S = 1.9 cm/g	70 mm	3'
71.224	Terminus Dam	Control Tower	RFT-250	105	S 81° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 9° E S = 1.9 cm/g	70 mm	3'
71.225	Terminus Dam	Crest	RFT-250	106	S 61° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 9° E S = 1.9 cm/g	70 mm	2'
71.226	Terminus Dam	North Abutment	RFT-250	107	S 81° E S = 1.9 cm/g	Down S = 1.9 cm/g	N 9° E S = 1.9 cm/g	70 mm	3'
71.227	Loma Linda Loma Linda University	Medical Center Basement	RFT-250	187	East S* = 1.9 cm/g	Down S* = 1.9 cm/g	North S* = 1.9 cm/g	70 mm	'
71.228	San Diego Gas and Electric Bldg.	Basement	RFT-250	209	East S* = 1.9 cm/g	Down S* = 1.9 cm/g	North S* = 1.9 cm/g	70 mm	5'
71.229	Anza Anza Post Office	Storage Room	RFT-250	181	N 45° E S* = 1.9 cm/g	Down S* = 1.9 cm/g	N 45° W S* = 1.9 cm/g	70 mm	4'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.230	Borrego Springs Fire Dept.	Shop	RFT-250	157	S 45° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 45° E S* = 1.9 cm/g	70 mm	3'
71.231	El Centro	Community Hospital	RFT-250	182	S 52° W S* = 1.97 cm/g	Down S* = 1.9 cm/g	S 38° E S* = 1.97 cm/g	70 mm	6'
71.232 Aftershock	Sand Canyon	Los Angeles County Fire Sta.	SMA-1	168	N 45° E S = 1.79 cm/g	Down S = 1.91 cm/g	N 45° W S = 1.87 cm/g	70 mm	3'
71.233 Aftershock	Los Angeles Van Norman Resv.	Meter House	SMA-1	214	North S = 1.85 cm/g	Down S = 1.85 cm/g	West S = 1.95 cm/g	70 mm	5'
71.234	Hemet Fire Station	Hose Storage Room	RFT-250	159	S 45° W S* = 1.9 cm/g	Down S* = 1.9 cm/g	S 45° E S* = 1.9 cm/g	70 mm	5'
71.235	Bakersfield	Harvey Auditorium	C&GS DM	18	LDM	West	MAG = 1	6"	3'
71.236	Bakersfield	Harvey Auditorium	C&GS DM	18	RDM	South	MAG = 1	6"	3'
71.237	Bakersfield	Harvey Auditorium	C&GS DM	29	Up S = 13.3 cm/g	South S = 13.4 cm/g	West S = 13.0 cm/g	6"	4'
71.238	Taft Lincoln School	Tunnel	C&GS	6	Up S = 18.0 cm/g	N 21° E S = 19.9 cm/g	S 69° E S = 20.2 cm/g	6"	7'
71.239	San Diego Light and Power Co.	Service Building	C&GS	5D	Up S = 20.3 cm/g	East S = 19.5 cm/g	South S = 20.1 cm/g	6"	8'
71.240	Cholame-Shandon	Array Sta. 2	AR-240	133	N 51° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 39° W S* = 7.6 cm/g	12"	4'
71.241	Cholame-Shandon	Array Sta. 8	AR-240	166	N 51° E S* = 7.6 cm/g	Down S* = 7.6 cm/g	N 39° W S* = 7.6 cm/g	12"	4'
71.242	Taft Lincoln School	Roof	AR-240	271	S 21° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 69° E S* = 7.6 cm/g	12"	6'
71.243	Buena Vista Taft	CWR site	AR-240	107	South S* = 7.6 cm/g	Down S* = 7.6 cm/g	East S* = 7.6 cm/g	12"	6'

*Nominal Sensitivity

NATIONAL OCEAN SURVEY NOAA: SEISMOLOGICAL FIELD SURVEY FOR EARTHQUAKE ON FEB. 9, 1971 (Contd)

Log No.	Address	Location	Machine type	Serial No.	Other identifying numbers			Record	
					1	2	3	Type	Length
71.244	Hoover Dam	Intake Tower	C&GS	B-2	Up S = 19.1 cm/g S 45° W** MAG = 1.1	N 45° W S = 20.8 cm/g N 45° W*** MAG = 1.1	N 45° E S = 20.9 cm/g	12"	6'
71.245	Hoover Dam	Oil House	C&GS	B-3	Up S = 19.3 cm/g S 45° W** MAG = 1.0	N 45° W S = 19.9 cm/g	N 45° W MAG = 1.0 N 45° E*** S = 20.2 cm/g	12"	8'
71.246	Hoover Dam	1215 Gallery	C&GS	B-1	Up S = 19.7 cm/g	S 45° W MAG = 1.0 S 45° E** S = 19.4 cm/g	S 45° E MAG = 1.0 S 45° W*** S = 19.3 cm/g	12"	7'
71.247	Los Angeles 808 S. Olive Ave.	Basement	AR-240	198	S 37° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 53° E S* = 7.6 cm/g	12"	18'
71.248	Cedar Springs	Pump House	AR-240	187	S 36° W S* = 7.6 cm/g	Down S* = 7.6 cm/g	S 54° E S* = 7.6 cm/g	12"	3'
71.249 After-shock	Los Angeles 8244 Orion	8th Floor	AR-240	199	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	5'
71.250 After-shock	Los Angeles 8244 Orion Blvd.	4th Floor	AR-240	210	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	5'
71.251 After-shock	Los Angeles 8244 Orion Blvd.	1st Floor	AR-240	190	North S* = 7.6 cm/g	Down S* = 7.6 cm/g	West S* = 7.6 cm/g	12"	6'

*Nominal Sensitivity.
**Identifying Number, 4.
***Identifying Number, 5.

Sample Accelerograms. Examples of sets of three building accelerograms obtained with AR-240 accelerographs on 12 in. wide paper may be seen in Figures 4 and 5 of Chapter 1 by Maley and Cloud. Examples of AR-240 records of ground sites are shown in Figure 6 of Chapter 1. Typical building records obtained on 70 mm. film with the SMA-1 accelerograph are shown in Figure 7, and on 35 mm. film with the MO-2 accelerograph in Figure 8, Chapter 1. A ground station record from an SMA-1 accelerograph is included as Figure 1 of the present chapter.

The records of Figure 2 are from a telephone line interconnected accelerograph system joining the Caltech campus, the Seismological Laboratory, and the Jet Propulsion Laboratory, over a distance of some six miles. These five RFT-250 accelerographs are so arranged that the first one to trigger from earthquake ground motion will simultaneously start the other instruments in the network.* For the San Fernando earthquake, the Seismological Laboratory and the Jet Propulsion Laboratory accelerographs should trigger about the same time, some one to two seconds before the initial earthquake waves would reach the Millikan Library accelerograph on the Caltech campus. A comparison of the records of Figure 2 shows that the Millikan Library recording was started in advance of the main earthquake ground motions as indicated at the other stations. A comparison of the Millikan Library record with that obtained at another building on the campus, the Athenaeum, which was not on the interconnected network,

*Keightley, W. O., "A Strong-Motion Accelerograph Array with Telephone Line Interconnections," Report No. EERL 70-05, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, 1970.

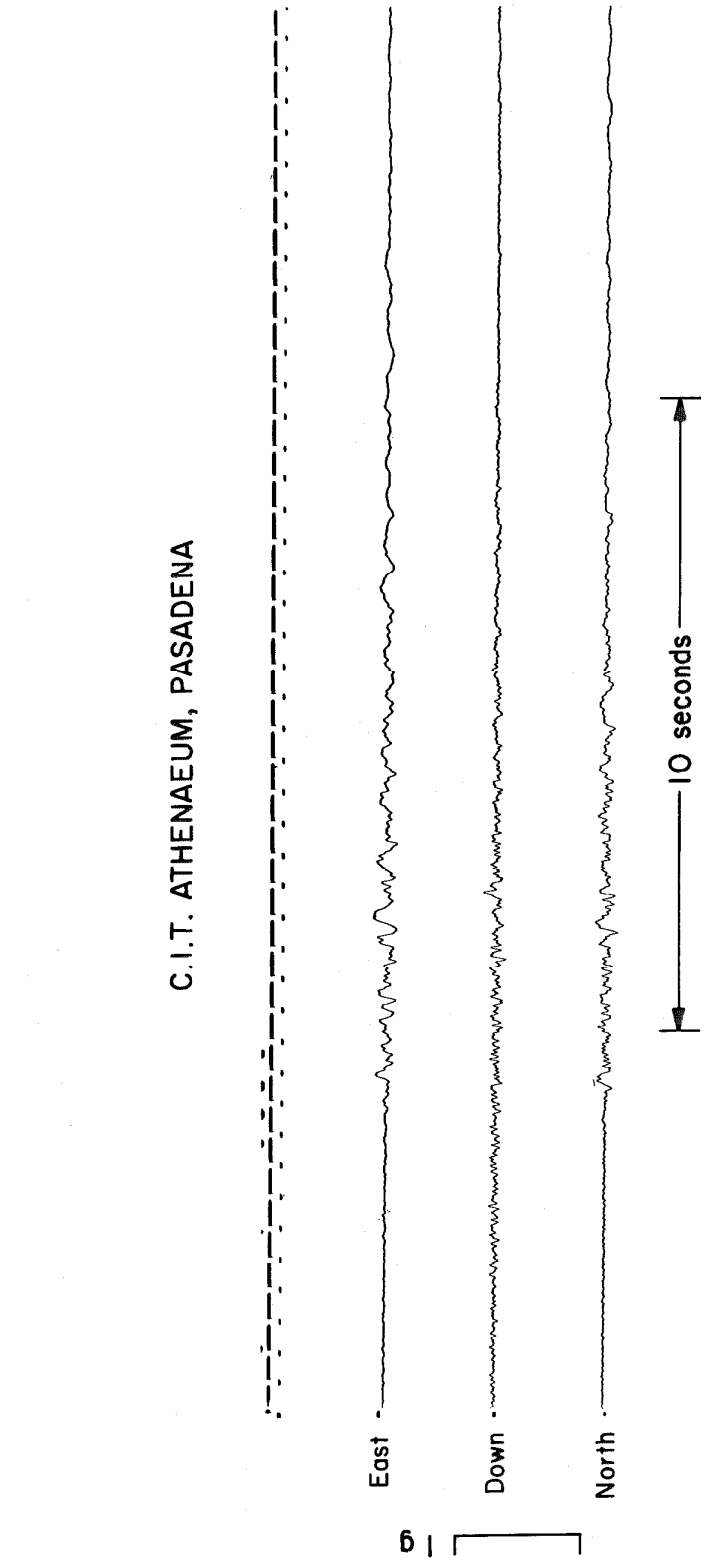

Figure 1 SMA-1 Accelerograph record from the Athenaeum, California Institute of Technology, Pasadena.

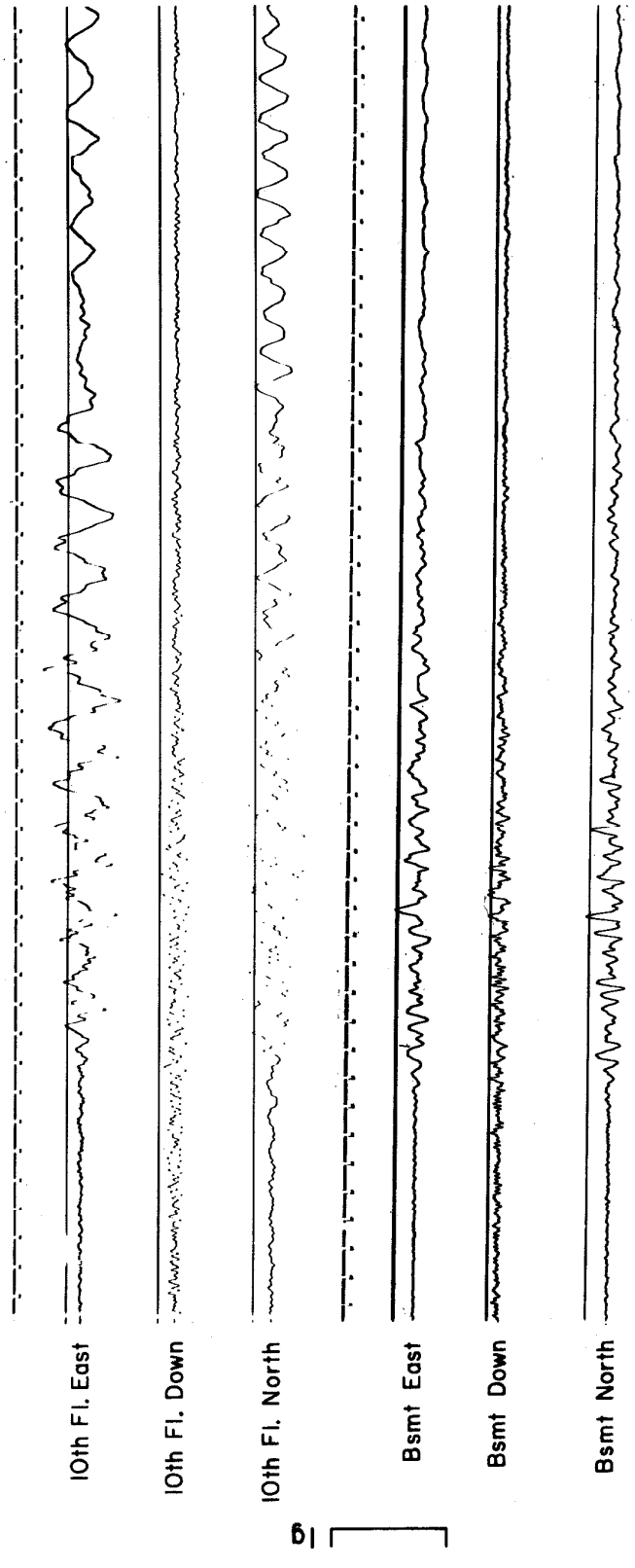

Figure 2a Accelerograph record from the interconnected instrument system, Millikan Library station on the C.I.T. campus, Pasadena.

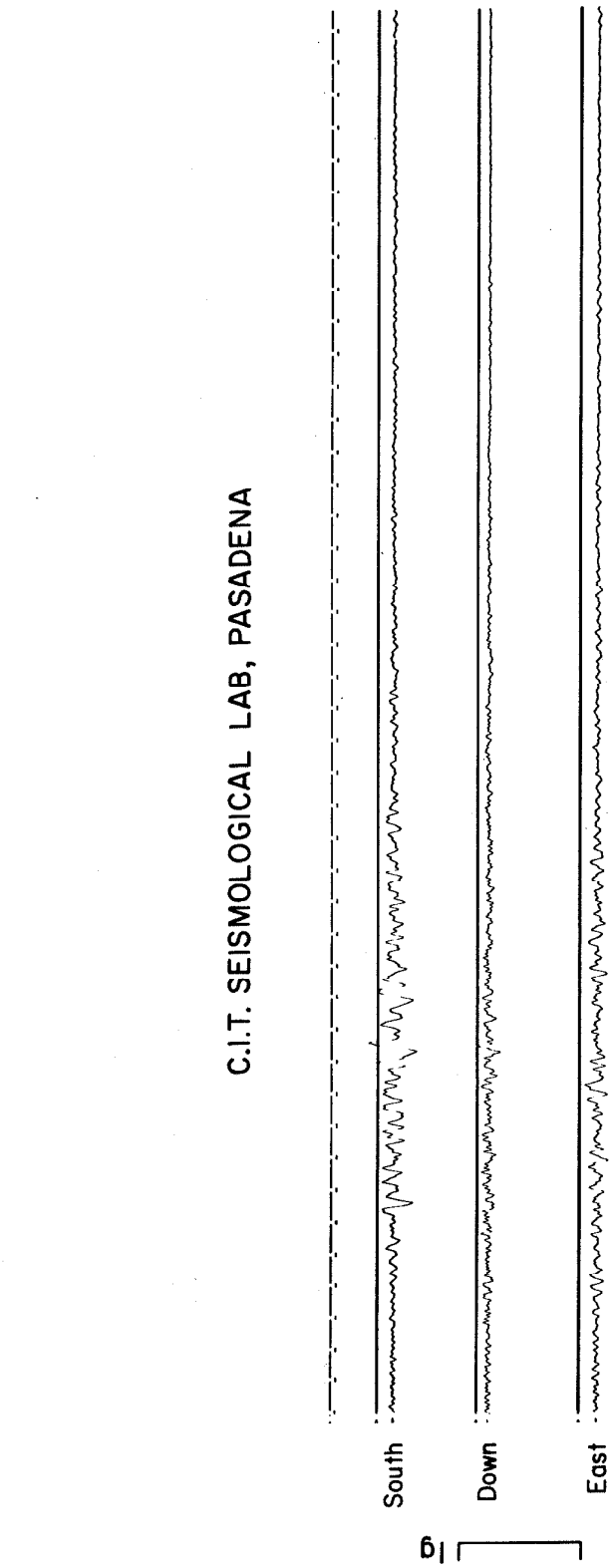

Figure 2b Accelerograph record from the interconnected instrument system station at the C.I.T. Seismological Laboratory, Pasadena.

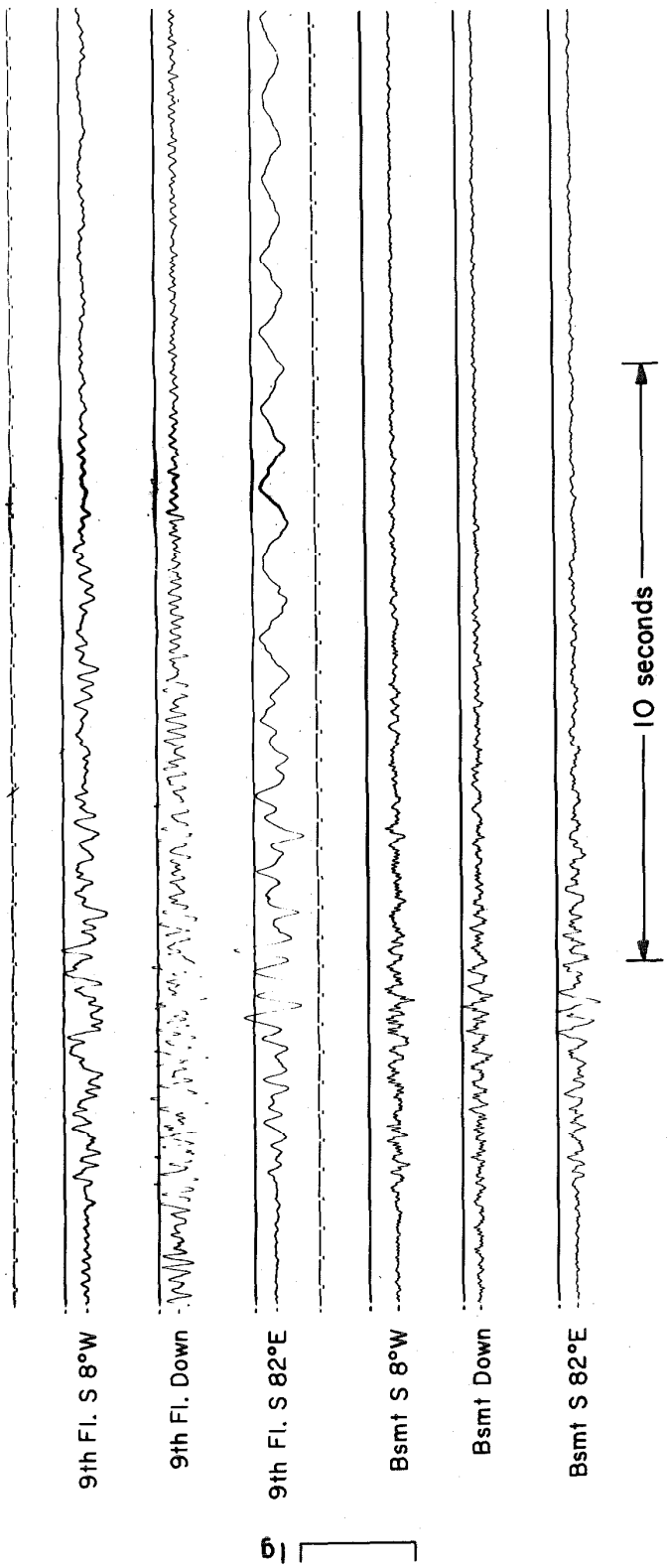

Figure 2c Accelerograph record from the interconnected instrument system station at the Jet Propulsion Laboratory, Pasadena.

indicates that the self-triggered Athenaeum accelerograph started before the distance-triggered Library instrument. This is because the SMA-1 accelerograph in the Athenaeum is triggered by a vertical starter, and the arrival of the vertical waves preceded the arrival of the horizontal waves which triggered the RFT-250 accelerographs in the network by an amount more than enough to make up for the gain in triggering time in the interconnected network. In this case the vertical starter was evidently a simpler way to ensure an early start than the interconnected network.

It is also evident that the additional complexity of the interconnection system has not reduced the reliability of the system, which operated correctly in all respects. For this particular earthquake, the main ground motion was preceded by smaller shaking which served to start the accelerograph in good time to record a relatively complete picture of significant ground motion. The telephone interconnected system, or an accelerograph with a memory, was therefore not required. This is probably also likely to be true for most damaging earthquakes, although the possibility certainly exists that in some cases some information might be lost for an abrupt beginning.

Millikan Library Response. The accelerogram of Figure 2a taken on the roof of the nine-story Millikan Library on the Caltech campus is of unusual interest because of the complete dynamic investigations which had been made on this building before the earthquake. *

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*Kuroiwa, J. H., "Vibration Test of a Multistory Building," Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, 1967.

Blandford, R. R., McLamore, V. R., and Aunon, J., "Structural Analysis of Millikan Library from Ambient Vibrations," Report No. 616-0268-2107, Teledyne Earth Sciences, February, 1968.

In Figure 3a is shown the record of a man-excited low-level vibration which indicates that the fundamental EW lateral natural period of vibration at small amplitudes of motion was 0.66 seconds before the earthquake. This value was also confirmed by forced vibration resonance tests at a considerably higher force level, and by ambient vibration tests involving wind and microtremor excitations. The earthquake accelerogram of Figure 3b shows that during the earthquake vibrations, which reached a peak acceleration of 0.37 g, the period of fundamental mode was 1.01 seconds. This considerable lengthening of the period is to be attributed to the much higher levels of the building motion and to the nonlinear character of the structure.

The accelerogram of Figure 3c shows that for the small building motions excited by a small earthquake aftershock, the fundamental period was 0.76 seconds. A low-level wind-excited test was then run to check the final post-earthquake state of the building, and the period was found to be 0.77 seconds, as in Figure 3d. It is evident that after the earthquake the small-amplitude motion had been permanently lengthened by some 15 percent. There was apparently no significant structural damage to the building, and the period change is probably to be attributed to alterations in the attachment of pre-cast concrete window panel sections which made up the N-S faces of the building.

Such permanent period changes have been noted in past earthquakes*, and have been observed in numerous buildings during the San Fernando earthquake, as will be reported in more detail in the course of investigations now being conducted.

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*Esteva, L., y Nieto, J. A., "El Temblor de Lima, Peru, October 17, 1966," Vol. XXXVII, Revista Ingenieria, Mexico, 1967.

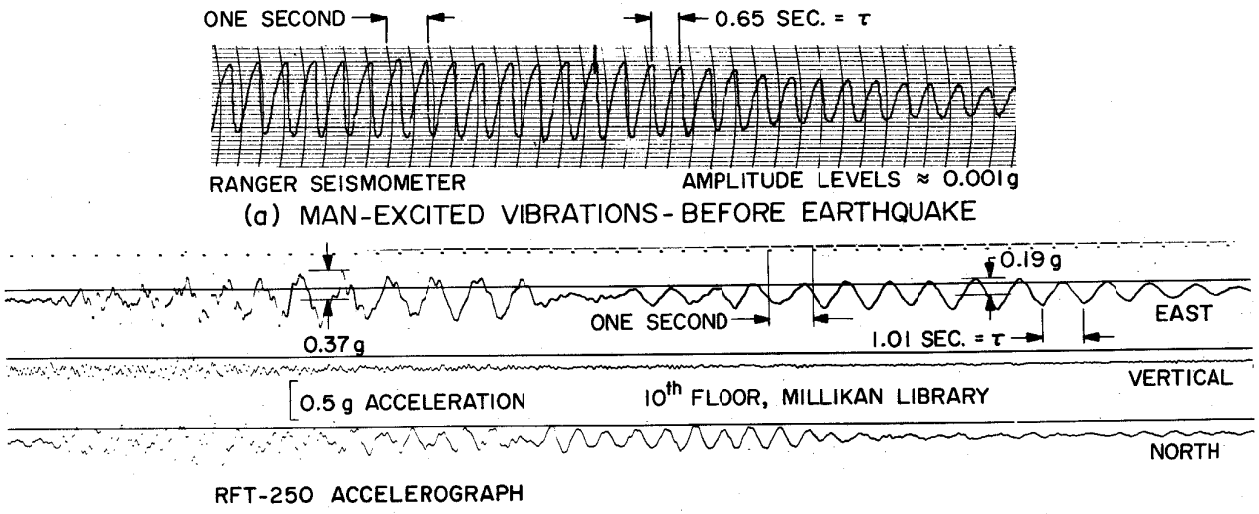

Figure 3. Instrument records from Millikan Library.

The Pacoima Dam Accelerogram. Because of the very special interest and importance of the Pacoima Dam record, which was obtained virtually on top of the earthquake, a special effort was made for a prompt analysis of the record and dissemination of the results. Since the site conditions under which the record was obtained were unusual, a special investigation was made of the situation there, and of the condition of the accelerograph after the earthquake. These investigations, and the analysis of the accelerogram, have been detailed in a paper to appear in a future issue of the Bulletin of the Seismological Society of America. To make this information available at an earlier date, the paper is being reproduced with some additions as Chapter 6 of the present report.

Response Spectrum Calculations. The response spectrum of the Pacoima Dam record, along with integrated ground velocity and displacement curves, is given in Chapter 6 following. Because of the special interest in response spectra from other key stations in the region, preliminary spectra have been computed from the uncorrected accelerogram data for several additional records, as given in Figures 4, 5, 6 and 7. These preliminary spectra will be superseded by slightly more accurate curves calculated according to standard procedures*, but the small differences involved will not be

[1] "Strong-Motion Earthquake Accelerogram - Digitized and Plotted Data," vol. I, part A, EERL 70-20, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, July 1969.

[2] Trifunac, M. D., "Low Frequency Digitization Errors and a New Method for Zero Baseline Correction of Strong-Motion Accelerograms," EERL 70-07, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, September 1970.

[3] Trifunac, M. D., F. E. Udwadia, and A. G. Brady, "High Frequency Errors and Instrument Corrections of Strong-Motion Accelerograms," EERL 71-05, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, July 1971.

[4] "Strong-Motion Earthquake Accelerograms - Digitized and Plotted Data," vol. II, part A. Corrected Accelerograms and Integrated Ground Velocity and Displacement Curves, EERL 71-50, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, July 1971.

significant for most engineering applications. In Figures 4 through 7 the top curve is for zero damping, and the lower three curves are for 2%, 5% and 10% damping respectively.

Acknowledgments. It will be recognized that the above data handling and processing program involved the cooperation of a large number of organizations and individuals, many of whom made major contributions of time under difficult circumstances. We particularly appreciate the fine cooperation we have always received from the Seismological Field Survey (NOAA) including W. K. Cloud, chief; W. R. Maley, head of the Los Angeles office; and E. C. Etheridge, of the Los Angeles staff. From the San Francisco office of the Seismological Field Survey, C. F. Knudson, B. J. Morrill, and their staff of technicians rendered great assistance. Virgilio Perez of the San Francisco office carried out the exacting job of preliminary checking and scaling of the records, and assisted with record digitization. A key member of the Caltech staff was Richard J. Dielman, who has been assisting the Seismological Field Survey with field installation and servicing, and who rendered great service after the earthquake in the recovery of records, in accelerograph site investigations, and in the handling of the records for processing. We were very fortunate in being able to borrow from the Lamont-Doherty Geological Observatory of Columbia University the services of M. D. Trifunac, whose past experience in accelerograph data processing proved invaluable to us. A. G. Brady, with the assistance of A. Vijayaraghavan, in a remarkably short time trained a very effective team of digitizing operators, and carried out the complicated programming details necessary for computer processing of the accelerograms. At the Jet Propulsion Laboratory we received very quick cooperation

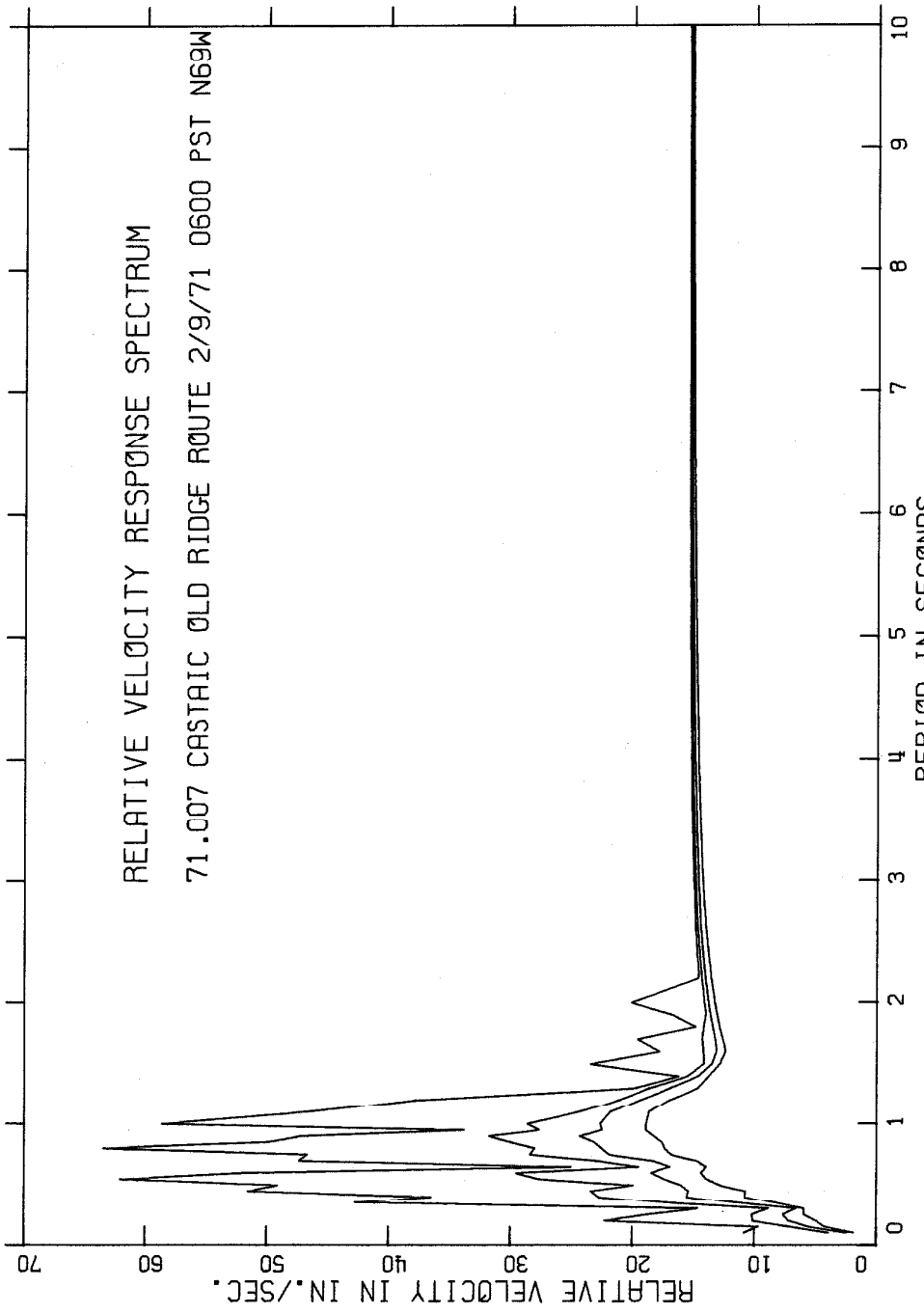

Figure 4a Preliminary Relative Velocity Response Spectrum for Castaic Old Ridge Route Station - Horizontal Component, N69W, 29 km. from epicenter.

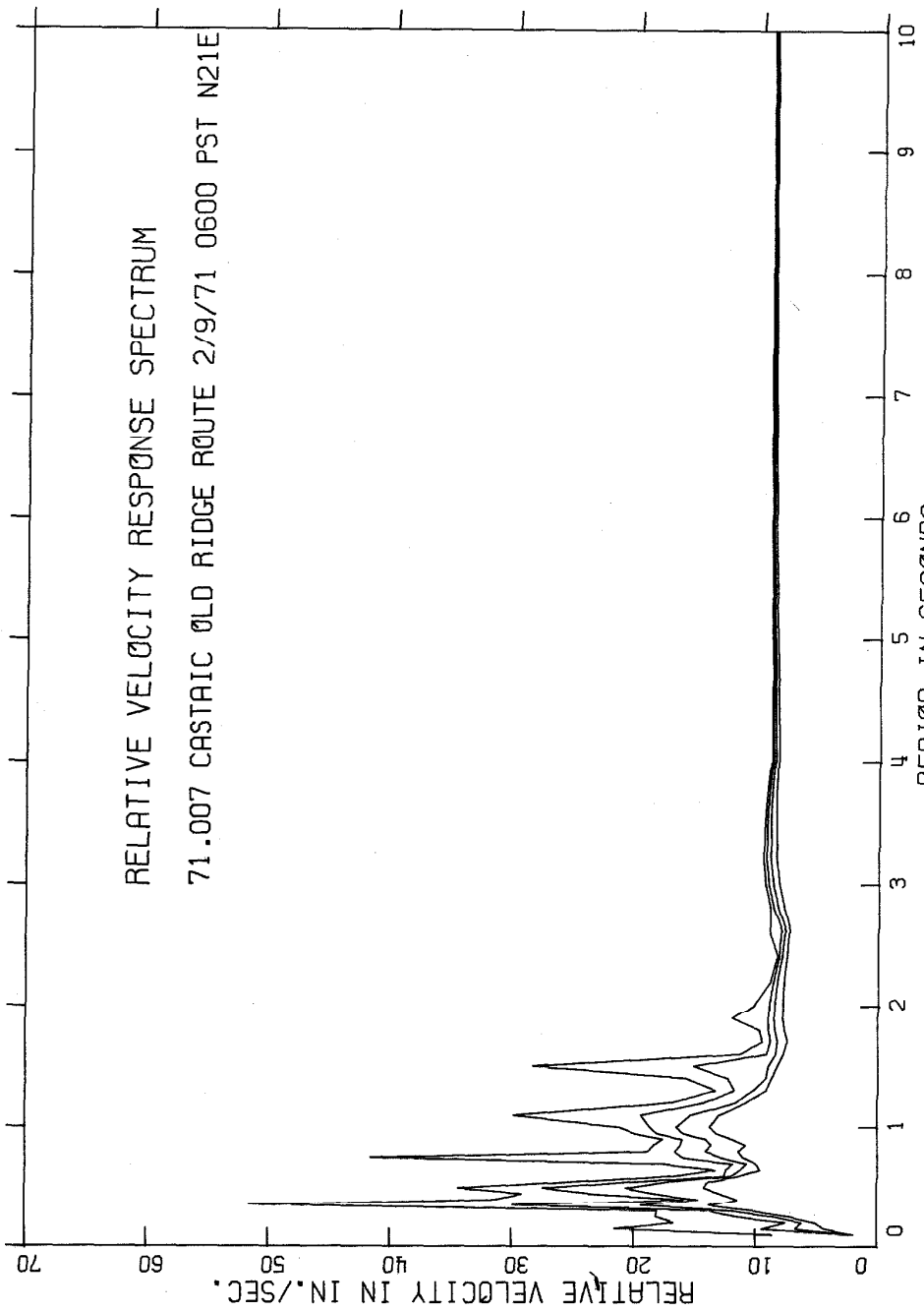

Figure 4b Preliminary Relative Velocity Response Spectrum for Castaic Old Ridge Route Station - Horizontal Component, N21E, 29 km. from epicenter.

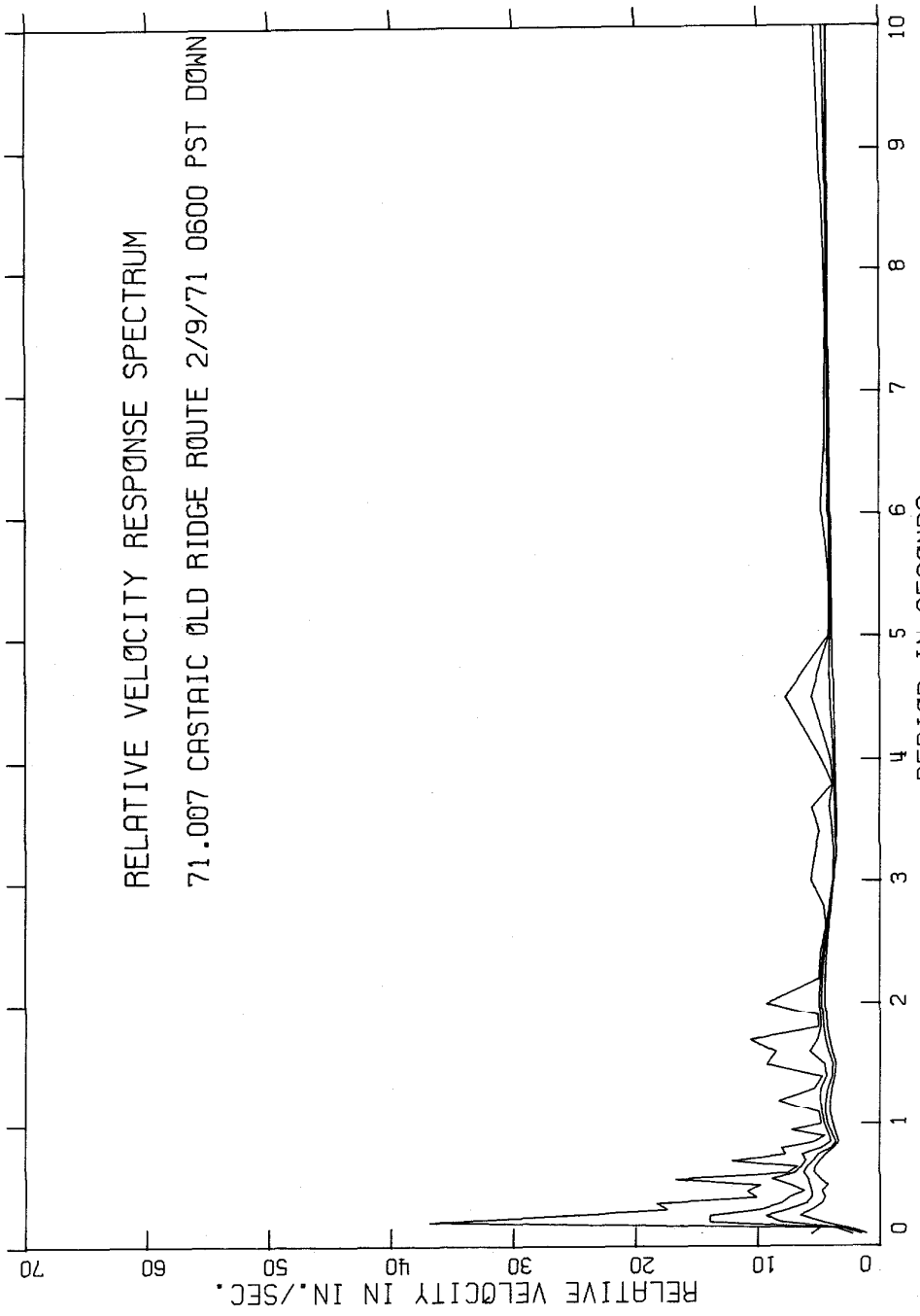

Figure 4c Preliminary Relative Velocity Response Spectrum for Castaic Old Ridge Route Station - Vertical Component, 29 km. from epicenter.

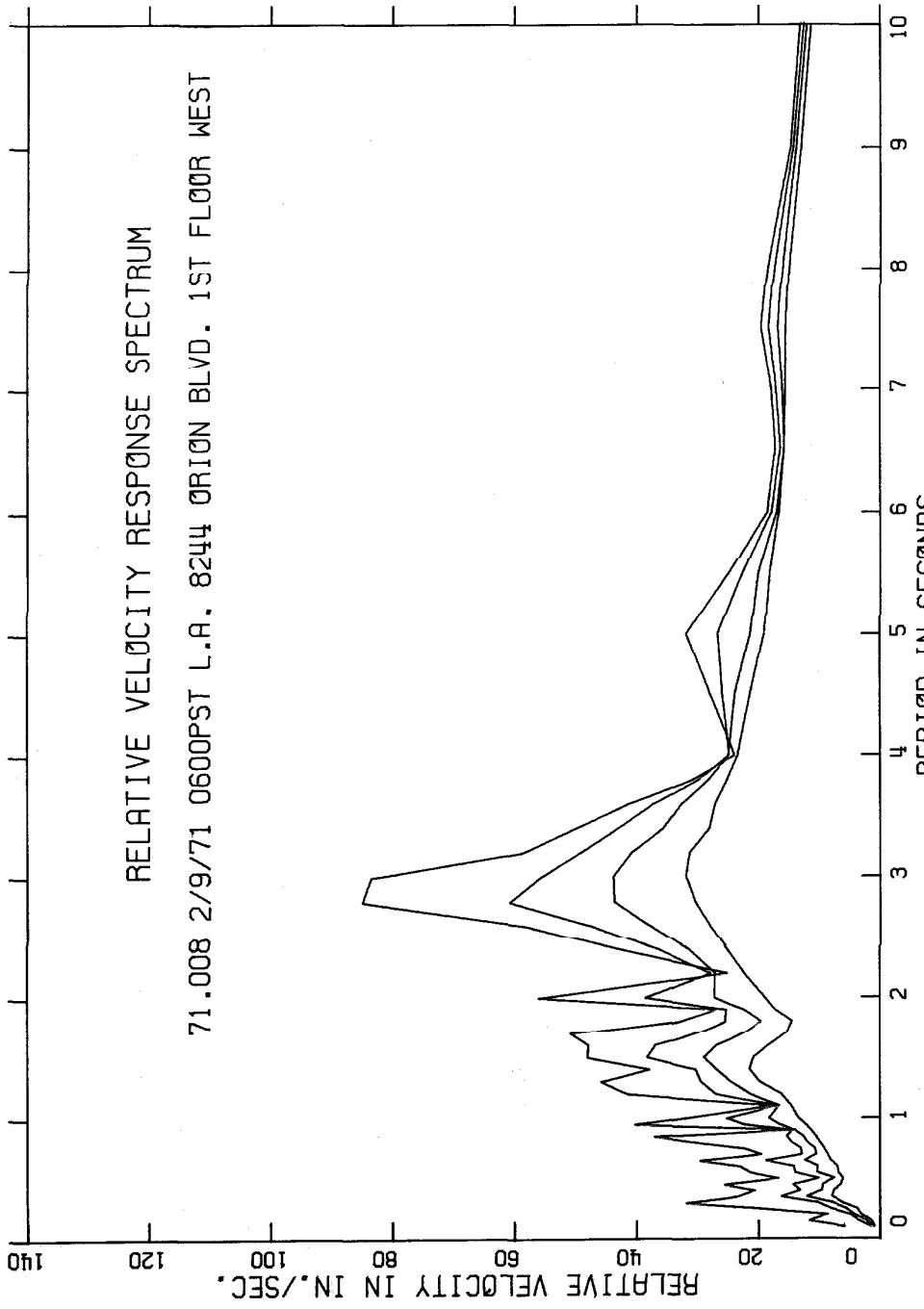

Figure 5a Preliminary Relative Velocity Response Spectrum for 8244 Orion St. Station - Horizontal Component, West, 20 km. from epicenter.

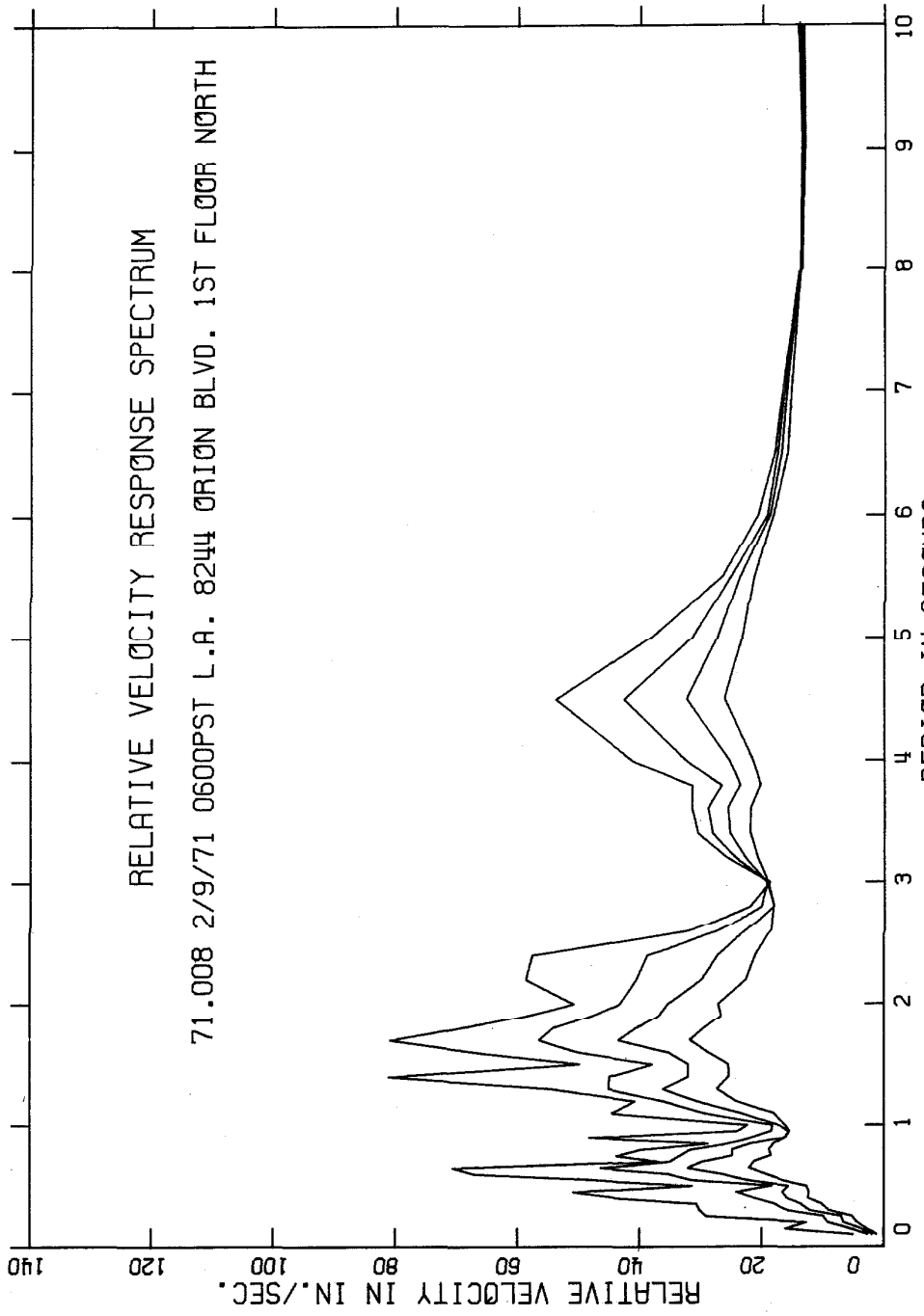

Figure 5b Preliminary Relative Velocity Response Spectrum for 8244 Orion St. Station - Horizontal Component, North, 20 km. from epicenter.

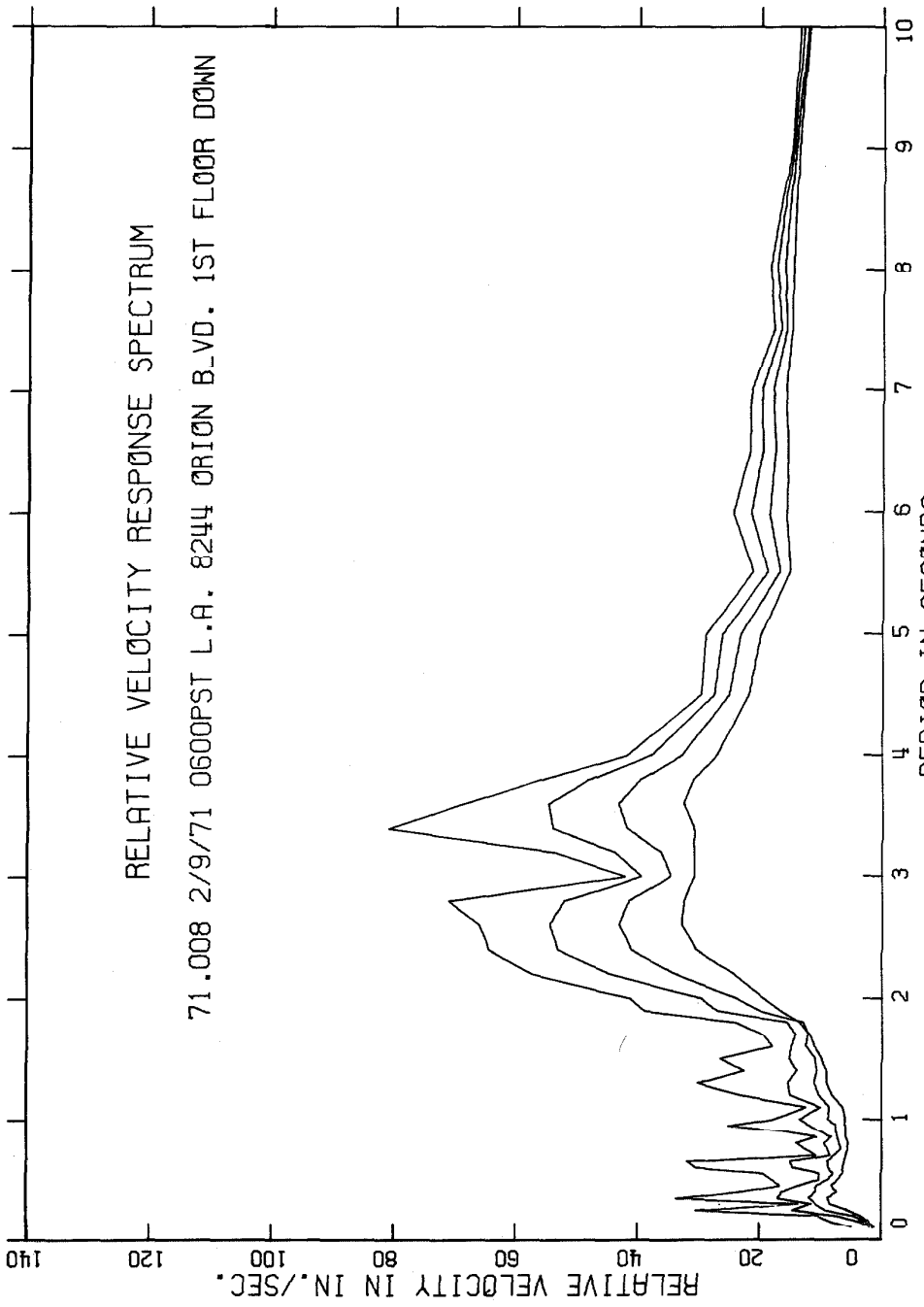

Figure 5c Preliminary Relative Velocity Response Spectrum for 8244 Orion St. Station - Vertical Component, 20 km. from epicenter.

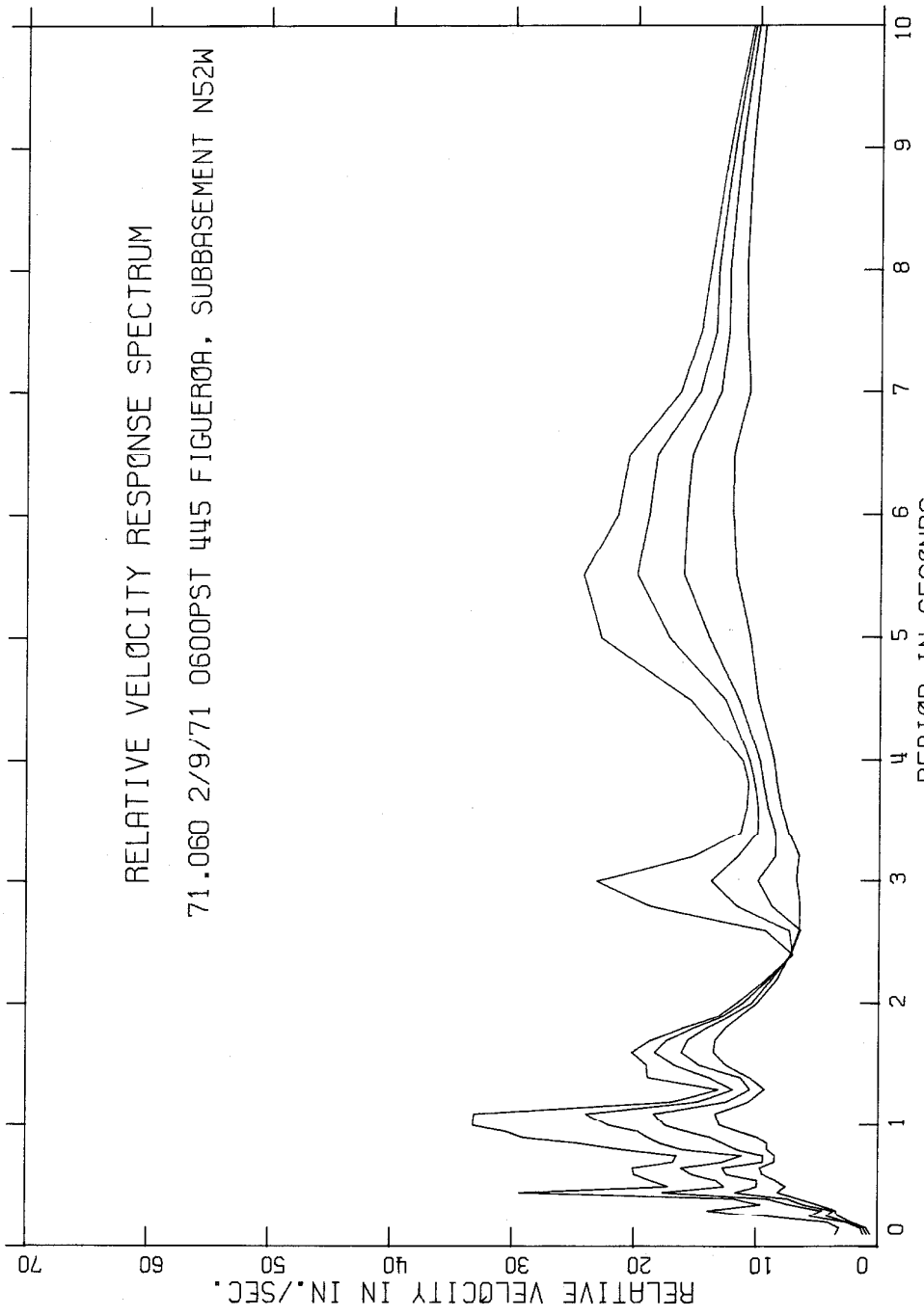

Figure 6a Preliminary Relative Velocity Response Spectrum for 445 S. Figueroa Station - Horizontal Component, N52W, 41 km. from epicenter.

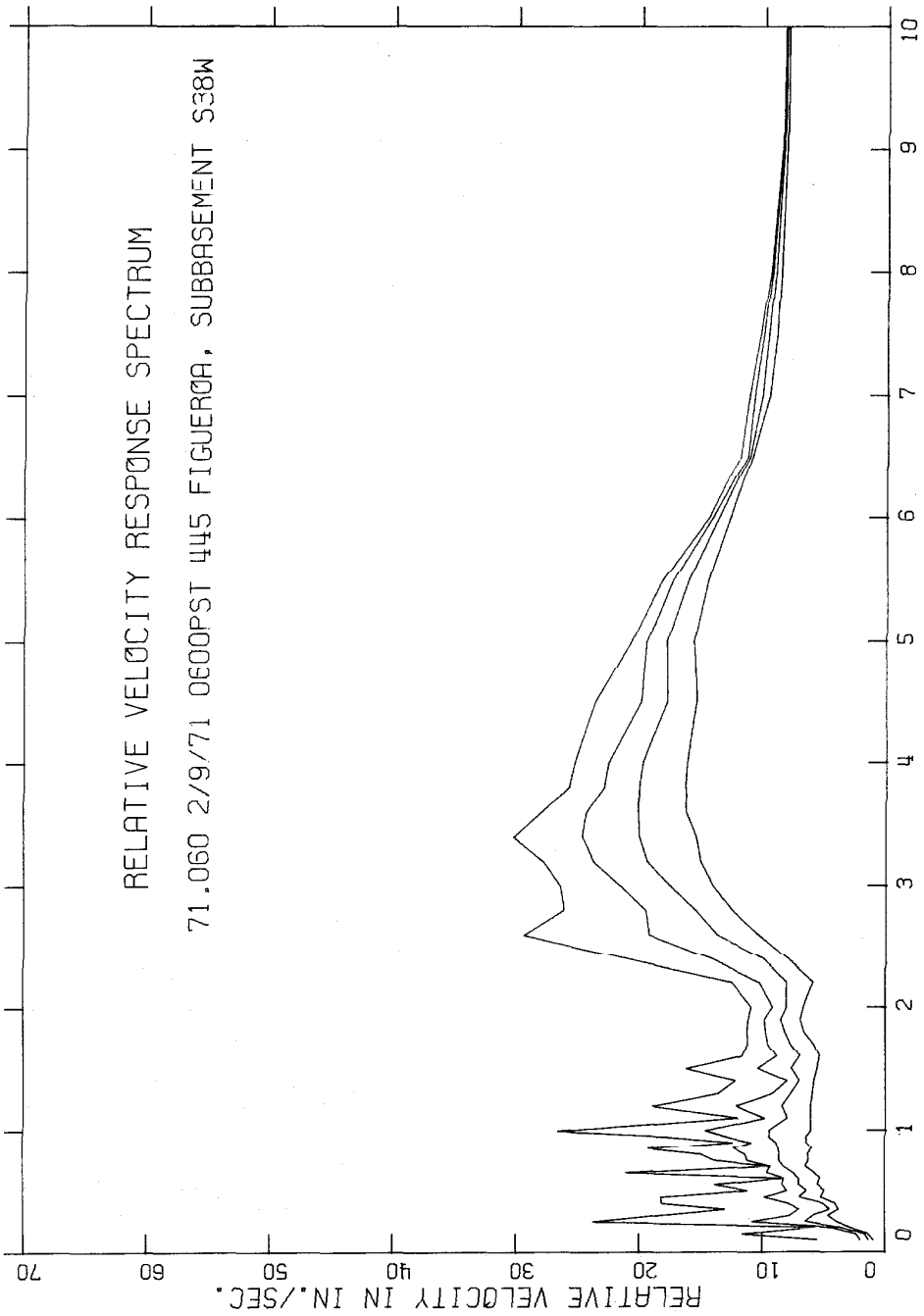

Figure 6b Preliminary Relative Velocity Response Spectrum for 445 S. Figueroa Station - Horizontal Component, S38W, 41 km. from epicenter.

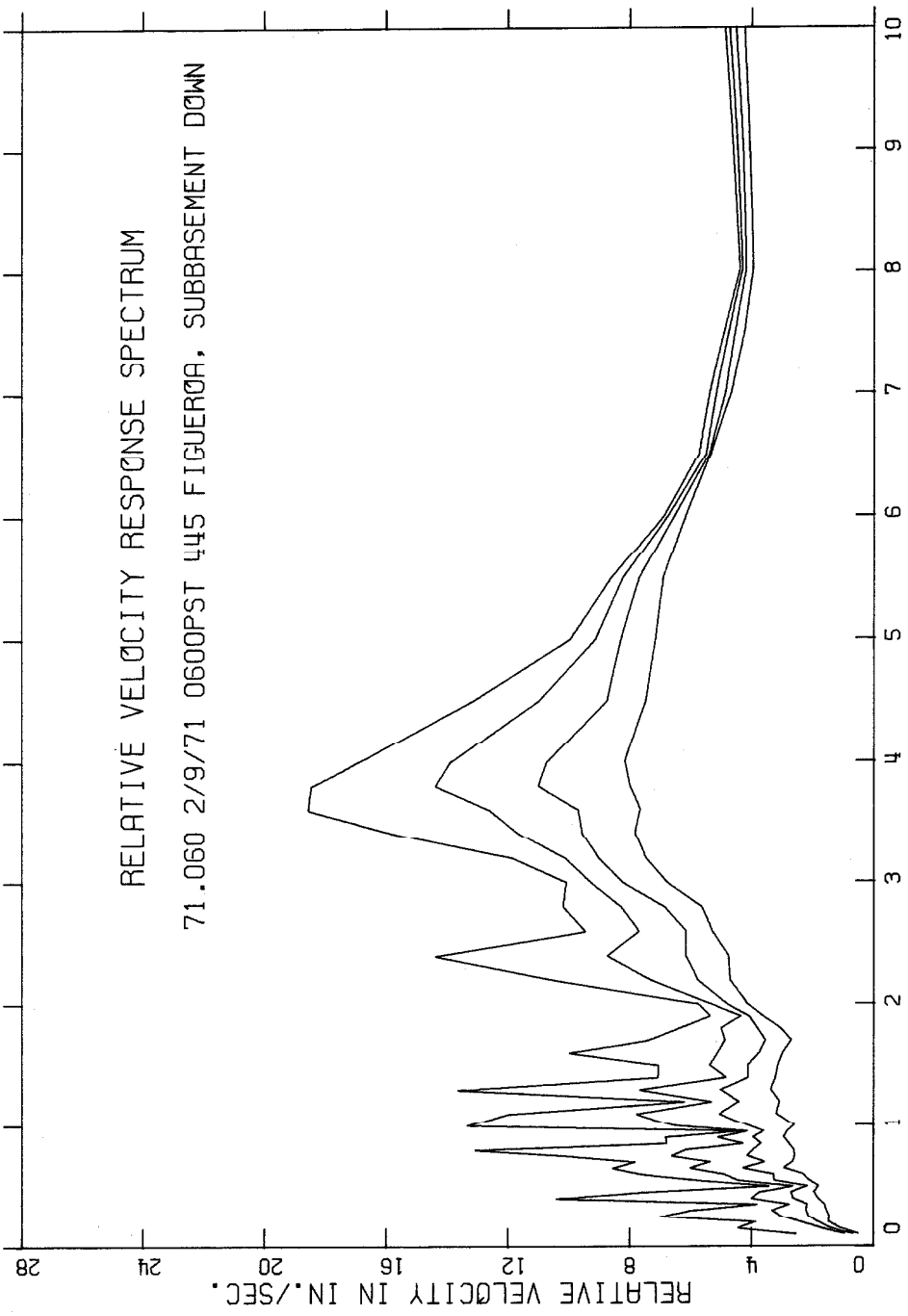

Figure 6c Preliminary Relative Velocity Response Spectrum for 445 S. Figueroa Station - Vertical Component, 41 km. from epicenter.

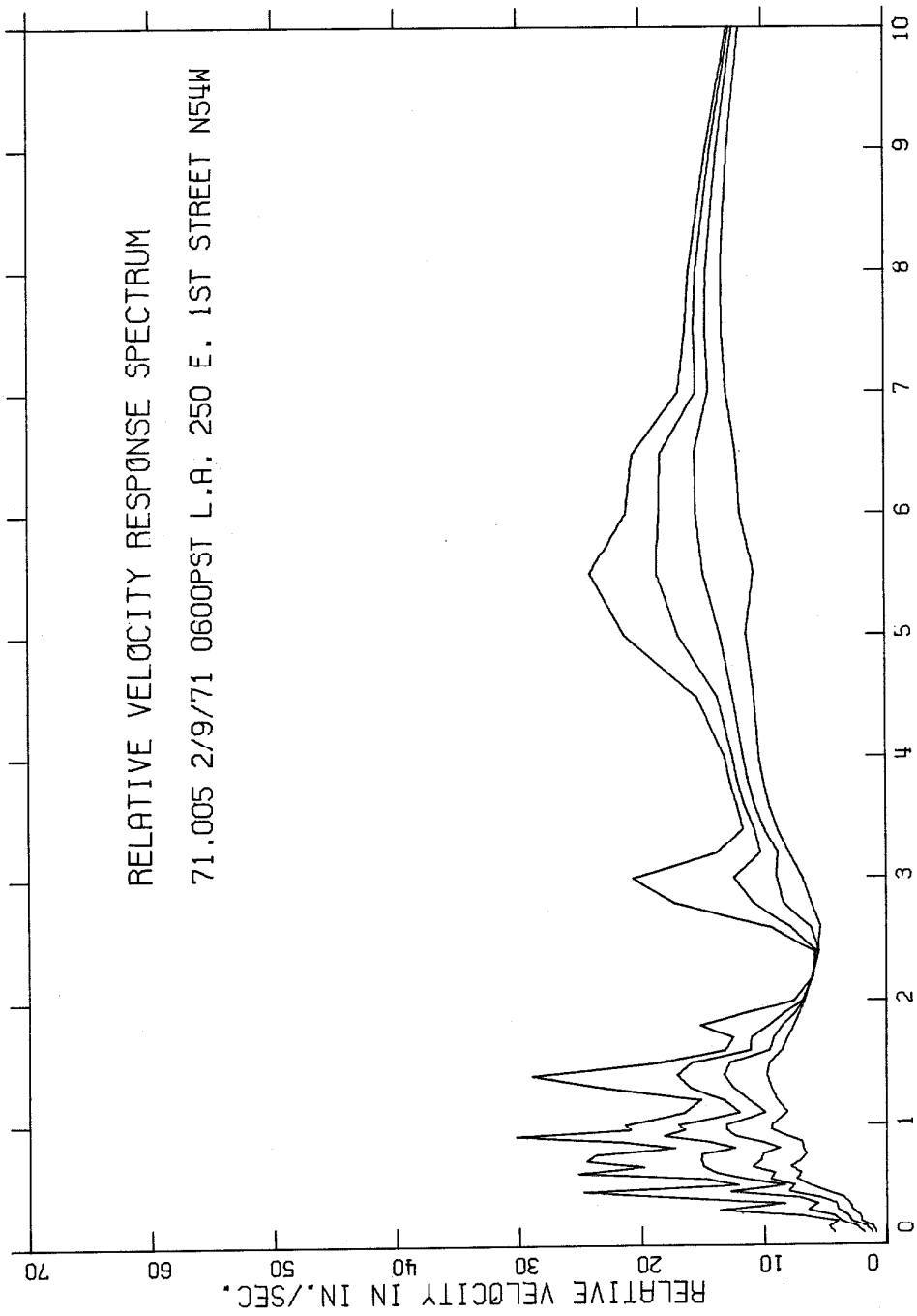

Figure 7a Preliminary Relative Velocity Response Spectrum for 250 E. First Station - Horizontal Component, N54W, 41 km. from epicenter.

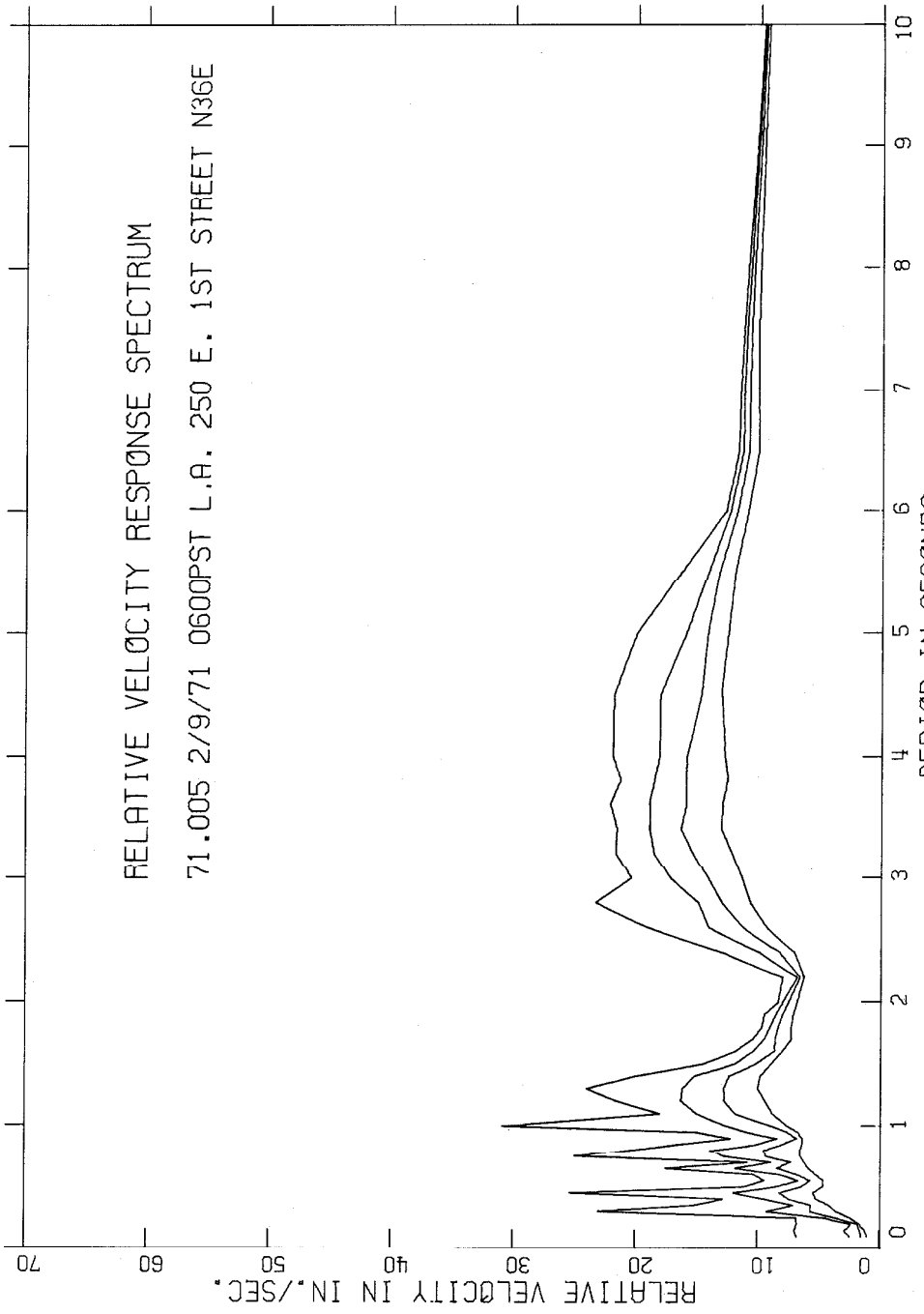

Figure 7b Preliminary Relative Velocity Response Spectrum for 250 E. First Station,- Horizontal Component, N36E, 41 km. from epicenter.

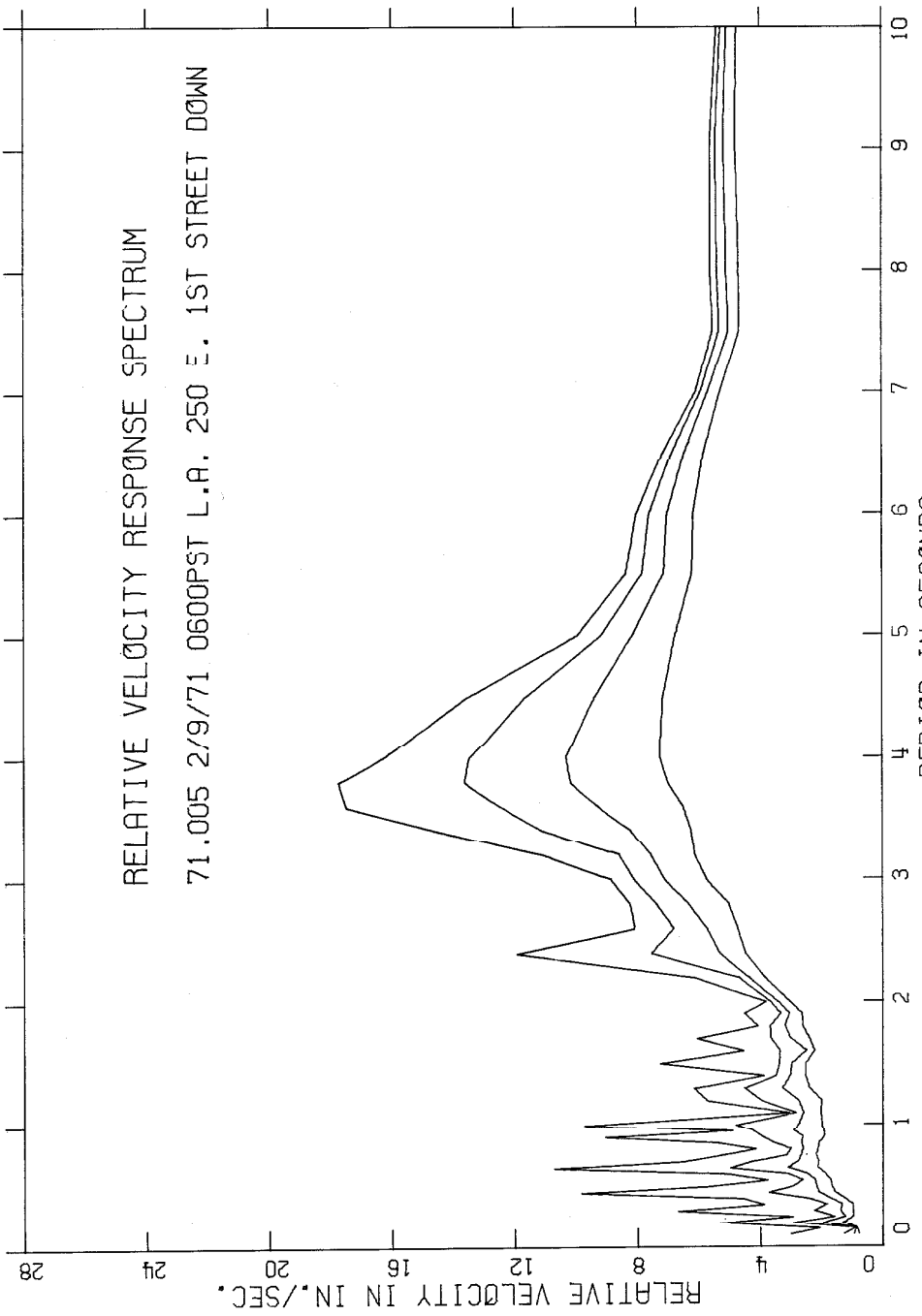

Figure 7c Preliminary Relative Velocity Response Spectrum for 250 E. First Station - Vertical Component, 41 km. from epicenter.

from W. H. Pickering, director, and M. E. Alper, who was our main coordinating link with J. P. L. R. B. Ford and R. D. Windmiller of the photographic processing laboratory were of great assistance in the reproduction of the records and M. R. Trubert offered very useful advice in laying the groundwork for the automatic digitizing process. The aid of J. D. Patterson in preparing basic maps is also appreciated.

The program was made possible and its prompt implementation after the earthquake was assured by the special efforts of C. C. Thiel, C. A. Babendreier, and M. P. Gaus of the Engineering Mechanics Department, Engineering Division, National Science Foundation.

Chapter 6

Analysis of the Pacoima Dam Accelerogram

by

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Lamont-Doherty Geological Observatory
Columbia University

and

D. E. Hudson
Earthquake Engineering Research Laboratory
California Institute of Technology

* * * *

Introduction. The Pacoima Dam accelerogram, recorded virtually in the center of the epicentral region, is of unique importance for earthquake engineering and for strong-motion seismology. Not only are the acceleration levels considerably higher than have ever been recorded for any past earthquake, but the sequence of initial aftershocks as revealed on the complete record gives an unprecedented picture of the early stages of seismic energy release.

Because of the special interest in this record, and because the local site conditions called for some special studies and explanations, the Pacoima Dam record was very carefully studied immediately following the earthquake. The present section, based on a paper to appear in the Bulletin of the Seismological Society of America, is included in the present volume to indicate the kind of analysis to which all accelerograms will ultimately be subjected, and to complete the picture of the overall scope of the cooperative program between the Seismological Field Survey and the California Institute of Technology.

The Earthquake. Although this 6.6 magnitude earthquake is not large from the seismological point of view, it was associated with very severe ground

motions and must be ranked as a major event from the standpoint of damage and general engineering implications.

The instrumentally determined focus of the main shock, at a depth of about 13 km, represented the region in which faulting was initiated. The fracture then propagated up and to the south, past and under the Pacoima Dam accelerograph site, and intercepted the surface in the Sylmar-San Fernando area (Figure 1). The Veterans Hospital which collapsed killing 44 people, and the Olive View Hospital which was severely damaged with 3 deaths, were located about 3 km to the north of the surface faulting (Figure 1).

The local severity of shaking in the Sylmar-San Fernando area appears to have been as strong as would be expected for the largest shocks in California, although longer fault breaks would result in greater durations of ground shaking. The idealized empirical relation between magnitude and fault length (Housner, 1970) would predict the fault length for this earthquake to be about 15 km, which is in excellent agreement with the observed surface faulting (Figure 1) and the overall dislocation size outlined by the distribution of aftershocks (Division of Geological and Planetary Sciences, California Institute of Technology, 1971 - Figure 2). For an earthquake of magnitude 8 or greater, the surface faulting might extend for several hundreds of kilometers and as a result the strong ground motion would last several times longer than the motion recorded during the San Fernando earthquake.

The Accelerograph Site. Because of the importance of the Pacoima Dam record and because of the rather special nature of the site, it is believed that a relatively detailed description of the site and of the instrument installation is justified.

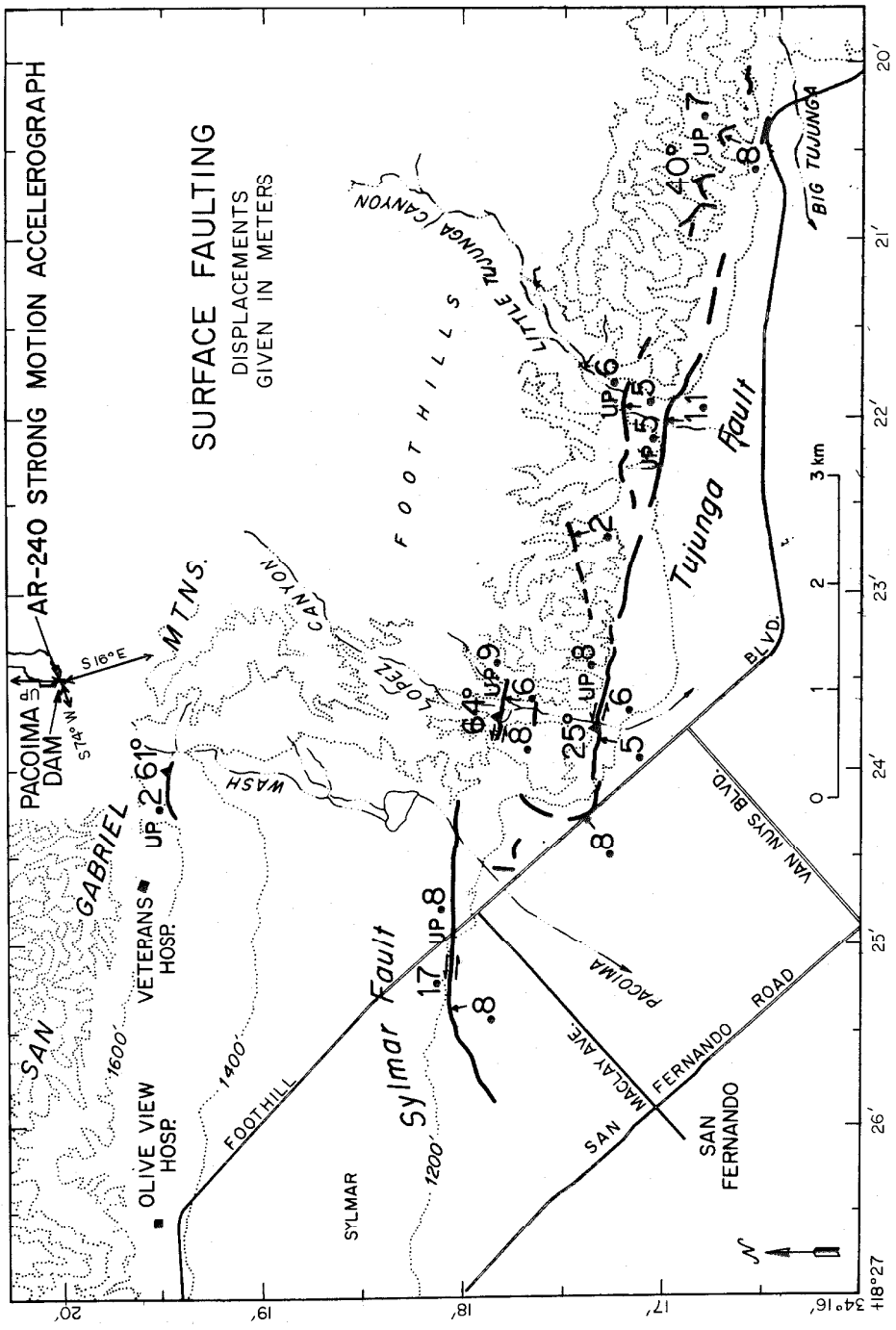

Figure 1 Surface faulting in the Sylmar-San Fernando-Tujunga area (reproduced by permission from the Division of Geological and Planetary Sciences, California Institute of Technology, and Kamb et al, 1971), and its relation to the recorded strong ground motion at the Pacoima Dam.

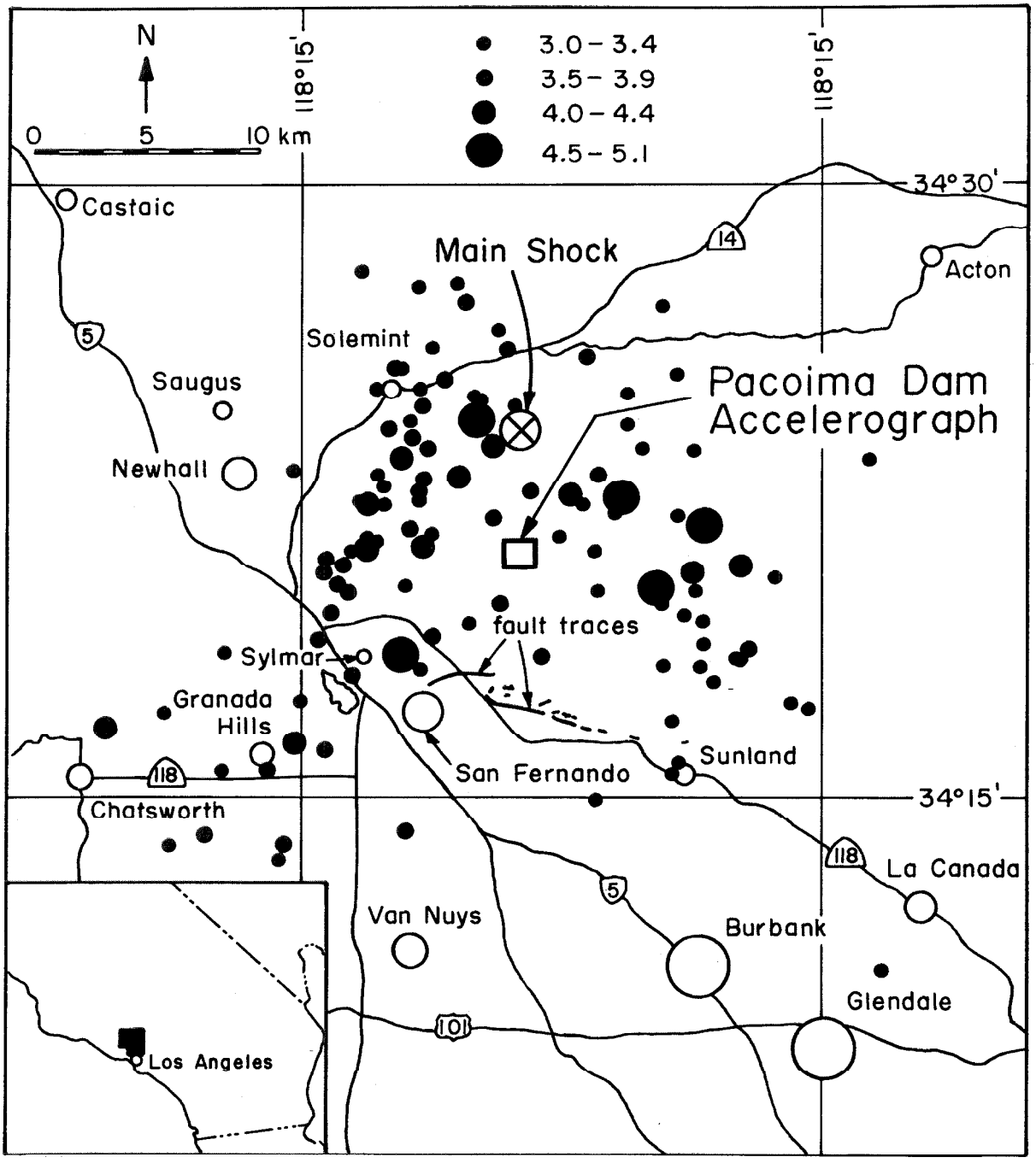

Figure 2 Map of the epicenters of the main shock and representative aftershocks of the San Fernando earthquake of magnitude 3.0 and greater, through 23 February 1971 (reproduced by permission from the Division of Geological and Planetary Sciences, California Institute of Technology, 1971).

Figure 3 shows an oblique aerial photograph looking south over the Pacoima Dam site with the San Fernando Valley in the distance. The location of the AR-240 accelerograph at Pacoima Dam is shown, and the locations of the two heavily damaged hospitals are indicated in the background. Figure 4 shows a close up view of the dam, with the location of the accelerograph on a rocky spine adjacent to the dam abutment indicated. Figure 5 shows a view of the circular instrument house seen from below on the dam, and Figure 6 is a view of the dam and the instrument house from above looking north. In both of these figures extensive cracking of the gneissic granite-diorite rock will be noted. Many of the cracks penetrate through the smooth gunite coating into the rock below.

It is not known, however, the extent to which the surface fractures of the gunite coating reflect the conditions of the major rock mass below. Relatively small cracks of the dimensions of the gunite fractures would be associated with higher frequencies than those involved in the approximately 10 cps motions observed on the record (Figures 11, 12 and 13). The extent to which presently unknown details of the ridge structure may influence the recorded motions is for the time being a matter for speculation.

As can be seen in Figure 5, about 5 meters to the west of the accelerograph a small rock slide occurred (about 5-10 m^3) during the earthquake, which fortunately was not large enough to disturb the accelerograph foundation. As will be seen in Figure 7, one of the cracks penetrated into the foundation of the instrument house, although as will be noted the instrument pier itself, which was separated by an inch or so from the foundation of the circular house, was not cracked. As of two months after the earthquake changes in the configuration of these foundation cracks indicate that long term motion of some kind is continuing. After the

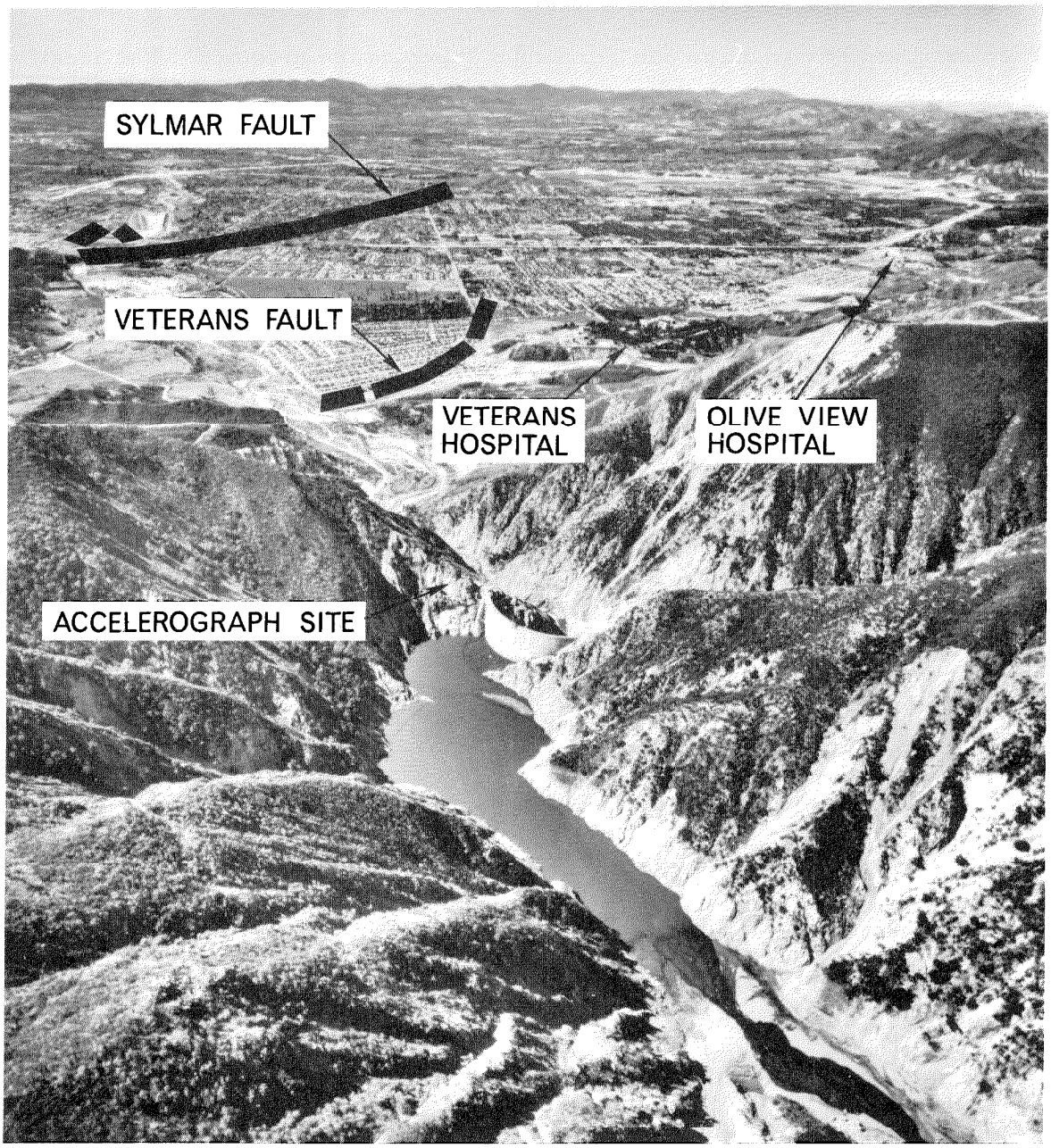

Figure 3 Oblique aerial view looking southwest over the Pacoima Dam site.

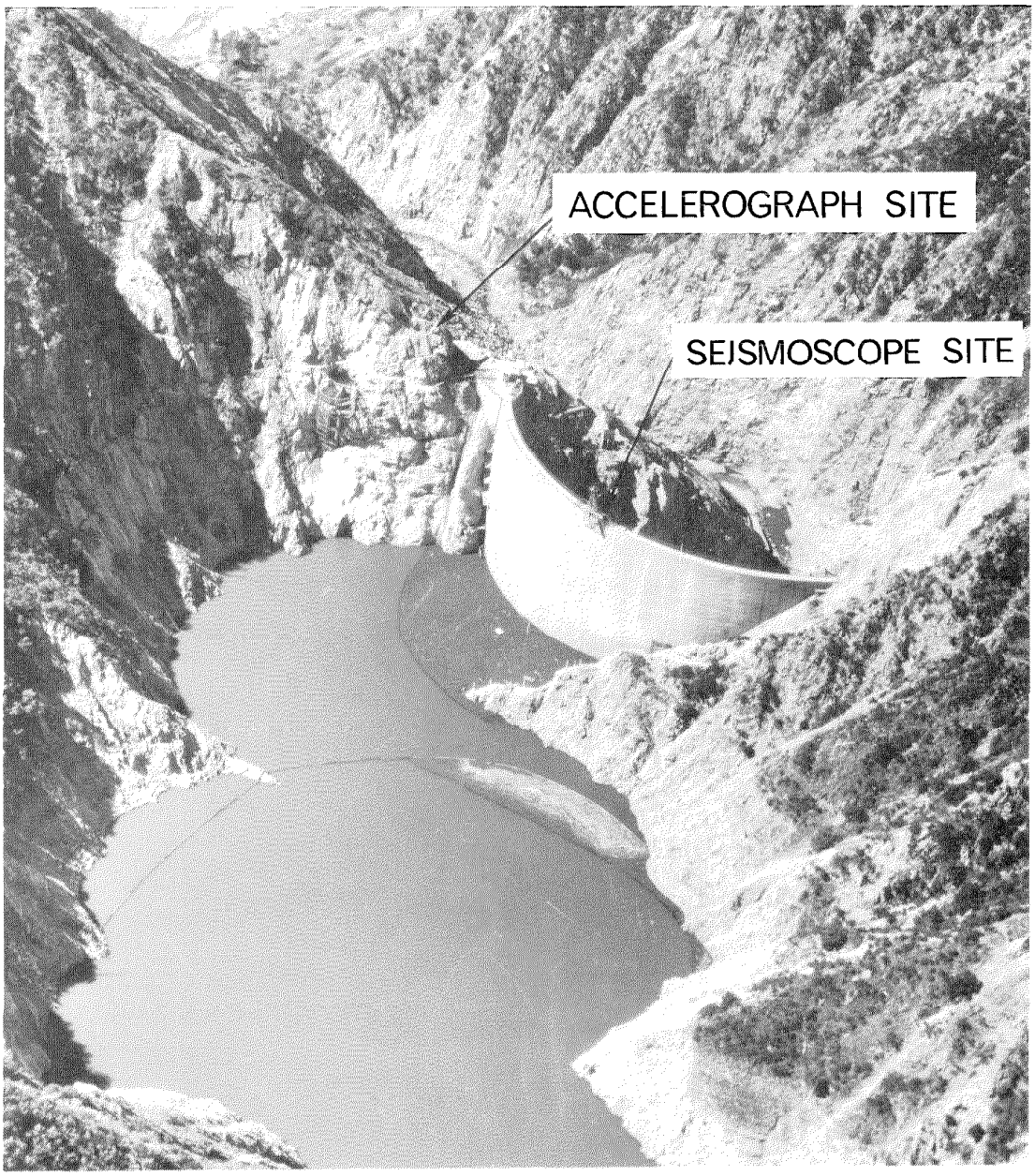

Figure 4 Close view of the Pacoima Dam.

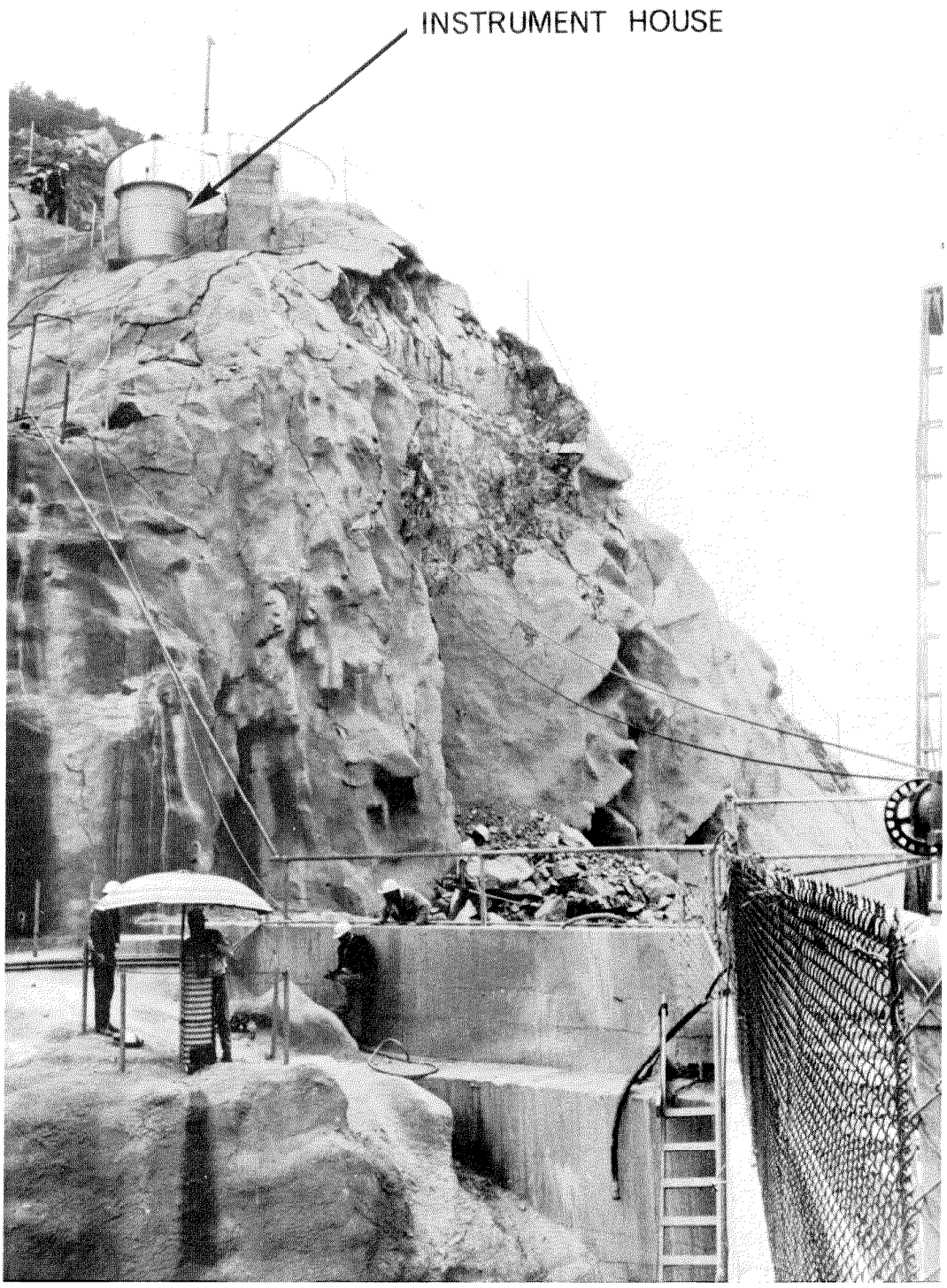

Figure 5 Strong-motion AR-240 accelerograph site and the small rock slide.

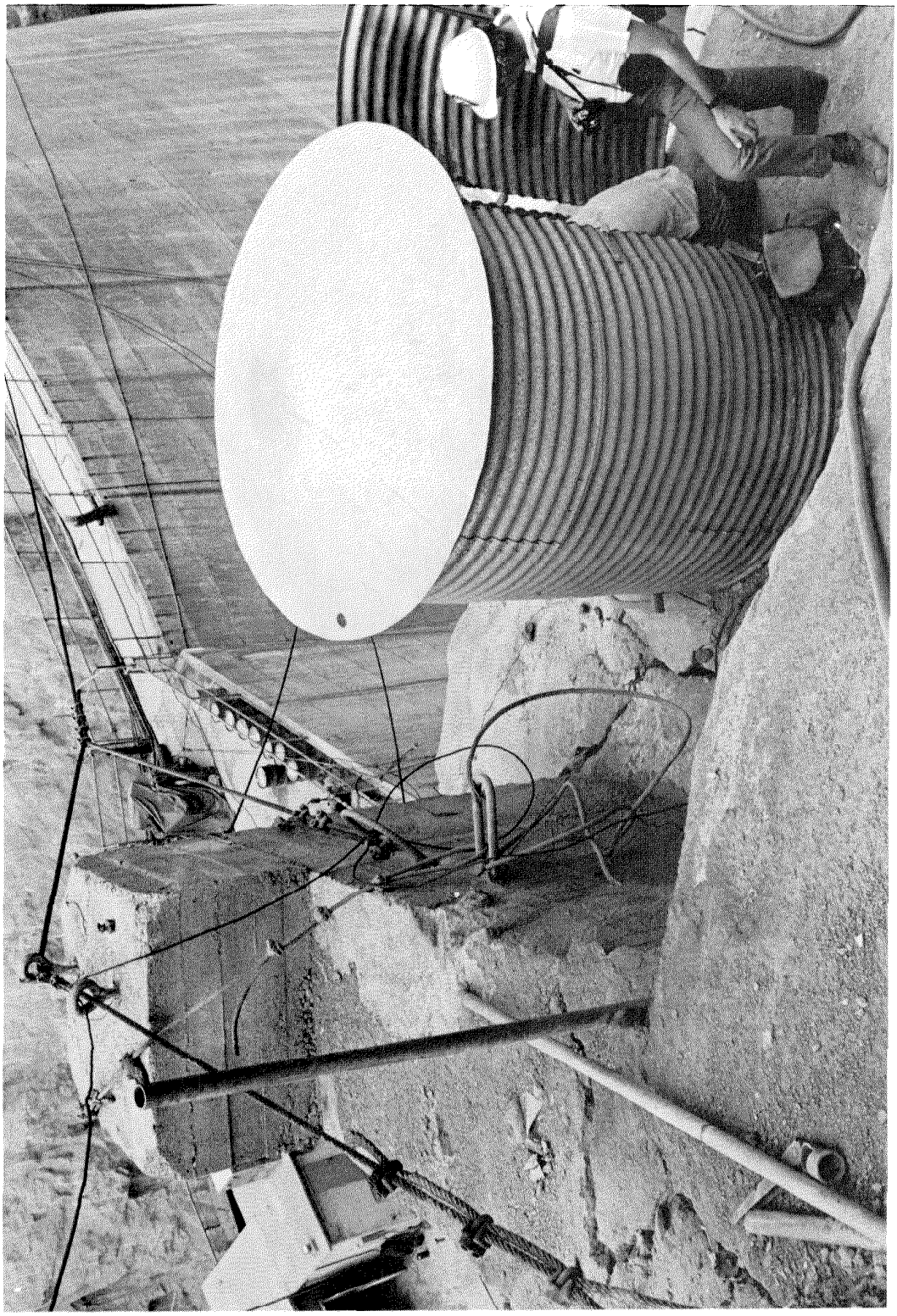

Figure 6 View of the dam and the instrument site.

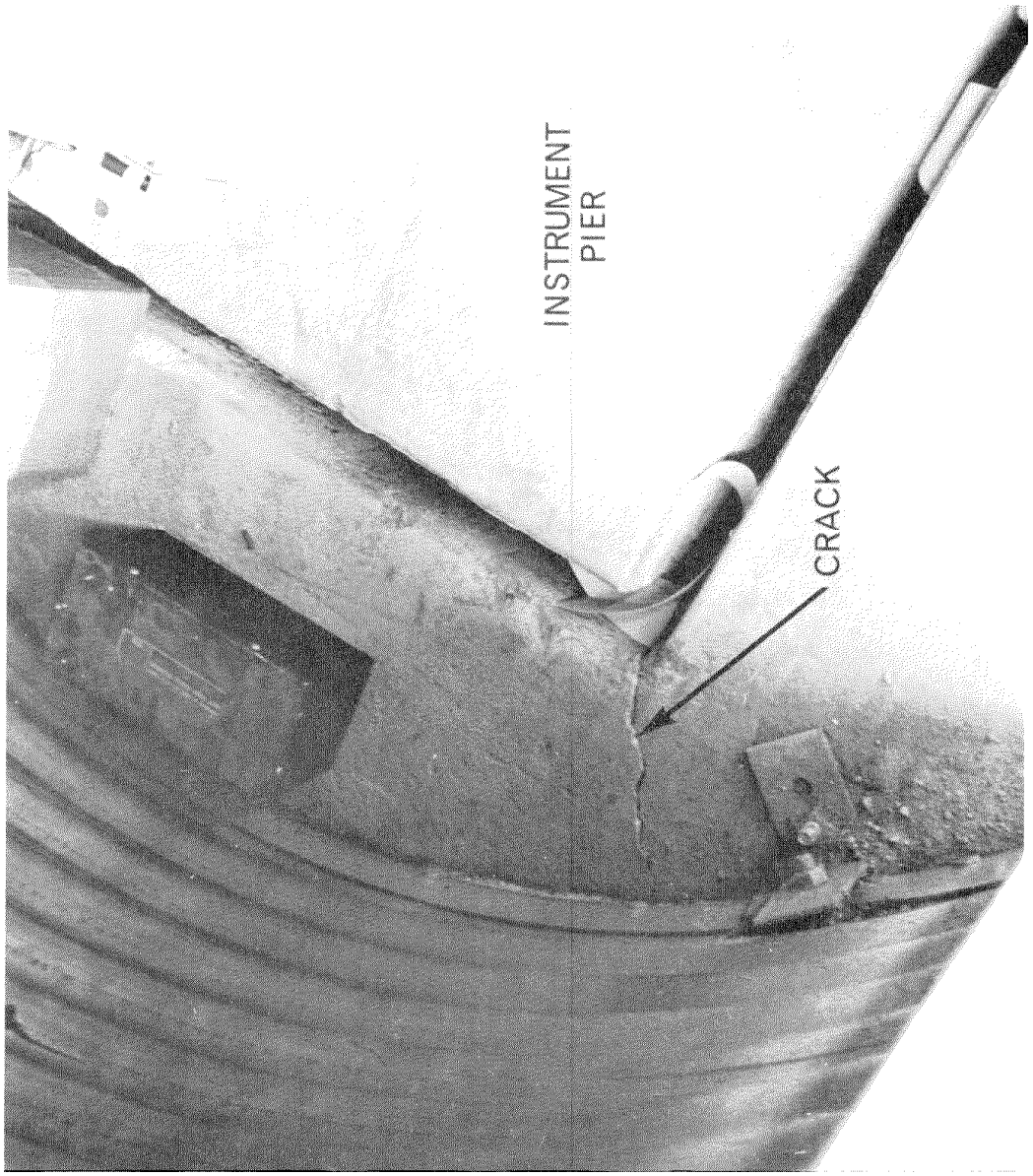

Figure 7 Cracks in the foundation of the instrument house.

earthquake, the instrument mounting pier was still solidly attached to the foundation rock, and the mounting bolts attaching the accelerograph to the pier were tight and undisturbed. The only sign of disturbance was a small permanent tilt of the instrument during the earthquake, which could be estimated to be of the order of 0.5° in the NW direction. The amount of this permanent tilt could be estimated with fair accuracy from the adjustments required after the earthquake to re-level the accelerograph (Dielman, personal communication). A view of the accelerograph mounted on its concrete pedestal within the circular house after the earthquake is shown in Figure 8.

A plan view of the dam, and the abutment area, with the instrument locations indicated, is shown in Figure 9. Also shown is the location of the Wilmot Seismoscope on the crest of the dam. During the first few seconds of earthquake motion, the motion of the crest of the dam was so severe that the seismoscope glass record plate was dislodged from its retaining ring, so that no useable seismoscope record was obtained.

As a further indication of the setting of the site within the aftershock region, Figure 2 may be referred to. The site is approximately 8 km south of the instrumentally determined epicenter and is nearly in the center and above the tentative fault dislocation surface striking $N72^{\circ}W$ and dropping about 45° towards the north (Kamb, et al, 1971).

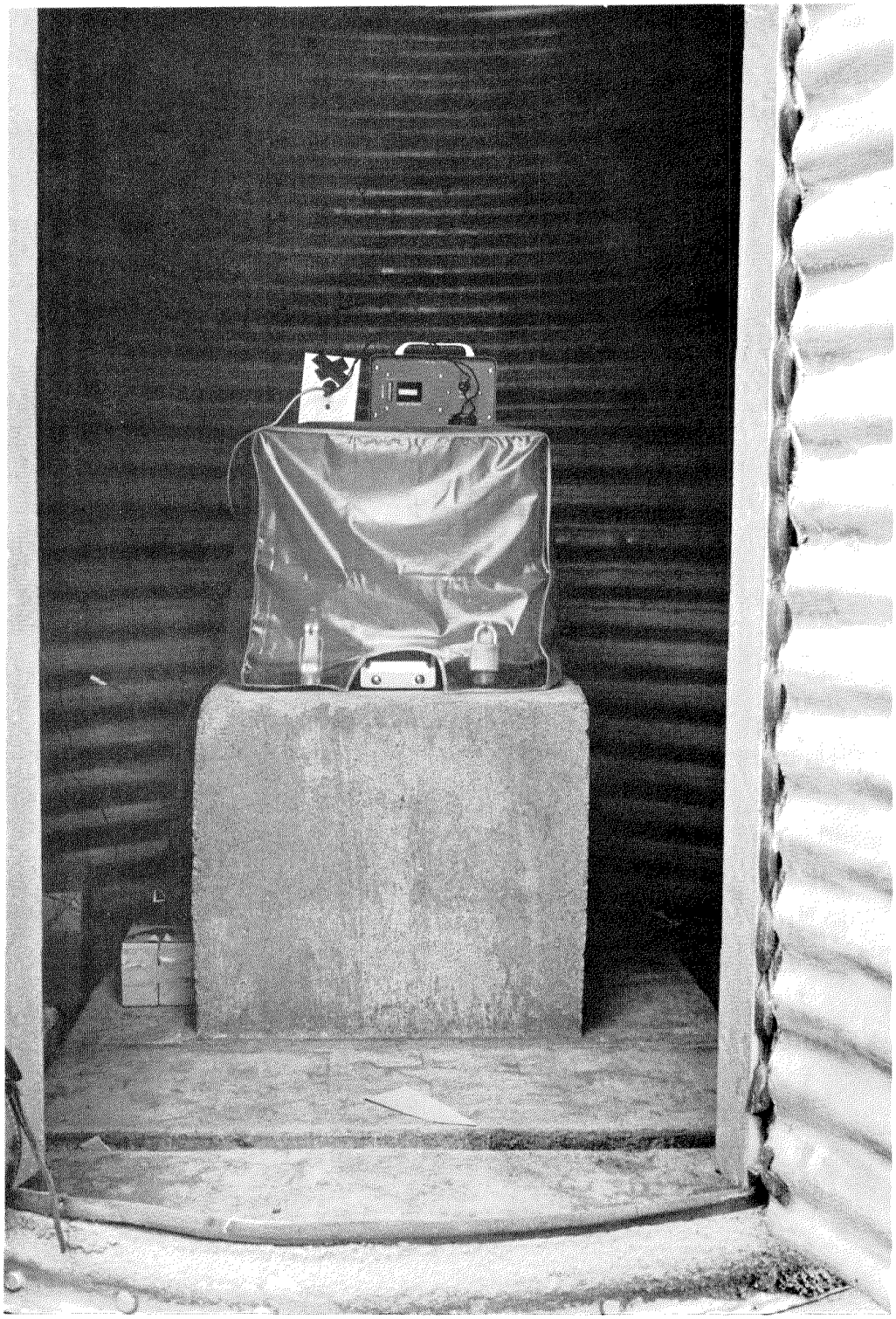

Figure 8 AR-240 accelerograph after the earthquake.

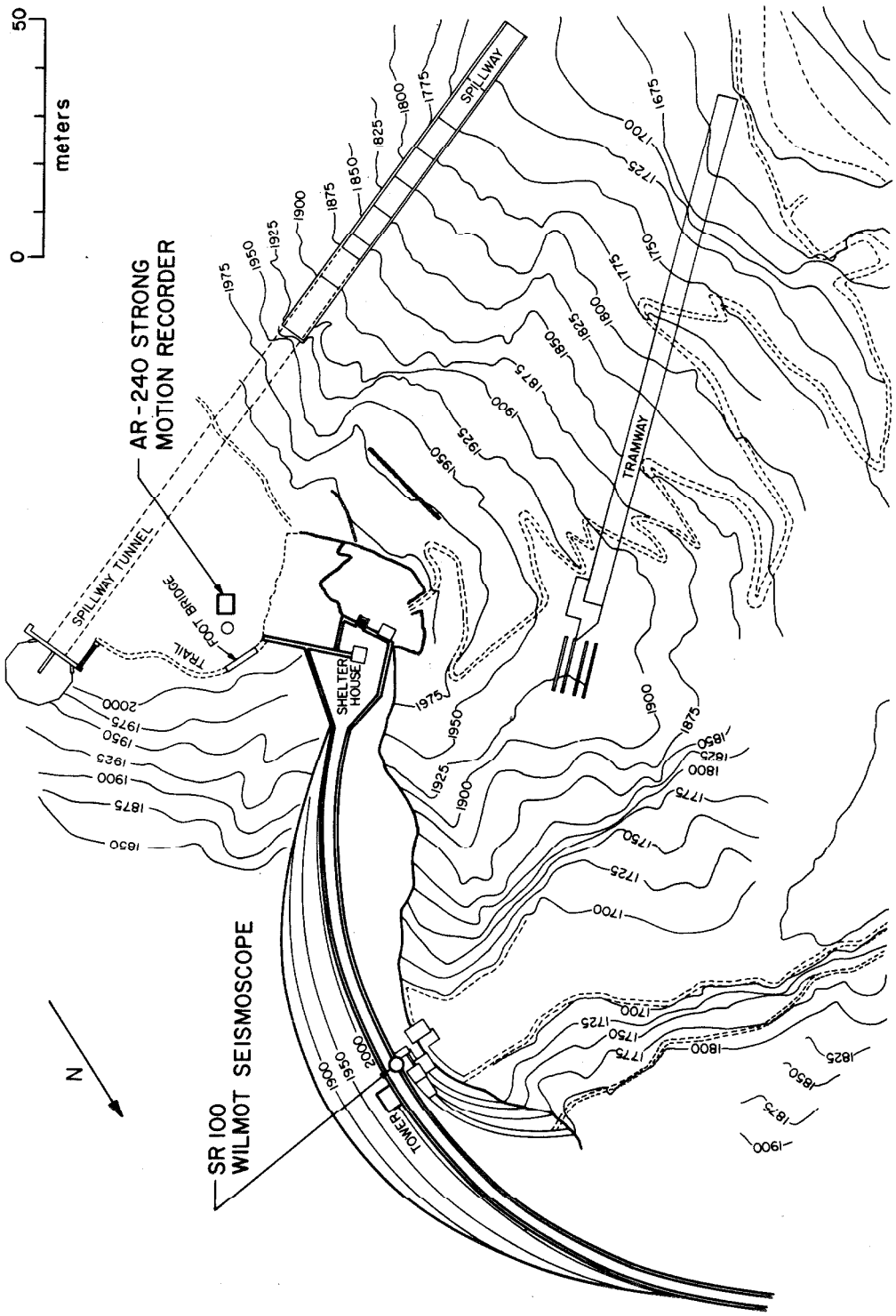

Figure 9 Pacoima Dam site with AR-240 strong-motion accelerograph and SR 100 Wilmot Seismoscope.

Accelerograph Performance. The AR-240 strong-motion accelerograph at the Pacoima Dam site records two horizontal and one vertical components of acceleration on 12 inch wide photographic paper. The accelerograph transducers have natural frequencies of about 19 cps and damping of approximately 60% critical (Hudson, 1970). The instrument is one of several owned by the Los Angeles County Flood Control District and is a part of the Southern California strong-motion accelerograph network maintained by the Seismological Field Survey of the NOAA National Ocean Survey.

As mentioned above, after the earthquake the accelerograph foundation remained tilted through a small angle which was estimated to be about 0.5 degrees. This small angle was sufficient to actuate the starting pendulum and the instrument recorded continuously for some six minutes until it ran out of paper. During this interval at least 30 aftershocks were recorded. In one sense, the small permanent tilt of the foundation can be considered to be a fortunate occurrence, since it permitted this recording of the beginning of the aftershock sequence, and indicated the exact sequence of aftershock events in the epicentral region. These details of the aftershock sequence will be of importance in investigating the mechanism of energy release.

In order to check the instrument performance, tilt, free vibration and damping tests were performed after the earthquake. The tilt test showed that the sensitivity of the accelerograph had not changed significantly. The alignment of the transducer axes relative to the

instrument base was also checked during the tilt test (Trifunac and Hudson, 1970). It was found that the two horizontal transducers were well within a 1^{o} alignment. The vertical transducer sensitivity vector was about 5 degrees from the vertical in the longitudinal direction.

Judging from the point of view of the accuracy of the typical strong-motion accelerograph (Trifunac and Hudson, 1970) it may be concluded that the AR-240 accelerograph at the Pacoima Dam site performed essentially to specifications and that the recorded acceleration traces may be adopted as representative of the actual motion of the instrument foundation. The peak acceleration values remained on scale on the photographic paper, and there is no evidence of appreciable nonlinear response at the maximum amplitudes involved.

After the earthquake the instrument base was tilted in approximately the NW direction, relative to its position prior to the earthquake. Since the preliminary calculations of the ground displacement indicated a significant shift in the accelerograph baseline, clearly a consequence of such tilt, tests were conducted to ascertain likely limits for such displacements. The accelerograph was tilted in the NW direction through an angle which just closed the starter pendulum gap, and in this way a lower bound estimate of the acceleration baseline shift could be determined. The results of this test are given in Table 1.

Table 1

Direction of baseline shift for tilt in NW direction	Baseline shift in cm/sec^2
N 74 E	13.3
Down	7.7
N 16 W	2.6

The integration of the digitized accelerograms (Figure 10) including the first aftershock (about 42 seconds) indicates that the tilt must have occurred within the first 10 to 15 seconds of the strong motion. This can be concluded from the behavior of the integrated velocity curves. If a straight line fitted to the velocity curves (Trifunac, 1970), over the interval between 12 and 42 seconds, is extrapolated back to the zero time, the resulting displacement curves indicate the following permanent displacements after the earthquake:

Table 2

Permanent displacement in direction	Permanent displacement amplitude in meters
N 74 E	1.0
Up	1.3
S 16 E	1.7

It might be tempting to interpret these results in terms of the observed surface fault displacements (Figure 1, Kamb et al, 1971). However, if it is assumed that the tilting indeed took place during the first 10 seconds, the lower bound for the "permanent displacements" obtained only from the tilt would be (based on data of Table 1):

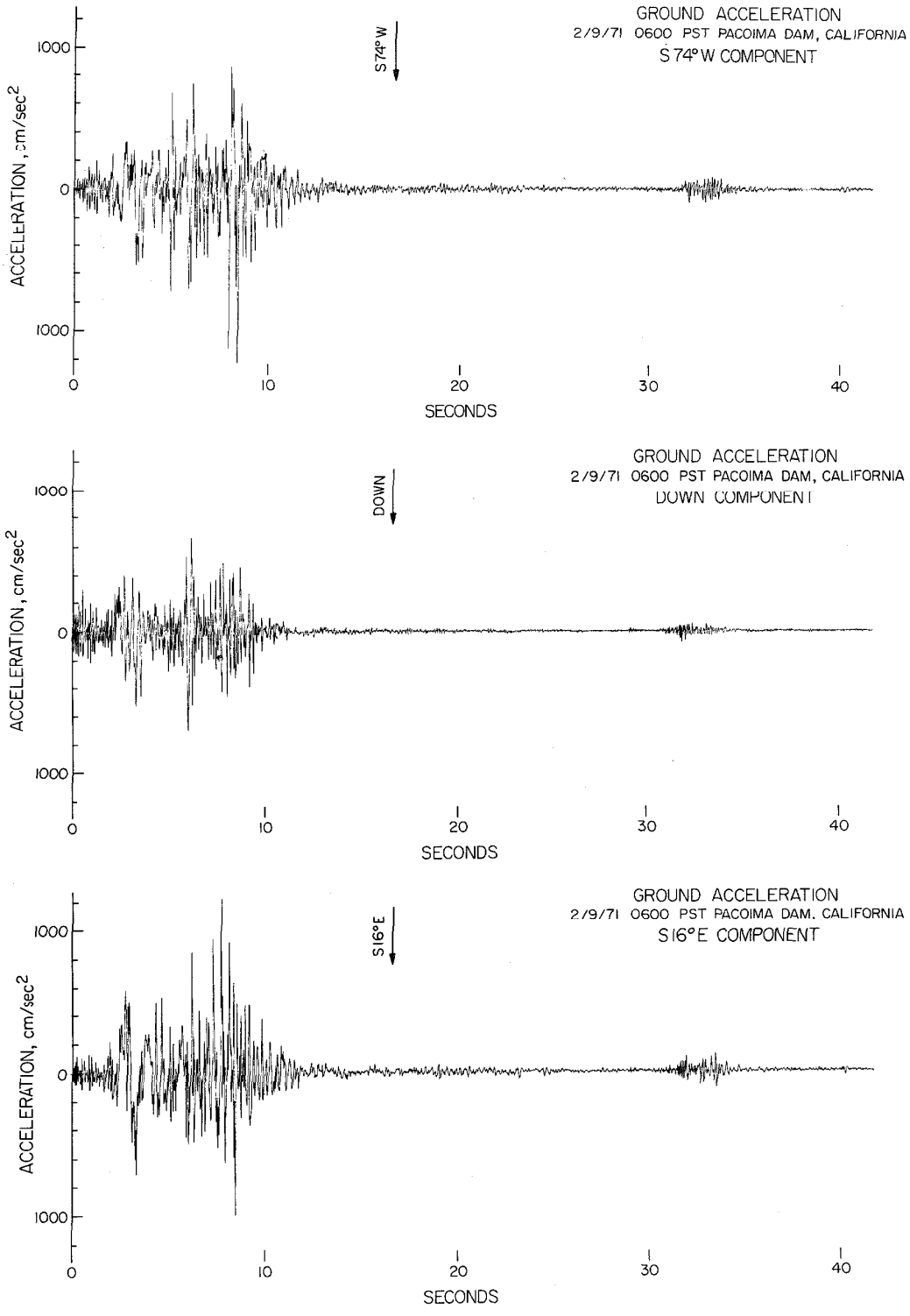

Figure 10 Plot of digitized accelerograms recorded at the Pacoima Dam.

Table 3

Permanent displacement in direction	Lower bounds on permanent displacement amplitudes caused by tilt in meters
S 74 W	4
Up	3
S 16 E	1

For this calculation it was assumed that the acceleration zero baseline is determined by its fixed position after the tilt is completed, 10 seconds after the instrument has triggered, and that the tilt occurred uniformly over the 10 second interval. Comparing the amplitudes given in Table 2 and Table 3 it may be concluded that the tilt was large enough to prevent any estimation of the permanent displacements associated with the earthquake.

Data Processing and Ground Motion Calculations. Figure 10 is a plot of the first 42 seconds of the digitized accelerograms including the first aftershock. The strong motion representing the main energy release lasted for about 7 seconds and the first aftershock was recorded about 29 seconds after the instrument was triggered. The first 15 seconds of the acceleration were chosen for the analysis of ground motion.

The AR-240 accelerogram was digitized at Caltech on a Benson Lehner 099D data reducer and processed by the standard methods developed in recent years for strong-motion accelerogram analysis (Hudson, et al, 1969). The quality of the original record was excellent. The trace was clear and continuous with the exception of one 1.25 g peak on the S 16° E

component at 7.6 seconds. At this point the trace was lost above the 1 g level and had to be extrapolated. Because of the excellent photographic quality of the trace, this extrapolation could be carried out with confidence. The error in the peak is believed to be less than 0.1 g, which would not appreciably influence any calculations based on the accelerogram. This digitization of the Pacoima Dam accelerogram is believed to be as accurate as may be achieved by presently available techniques and equipment.

The baseline correction was performed by high-pass filtering the uncorrected data above the frequency 0.07 cps. This means that all periods longer than approximately 16 seconds have been removed from the record, and hence that no information on permanent displacements is to be expected from the analysis. This filtering procedure, and the least square fitting of a straight line to the ground velocity, which gives an estimate of the initial velocity, constitute a new method recently proposed for standard baseline correction of the strong-motion accelerograms (Trifunac, 1970). The resulting acceleration, velocity and displacement curves are shown for the three recorded components in Figures 11, 12 and 13. As may be seen in these figures, the maximum acceleration is 1.25 g for both horizontal components and 0.70 g for the vertical component, and the peak velocity is 115 cm/sec.

As already mentioned the tilting of the instrument base must have taken place during the first 15 seconds of the strong motion. Thus the displacements in Figures 11, 12 and 13 may contain an unknown contribution from the tilting of the instrument in addition to the actual ground motion. Nevertheless, the computed ground motion indicates that the biggest displacements were vertical and in the North-South direction, in general agreement with observed surface faulting (Figure 1).

In terms of acceleration amplitude the ground motions recorded at the Pacoima Dam site are the largest so far measured during any earthquake.

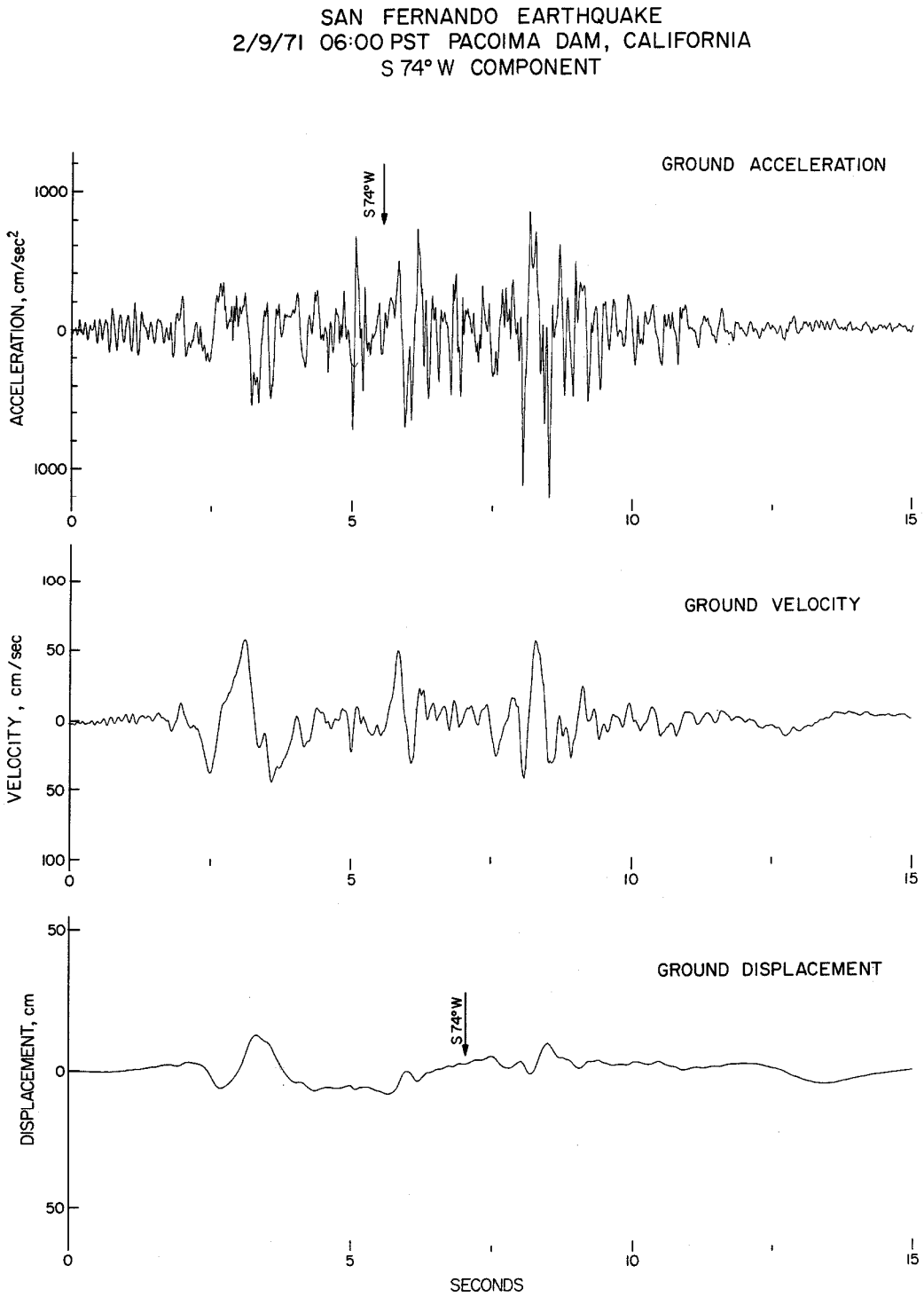

Figure 11 S 74° W motion, Pacoima Dam.

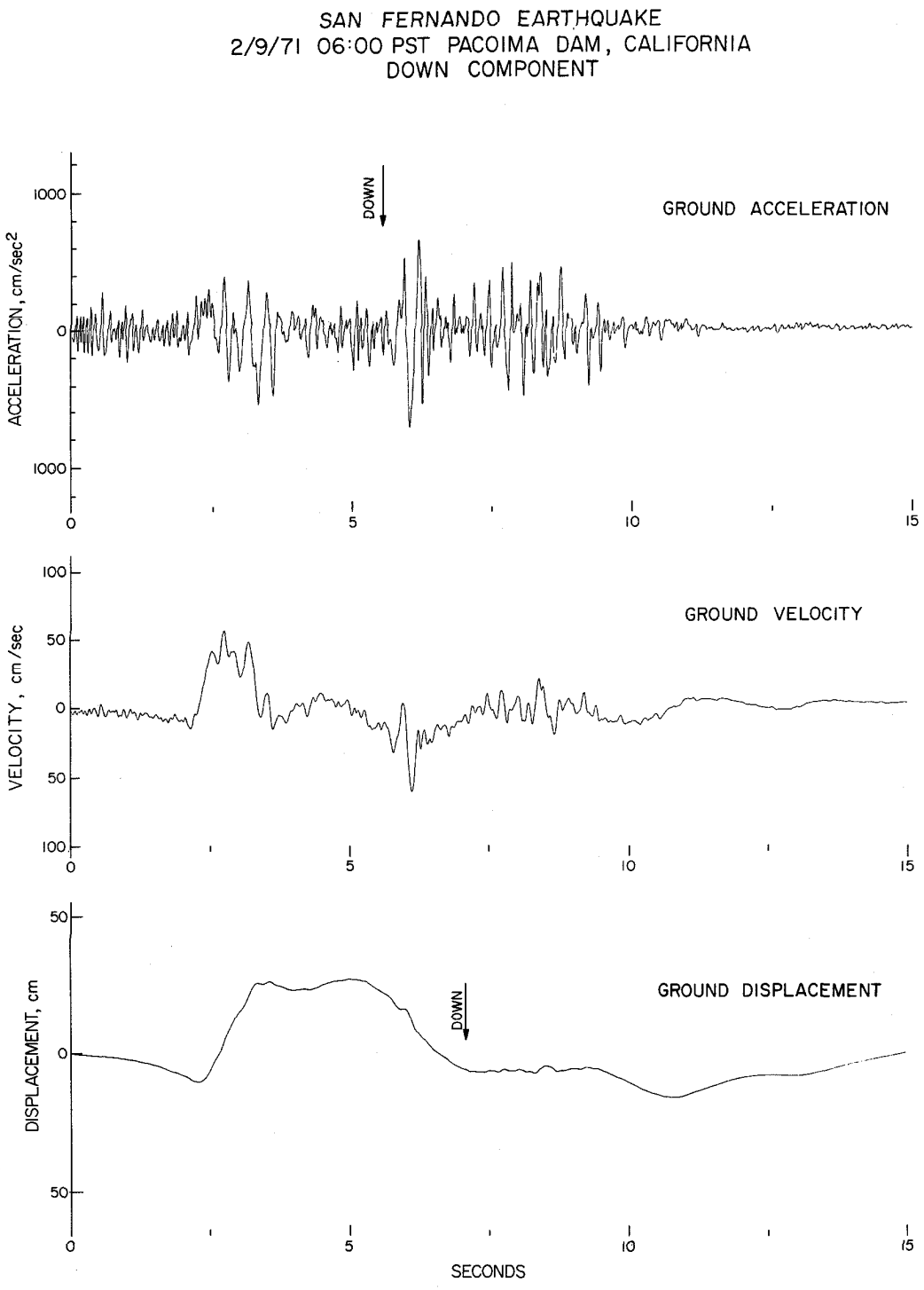

Figure 12 Down motion, Pacoima Dam.

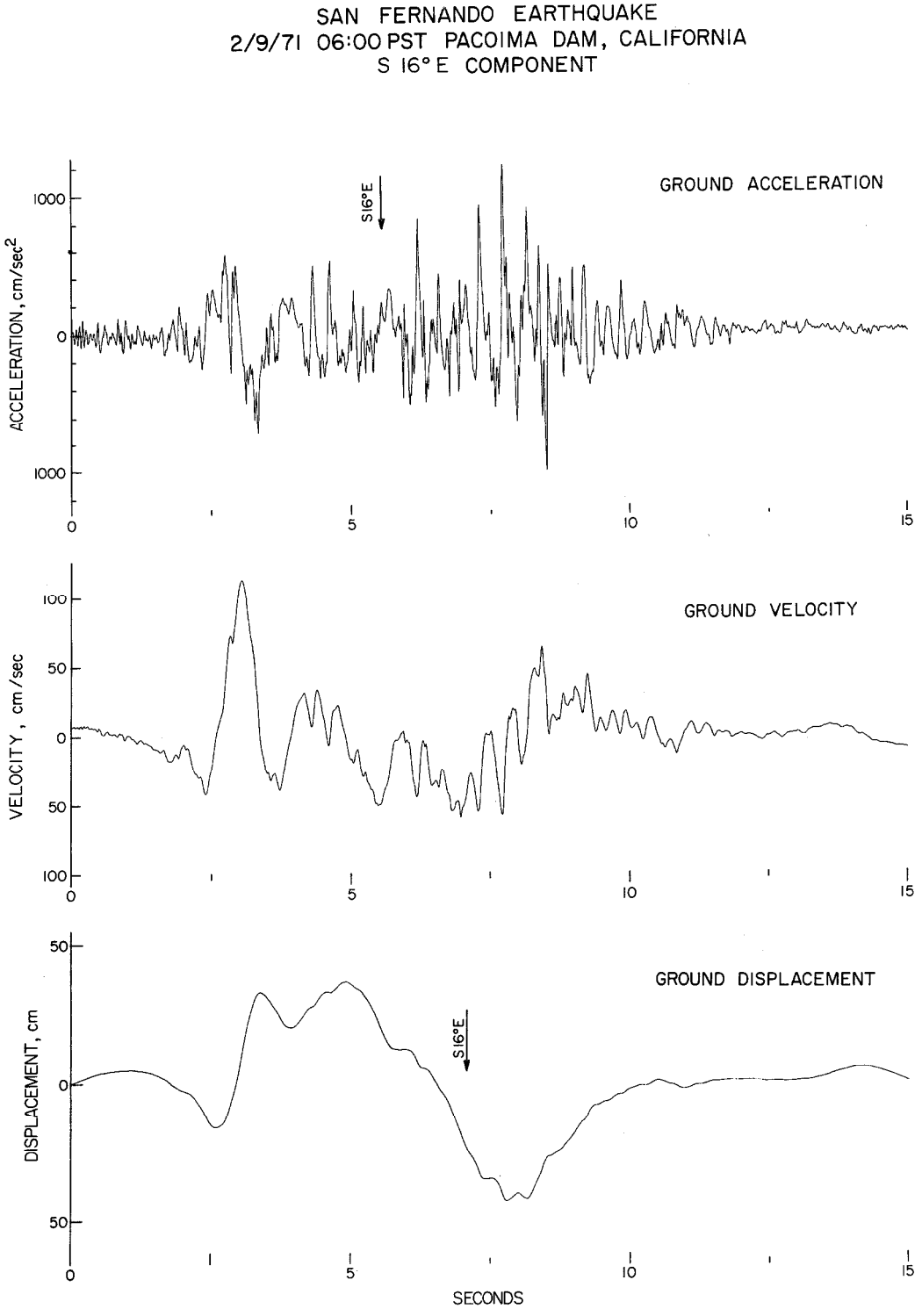

Figure 13 S 16° E motion, Pacoima Dam.

The relatively short duration of the severe shaking is a consequence of the short fault rupture.

Response Spectra. The computed relative velocity and $S_d\frac{2\pi}{T}$ response spectra (S_d = displacement spectrum; T = period) are shown in Figures 14 and 15. For each acceleration component the response spectrum curves were calculated for 0, 2, 5, 10 and 20 percent of critical damping. As expected, the relative velocity and $S_d\frac{2\pi}{T}$ spectra are very similar for short periods while the $S_d\frac{2\pi}{T}$ spectrum falls off more rapidly for longer periods. It may be recalled that the zero damped relative velocity response spectrum is an approximate representative of the Fourier amplitude spectrum of the accelerogram.

The spectrum curves for the horizontal S 16 E and S 74 W components show peaks at about 0.4 and 1.4 second periods, while the spectra for the vertical component indicates predominant periods near 0.3 and 2 seconds. The short duration of the strong motion is reflected in the nature of the response spectra of Figure 14 which shows a relatively flat character for periods longer than 5 or 6 seconds. In the period range 0.5 to about 3 seconds the spectral amplitudes are similar to those calculated for the El Centro 1940 accelerogram (Alford, et al, 1951). The high frequency spectral amplitudes in the Pacoima Dam record are not incompatible with past experience. Similar high frequency characteristics can be noted on records from the Parkfield, California, earthquake if June 27, 1966 (Housner and Trifunac, 1967) and for the Koyna, India, earthquake of December 10, 1967 (Gupta, et al, 1971). Direct comparisons with these other earthquakes are difficult because of significant differences in the location of the accelerographs with respect to the pattern of faulting,

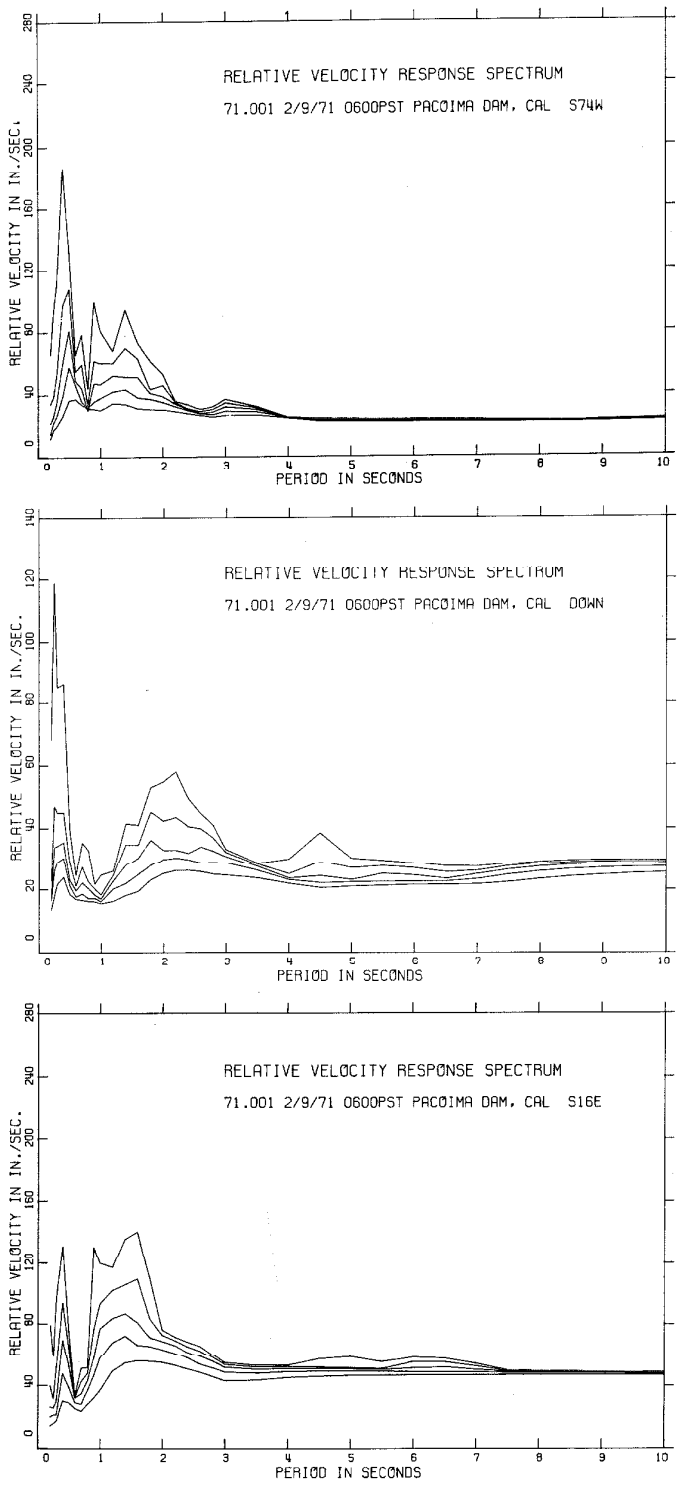

Figure 14 Relative velocity response spectra, Pacoima Dam. The curves are for 0, 2, 5, 10, and 20 percent damping.

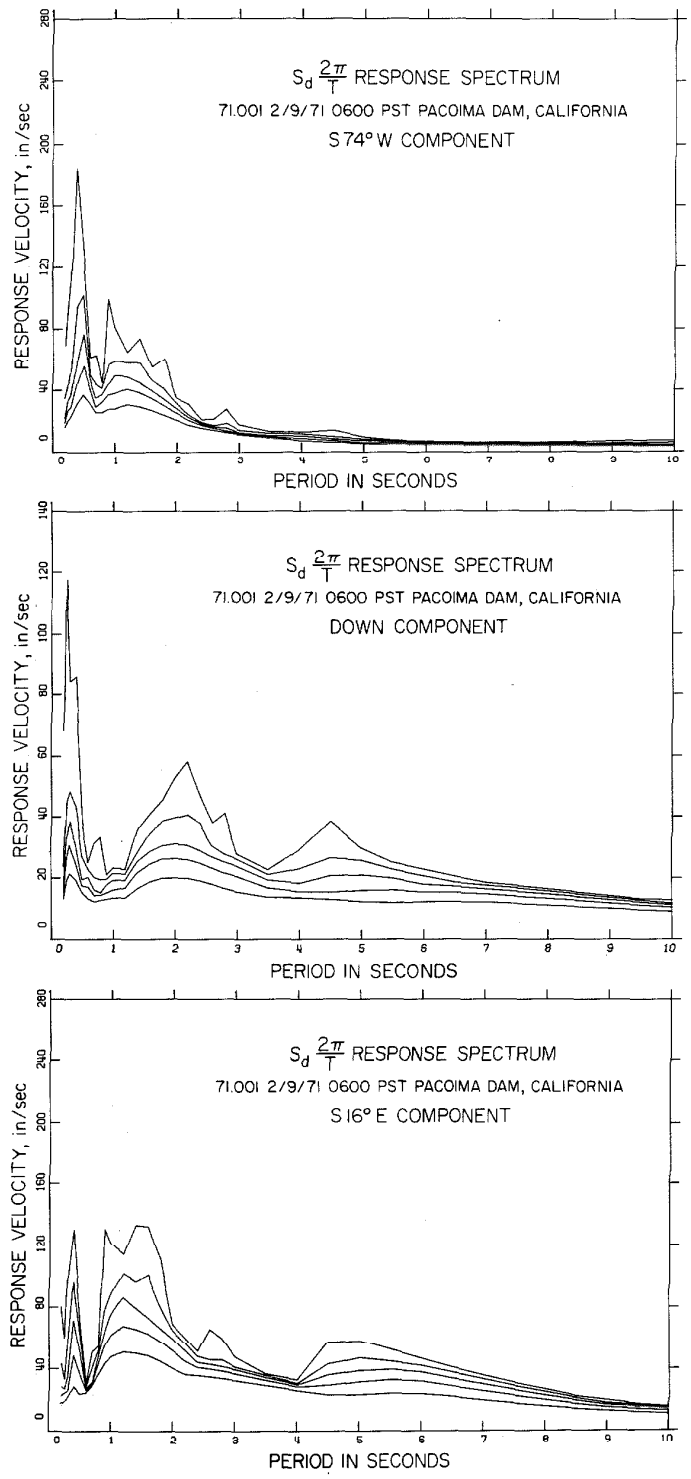

Figure 15 $S_d \frac{2\pi}{T}$ response spectra, Pacoima Dam. The curves are for 0, 2, 5, 10, and 20 percent damping.

and in the sizes of the events. Table 4 gives an approximate idea of such comparisons.

Table 4

Earthquake	Magnitude	Distance* km	Peak Accel. g	Peak Velocity in/sec	Approx S_V for T>3 sec in/sec
San Fernando, 1971	6.6[1]	5	1.25	45	50
El Centro, 1940	6.4[2]	10[2]	0.33	17	30
Parkfield, 1966	5.5[3]	0.2[5]	0.50	28	30
Koyna, India, 1967	6-6.3[4]	5	0.63[6]	9	15

*Estimated distance from accelerograph to portion of fault surface associated with maximum energy release.

1. Division of Geological and Planetary Sciences, California Institute of Technology (1971).

2. M. D. Trifunac and J. N. Brune (1970).

3. G. W. Housner and M. D. Trifunac (1967).

4. H. G. Gupta, B. K. Rastogi and H. Narain (1971).

5. K. Aki (1968).

6. J. Krishna, et al., 1969

The strong earthquake ground motion recorded during the Parkfield, California, 1966 earthquake (Housner and Trifunac, 1967) may be considered as a typical example of a short impulsive type ground motion. On the other hand the motion recorded at El Centro during the Imperial Valley, California, 1940 earthquake (Trifunac and Brune, 1970) is an example of the relatively long shaking produced by multiple events successively occurring along a fault about 40 miles long. The ground acceleration, velocity and displacement curves plotted in Figures 11, 12 and 13 show that from the engineering

point of view, the duration of the energy release during the San Fernando earthquake is somewhere between that of Parkfield and El Centro.

The Engineering Significance of the Pacoima Results. One of the important facts about strong earthquake ground motion is that large ground acceleration amplitudes in themselves do not necessarily indicate severe damage to structures. It is also clear that high spectral accelerations do not always tell the whole story. The response spectrum curves alone cannot give a complete picture of the effects of the time duration of the acceleration history. These facts have been clearly demonstrated by the spectra calculated for the Parkfield earthquake (Housner and Trifunac, 1967) and the El Centro earthquake (Alford, et al, 1951). Thus the high spectral amplitudes in Figures 14 and 15 do not necessarily mean that this motion was very destructive for structures of all types. Pacoima Dam, for example, apparently suffered no significant damage.

The San Fernando earthquake with strong motion lasting about 7 seconds now becomes an excellent example of a strong ground acceleration of short to moderately long duration. If the shaking had continued for another few seconds much greater damage would have resulted, and many buildings and bridges so far only partially damaged would have collapsed. It is mainly this effect of the duration of shaking on structural damage that calls for detailed investigations of the pattern of earthquake energy release in time.

The Complete Pacoima Record. As mentioned above, the Pacoima Dam record is unique in that a small permanent tilt of the horizontal starter pendulum kept the accelerograph running to record a whole initial sequence

of aftershocks in exact time scale. Because of the special interest of this complete accelerogram for earthquake mechanism studies and for strong-motion seismology in general, the complete 360 seconds of the accelerogram are reproduced to scale in Figure 16.

Digital Printout. As an example of the type of digital printout which will ultimately be prepared for all accelerograms, Table 5 gives the final complete digitization of the Pacoima accelerogram in "uncorrected" form. This has been reproduced from the volume of standard digitized data which presents the first installment of digitized accelerograms from the San Fernando earthquake.* Complete details on the digitization methods used, and of various errors and corrections to be applied in later analyses will be found in the references in the footnote in Chapter 5, p. 190.

Acknowledgments. In addition to the acknowledgments of Chapter 5, we are indebted to the Los Angeles County Flood Control District for their forward-looking program of instrumentation and in particular to Mr. E. J. Zielbauer of that organization for cooperation with instrument siting, site visits after the earthquake, and for providing maps and information on the site and the dam.

We wish also to thank Professors C. Allen and B. Kamb of the California Institute of Technology for permission to reproduce their data in Figures 1 and 2.

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*Strong-Motion Earthquake Accelerograms - Digitized and Plotted Data, vol. I, part C, EERL 71-20, Earthquake Engineering Research Laboratory, California Institute of Technology, Pasadena, 1971.

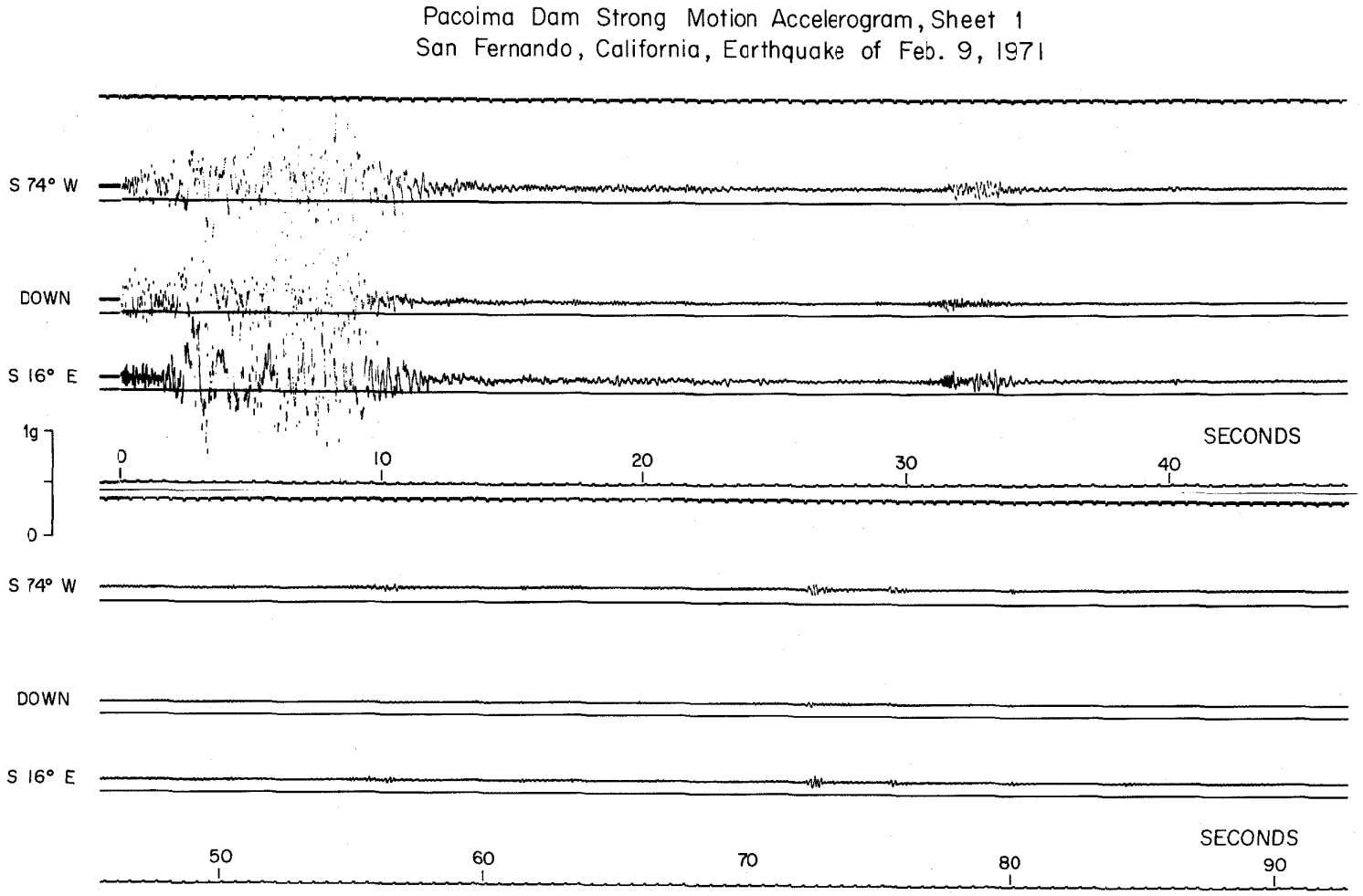

Figure 16 Pacoima Dam accelerograph record.

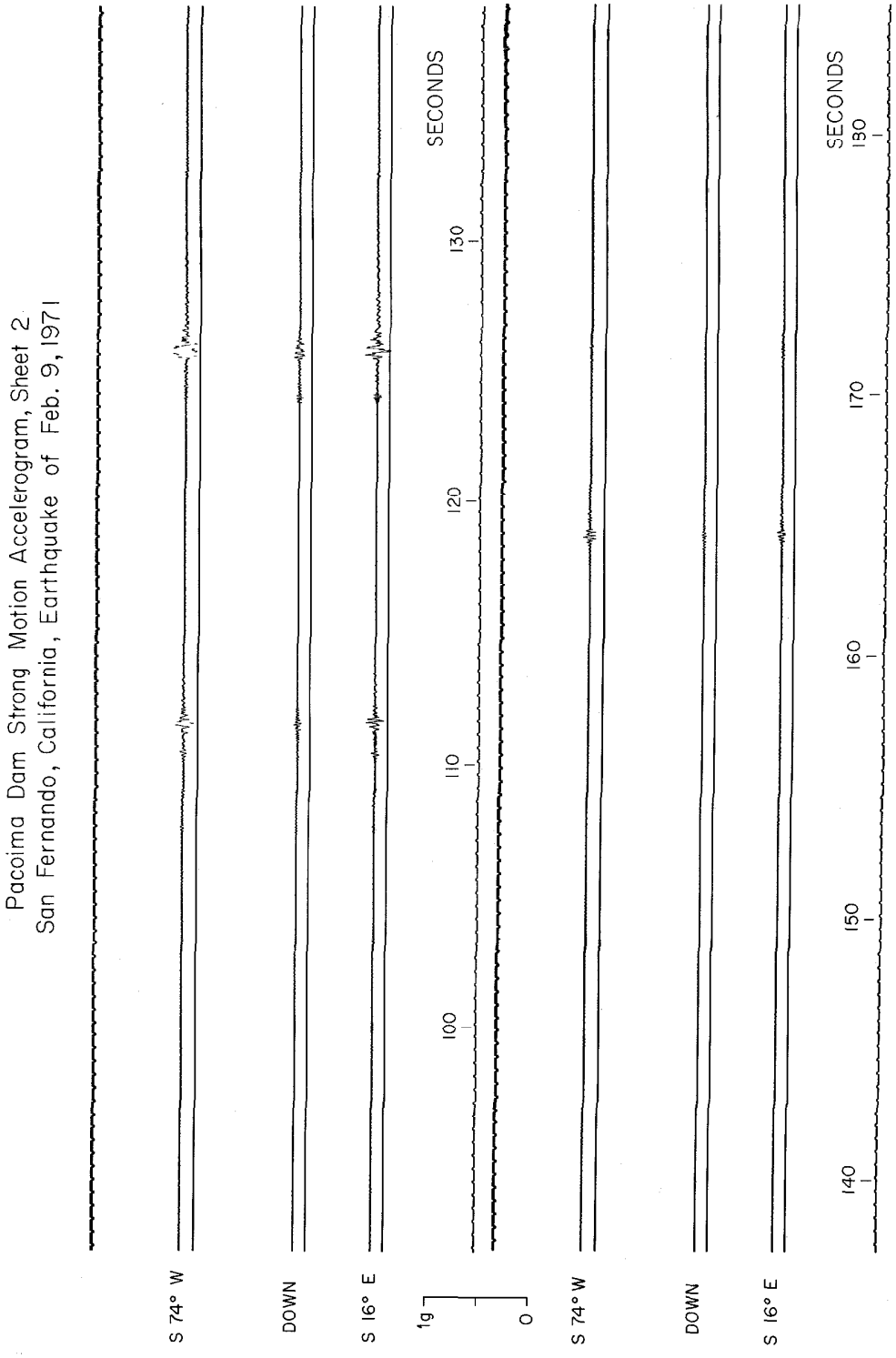

Figure 16 (cont'd)

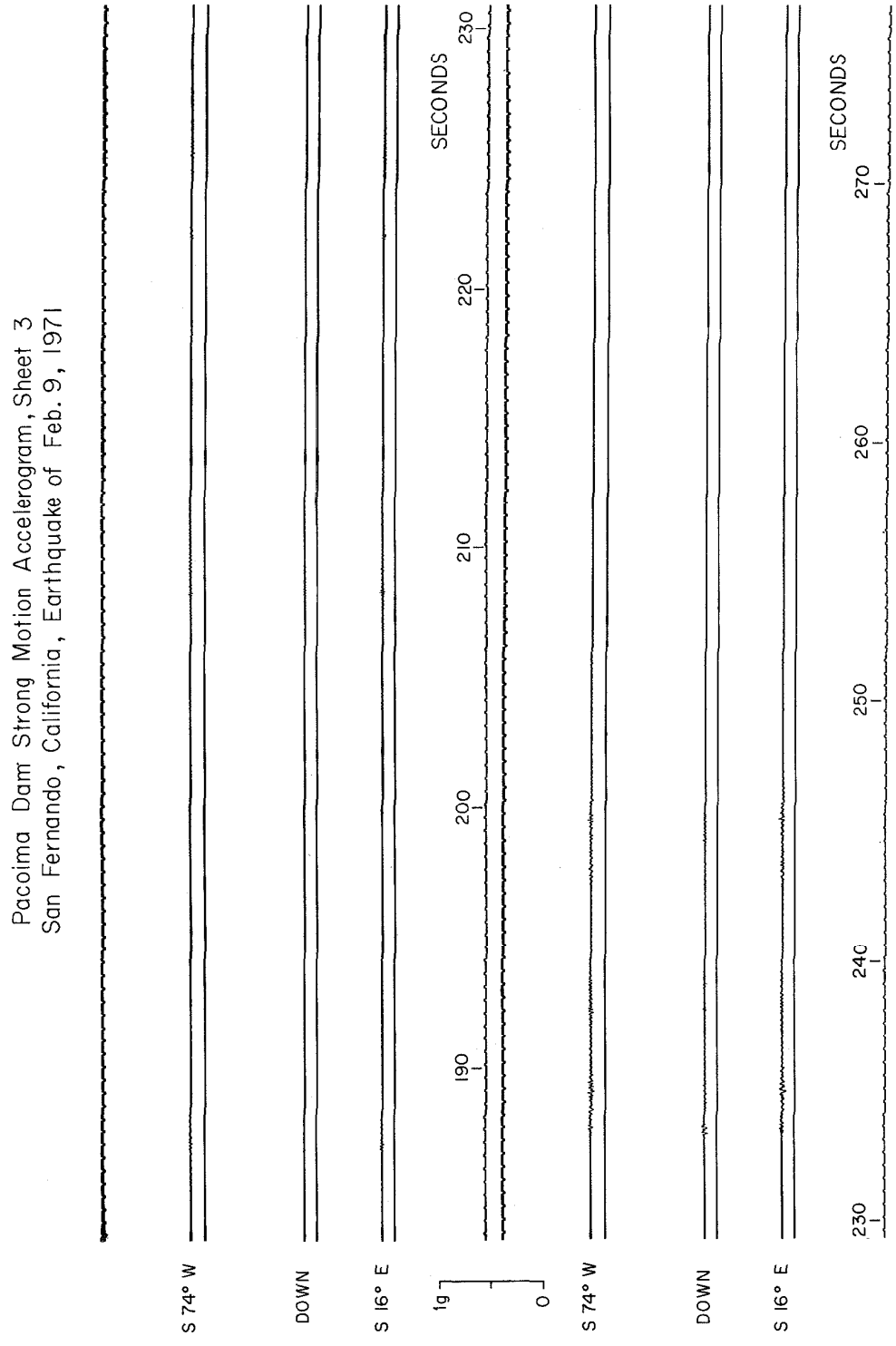

Figure 16 (cont'd)

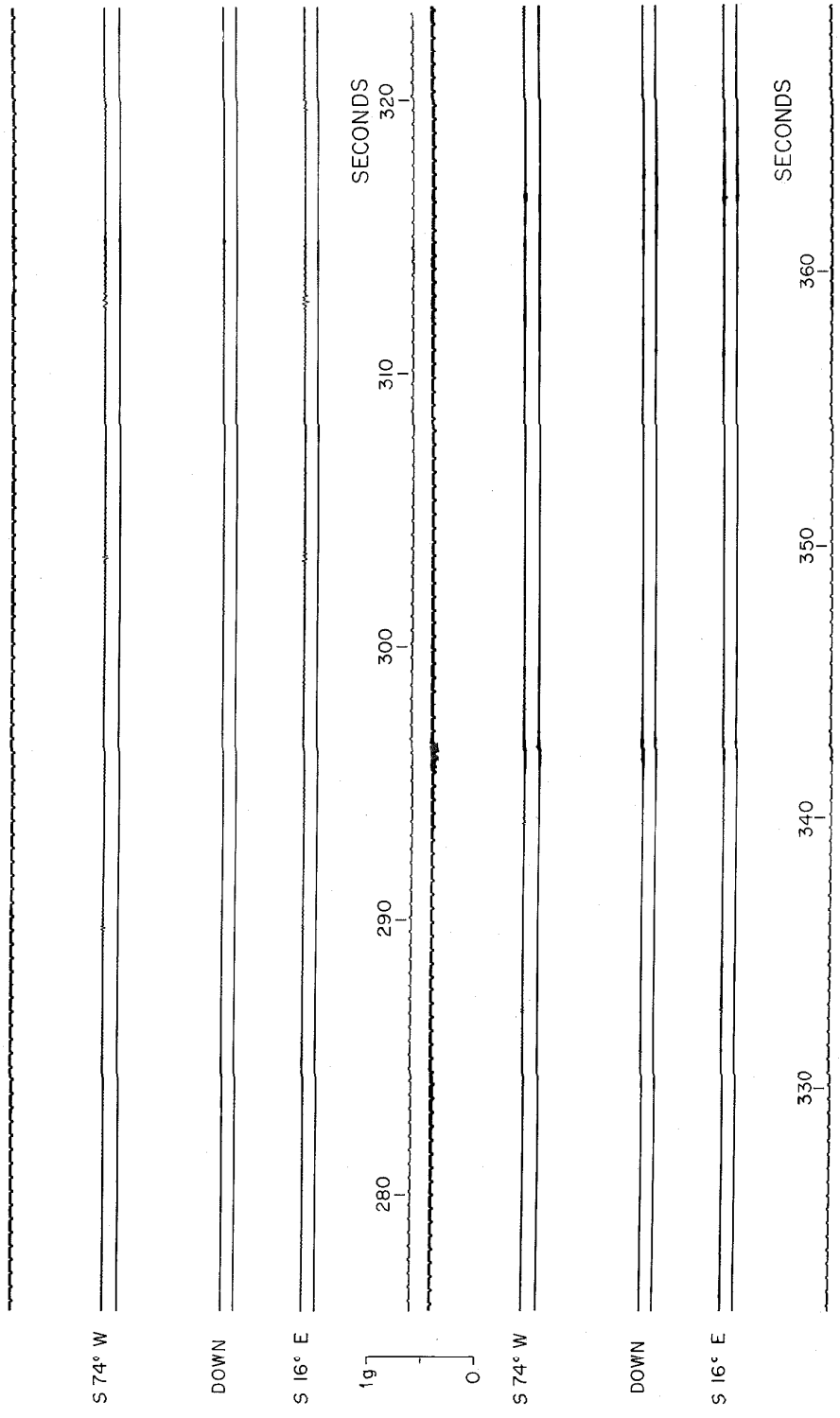

Figure 16 (cont'd)

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T3093

TABLE V

71.001 2/9/71 0600PST PACOIMA DAM CAL. S16E

3002 POINTS 41.822 SECONDS

SCALED DATA, WITH THE DIGITIZED FIXED TRACE SMOOTHED AND SUBTRACTED, THE TIMING MARKS SMOOTHED BEFORE USE, AND A HORIZONTAL ZERO LINE FIXED FOR ZERO MEAN VALUE, WHICH SIMULTANEOUSLY MINIMIZES THE RMS ACCELERATION.

UNITS ARE SEC, G/10.

THE RMS ACCELERATION OF THIS COMPLETE RECORD, MINIMIZED IN THE ABOVE ALIGNMENT CORRECTION, IS 1.1934 G/10.

TIME	ACCLN	TIME	ACCLN	TIME	ACCLN	TIME	ACCLN
0.0	0.038	0.015	0.197	0.023	0.218	0.035	0.365
0.043	0.365	0.061	-0.241	0.069	-0.536	0.071	-0.540
0.079	-0.124	0.091	0.259	0.097	0.546	0.104	0.508
0.114	-0.015	0.120	-0.356	0.129	-0.634	0.137	-0.339
0.142	0.259	0.153	0.595	0.162	0.818	0.163	0.608
0.173	0.246	0.175	-0.247	0.180	-0.525	0.186	-0.824
0.190	-0.609	0.200	-0.113	0.203	0.157	0.206	0.548
0.213	0.843	0.216	1.184	0.223	0.780	0.228	0.215
0.234	-0.366	0.246	-0.770	0.249	-0.421	0.256	-0.038
0.266	0.278	0.272	0.518	0.280	0.387	0.294	0.147
0.300	-0.262	0.305	-0.472	0.312	-0.548	0.318	-0.489
0.332	-0.292	0.336	-0.005	0.343	0.180	0.353	0.243
0.364	0.171	0.371	0.036	0.374	-0.124	0.384	-0.187
0.394	-0.225	0.402	-0.061	0.406	0.103	0.412	0.229
0.424	0.187	0.430	-0.049	0.437	-0.373	0.450	-0.748
0.455	-0.756	0.465	-0.264	0.473	0.279	0.480	0.827
0.490	1.057	0.498	0.355	0.513	-0.609	0.523	-1.034
0.529	-1.152	0.539	-1.056	0.551	-0.605	0.571	0.031
0.584	-0.020	0.592	0.346	0.604	0.675	0.607	0.898
0.618	0.540	0.632	0.325	0.643	0.304	0.650	-0.024
0.656	-0.306	0.663	-0.433	0.675	-0.618	0.678	-0.572
0.688	-0.281	0.696	-0.058	0.707	0.009	0.716	-0.020
0.724	-0.176	0.740	0.127	0.742	0.283	0.755	0.240
0.767	0.047	0.773	-0.054	0.783	-0.084	0.803	-0.442
0.814	-0.606	0.828	-0.093	0.836	0.606	0.852	1.297
0.854	0.905	0.862	0.480	0.867	0.118	0.874	-0.270
0.882	-0.531	0.887	-0.333	0.892	0.033	0.900	0.298
0.903	0.193	0.911	-0.114	0.915	-0.489	0.920	-0.767
0.928	-1.053	0.938	-1.239	0.946	-1.075	0.953	-0.809
0.959	0.012	0.971	0.622	0.977	1.153	0.984	1.165
0.994	0.912	0.999	0.614	1.007	0.176	1.023	-0.170
1.027	-0.187	1.038	0.066	1.046	-0.094	1.058	-0.414
1.064	-0.608	1.066	-0.839	1.073	-0.911	1.076	-0.722
1.083	-0.402	1.086	-0.061	1.091	0.125	1.097	0.196
1.106	0.108	1.109	-0.221	1.120	-0.414	1.130	-0.549
1.132	-0.558	1.148	-0.326	1.171	-0.566	1.176	-0.280
1.183	0.082	1.186	0.453	1.198	0.802	1.209	0.520
1.224	0.402	1.236	0.107	1.249	-0.120	1.257	-0.171
1.264	-0.390	1.277	-0.596	1.284	-0.672	1.295	-0.449
1.313	0.221	1.318	0.406	1.328	0.158	1.337	-0.091
1.347	-0.293	1.361	-0.154	1.331	-0.348	1.396	-0.196
1.408	0.102	1.428	-0.407	1.439	-0.900	1.454	-0.437
1.466	-0.075	1.476	0.123	1.501	-0.260	1.519	-0.033
1.527	0.022	1.540	-0.117	1.554	-0.459	1.565	-0.391
1.574	-0.417	1.587	-0.088	1.602	0.350	1.612	0.303
1.633	0.632	1.648	0.113	1.661	-0.598	1.671	-1.390
1.685	-1.424	1.695	-1.033	1.704	-0.974	1.719	-1.029
1.733	-0.309	1.753	0.209	1.771	-0.284	1.786	0.162
1.798	0.461	1.813	0.784	1.826	1.016	1.835	1.230
1.853	0.544	1.861	0.220	1.875	-0.004	1.888	-0.379
1.898	-0.758	1.912	-1.112	1.918	-0.030	1.922	0.833
1.928	1.397	1.935	1.755	1.942	2.151	1.953	1.717
1.962	1.266	1.969	0.963	1.979	0.689	1.985	0.533
1.994	0.554	2.007	0.268	2.012	-0.082	2.020	-0.583
2.027	-0.954	2.032	-1.278	2.040	-1.366	2.045	-0.840
2.049	-0.124	2.065	0.962	2.074	0.090	2.086	-0.710
2.099	-1.295	2.116	-1.914	2.127	-1.948	2.139	-1.771
2.154	-1.830	2.174	-1.590	2.189	-1.355	2.199	-0.921
2.209	-0.412	2.219	-0.054	2.224	-0.104	2.234	-0.466
2.261	-0.803	2.268	-0.437	2.283	0.060	2.299	0.691
2.309	0.119	2.316	-0.753	2.328	-1.549	2.339	-2.108
2.347	-2.454	2.367	-1.717	2.381	-1.068	2.389	-0.752
2.401	-0.239	2.419	1.122	2.426	1.829	2.434	2.385
2.441	2.806	2.449	3.109	2.461	2.911	2.467	2.267
2.476	1.783	2.487	1.442	2.489	1.590	2.501	2.209
2.512	2.621	2.519	2.992	2.527	3.219	2.532	3.304
2.547	3.379	2.565	2.824	2.580	2.588	2.597	2.125
2.609	1.733	2.627	1.636	2.635	1.350	2.645	1.329
2.649	1.527	2.655	1.577	2.669	1.543	2.689	0.945
2.705	2.735	2.714	3.884	2.722	4.722	2.733	4.444
2.745	5.025	2.765	5.884	2.778	5.235	2.784	4.545
2.803	4.435	2.809	3.741	2.819	2.191	2.829	1.163
2.840	-0.193	2.853	-1.039	2.867	-2.770	2.877	-0.585
2.883	1.259	2.890	2.960	2.896	4.421	2.903	4.665
2.913	3.545	2.924	2.703	2.931	3.321	2.936	4.252
2.939	4.706	2.951	5.073	2.960	4.550	2.969	3.969
2.977	3.489	2.987	2.899	2.992	2.242	3.003	1.716
3.016	1.421	3.025	0.873	3.036	0.258	3.048	-0.163
3.054	-0.850	3.061	-1.056	3.072	-1.557	3.077	-1.920
3.085	-2.244	3.100	-2.105	3.112	-2.986	3.123	-3.883
3.136	-5.032	3.141	-3.917	3.146	-3.108	3.153	-2.544
3.161	-3.058	3.174	-3.614	3.182	-3.345	3.189	-2.991
3.197	-2.684	3.201	-2.309	3.214	-2.116	3.232	-2.883
3.240	-2.538	3.247	-2.403	3.265	-3.620	3.273	-4.197
3.283	-5.393	3.291	-6.252	3.301	-5.309	3.309	-4.682
3.319	-4.147	3.327	-5.145	3.334	-6.362	3.352	-7.326
3.360	-5.743	3.367	-4.122	3.372	-3.419	3.375	-3.187
3.378	-3.183	3.386	-2.884	3.391	-2.737	3.398	-2.556
3.404	-2.224	3.411	-1.727	3.419	-1.407	3.432	-2.005
3.442	-2.194	3.451	-2.287	3.457	-2.418	3.465	-2.136
3.472	-1.765	3.478	-1.508	3.485	-1.033	3.495	-0.650
3.498	-0.106	3.505	0.559	3.515	0.053	3.525	-0.923
3.529	-1.627	3.543	-2.195	3.544	-1.913	3.554	-1.050
3.559	-0.288	3.567	0.571	3.571	1.018	3.589	1.561
3.595	0.988	3.603	0.479	3.612	0.332	3.627	0.614
3.633	0.248	3.641	-0.434	3.645	-1.070	3.650	-1.664

3.654	-1.921	3.663	-2.038	3.669	-1.596	3.682	-1.309
3.686	-1.638	3.699	-1.873	3.712	-1.119	3.724	-0.357
3.727	0.595	3.733	1.252	3.742	1.657	3.748	1.909
3.753	2.057	3.760	2.205	3.775	2.298	3.783	2.349
3.798	2.690	3.810	2.669	3.818	2.417	3.838	2.185
3.860	2.257	3.878	1.954	3.894	1.748	3.908	1.504
3.923	1.790	3.931	2.001	3.937	2.249	3.947	2.455
3.952	2.682	3.959	2.724	3.972	2.547	3.987	2.366
3.994	2.042	4.014	1.616	4.020	1.376	4.032	1.123
4.039	1.055	4.044	1.017	4.054	0.895	4.064	0.697
4.075	0.562	4.092	0.532	4.100	0.574	4.110	0.797
4.132	0.687	4.140	0.826	4.150	0.754	4.160	-0.025
4.168	-0.762	4.180	-1.490	4.183	-1.882	4.196	-2.290
4.204	-2.194	4.213	-1.954	4.224	-1.592	4.234	-2.013
4.251	-2.502	4.262	-3.020	4.269	-2.152	4.286	-1.277
4.292	-0.030	4.304	1.262	4.309	2.542	4.317	3.624
4.325	4.420	4.339	5.005	4.349	4.095	4.358	3.123
4.372	1.940	4.378	1.135	4.385	0.407	4.395	-0.347
4.403	-0.751	4.410	-1.063	4.418	-1.366	4.423	-1.522
4.428	-1.602	4.443	-1.661	4.448	-1.762	4.458	-2.032
4.463	-2.752	4.473	-3.240	4.478	-2.364	4.484	-1.981
4.491	-1.779	4.494	-1.598	4.503	-1.442	4.516	-1.859
4.527	-2.352	4.531	-2.756	4.541	-3.076	4.547	-3.101
4.557	-2.697	4.562	-2.326	4.574	-2.019	4.584	-2.111
4.589	-1.694	4.594	-0.697	4.602	0.415	4.607	1.792
4.610	3.043	4.623	4.011	4.628	4.512	4.637	4.971
4.647	5.358	4.653	4.415	4.655	3.194	4.663	2.154
4.670	1.492	4.676	0.810	4.683	0.317	4.693	-0.028
4.700	0.368	4.708	0.536	4.719	0.409	4.728	0.645
4.736	1.003	4.747	0.771	4.762	0.152	4.768	-0.514
4.775	-1.204	4.780	-1.899	4.791	-2.278	4.800	-1.988
4.809	-2.013	4.816	-1.559	4.821	-1.626	4.837	-2.136
4.844	-1.871	4.857	-1.104	4.865	-1.147	4.870	-1.585
4.886	-1.319	4.899	-1.682	4.906	-1.972	4.928	-2.819
4.937	-2.276	4.948	-2.171	4.963	-1.922	4.971	-1.370
4.984	-0.604	4.992	-0.065	4.997	0.344	5.008	-0.065
5.013	-0.444	5.017	-0.919	5.026	-1.222	5.035	-0.797
5.041	-0.031	5.049	0.770	5.056	1.532	5.061	2.218
5.069	3.199	5.074	1.983	5.085	1.397	5.088	1.128
5.098	0.829	5.108	0.866	5.115	0.151	5.120	-0.448
5.124	-1.214	5.128	-1.812	5.134	-2.280	5.146	-2.941
5.157	-3.560	5.164	-2.870	5.170	-2.377	5.178	-1.995
5.191	-2.319	5.200	-1.688	5.206	-0.673	5.216	-0.202
5.224	0.089	5.226	0.341	5.232	0.977	5.237	1.629
5.243	2.008	5.250	0.535	5.256	-0.211	5.268	-1.706
5.284	-2.864	5.287	-2.005	5.297	-1.041	5.305	-0.679
5.313	-0.452	5.318	-0.658	5.329	-0.915	5.341	-1.038
5.354	-1.320	5.358	-0.613	5.367	-0.112	5.370	0.275
5.378	-0.087	5.388	-0.806	5.404	-1.555	5.405	-2.120
5.409	-2.764	5.417	-2.835	5.423	-2.300	5.431	-1.816
5.435	-0.885	5.443	-0.413	5.446	-0.123	5.452	-0.043
5.459	-0.135	5.464	-0.426	5.477	-0.661	5.483	-0.526
5.488	-0.076	5.494	0.215	5.503	0.628	5.511	0.224
5.517	0.051	5.524	-0.054	5.528	0.241	5.538	0.654
5.546	1.223	5.553	1.703	5.561	2.128	5.567	2.326
5.575	2.229	5.580	1.879	5.587	1.437	5.595	1.277

5.606	1.126	5.614	0.970	5.629	0.877	5.643	1.168
5.650	1.555	5.660	1.942	5.669	2.435	5.679	2.978
5.686	3.130	5.692	3.235	5.702	3.290	5.705	3.281
5.718	3.218	5.729	3.066	5.739	2.814	5.747	2.338
5.754	1.908	5.762	1.470	5.767	0.982	5.772	0.682
5.783	0.282	5.794	0.349	5.804	0.155	5.819	-0.258
5.825	0.020	5.828	0.285	5.835	0.458	5.848	0.563
5.858	0.697	5.866	0.916	5.872	1.135	5.879	1.282
5.884	0.962	5.889	0.764	5.897	0.347	5.903	0.279
5.907	0.473	5.913	0.620	5.920	0.713	5.931	0.098
5.937	-1.772	5.946	-2.838	5.955	-4.716	5.962	-1.684
5.973	2.155	5.985	0.660	5.994	-0.569	5.998	-0.923
6.002	-0.873	6.014	-0.330	6.024	-0.035	6.035	-0.751
6.041	-1.614	6.051	-2.844	6.056	-4.052	6.061	-4.658
6.072	-5.189	6.077	-4.583	6.087	-4.339	6.094	-4.532
6.102	-3.657	6.107	-2.747	6.113	-2.036	6.118	-1.430
6.124	-0.929	6.128	-1.463	6.133	-2.175	6.139	-2.773
6.144	-2.962	6.155	-2.512	6.160	-1.817	6.170	-0.870
6.176	-0.070	6.186	1.445	6.191	2.018	6.198	3.403
6.206	5.054	6.212	6.679	6.224	8.472	6.230	6.767
6.242	4.733	6.271	1.975	6.282	0.480	6.287	-0.425
6.292	-0.969	6.295	-1.457	6.302	-1.752	6.309	-1.301
6.318	-0.855	6.323	0.732	6.327	2.433	6.335	0.492
6.351	-3.505	6.358	-5.063	6.366	-4.550	6.369	-3.876
6.376	-3.236	6.380	-3.679	6.392	-3.944	6.402	-4.105
6.405	-3.465	6.408	-2.711	6.413	-2.341	6.426	-2.228
6.431	-1.630	6.433	-1.040	6.434	-0.645	6.439	-0.573
6.443	-0.186	6.446	0.050	6.451	0.378	6.454	0.710
6.461	0.980	6.464	0.655	6.475	-0.023	6.478	0.381
6.487	0.755	6.493	1.008	6.500	0.793	6.510	0.220
6.516	-0.071	6.524	-0.475	6.529	-0.816	6.539	-1.073
6.554	-1.301	6.560	-1.440	6.567	-0.640	6.570	0.673
6.575	1.823	6.578	2.572	6.581	3.524	6.593	4.344
6.604	3.527	6.609	1.734	6.614	1.182	6.619	0.937
6.622	0.163	6.627	0.087	6.630	-0.419	6.634	-0.444
6.640	-0.865	6.655	-1.442	6.665	-1.809	6.670	-2.036
6.676	-2.314	6.683	-2.440	6.696	-2.693	6.699	-2.566
6.702	-2.596	6.709	-2.322	6.719	-1.905	6.720	-1.467
6.727	-1.046	6.733	-0.604	6.740	-0.419	6.747	-0.587
6.755	-1.021	6.763	-1.935	6.771	-2.701	6.774	-3.762
6.783	-4.625	6.786	-3.345	6.793	-1.505	6.799	-0.334
6.806	0.158	6.822	-0.119	6.827	0.264	6.837	0.706
6.850	1.064	6.853	1.350	6.857	1.729	6.868	2.200
6.875	1.042	6.883	0.209	6.889	-0.175	6.896	0.124
6.901	0.625	6.909	0.966	6.917	-0.453	6.926	-1.430
6.937	-2.504	6.945	-4.285	6.960	-3.135	6.965	0.528
6.973	3.875	6.981	2.452	6.991	1.492	6.993	1.024
7.003	0.628	7.013	0.801	7.019	1.003	7.024	1.180
7.032	1.378	7.040	1.639	7.047	1.841	7.055	2.035
7.060	2.481	7.067	2.961	7.073	3.319	7.077	3.513
7.090	3.311	7.100	2.902	7.103	2.212	7.109	1.555
7.116	1.105	7.123	0.936	7.128	0.608	7.136	0.520
7.144	-0.074	7.150	-0.954	7.155	-1.341	7.169	-1.543
7.182	-1.093	7.190	-1.804	7.195	-2.288	7.201	-2.355
7.205	-2.743	7.215	-2.785	7.223	-2.882	7.228	-3.067
7.238	-3.357	7.247	-3.509	7.257	-2.995	7.264	-2.072

7.265	-0.990	7.272	-0.396	7.278	0.387	7.283	0.707
7.290	0.939	7.296	1.709	7.306	4.480	7.316	8.762
7.326	9.415	7.337	8.081	7.357	5.466	7.362	4.165
7.375	3.280	7.377	2.863	7.385	2.766	7.391	2.244
7.396	1.599	7.403	1.022	7.411	0.382	7.414	0.054
7.423	-0.187	7.436	-0.595	7.441	-0.183	7.449	0.069
7.462	-0.205	7.473	0.241	7.483	0.852	7.490	1.146
7.493	1.458	7.500	0.712	7.508	-0.215	7.518	-2.434
7.531	-3.605	7.541	-3.184	7.552	-3.546	7.555	-2.687
7.573	-1.853	7.580	-3.121	7.590	-4.198	7.603	-5.445
7.611	-4.093	7.619	-3.344	7.621	-2.864	7.627	-2.523
7.634	-2.636	7.645	-2.855	7.650	-3.280	7.657	-3.722
7.667	-4.543	7.678	-3.428	7.680	-2.552	7.690	-2.194
7.698	-1.693	7.703	-1.377	7.706	-0.783	7.713	-0.135
7.719	1.983	7.726	5.251	7.729	8.518	7.732	11.120
7.739	11.765	7.748	12.422	7.755	11.693	7.758	10.637
7.763	8.073	7.768	7.563	7.778	4.620	7.788	3.357
7.789	4.254	7.796	4.671	7.802	5.004	7.809	5.467
7.814	4.385	7.817	2.835	7.823	1.661	7.827	-0.011
7.830	-1.186	7.836	-1.885	7.843	-0.664	7.849	0.784
7.853	1.748	7.862	2.856	7.867	2.371	7.875	1.807
7.882	1.306	7.890	0.880	7.893	0.514	7.897	-0.089
7.902	-0.539	7.913	-0.775	7.919	-0.035	7.931	0.365
7.939	-0.368	7.944	-1.185	7.952	-2.044	7.959	-3.168
7.965	-4.259	7.973	-5.076	7.985	-5.969	7.993	-6.495
8.001	-5.072	8.006	-3.665	8.016	-2.423	8.024	-2.781
8.032	-3.227	8.040	-2.469	8.043	-2.039	8.048	-1.378
8.051	0.074	8.058	0.963	8.063	1.978	8.068	2.281
8.074	2.664	8.082	1.982	8.087	1.170	8.090	0.707
8.095	0.176	8.102	1.343	8.107	1.785	8.113	2.223
8.115	2.833	8.121	3.221	8.128	3.423	8.134	3.133
8.141	2.960	8.147	3.807	8.154	4.788	8.162	6.127
8.172	8.691	8.175	9.209	8.195	6.486	8.200	4.860
8.206	3.122	8.209	2.195	8.217	1.913	8.221	1.299
8.229	1.623	8.237	1.855	8.245	1.910	8.250	1.712
8.258	1.484	8.265	1.274	8.272	0.882	8.273	0.541
8.281	0.305	8.286	0.044	8.290	-0.293	8.296	-0.487
8.298	-1.017	8.303	-1.657	8.309	-2.184	8.318	-1.565
8.324	-0.731	8.331	-0.049	8.337	0.212	8.344	-0.529
8.355	-1.111	8.359	0.296	8.370	2.232	8.378	4.119
8.392	6.405	8.406	4.632	8.415	1.916	8.418	-0.665
8.428	-2.480	8.436	-4.922	8.446	-6.127	8.451	-5.714
8.456	-4.548	8.461	-3.264	8.466	-2.375	8.474	-2.076
8.482	-4.404	8.493	-6.261	8.500	-7.620	8.510	-9.326
8.521	-10.218	8.526	-7.616	8.528	-5.152	8.541	-1.691
8.548	1.029	8.553	3.509	8.561	4.907	8.567	3.779
8.572	2.672	8.579	1.993	8.586	1.451	8.595	1.207
8.602	1.056	8.607	0.748	8.613	0.378	8.618	-0.093
8.627	-0.295	8.635	-0.645	8.646	-0.815	8.658	-0.767
8.669	-1.150	8.673	-0.931	8.678	-0.956	8.684	-0.210
8.686	0.518	8.691	0.703	8.694	0.724	8.697	1.179
8.707	0.704	8.710	0.333	8.720	-0.496	8.732	-0.958
8.737	1.428	8.743	2.300	8.752	2.852	8.757	3.412
8.760	3.753	8.767	3.925	8.777	3.854	8.785	3.239
8.791	2.199	8.798	1.328	8.805	0.368	8.810	-0.769
8.816	-1.876	8.821	-2.980	8.830	-3.321	8.838	-1.746

8.844	-0.462	8.849	-0.105	8.863	-0.366	8.873	-0.421
8.878	-0.636	8.884	-0.089	8.889	0.373	8.897	0.900
8.901	1.245	8.911	1.565	8.916	1.072	8.922	0.802
8.935	0.545	8.944	0.250	8.950	-0.293	8.964	-1.039
8.975	0.881	8.982	2.451	8.988	4.333	8.995	4.653
9.002	2.926	9.007	1.073	9.012	0.252	9.017	-0.435
9.036	-1.088	9.043	-0.886	9.055	-0.785	9.065	-1.034
9.080	-1.371	9.088	-1.678	9.089	-1.897	9.099	-2.011
9.109	-2.176	9.118	-2.424	9.126	-2.441	9.134	-2.189
9.141	-1.697	9.144	-0.829	9.151	0.358	9.161	1.360
9.164	2.770	9.174	3.915	9.179	4.366	9.184	4.627
9.194	4.757	9.207	4.807	9.215	4.276	9.220	3.241
9.227	2.120	9.233	1.093	9.240	-0.246	9.243	-1.215
9.250	-2.322	9.257	-3.034	9.266	-3.451	9.276	-3.206
9.291	-3.560	9.301	-3.888	9.309	-3.560	9.316	-3.282
9.329	-3.142	9.336	-2.987	9.347	-2.868	9.360	-2.986
9.367	-2.426	9.377	-1.718	9.382	-0.594	9.392	0.105
9.400	0.673	9.408	1.183	9.418	1.701	9.425	1.903
9.433	2.202	9.444	2.038	9.453	1.660	9.456	0.982
9.464	0.544	9.466	0.051	9.474	-0.509	9.479	-0.887
9.484	-1.157	9.499	-0.938	9.506	-0.744	9.517	-0.811
9.524	-0.938	9.530	-1.266	9.547	-1.754	9.552	-1.190
9.562	-0.521	9.568	-0.003	9.581	0.566	9.591	1.105
9.598	1.463	9.603	1.606	9.608	1.749	9.619	1.791
9.632	1.741	9.652	1.690	9.660	1.462	9.669	1.096
9.677	0.569	9.689	0.085	9.695	-0.341	9.708	-0.767
9.718	-1.032	9.733	-1.327	9.746	-1.555	9.754	-1.678
9.769	-1.636	9.794	-2.075	9.804	-1.494	9.814	-0.593
9.824	0.392	9.837	1.099	9.842	1.739	9.850	2.420
9.857	3.237	9.862	3.687	9.876	2.819	9.888	1.796
9.896	1.151	9.900	0.949	9.908	0.625	9.919	0.283
9.929	-0.066	9.936	-0.517	9.939	-0.980	9.946	-1.389
9.952	-1.810	9.964	-2.084	9.969	-2.059	9.975	-1.849
9.989	-1.723	9.998	-1.273	10.005	-0.772	10.015	-0.330
10.038	-0.226	10.045	-0.066	10.053	0.258	10.060	0.439
10.066	0.599	10.081	0.598	10.099	0.850	10.107	0.396
10.121	0.088	10.130	-0.093	10.132	-0.392	10.137	-0.818
10.144	-1.083	10.152	-1.306	10.172	-0.923	10.182	-1.214
10.190	-1.442	10.196	-1.741	10.218	-1.341	10.223	-0.849
10.226	-0.373	10.238	0.090	10.249	0.519	10.253	1.092
10.263	1.513	10.266	1.732	10.274	1.925	10.279	2.115
10.291	2.077	10.301	1.929	10.316	1.600	10.324	1.301
10.336	1.070	10.342	0.661	10.351	0.404	10.357	0.227
10.376	0.147	10.381	0.071	10.397	-0.161	10.399	-0.481
10.410	-0.742	10.420	-0.881	10.425	-1.109	10.435	-1.336
10.442	-1.471	10.450	-1.614	10.457	-1.686	10.467	-1.564
10.475	-1.454	10.493	-1.332	10.502	-1.084	10.510	-0.899
10.517	-0.743	10.522	-0.629	10.528	-0.701	10.535	-1.063
10.542	-1.341	10.552	-1.476	10.558	-0.819	10.570	-0.146
10.575	0.162	10.585	0.473	10.588	0.035	10.596	-0.542
10.616	-1.127	10.623	-0.614	10.635	0.094	10.640	0.527
10.655	0.915	10.658	1.243	10.670	1.146	10.675	0.851
10.681	0.540	10.691	0.455	10.696	0.430	10.703	0.577
10.708	0.615	10.721	0.228	10.738	-0.135	10.748	-0.522
10.756	-0.695	10.771	-0.926	10.781	-1.171	10.798	-1.108
10.811	-1.015	10.814	-1.141	10.824	-1.360	10.829	-1.360

10.837	-0.581	10.846	0.375	10.854	1.187	10.862	1.853
10.871	1.592	10.887	0.897	10.904	1.238	10.929	0.826
10.945	1.057	10.950	1.293	10.960	1.441	10.969	1.407
10.980	0.914	10.989	0.519	10.997	0.270	11.007	0.485
11.024	0.645	11.029	0.843	11.039	0.961	11.049	0.894
11.062	0.607	11.069	0.540	11.090	0.502	11.102	0.212
11.110	-0.087	11.122	-0.445	11.138	-0.777	11.150	-1.068
11.160	-1.232	11.175	-1.278	11.188	-1.127	11.195	-0.836
11.203	-0.491	11.225	0.002	11.233	0.057	11.253	0.179
11.266	0.419	11.274	0.600	11.282	0.764	11.294	0.907
11.302	0.971	11.315	0.811	11.328	0.726	11.348	0.541
11.361	0.373	11.373	0.061	11.386	-0.170	11.404	-0.410
11.424	-0.360	11.439	-0.448	11.450	-0.747	11.463	-1.155
11.478	-1.025	11.498	-1.092	11.509	-0.801	11.516	-0.309
11.524	0.231	11.536	0.500	11.542	0.773	11.552	0.866
11.562	0.731	11.573	0.474	11.582	0.302	11.593	0.234
11.608	0.150	11.618	-0.136	11.623	-0.275	11.634	-0.431
11.643	-0.532	11.649	-0.338	11.662	-0.086	11.690	0.306
11.702	0.255	11.717	0.263	11.740	-0.116	11.745	-0.200
11.759	-0.082	11.768	-0.052	11.777	-0.128	11.789	-0.503
11.809	-1.126	11.827	-0.301	11.840	-0.023	11.851	0.103
11.870	0.440	11.876	0.372	11.886	0.259	11.904	0.255
11.930	0.019	11.950	0.275	11.960	0.296	11.985	0.237
12.013	-0.058	12.024	-0.251	12.037	-0.294	12.050	-0.163
12.065	-0.226	12.092	0.169	12.113	0.068	12.129	0.144
12.156	-0.067	12.162	-0.130	12.169	-0.151	12.184	-0.076
12.195	-0.093	12.215	-0.051	12.228	-0.097	12.261	-0.224
12.290	-0.346	12.299	-0.270	12.313	-0.237	12.328	-0.090
12.353	-0.208	12.373	-0.124	12.401	0.309	12.422	0.393
12.446	0.591	12.454	0.603	12.460	0.493	12.469	0.249
12.480	-0.033	12.494	-0.059	12.502	0.076	12.535	0.181
12.552	0.345	12.568	0.243	12.593	0.180	12.612	-0.069
12.621	-0.305	12.640	-0.394	12.661	-0.242	12.676	-0.213
12.699	-0.357	12.714	-0.336	12.724	-0.361	12.739	-0.130
12.749	0.245	12.761	0.480	12.791	0.257	12.817	0.551
12.831	0.281	12.839	0.146	12.857	0.079	12.879	0.146
12.920	0.023	12.947	0.073	12.977	-0.003	12.995	0.178
13.010	0.460	13.025	0.038	13.045	-0.223	13.056	-0.383
13.073	-0.291	13.085	-0.312	13.104	-0.207	13.124	0.016
13.143	0.028	13.163	0.217	13.171	0.444	13.184	0.508
13.197	0.570	13.216	0.343	13.224	0.254	13.232	0.245
13.250	0.275	13.295	0.055	13.321	0.118	13.338	-0.022
13.349	0.054	13.364	-0.001	13.382	0.096	13.407	-0.027
13.422	0.036	13.437	0.082	13.448	0.179	13.460	0.229
13.475	0.267	13.488	0.229	13.508	0.141	13.524	0.060
13.537	0.052	13.546	0.081	13.551	0.140	13.554	0.216
13.566	0.279	13.579	0.266	13.585	0.157	13.592	0.098
13.600	0.022	13.615	-0.138	13.627	-0.092	13.646	-0.147
13.673	-0.088	13.693	0.126	13.698	0.114	13.732	-0.173
13.745	-0.173	13.760	-0.232	13.772	-0.346	13.791	-0.333
13.800	-0.224	13.806	-0.123	13.826	-0.047	13.837	0.155
13.851	0.366	13.857	0.345	13.877	0.121	13.902	0.100
13.920	-0.161	13.935	-0.182	13.941	-0.169	13.949	0.020
13.967	0.020	13.987	-0.186	14.004	-0.355	14.022	-0.334
14.041	-0.477	14.053	-0.460	14.083	-0.469	14.097	-0.376
14.115	-0.027	14.135	-0.082	14.145	0.028	14.155	0.103

14.163	0.188	14.175	0.167	14.185	0.044	14.188	-0.158
14.198	-0.234	14.204	-0.301	14.214	-0.301	14.231	-0.154
14.250	-0.242	14.268	-0.352	14.278	-0.436	14.285	-0.327
14.296	-0.116	14.305	-0.150	14.329	-0.504	14.336	-0.516
14.346	-0.453	14.362	-0.159	14.393	0.089	14.397	0.094
14.425	-0.033	14.444	-0.003	14.471	-0.294	14.481	-0.315
14.505	0.030	14.530	-0.053	14.550	0.018	14.569	-0.012
14.594	0.056	14.609	0.018	14.619	-0.016	14.627	-0.016
14.652	-0.147	14.665	-0.067	14.675	-0.113	14.698	0.009
14.706	0.056	14.721	-0.012	14.727	-0.197	14.739	-0.235
14.754	-0.206	14.773	-0.046	14.793	-0.075	14.821	0.034
14.825	0.093	14.837	0.077	14.859	-0.079	14.883	-0.037
14.896	0.068	14.910	-0.105	14.918	-0.054	14.934	-0.075
14.944	0.009	14.960	-0.063	14.974	-0.168	14.988	-0.219
15.006	-0.126	15.026	-0.097	15.039	-0.139	15.061	0.088
15.067	0.004	15.087	-0.013	15.115	0.008	15.131	0.012
15.172	-0.093	15.199	0.012	15.217	-0.026	15.243	0.049
15.261	0.024	15.297	0.104	15.315	0.074	15.335	0.074
15.369	0.044	15.382	0.073	15.407	-0.218	15.417	-0.247
15.432	-0.180	15.446	-0.029	15.473	0.182	15.484	0.207
15.487	0.299	15.510	0.442	15.520	0.291	15.541	0.118
15.537	0.189	15.607	0.070	15.637	0.133	15.663	-0.019
15.674	0.006	15.689	-0.057	15.719	0.195	15.742	0.460
15.756	0.557	15.775	0.393	15.788	0.115	15.814	-0.105
15.817	-0.042	15.834	-0.067	15.842	-0.025	15.855	-0.046
15.896	0.181	15.916	0.079	15.960	-0.018	16.002	0.230
16.026	-0.040	16.046	-0.086	16.064	-0.032	16.085	-0.099
16.123	0.018	16.140	0.081	16.154	0.077	16.179	-0.046
16.201	-0.193	16.220	-0.282	16.265	-0.325	16.288	-0.245
16.302	-0.039	16.314	0.121	16.327	0.293	16.337	0.322
16.347	0.305	16.360	0.234	16.373	0.196	16.386	0.082
16.413	-0.163	16.427	0.001	16.465	0.143	16.485	0.013
16.495	-0.215	16.514	-0.358	16.526	-0.228	16.560	-0.271
16.580	-0.048	16.593	0.007	16.605	-0.018	16.629	-0.153
16.649	-0.123	16.664	-0.153	16.690	-0.035	16.715	-0.081
16.728	-0.065	16.759	-0.183	16.781	-0.065	16.810	-0.065
16.840	0.028	16.853	0.112	16.886	0.200	16.905	0.137
16.953	0.179	16.981	0.116	17.012	0.226	17.024	0.100
17.047	-0.249	17.056	-0.283	17.081	-0.131	17.102	-0.110
17.130	0.155	17.150	0.076	17.162	-0.080	17.170	-0.257
17.185	-0.316	17.206	-0.151	17.216	-0.177	17.255	0.013
17.275	-0.029	17.281	0.001	17.303	-0.100	17.329	0.026
17.352	-0.074	17.372	-0.015	17.392	-0.095	17.415	-0.062
17.433	-0.087	17.446	-0.071	17.479	-0.016	17.503	-0.076
17.525	0.177	17.544	0.046	17.567	0.172	17.590	0.037
17.613	0.163	17.617	0.188	17.632	0.108	17.648	-0.049
17.663	0.031	17.674	0.170	17.694	0.031	17.707	-0.125
17.719	-0.113	17.727	0.039	17.755	0.017	17.774	0.122
17.786	0.197	17.802	0.302	17.812	0.218	17.827	-0.086
17.828	-0.098	17.848	0.069	17.872	-0.087	17.891	0.073
17.905	0.241	17.918	0.118	17.940	-0.009	17.959	0.029
17.982	-0.241	17.992	-0.263	18.010	0.061	18.017	0.048
18.036	-0.133	18.071	-0.050	18.108	-0.190	18.133	-0.014
18.149	0.003	18.175	0.145	18.183	0.242	18.195	0.187
18.219	-0.075	18.268	-0.232	18.295	-0.089	18.319	-0.128
18.348	0.053	18.363	0.234	18.371	0.305	18.407	0.372

18.422	0.313	18.440	0.123	18.467	-0.159	18.487	-0.033
18.515	-0.130	18.526	-0.118	18.551	0.118	18.582	-0.085
18.600	-0.018	18.626	0.003	18.642	0.087	18.660	0.112
18.683	0.125	18.709	0.213	18.735	0.309	18.747	0.267
18.761	0.149	18.786	0.027	18.809	-0.235	18.845	-0.121
18.897	0.018	18.920	-0.130	18.930	-0.319	18.955	-0.378
18.973	-0.298	18.982	-0.290	18.991	-0.256	19.010	-0.247
19.030	-0.054	19.043	0.153	19.059	0.401	19.082	0.422
19.095	0.515	19.107	0.435	19.122	0.039	19.133	-0.264
19.149	-0.512	19.163	-0.466	19.176	-0.491	19.200	-0.226
19.212	-0.201	19.226	-0.045	19.246	0.140	19.258	0.195
19.277	0.060	19.297	0.098	19.318	-0.053	19.333	-0.150
19.348	-0.053	19.364	-0.011	19.382	-0.217	19.397	-0.246
19.413	-0.175	19.430	-0.057	19.458	0.078	19.474	0.091
19.492	0.213	19.504	0.343	19.517	0.310	19.535	0.120
19.553	-0.027	19.584	-0.119	19.596	-0.212	19.612	-0.275
19.633	-0.313	19.655	-0.123	19.686	0.129	19.724	0.163
19.751	0.008	19.764	0.096	19.776	0.126	19.803	-0.064
19.825	-0.051	19.851	-0.253	19.860	-0.224	19.875	-0.085
19.888	0.054	19.903	-0.085	19.926	-0.199	19.942	-0.073
19.968	0.053	19.992	0.196	20.017	0.128	20.033	-0.082
20.069	-0.260	20.101	-0.218	20.134	-0.046	20.165	0.257
20.168	0.228	20.199	0.118	20.207	0.219	20.222	0.231
20.232	0.151	20.240	-0.161	20.254	-0.304	20.263	-0.233
20.277	-0.170	20.280	-0.191	20.308	-0.275	20.319	-0.162
20.332	-0.010	20.365	-0.196	20.387	0.140	20.415	0.085
20.470	0.219	20.506	0.071	20.522	0.134	20.550	-0.001
20.577	-0.136	20.598	-0.254	20.621	-0.427	20.640	-0.275
20.655	-0.069	20.668	0.179	20.681	0.318	20.697	0.327
20.717	0.301	20.731	0.087	20.770	-0.019	20.791	-0.187
20.817	-0.111	20.837	-0.141	20.856	0.027	20.869	0.158
20.881	0.103	20.906	-0.112	20.928	-0.095	20.954	-0.238
20.975	-0.124	20.988	-0.061	21.005	-0.103	21.039	0.115
21.064	0.094	21.082	0.120	21.114	-0.070	21.142	0.153
21.174	0.212	21.182	0.208	21.205	0.238	21.226	0.120
21.247	-0.028	21.303	-0.116	21.322	-0.078	21.345	-0.116
21.369	-0.015	21.392	0.040	21.413	0.158	21.441	0.246
21.452	0.250	21.475	0.153	21.509	-0.040	21.531	0.044
21.547	0.006	21.568	0.115	21.579	0.145	21.609	0.019
21.632	-0.137	21.661	-0.003	21.676	0.090	21.715	0.212
21.744	0.090	21.774	0.279	21.800	-0.041	21.833	0.119
21.857	0.064	21.877	-0.066	21.918	-0.125	21.938	0.060
21.977	0.275	22.005	0.085	22.041	-0.315	22.059	-0.147
22.082	-0.193	22.107	-0.046	22.136	0.051	22.161	-0.021
22.185	0.042	22.217	-0.017	22.235	0.025	22.254	-0.097
22.282	-0.203	22.295	-0.182	22.313	-0.207	22.336	-0.153
22.356	-0.035	22.368	0.083	22.376	0.116	22.391	0.116
22.405	0.048	22.435	-0.137	22.458	0.018	22.483	-0.049
22.512	0.022	22.535	0.018	22.561	0.064	22.594	-0.067
22.625	-0.101	22.665	-0.182	22.686	-0.119	22.719	-0.287
22.752	-0.044	22.780	0.028	22.798	0.129	22.820	0.006
22.838	-0.125	22.865	-0.070	22.904	-0.231	22.927	-0.024
22.951	-0.062	22.977	-0.033	23.031	-0.307	23.057	-0.105
23.092	-0.046	23.116	0.143	23.144	0.080	23.172	0.190
23.186	0.223	23.208	0.185	23.221	0.059	23.240	-0.080
23.260	-0.286	23.288	-0.451	23.304	-0.484	23.319	-0.413

23.333	-0.194	23.351	-0.030	23.390	0.214	23.407	0.193
23.425	0.214	23.451	0.147	23.490	-0.018	23.526	-0.010
23.562	-0.027	23.588	0.007	23.622	0.116	23.633	0.083
23.661	-0.010	23.674	-0.023	23.712	-0.069	23.718	-0.044
23.739	0.069	23.764	0.141	23.777	0.153	23.797	0.052
23.821	-0.041	23.837	0.005	23.860	-0.003	23.893	0.043
23.911	0.030	23.937	0.047	23.966	0.004	24.030	0.088
24.064	0.050	24.098	0.062	24.138	0.163	24.170	0.108
24.190	0.137	24.226	0.073	24.258	0.090	24.279	-0.041
24.286	-0.049	24.317	0.017	24.343	-0.092	24.359	-0.118
24.387	0.042	24.410	0.045	24.441	0.121	24.470	0.032
24.488	0.133	24.522	0.182	24.540	-0.003	24.566	-0.130
24.592	-0.391	24.607	-0.278	24.636	-0.232	24.657	0.033
24.672	0.138	24.708	0.235	24.716	0.201	24.740	0.078
24.779	-0.040	24.833	-0.196	24.859	-0.281	24.893	-0.151
24.918	0.047	24.932	0.093	24.963	-0.008	24.985	0.008
25.014	-0.047	25.040	0.054	25.058	0.046	25.073	-0.018
25.105	-0.157	25.126	-0.089	25.156	-0.068	25.180	0.070
25.188	0.058	25.211	-0.090	25.252	-0.145	25.276	-0.048
25.284	0.066	25.289	0.083	25.320	0.061	25.342	0.087
25.355	0.036	25.376	-0.124	25.399	-0.036	25.428	-0.082
25.464	0.090	25.483	0.044	25.501	0.107	25.521	0.162
25.548	0.103	25.605	-0.104	25.624	-0.016	25.650	0.084
25.728	0.007	25.749	0.078	25.777	0.019	25.825	0.052
25.851	0.026	25.903	0.055	25.936	-0.013	25.956	0.003
25.990	-0.078	26.032	0.010	26.037	0.014	26.071	0.056
26.116	-0.109	26.143	-0.075	26.182	0.029	26.190	0.054
26.208	0.037	26.242	-0.077	26.274	-0.031	26.307	-0.031
26.334	0.065	26.365	-0.142	26.375	-0.150	26.422	-0.003
26.468	0.076	26.505	0.004	26.533	-0.085	26.559	0.004
26.603	-0.039	26.648	-0.161	26.661	-0.148	26.681	-0.077
26.715	-0.001	26.726	-0.022	26.747	0.024	26.775	0.015
26.791	0.015	26.808	-0.006	26.831	-0.006	26.878	-0.107
26.904	-0.095	26.935	-0.112	26.968	-0.011	26.994	-0.032
27.008	-0.011	27.048	-0.058	27.077	-0.012	27.119	0.047
27.144	0.013	27.177	0.042	27.204	-0.034	27.232	-0.025
27.255	-0.038	27.276	-0.013	27.322	-0.072	27.336	-0.013
27.361	0.050	27.392	0.033	27.426	-0.010	27.444	-0.006
27.467	-0.027	27.485	0.036	27.516	-0.128	27.545	-0.027
27.568	-0.057	27.578	-0.014	27.594	0.137	27.614	0.209
27.635	0.179	27.671	0.002	27.700	-0.086	27.724	-0.070
27.737	-0.095	27.760	-0.061	27.775	-0.087	27.799	0.002
27.845	0.128	27.907	-0.040	27.920	-0.045	27.942	-0.061
27.978	-0.133	28.001	-0.074	28.040	-0.007	28.060	-0.036
28.086	-0.045	28.120	-0.095	28.148	0.086	28.182	0.002
28.203	0.027	28.245	-0.074	28.278	0.069	28.306	-0.032
28.340	-0.095	28.363	-0.171	28.383	-0.057	28.410	0.028
28.427	0.112	28.450	0.053	28.477	0.024	28.510	-0.064
28.546	0.021	28.569	-0.021	28.595	-0.029	28.638	0.022
28.657	-0.008	28.674	0.022	28.585	0.064	28.698	0.048
28.711	0.027	28.728	0.007	*28.742	-0.035	28.764	-0.047
28.777	-0.055	28.808	-0.025	28.829	0.013	28.849	-0.008
28.861	0.004	28.882	0.058	28.897	0.070	28.910	0.062
28.934	-0.002	28.948	-0.011	28.964	-0.066	28.985	-0.122
28.995	-0.126	29.003	-0.084	29.026	0.008	29.031	-0.001
29.051	-0.069	29.064	0.003	29.075	0.112	29.079	0.217

29.095	0.132	29.102	-0.028	29.113	-0.146	29.123	-0.158
29.136	-0.049	29.144	-0.028	29.159	-0.020	29.184	-0.008
29.202	-0.038	29.210	-0.025	29.222	0.046	29.230	0.0
29.251	-0.114	29.261	-0.076	29.274	0.029	29.290	0.143
29.311	0.041	29.324	0.088	29.334	0.130	29.349	0.058
29.362	-0.081	29.375	-0.102	29.382	-0.073	29.401	0.003
29.413	-0.035	29.419	-0.026	29.442	-0.001	29.452	-0.018
29.478	-0.081	29.490	-0.082	29.512	-0.006	29.519	0.011
29.543	0.010	29.558	0.061	29.576	0.111	29.588	0.073
29.602	0.010	29.619	0.035	29.646	0.001	29.668	0.034
29.676	0.084	29.686	0.051	29.718	-0.009	29.726	-0.030
29.746	-0.026	29.787	-0.035	29.796	-0.001	29.814	0.083
29.831	0.074	29.850	0.036	29.881	-0.074	29.888	-0.061
29.909	-0.007	29.935	0.064	29.951	0.060	29.966	0.026
29.985	-0.020	30.007	0.013	30.036	0.114	30.038	0.114
30.054	0.059	30.072	0.047	30.101	-0.008	30.122	0.025
30.142	0.013	30.166	0.038	30.191	0.004	30.209	-0.051
30.230	-0.106	30.241	-0.093	30.262	-0.043	30.277	0.029
30.298	0.130	30.304	0.134	30.317	0.100	30.332	0.011
30.347	-0.035	30.370	-0.035	30.389	-0.141	30.402	-0.115
30.412	-0.023	30.430	0.023	30.443	0.006	30.470	-0.078
30.488	0.006	30.501	-0.045	30.521	-0.116	30.535	-0.036
30.545	0.082	30.555	0.153	30.571	0.111	30.579	0.014
30.591	-0.020	30.617	-0.032	30.626	-0.091	30.643	-0.201
30.649	-0.205	30.657	-0.117	30.669	-0.024	30.685	0.094
30.700	0.148	30.721	0.060	30.734	0.081	30.761	-0.033
30.782	-0.151	30.795	-0.025	30.805	0.080	30.821	0.046
30.834	-0.089	30.849	-0.144	30.857	-0.093	30.870	-0.022
30.871	-0.013	30.899	-0.073	30.912	0.028	30.930	0.083
30.948	0.200	30.956	0.162	30.962	0.091	30.967	-0.019
30.977	-0.103	30.987	-0.078	30.998	0.010	31.006	0.014
31.014	-0.040	31.027	-0.129	31.035	-0.200	31.045	-0.175
31.053	-0.032	31.059	0.115	31.068	0.090	31.079	0.006
31.085	-0.146	31.092	-0.230	31.100	-0.218	31.116	-0.066
31.126	0.170	31.134	0.355	31.139	0.363	31.149	0.250
31.155	0.081	31.165	-0.028	31.170	-0.003	31.178	0.085
31.188	0.072	31.199	-0.088	31.215	-0.168	31.230	-0.231
31.241	-0.214	31.247	-0.079	31.254	0.026	31.265	0.051
31.280	-0.012	31.289	-0.092	31.299	-0.130	31.312	-0.041
31.327	0.144	31.343	0.072	31.356	0.089	31.370	0.022
31.383	-0.083	31.389	-0.083	31.402	0.047	31.409	0.072
31.420	0.030	31.427	-0.117	31.431	-0.231	31.440	-0.298
31.448	-0.231	31.459	-0.042	31.469	0.106	31.477	0.110
31.493	0.029	31.514	-0.072	31.522	-0.034	31.528	0.092
31.533	0.240	31.538	0.358	31.549	0.311	31.556	0.008
31.564	-0.211	31.569	-0.333	31.572	-0.363	31.577	-0.304
31.588	-0.039	31.591	0.163	31.596	0.243	31.604	0.146
31.611	-0.022	31.617	-0.203	31.624	-0.376	31.630	-0.448
31.633	-0.368	31.641	-0.157	31.646	0.091	31.653	0.306
31.656	0.483	31.661	0.533	31.667	0.415	31.674	0.057
31.680	-0.199	31.691	-0.440	31.695	-0.414	31.704	-0.115
31.711	0.196	31.716	0.516	31.724	0.634	31.727	0.499
31.733	0.314	31.741	-0.090	31.749	-0.326	31.754	-0.423
31.762	-0.507	31.769	-0.360	31.775	-0.048	31.778	0.238
31.782	0.436	31.790	0.646	31.796	0.638	31.803	0.322
31.811	0.019	31.817	-0.272	31.828	-0.596	31.835	-0.600

31.843	-0.268	31.849	0.162	31.856	0.461	31.862	0.579
31.869	0.162	31.878	-0.095	31.887	-0.473	31.895	-0.546
31.904	-0.402	31.911	-0.129	31.916	0.153	31.924	0.587
31.925	0.642	31.937	0.524	31.943	0.314	31.949	-0.011
31.956	-0.141	31.962	0.158	31.970	0.393	31.977	0.684
31.983	0.874	31.990	1.017	31.996	0.915	32.003	0.600
32.007	0.301	32.016	-0.036	32.022	-0.254	32.027	-0.406
32.033	-0.515	32.040	-0.452	32.048	-0.254	32.054	-0.330
32.072	-0.692	32.075	-0.696	32.090	-0.263	32.104	-0.334
32.119	-0.355	32.130	-0.267	32.140	0.197	32.146	0.445
32.156	0.374	32.175	0.146	32.188	-0.182	32.196	-0.371
32.204	-0.401	32.214	-0.262	32.222	-0.119	32.228	0.041
32.248	-0.039	32.254	0.100	32.264	0.243	32.269	0.437
32.282	0.273	32.297	0.037	32.311	-0.135	32.318	-0.160
32.327	-0.021	32.334	0.134	32.339	0.172	32.350	0.122
32.358	-0.034	32.371	-0.173	32.384	-0.245	32.389	-0.219
32.400	-0.232	32.408	-0.198	32.412	0.012	32.418	0.278
32.423	0.206	32.444	-0.114	32.449	0.033	32.463	0.286
32.472	0.240	32.481	-0.072	32.494	-0.345	32.501	-0.367
32.507	-0.266	32.512	-0.131	32.519	0.075	32.525	0.020
32.533	-0.055	32.541	-0.085	32.551	-0.034	32.567	0.100
32.579	0.248	32.590	0.323	32.600	0.273	32.609	0.172
32.622	0.129	32.632	0.209	32.639	0.285	32.656	0.243
32.687	0.420	32.697	0.365	32.710	0.085	32.720	-0.078
32.741	-0.230	32.752	-0.492	32.762	-0.909	32.770	-0.976
32.776	-0.804	32.785	-0.236	32.793	0.088	32.799	0.253
32.809	0.198	32.820	0.117	32.832	0.340	32.840	0.483
32.850	0.626	32.859	0.777	32.869	0.689	32.884	0.027
32.892	-0.365	32.900	-0.664	32.915	-0.870	32.921	-0.795
32.937	-0.761	32.949	-0.593	32.959	-0.341	32.968	0.017
32.981	0.358	32.993	0.585	32.999	0.711	33.009	0.665
33.019	0.399	33.027	0.315	33.040	0.197	33.053	0.079
33.061	-0.073	33.071	-0.263	33.081	-0.275	33.090	-0.171
33.102	-0.049	33.113	-0.011	33.136	-0.133	33.139	-0.078
33.150	0.023	33.155	0.145	33.165	0.005	33.183	-0.141
33.191	-0.247	33.209	-0.428	33.222	-0.474	33.238	-0.365
33.246	-0.386	33.253	-0.360	33.264	0.055	33.269	0.288
33.276	0.469	33.294	0.368	33.305	0.562	33.313	0.793
33.318	0.953	33.326	0.861	33.336	0.271	33.347	0.061
33.361	0.010	33.372	-0.112	33.385	-0.195	33.393	-0.171
33.405	-0.011	33.406	0.010	33.416	-0.078	33.426	-0.247
33.437	-0.466	33.450	-0.634	33.462	-0.773	33.470	-0.537
33.481	-0.369	33.489	-0.247	33.499	0.288	33.510	0.768
33.515	1.088	33.528	1.198	33.535	1.092	33.548	0.751
33.554	0.675	33.568	0.558	33.574	0.208	33.587	-0.259
33.595	-0.567	33.607	-0.899	33.615	-1.165	33.621	-1.173
33.633	-0.971	33.639	-0.701	33.646	-0.495	33.649	-0.344
33.654	-0.272	33.667	-0.352	33.678	-0.428	33.686	-0.205
33.693	0.052	33.700	0.258	33.716	0.364	33.729	0.435
33.737	0.288	33.745	0.022	33.753	-0.150	33.763	-0.260
33.770	-0.277	33.783	-0.075	33.796	0.119	33.807	0.270
33.814	0.355	33.830	0.279	33.845	0.321	33.858	0.359
33.867	0.354	33.875	0.325	33.893	0.0	33.908	-0.130
33.928	-0.417	33.932	-0.421	33.941	-0.345	33.957	-0.232
33.963	-0.262	33.983	-0.384	33.991	-0.265	34.004	-0.182
34.020	-0.153	34.030	-0.111	34.045	0.121	34.068	0.285

34.086	0.432	34.100	0.579	34.112	0.621	34.121	0.528
34.128	0.427	34.134	0.238	34.152	0.035	34.162	-0.074
34.178	-0.184	34.193	-0.155	34.200	-0.201	34.213	-0.285
34.219	-0.348	34.226	-0.386	34.232	-0.328	34.242	-0.168
34.256	-0.063	34.272	-0.042	34.284	-0.004	34.289	0.089
34.298	0.190	34.305	0.177	34.314	0.085	34.326	-0.025
34.340	-0.055	34.358	-0.046	34.368	-0.080	34.387	-0.173
34.406	-0.118	34.426	-0.072	34.445	0.029	34.469	0.130
34.482	0.130	34.503	0.151	34.511	0.139	34.524	0.071
34.539	-0.046	34.558	-0.067	34.576	-0.055	34.600	-0.088
34.613	-0.109	34.632	-0.147	34.653	-0.101	34.674	-0.105
34.684	-0.054	34.697	0.081	34.708	0.173	34.723	0.241
34.742	0.321	34.755	0.355	34.762	0.329	34.770	0.245
34.775	0.161	34.786	0.102	34.809	0.115	34.815	0.090
34.825	0.001	34.841	-0.117	34.864	-0.053	34.890	-0.150
34.898	-0.108	34.911	0.014	34.937	-0.015	34.948	-0.002
34.971	0.019	35.007	-0.019	35.020	-0.007	35.034	0.014
35.052	-0.002	35.076	-0.015	35.091	0.031	35.107	0.099
35.120	0.082	35.143	0.048	35.169	-0.082	35.185	-0.070
35.209	-0.112	35.224	-0.125	35.239	-0.184	35.255	-0.125
35.267	-0.049	35.283	0.031	35.301	0.103	35.324	0.052
35.335	0.090	35.352	0.166	35.361	0.128	35.379	0.040
35.394	-0.028	35.425	-0.024	35.437	-0.040	35.453	-0.120
35.463	-0.099	35.484	-0.011	35.497	-0.028	35.509	-0.040
35.525	0.006	35.535	-0.003	35.561	-0.028	35.592	-0.091
35.623	-0.028	35.635	-0.028	35.666	-0.012	35.687	-0.058
35.726	-0.096	35.759	-0.046	35.783	0.096	35.801	0.163
35.834	0.163	35.850	0.133	35.869	0.032	35.894	-0.032
35.926	0.022	35.938	0.009	35.956	-0.054	35.985	0.009
35.995	-0.013	36.014	-0.093	36.050	-0.119	36.082	-0.233
36.087	-0.212	36.110	-0.111	36.147	-0.074	36.163	0.001
36.186	0.085	36.220	0.114	36.235	0.059	36.253	-0.093
36.259	-0.093	36.280	-0.005	36.296	-0.050	36.306	-0.064
36.322	-0.140	36.326	-0.157	36.340	-0.065	36.355	-0.018
36.376	-0.044	36.389	-0.061	36.420	0.049	36.445	-0.002
36.486	0.027	36.522	0.048	36.539	0.065	36.575	-0.083
36.583	-0.108	36.599	-0.116	36.622	-0.079	36.643	0.022
36.653	0.069	36.677	0.132	36.688	0.094	36.713	0.026
36.743	0.018	36.758	-0.012	36.778	-0.138	36.799	-0.071
36.834	-0.059	36.868	0.008	36.896	-0.055	36.924	-0.017
36.946	-0.021	36.984	0.054	36.998	0.033	37.036	-0.026
37.057	0.012	37.073	0.012	37.102	0.104	37.114	0.083
37.140	0.066	37.166	-0.010	37.196	-0.086	37.243	-0.095
37.256	-0.040	37.276	0.057	37.294	0.103	37.310	0.095
37.331	0.052	37.360	-0.066	37.372	-0.007	37.390	0.014
37.414	-0.028	37.433	-0.104	37.445	-0.087	37.472	-0.151
37.484	-0.113	37.492	-0.003	37.500	0.077	37.511	0.081
37.537	0.047	37.550	0.017	37.583	-0.122	37.594	-0.093
37.615	0.096	37.635	0.029	37.659	0.062	37.685	-0.052
37.701	0.074	37.714	0.095	37.745	-0.049	37.766	-0.011
37.795	-0.053	37.815	-0.003	37.825	0.026	37.851	0.013
37.867	0.042	37.889	0.034	37.920	0.109	37.958	0.062
37.977	-0.039	38.022	-0.124	38.052	-0.044	38.097	0.014
38.130	-0.054	38.159	-0.054	38.185	-0.088	38.207	-0.038
38.225	-0.004	38.270	0.034	38.309	-0.072	38.342	-0.022
38.374	-0.026	38.427	-0.043	38.440	-0.005	38.463	0.125

38.484	0.049	38.535	0.045	38.556	-0.022	38.581	-0.060
38.605	-0.056	38.619	-0.010	38.648	0.074	38.660	0.036
38.682	-0.035	38.703	-0.010	38.742	-0.035	38.763	-0.022
38.789	-0.039	38.812	0.079	38.828	0.045	38.847	0.011
38.884	-0.102	38.903	-0.022	38.931	-0.022	38.950	0.075
38.963	0.151	38.979	0.092	39.005	-0.025	39.028	0.041
39.063	-0.013	39.084	0.084	39.095	0.054	39.124	-0.068
39.136	-0.064	39.170	-0.106	39.199	-0.018	39.220	-0.060
39.233	-0.039	39.254	0.075	39.267	0.023	39.280	0.015
39.304	0.070	39.314	0.045	39.336	-0.061	39.362	-0.048
39.393	-0.074	39.409	-0.023	39.424	0.015	39.458	-0.078
39.471	-0.070	39.500	-0.100	39.531	-0.066	39.539	-0.066
39.574	-0.020	39.581	-0.028	39.612	0.093	39.646	-0.033
39.680	0.0	39.704	-0.050	39.733	0.004	39.759	-0.109
39.783	-0.046	39.816	0.016	39.847	0.071	39.881	0.004
39.902	-0.043	39.919	-0.026	39.944	-0.047	39.965	-0.022
39.991	-0.047	40.016	-0.001	40.038	-0.010	40.073	0.045
40.086	0.028	40.118	-0.090	40.133	-0.065	40.148	-0.018
40.160	-0.002	40.167	0.040	40.185	0.133	40.198	0.099
40.212	0.011	40.225	-0.065	40.236	-0.036	40.246	0.057
40.261	0.158	40.280	0.077	40.294	-0.057	40.301	-0.112
40.315	-0.150	40.340	-0.319	40.348	-0.319	40.364	-0.188
40.373	-0.037	40.380	0.081	40.386	0.136	40.409	0.140
40.425	0.165	40.441	0.169	40.462	0.152	40.468	0.110
40.493	-0.021	40.513	0.038	40.541	-0.088	40.557	-0.042
40.583	-0.084	40.591	-0.046	40.610	0.004	40.620	0.008
40.646	-0.034	40.657	-0.013	40.679	-0.017	40.707	0.033
40.732	0.021	40.744	0.008	40.760	-0.017	40.787	0.033
40.812	-0.022	40.842	0.024	40.871	0.003	40.889	0.015
40.902	0.002	40.921	-0.116	40.947	-0.074	40.984	-0.020
40.992	-0.020	41.023	0.046	41.036	0.029	41.063	-0.022
41.086	0.015	41.112	0.069	41.124	0.040	41.152	-0.078
41.176	-0.041	41.203	-0.087	41.236	-0.020	41.267	-0.091
41.283	-0.049	41.314	-0.032	41.351	-0.036	41.371	-0.014
41.397	0.024	41.423	-0.052	41.444	0.007	41.476	-0.038
41.504	-0.009	41.528	-0.017	41.549	0.013	41.572	-0.021
41.603	0.021	41.622	0.001	41.647	0.027	41.678	-0.039
41.699	-0.004	41.728	-0.032	41.736	-0.040	41.756	-0.005
41.792	-0.066	41.822	-0.040				

IC041

71.001 2/9/71 0600PST PACOIMA DAM CAL. S74W

2685 POINTS 41.728 SECONDS

SCALED DATA, WITH THE DIGITIZED FIXED TRACE SMOOTHED
AND SUBTRACTED, THE TIMING MARKS SMOOTHED BEFORE USE,
AND A HORIZONTAL ZERO LINE FIXED FOR ZERO MEAN VALUE,
WHICH SIMULTANEOUSLY MINIMIZES THE RMS ACCELERATION.

UNITS ARE SEC, G/10.

THE RMS ACCELERATION OF THIS COMPLETE RECORD, MINIMIZED
IN THE ABOVE ALIGNMENT CORRECTION, IS 1.1369 G/10.

TIME	ACCLN	TIME	ACCLN	TIME	ACCLN	TIME	ACCLN
0.0	-0.367	0.015	-0.215	0.025	-0.084	0.036	-0.050
0.049	0.035	0.058	0.086	0.064	0.154	0.069	0.086
0.076	-0.016	0.082	-0.198	0.089	-0.355	0.092	-0.389
0.102	-0.321	0.109	-0.177	0.117	0.124	0.129	0.632
0.130	0.721	0.137	0.742	0.142	0.662	0.148	0.403
0.163	-0.207	0.172	-0.143	0.178	-0.097	0.183	-0.160
0.190	-0.262	0.198	-0.334	0.205	-0.296	0.211	-0.139
0.223	0.306	0.229	0.488	0.238	0.534	0.247	0.348
0.257	-0.038	0.269	-0.542	0.279	-0.729	0.287	-0.653
0.294	-0.373	0.308	-0.009	0.318	0.237	0.325	0.359
0.336	0.101	0.353	0.016	0.361	-0.027	0.374	0.033
0.389	0.274	0.394	0.587	0.401	0.719	0.406	0.524
0.419	-0.019	0.429	-0.354	0.440	-0.706	0.449	-0.994
0.460	-0.736	0.470	-0.159	0.480	0.476	0.491	0.777
0.510	0.429	0.523	0.086	0.531	-0.495	0.539	-0.732
0.551	-0.402	0.571	0.208	0.582	0.437	0.597	0.725
0.604	0.623	0.610	0.538	0.625	0.550	0.635	0.203
0.656	-1.272	0.668	-1.607	0.684	-0.836	0.699	0.672
0.709	1.329	0.716	1.532	0.734	1.053	0.742	0.672
0.755	0.405	0.777	-0.592	0.790	-1.223	0.800	-1.456
0.814	-0.829	0.837	0.615	0.846	0.891	0.852	1.030
0.860	1.081	0.874	0.962	0.888	0.335	0.902	-0.449
0.911	-0.661	0.926	-0.907	0.934	-0.721	0.946	-0.238
0.959	0.338	0.972	0.584	0.985	0.888	0.999	1.045
1.010	0.744	1.027	0.091	1.040	-1.006	1.053	-1.367
1.063	-1.519	1.071	-1.371	1.087	-0.355	1.106	1.226
1.119	1.980	1.145	0.577	1.160	-1.212	1.170	-1.712
1.178	-1.809	1.188	-1.695	1.201	-1.111	1.217	0.321
1.229	1.012	1.237	1.309	1.262	0.681	1.277	0.253
1.289	0.329	1.313	0.083	1.320	0.139	1.342	-0.383
1.355	-0.692	1.368	-0.349	1.391	0.392	1.400	0.558
1.420	0.290	1.453	-0.684	1.468	-0.994	1.487	-0.646
1.507	0.336	1.516	0.599	1.529	0.781	1.540	0.701
1.559	0.595	1.572	0.667	1.589	0.412	1.605	0.090
1.627	-0.830	1.638	-0.982	1.648	-0.813	1.670	-0.029
1.685	0.170	1.693	-0.076	1.713	-0.584	1.730	-0.737
1.745	-0.190	1.760	0.555	1.780	-0.661	1.791	-1.720
1.805	-1.996	1.825	-1.305	1.842	0.542	1.862	1.173
1.868	1.144	1.880	1.182	1.893	0.787	1.902	0.669
1.920	0.851	1.934	1.342	1.952	2.177	1.965	2.465
1.979	2.206	1.997	0.283	2.019	-1.459	2.027	-1.913
2.039	-1.802	2.059	-1.294	2.069	-1.057	2.087	-0.900
2.101	-1.121	2.112	-1.290	2.126	-1.087	2.133	-0.816
2.141	-0.740	2.154	-0.816	2.169	-0.324	2.194	0.332
2.209	0.569	2.228	0.357	2.251	-0.893	2.259	-1.067
2.274	-0.414	2.286	0.280	2.298	-0.190	2.313	-1.161
2.328	-1.504	2.341	-1.297	2.353	-1.102	2.368	-1.306
2.384	-2.026	2.389	-2.268	2.403	-1.920	2.414	-1.645
2.431	-1.955	2.441	-2.188	2.452	-2.336	2.467	-2.086
2.496	-1.066	2.512	-0.447	2.532	0.514	2.554	1.802
2.572	2.535	2.584	2.306	2.601	2.001	2.622	2.662
2.640	3.390	2.654	3.178	2.674	2.453	2.697	3.466
2.714	2.271	2.722	1.432	2.735	1.711	2.748	0.830
2.765	0.058	2.779	0.406	2.786	0.473	2.802	0.740
2.817	0.604	2.842	1.710	2.858	0.494	2.865	-0.773
2.886	1.722	2.898	1.108	2.904	0.641	2.918	1.709
2.926	2.463	2.946	1.298	2.957	0.247	2.975	0.891
2.983	1.492	2.992	1.691	3.005	1.399	3.016	1.157
3.031	1.437	3.044	1.759	3.057	1.716	3.069	2.208
3.082	2.707	3.110	1.288	3.120	0.889	3.126	0.601
3.135	0.338	3.141	0.126	3.148	-0.098	3.154	-0.509
3.164	-0.882	3.174	-1.501	3.192	-3.773	3.201	-5.362
3.207	-5.476	3.224	-4.256	3.233	-3.379	3.240	-3.104
3.255	-3.472	3.263	-3.718	3.275	-4.011	3.284	-3.756
3.293	-3.587	3.301	-3.456	3.311	-3.680	3.330	-5.312
3.365	-2.088	3.373	-1.075	3.380	-0.795	3.395	-0.249
3.411	0.730	3.423	1.238	3.429	1.412	3.442	0.967
3.462	1.445	3.474	2.026	3.485	1.199	3.508	-1.606
3.516	-2.411	3.536	-4.809	3.543	-4.996	3.554	-4.479
3.566	-3.975	3.577	-4.089	3.602	-2.085	3.618	0.292
3.641	1.546	3.650	1.338	3.666	1.024	3.674	1.405
3.687	1.859	3.715	0.083	3.725	-0.324	3.732	-0.510
3.747	-0.265	3.760	-0.083	3.773	0.641	3.788	1.146
3.807	0.878	3.815	1.009	3.830	1.077	3.855	0.933
3.878	0.991	3.894	0.894	3.913	1.181	3.938	1.465
3.959	1.164	3.977	1.532	4.007	2.515	4.017	2.701
4.034	2.213	4.064	0.060	4.078	-0.855	4.090	-1.224
4.107	-1.881	4.117	-2.025	4.133	-2.191	4.160	-2.742
4.183	-1.789	4.195	-0.107	4.211	0.736	4.229	1.045
4.243	0.778	4.256	0.239	4.264	-0.070	4.276	-0.303
4.302	0.963	4.330	2.734	4.344	2.086	4.370	2.873
4.382	2.441	4.402	1.187	4.416	0.636	4.430	-0.496
4.438	-0.691	4.448	-0.475	4.460	-0.340	4.478	-0.776
4.496	-0.162	4.504	0.190	4.529	-0.116	4.551	-0.777
4.562	-3.142	4.582	-1.023	4.590	0.057	4.604	0.591
4.622	0.129	4.630	-0.710	4.643	-1.380	4.653	-1.634
4.668	-1.118	4.690	1.013	4.701	1.539	4.711	1.310
4.721	1.098	4.728	1.123	4.749	0.886	4.765	-0.991
4.778	-0.305	4.793	0.428	4.801	-0.229	4.811	-0.547
4.832	1.207	4.845	2.813	4.858	1.906	4.883	-0.285
4.896	-0.696	4.906	-0.399	4.919	0.008	4.938	-0.374
4.954	-1.493	4.969	-2.285	4.981	-2.120	5.002	-5.167
5.007	-7.387	5.030	-3.035	5.048	3.113	5.061	6.803
5.080	4.663	5.095	3.752	5.105	3.532	5.114	2.739
5.128	0.443	5.142	-0.617	5.159	0.082	5.177	-2.647
5.190	-4.460	5.212	0.260	5.219	3.078	5.255	-0.897

5.268	-1.516	5.280	-1.063	5.293	-0.897	5.302	-1.016
5.314	-1.686	5.321	-1.851	5.342	-0.661	5.352	-0.322
5.361	-0.462	5.370	-0.606	5.386	-0.428	5.405	-0.237
5.413	-0.149	5.420	0.072	5.439	0.745	5.449	0.987
5.459	1.118	5.473	1.631	5.480	1.910	5.502	-0.573
5.512	-1.560	5.520	-1.810	5.530	-1.730	5.540	-1.679
5.564	-0.146	5.575	0.926	5.582	1.189	5.595	0.825
5.604	0.329	5.612	0.108	5.625	0.667	5.637	1.104
5.656	1.824	5.668	2.176	5.679	2.303	5.693	2.141
5.716	1.912	5.727	1.679	5.741	1.247	5.750	0.823
5.768	1.899	5.791	3.056	5.814	4.335	5.825	4.988
5.845	3.915	5.866	3.788	5.874	-0.102	5.880	-0.589
5.893	-0.797	5.919	-4.522	5.937	-7.230	5.962	-5.933
5.988	-3.222	6.002	-2.311	6.020	-1.247	6.041	-4.091
6.053	-6.739	6.074	-3.723	6.100	-0.520	6.113	1.023
6.129	1.539	6.139	1.887	6.154	4.560	6.163	7.433
6.189	5.407	6.197	5.653	6.206	5.166	6.222	3.183
6.230	2.593	6.238	2.937	6.255	1.165	6.264	-2.246
6.274	-2.708	6.290	0.385	6.302	1.673	6.308	2.118
6.328	-0.704	6.343	-4.133	6.356	-5.023	6.369	-4.048
6.379	-3.014	6.385	-1.964	6.393	-0.447	6.408	1.252
6.415	1.837	6.426	2.434	6.438	1.519	6.446	0.930
6.457	0.641	6.477	1.569	6.490	0.493	6.495	-0.151
6.503	-0.563	6.518	-1.715	6.532	-3.465	6.542	-3.800
6.562	0.233	6.576	1.407	6.588	1.038	6.594	0.758
6.606	0.529	6.617	0.754	6.627	0.927	6.640	1.207
6.653	0.872	6.660	0.592	6.670	0.397	6.681	0.520
6.694	0.138	6.714	-0.959	6.725	-1.519	6.738	-2.383
6.760	-4.773	6.784	0.511	6.796	3.294	6.804	2.998
6.812	2.044	6.827	2.646	6.837	3.637	6.847	4.010
6.865	1.010	6.880	-1.660	6.894	-1.299	6.909	-1.626
6.930	-4.910	6.957	-1.046	6.962	2.285	6.985	-0.402
7.001	0.806	7.009	1.166	7.016	1.357	7.034	1.085
7.044	1.284	7.054	1.462	7.067	0.996	7.077	0.848
7.083	0.945	7.098	0.517	7.108	0.220	7.114	-0.085
7.127	-0.326	7.141	0.224	7.159	1.148	7.178	-0.475
7.187	-0.945	7.206	-1.636	7.226	-1.026	7.234	-1.814
7.244	-2.420	7.267	-0.395	7.283	-1.399	7.305	1.202
7.316	3.130	7.339	1.478	7.350	1.308	7.359	0.791
7.368	0.422	7.377	0.507	7.391	0.045	7.403	-0.184
7.424	1.020	7.434	1.837	7.457	-0.938	7.470	-1.595
7.488	-3.133	7.503	-3.468	7.513	-3.299	7.516	-3.125
7.529	-3.273	7.542	-2.494	7.555	-1.600	7.572	-2.371
7.580	-3.354	7.604	-1.244	7.617	0.226	7.624	0.621
7.632	0.794	7.642	0.934	7.653	1.324	7.670	2.875
7.690	1.569	7.708	0.112	7.732	2.993	7.761	0.518
7.768	0.620	7.781	0.704	7.797	1.441	7.809	0.289
7.817	-0.715	7.843	3.174	7.853	3.322	7.859	3.568
7.885	1.555	7.908	-0.131	7.921	-0.399	7.931	-0.017
7.939	0.461	7.957	-1.301	7.971	-2.348	7.986	-0.886
7.993	0.304	7.997	0.842	8.019	-1.493	8.040	-11.484
8.081	-3.574	8.089	-3.383	8.100	-2.735	8.121	0.862
8.147	4.714	8.160	8.633	8.175	7.506	8.196	4.803
8.208	4.552	8.216	4.391	8.231	4.701	8.250	5.531
8.263	6.802	8.268	7.175	8.281	6.035	8.293	3.302
8.304	2.560	8.311	2.352	8.324	1.912	8.352	-3.186

8.357	-3.292	8.382	-0.890	8.392	0.297	8.410	-3.178
8.423	-7.030	8.461	0.131	8.462	-0.162	8.469	-0.463
8.510	-12.514	8.548	-3.429	8.564	1.702	8.576	0.295
8.585	-0.396	8.594	-0.612	8.607	-0.214	8.613	0.087
8.627	0.307	8.635	0.557	8.646	0.833	8.653	1.010
8.673	2.854	8.682	4.849	8.694	6.099	8.719	4.010
8.730	2.535	8.753	0.124	8.773	-3.147	8.785	-4.868
8.806	-1.677	8.820	1.267	8.825	1.827	8.836	2.229
8.844	1.792	8.869	-0.398	8.876	-0.805	8.884	-1.161
8.906	-2.759	8.919	-3.340	8.937	-4.929	8.957	-0.535
8.977	4.880	8.990	3.049	9.003	1.261	9.012	0.439
9.022	0.913	9.041	2.473	9.050	2.947	9.063	3.358
9.071	3.176	9.083	2.900	9.094	2.714	9.104	2.798
9.116	2.997	9.123	3.078	9.131	3.107	9.146	2.950
9.162	1.285	9.187	-2.215	9.200	-5.300	9.207	-5.097
9.243	-2.419	9.261	0.432	9.273	-0.026	9.281	-0.301
9.299	0.580	9.308	0.902	9.316	1.207	9.326	1.364
9.339	1.580	9.352	1.452	9.362	0.901	9.374	-0.353
9.398	-2.514	9.412	-3.680	9.423	-4.464	9.436	-4.040
9.456	-0.456	9.464	1.277	9.471	1.769	9.486	1.654
9.497	1.781	9.507	1.934	9.532	0.607	9.548	-0.363
9.558	-0.863	9.573	-1.325	9.580	-1.542	9.598	-0.724
9.616	0.208	9.634	1.360	9.644	1.809	9.652	2.114
9.664	1.958	9.679	1.746	9.703	0.546	9.715	-0.081
9.723	-0.454	9.730	-0.552	9.741	-0.382	9.750	-0.251
9.761	-0.103	9.776	-0.145	9.792	-0.234	9.806	-0.429
9.820	-1.023	9.827	-1.260	9.840	-1.302	9.852	-1.205
9.862	-0.976	9.868	-0.667	9.880	0.036	9.895	1.227
9.906	1.922	9.916	2.456	9.928	2.282	9.944	1.964
9.959	1.714	9.974	1.290	9.997	-0.397	10.007	-0.858
10.027	-1.960	10.035	-2.422	10.045	-2.685	10.051	-2.401
10.059	-1.871	10.074	-1.024	10.083	0.446	10.091	0.878
10.106	-0.338	10.117	-0.863	10.129	-1.126	10.137	-0.961
10.140	-0.847	10.153	-0.745	10.160	-0.889	10.170	-1.008
10.178	-1.182	10.191	-0.474	10.200	0.373	10.206	0.755
10.218	1.170	10.229	0.911	10.244	0.521	10.256	0.386
10.271	0.292	10.283	0.369	10.301	0.602	10.317	0.936
10.326	1.284	10.337	1.415	10.346	1.542	10.357	1.707
10.372	1.241	10.389	0.495	10.402	-0.124	10.412	-0.353
10.424	-0.476	10.435	-0.641	10.449	-0.810	10.469	-1.637
10.484	-2.162	10.490	-2.370	10.504	-2.514	10.520	-2.701
10.537	-1.718	10.555	0.769	10.568	0.990	10.577	0.600
10.588	0.206	10.597	0.121	10.607	0.290	10.618	0.460
10.625	0.752	10.638	0.964	10.655	0.532	10.661	0.226
10.670	-0.032	10.681	0.137	10.690	0.519	10.705	1.124
10.711	0.824	10.731	0.048	10.743	-0.151	10.758	-0.329
10.771	-0.575	10.788	-1.084	10.811	-2.673	10.829	-0.508
10.844	1.479	10.857	1.038	10.869	0.670	10.879	1.059
10.891	1.381	10.907	1.263	10.917	1.334	10.932	1.661
10.942	1.516	10.954	1.372	10.962	1.169	10.977	0.423
10.989	0.071	10.999	-0.069	11.007	0.015	11.017	0.075
11.027	0.012	11.039	-0.052	11.049	-0.014	11.055	0.024
11.072	-0.107	11.084	-0.226	11.090	-0.201	11.102	-0.163
11.120	-0.400	11.135	-0.722	11.148	-1.032	11.162	-1.252
11.175	-1.426	11.185	-1.155	11.200	-0.469	11.208	-0.011
11.221	0.218	11.233	0.264	11.243	0.311	11.256	0.616

11.266	0.802	11.274	0.865	11.287	0.742	11.300	0.543
11.307	0.454	11.320	0.590	11.337	0.695	11.351	0.424
11.366	0.161	11.384	0.110	11.401	-0.093	11.411	-0.428
11.425	-0.555	11.442	-0.500	11.457	-0.619	11.473	-0.916
11.485	-1.098	11.499	-0.734	11.513	-0.217	11.524	0.012
11.541	0.253	11.554	0.600	11.570	1.147	11.580	1.325
11.588	1.409	11.598	1.282	11.615	0.913	11.631	0.104
11.643	-0.222	11.656	-0.303	11.664	-0.218	11.680	-0.180
11.694	-0.308	11.713	-0.439	11.733	-0.372	11.754	-0.313
11.774	-0.542	11.792	-0.957	11.809	-0.652	11.817	0.005
11.833	0.424	11.845	0.381	11.858	0.322	11.866	0.356
11.873	0.385	11.891	0.288	11.901	0.093	11.914	-0.111
11.924	-0.035	11.937	0.012	11.952	-0.073	11.963	-0.188
11.978	-0.273	11.993	-0.391	12.009	-0.485	12.024	-0.604
12.044	-0.434	12.064	0.074	12.080	0.281	12.090	0.409
12.103	0.446	12.111	0.396	12.124	0.260	12.134	0.078
12.143	-0.156	12.154	-0.296	12.164	-0.224	12.170	-0.130
12.182	-0.071	12.194	-0.097	12.208	-0.173	12.222	-0.313
12.240	-0.555	12.265	-0.771	12.276	-0.666	12.288	-0.458
12.295	-0.327	12.308	-0.043	12.316	-0.115	12.328	-0.217
12.336	-0.259	12.348	-0.196	12.356	-0.128	12.369	0.028
12.383	0.198	12.396	0.308	12.414	0.375	12.426	0.307
12.437	0.129	12.452	-0.044	12.464	-0.117	12.475	0.010
12.489	0.175	12.500	0.078	12.517	0.031	12.540	-0.096
12.555	-0.224	12.565	-0.372	12.577	-0.440	12.588	-0.376
12.605	-0.216	12.618	-0.029	12.635	0.144	12.651	-0.021
12.665	-0.403	12.678	-0.704	12.700	-0.793	12.713	-0.907
12.726	-0.666	12.738	-0.213	12.746	-0.103	12.758	-0.213
12.766	-0.293	12.779	-0.141	12.791	0.117	12.799	0.325
12.806	0.401	12.826	0.308	12.844	0.422	12.857	0.672
12.867	0.769	12.875	0.816	12.887	0.739	12.899	0.566
12.915	-0.019	12.927	-0.244	12.935	-0.354	12.953	-0.435
12.963	-0.414	12.978	-0.316	12.990	-0.194	13.000	-0.071
13.018	-0.135	13.031	-0.020	13.043	0.238	13.056	0.412
13.066	0.369	13.076	0.323	13.100	0.390	13.113	0.250
13.131	0.064	13.149	0.212	13.161	0.352	13.174	0.216
13.191	-0.115	13.202	-0.255	13.211	-0.297	13.222	-0.234
13.239	0.016	13.245	0.224	13.257	0.414	13.269	0.473
13.282	0.435	13.297	0.325	13.308	0.189	13.330	-0.044
13.343	0.130	13.349	0.397	13.361	0.477	13.377	0.384
13.392	0.286	13.409	0.036	13.430	-0.197	13.443	-0.011
13.453	0.222	13.468	0.400	13.486	0.256	13.501	0.043
13.509	-0.062	13.523	-0.181	13.539	-0.020	13.557	0.268
13.575	0.462	13.589	0.556	13.600	0.585	13.615	0.492
13.628	0.292	13.641	0.220	13.660	0.051	13.691	-0.140
13.707	-0.085	13.731	-0.013	13.747	-0.094	13.758	-0.192
13.773	-0.103	13.790	-0.014	13.800	-0.133	13.813	-0.264
13.828	-0.082	13.836	0.130	13.847	0.181	13.857	0.164
13.870	0.291	13.882	0.397	13.898	0.193	13.908	-0.023
13.916	-0.184	13.925	-0.235	13.936	-0.159	13.948	-0.129
13.962	-0.180	13.976	-0.096	13.987	-0.028	14.000	-0.104
14.013	-0.147	14.036	-0.181	14.050	-0.215	14.073	-0.283
14.092	-0.139	14.101	0.077	14.109	0.149	14.124	0.175
14.138	0.242	14.161	0.357	14.178	0.208	14.191	0.107
14.211	0.060	14.224	-0.046	14.239	-0.267	14.254	-0.411
14.265	-0.462	14.275	-0.347	14.283	-0.118	14.293	-0.017

14.305	-0.101	14.319	-0.229	14.337	-0.178	14.354	-0.208
14.369	-0.119	14.383	0.038	14.398	0.140	14.410	0.119
14.428	0.140	14.444	0.030	14.459	-0.085	14.471	0.013
14.482	0.072	14.504	-0.030	14.523	-0.149	14.536	-0.038
14.558	0.059	14.584	0.275	14.596	0.169	14.609	-0.132
14.627	-0.369	14.647	-0.145	14.673	-0.102	14.688	-0.060
14.701	-0.073	14.724	0.021	14.737	0.135	14.750	0.249
14.772	0.118	14.791	0.050	14.818	-0.018	14.832	-0.001
14.852	0.050	14.875	-0.044	14.885	-0.201	14.903	-0.336
14.916	-0.281	14.928	-0.235	14.941	-0.315	14.960	-0.413
14.975	-0.231	14.988	-0.023	15.000	0.057	15.013	0.011
15.021	0.108	15.029	0.227	15.046	0.278	15.057	0.206
15.075	0.061	15.088	0.125	15.113	-0.066	15.144	-0.210
15.166	-0.176	15.197	-0.244	15.218	-0.126	15.238	-0.028
15.258	-0.029	15.285	0.073	15.310	0.111	15.340	0.077
15.361	0.055	15.377	0.119	15.400	-0.025	15.436	-0.153
15.454	-0.009	15.474	0.156	15.494	0.105	15.507	0.173
15.517	0.232	15.530	0.198	15.543	0.270	15.558	0.160
15.566	-0.023	15.591	-0.273	15.610	0.036	15.627	0.303
15.645	0.231	15.669	0.006	15.692	-0.206	15.714	-0.096
15.727	-0.003	15.733	0.086	15.743	0.188	15.753	0.238
15.768	0.174	15.778	0.225	15.786	0.238	15.799	0.204
15.807	0.102	15.814	0.034	15.830	-0.089	15.840	-0.060
15.850	-0.034	15.867	0.071	15.876	0.164	15.891	0.257
15.903	0.194	15.921	0.100	15.931	0.058	15.944	-0.032
15.959	0.053	15.969	0.108	15.980	0.167	15.992	0.112
16.005	0.057	16.018	0.116	16.031	0.132	16.041	0.107
16.051	0.035	16.062	-0.063	16.075	-0.148	16.085	-0.216
16.100	-0.267	16.120	-0.178	16.128	0.038	16.141	0.131
16.153	0.076	16.163	-0.022	16.174	-0.073	16.187	-0.022
16.200	0.024	16.220	0.079	16.233	0.023	16.245	-0.057
16.255	-0.134	16.265	-0.193	16.273	-0.244	16.284	-0.270
16.304	-0.126	16.314	0.077	16.322	0.191	16.330	0.220
16.337	0.271	16.350	0.296	16.360	0.271	16.373	0.181
16.385	0.033	16.391	-0.145	16.411	-0.146	16.426	-0.112
16.444	-0.006	16.449	0.091	16.457	0.142	16.472	0.069
16.485	0.014	16.503	-0.025	16.513	-0.063	16.521	-0.152
16.539	-0.275	16.554	-0.216	16.565	-0.115	16.577	0.020
16.587	0.122	16.595	0.168	16.606	0.185	16.615	0.172
16.623	0.113	16.633	0.091	16.639	0.036	16.652	-0.028
16.669	0.023	16.679	0.061	16.687	0.099	16.698	0.098
16.720	0.034	16.733	-0.072	16.748	-0.127	16.759	-0.080
16.774	-0.030	16.784	-0.055	16.800	0.008	16.810	0.042
16.823	0.055	16.838	0.021	16.850	-0.005	16.864	0.054
16.874	0.113	16.886	0.168	16.892	0.190	16.909	0.198
16.928	0.138	16.945	0.083	16.961	0.032	16.974	0.083
16.991	0.121	17.002	0.104	17.015	0.091	17.029	0.133
17.040	0.171	17.060	0.074	17.074	-0.087	17.088	-0.206
17.106	-0.261	17.122	-0.194	17.134	-0.125	17.147	-0.024
17.158	0.018	17.175	-0.016	17.186	-0.067	17.201	-0.131
17.221	-0.097	17.245	-0.148	17.258	-0.088	17.272	-0.037
17.290	-0.067	17.303	-0.025	17.314	0.039	17.326	-0.016
17.331	-0.105	17.344	-0.164	17.362	-0.083	17.373	-0.037
17.385	0.023	17.395	0.095	17.403	0.133	17.418	0.010
17.428	-0.142	17.438	-0.286	17.446	-0.363	17.457	-0.413
17.470	-0.354	17.482	-0.265	17.490	-0.125	17.495	-0.023

17.500	0.040	17.513	0.146	17.528	0.117	17.539	0.104
17.548	0.096	17.562	-0.044	17.576	-0.239	17.589	-0.090
17.599	0.011	17.608	0.092	17.627	0.020	17.640	0.045
17.650	0.067	17.671	-0.039	17.677	-0.183	17.687	-0.225
17.697	-0.187	17.710	-0.145	17.719	-0.187	17.727	-0.246
17.740	-0.141	17.745	-0.039	17.753	0.050	17.764	0.109
17.777	0.080	17.789	0.118	17.799	0.046	17.809	-0.077
17.817	-0.208	17.825	-0.268	17.836	-0.174	17.843	-0.111
17.854	-0.035	17.864	0.042	17.887	0.126	17.899	0.080
17.917	0.042	17.930	0.008	17.949	-0.090	17.964	-0.153
17.974	-0.107	17.980	-0.026	17.994	0.050	18.002	0.008
18.012	-0.119	18.023	-0.234	18.033	-0.145	18.041	-0.060
18.057	0.071	18.070	0.118	18.079	0.148	18.087	0.173
18.105	0.084	18.118	-0.064	18.133	-0.196	18.144	-0.115
18.152	0.004	18.165	0.122	18.174	0.156	18.187	0.177
18.198	0.105	18.211	-0.030	18.224	-0.166	18.244	-0.302
18.255	-0.234	18.260	-0.179	18.275	-0.073	18.286	-0.094
18.301	-0.027	18.312	0.071	18.321	0.134	18.332	0.189
18.352	0.049	18.363	-0.023	18.376	0.032	18.386	0.108
18.397	0.205	18.409	0.286	18.422	0.235	18.436	0.142
18.449	-0.130	18.464	-0.202	18.474	-0.219	18.489	-0.249
18.505	-0.215	18.515	-0.088	18.528	0.022	18.537	-0.029
18.547	-0.097	18.567	0.022	18.577	0.111	18.583	0.153
18.593	0.191	18.604	0.225	18.619	0.254	18.637	0.153
18.645	0.013	18.661	-0.055	18.671	0.025	18.684	0.173
18.691	0.216	18.702	0.249	18.722	0.203	18.733	0.241
18.743	0.253	18.761	0.219	18.779	0.202	18.794	0.211
18.807	0.155	18.820	-0.023	18.832	-0.133	18.848	-0.184
18.863	-0.197	18.884	-0.167	18.897	-0.176	18.917	-0.083
18.927	-0.015	18.945	0.112	18.963	0.069	18.979	0.027
18.990	0.044	19.010	0.005	19.025	0.060	19.036	0.153
19.049	0.331	19.061	0.407	19.067	0.433	19.087	0.327
19.102	0.127	19.123	-0.229	19.133	-0.152	19.146	-0.085
19.166	-0.161	19.192	-0.085	19.205	-0.136	19.226	0.118
19.246	0.397	19.259	0.308	19.274	0.177	19.292	-0.014
19.312	-0.146	19.318	-0.205	19.330	-0.256	19.336	-0.337
19.358	-0.252	19.366	-0.058	19.377	0.134	19.387	0.260
19.399	0.306	19.415	0.264	19.427	0.179	19.436	0.098
19.456	-0.008	19.469	0.030	19.482	0.089	19.497	0.034
19.509	-0.038	19.525	-0.119	19.541	-0.039	19.550	0.021
19.566	0.101	19.574	0.037	19.592	-0.090	19.605	-0.162
19.614	-0.205	19.622	-0.252	19.641	-0.201	19.655	-0.049
19.666	0.053	19.679	0.108	19.694	0.095	19.705	0.052
19.725	-0.113	19.736	-0.185	19.753	-0.131	19.763	-0.033
19.772	0.018	19.789	0.001	19.808	-0.076	19.829	-0.220
19.852	-0.127	19.860	-0.021	19.870	0.021	19.881	-0.043
19.893	-0.094	19.901	-0.098	19.922	-0.039	19.940	0.020
19.947	0.063	19.963	0.122	19.978	0.054	19.997	-0.095
20.010	-0.180	20.051	-0.155	20.067	-0.163	20.075	-0.168
20.090	-0.219	20.106	-0.172	20.119	-0.066	20.132	0.001
20.142	0.039	20.153	0.069	20.163	0.081	20.181	0.208
20.194	0.285	20.215	0.060	20.227	-0.123	20.246	-0.097
20.266	-0.148	20.285	-0.250	20.298	-0.191	20.308	-0.123
20.316	-0.093	20.330	-0.119	20.345	-0.038	20.352	0.076
20.365	0.144	20.381	0.080	20.390	-0.038	20.405	0.093
20.413	0.199	20.421	0.258	20.447	0.190	20.460	0.249

20.473	0.300	20.486	0.351	20.512	0.215	20.520	0.029
20.530	-0.111	20.541	-0.166	20.559	-0.137	20.572	-0.171
20.579	-0.200	20.593	-0.158	20.605	-0.099	20.627	-0.179
20.647	-0.031	20.655	0.058	20.666	0.130	20.676	0.176
20.692	0.193	20.702	0.168	20.717	0.130	20.725	0.108
20.734	0.134	20.754	0.206	20.768	0.167	20.778	0.099
20.793	-0.007	20.807	-0.176	20.822	-0.257	20.841	-0.121
20.856	0.023	20.874	-0.020	20.888	0.005	20.900	0.018
20.913	-0.033	20.926	-0.105	20.935	-0.071	20.947	-0.042
20.965	-0.110	20.979	-0.258	20.991	-0.279	21.007	-0.144
21.025	0.038	21.036	0.118	21.046	0.178	21.064	0.224
21.083	0.093	21.099	-0.077	21.120	-0.009	21.132	-0.022
21.143	-0.052	21.167	0.011	21.192	-0.010	21.201	0.020
21.218	-0.036	21.232	-0.112	21.257	-0.163	21.280	-0.121
21.286	-0.087	21.299	-0.041	21.322	-0.079	21.337	-0.063
21.351	-0.037	21.368	-0.088	21.382	-0.089	21.397	-0.063
21.408	-0.030	21.421	0.034	21.434	0.097	21.447	0.118
21.465	0.059	21.478	-0.009	21.495	-0.128	21.516	-0.073
21.545	-0.010	21.570	-0.040	21.584	0.002	21.596	0.044
21.610	0.070	21.633	-0.015	21.641	-0.100	21.654	-0.236
21.662	-0.296	21.680	-0.177	21.687	0.030	21.697	0.310
21.706	0.373	21.714	0.399	21.733	0.386	21.741	0.365
21.752	0.258	21.759	0.148	21.765	0.030	21.775	-0.144
21.793	-0.043	21.805	0.042	21.815	-0.001	21.828	-0.052
21.842	-0.111	21.860	-0.018	21.874	0.172	21.887	0.274
21.898	0.202	21.911	0.125	21.923	0.015	21.938	-0.104
21.952	0.006	21.967	0.108	21.977	0.159	21.995	0.218
22.008	0.129	22.021	-0.011	22.034	-0.088	22.054	-0.177
22.070	-0.241	22.089	-0.148	22.102	-0.071	22.112	0.0
22.121	0.038	22.131	0.004	22.146	0.064	22.161	0.123
22.174	0.157	22.182	0.156	22.202	0.220	22.235	0.109
22.249	-0.001	22.266	-0.133	22.282	-0.277	22.300	-0.349
22.320	-0.290	22.341	-0.049	22.356	0.061	22.363	0.082
22.371	0.108	22.382	0.069	22.394	-0.011	22.409	-0.079
22.422	0.014	22.437	0.090	22.456	0.056	22.468	0.089
22.478	0.102	22.501	0.047	22.515	0.008	22.537	0.042
22.553	0.050	22.574	0.024	22.594	-0.145	22.609	-0.268
22.629	-0.349	22.642	-0.290	22.653	-0.121	22.660	0.002
22.671	0.074	22.683	0.019	22.691	-0.015	22.706	0.006
22.722	-0.066	22.737	-0.156	22.752	-0.059	22.763	0.022
22.770	0.089	22.788	0.148	22.810	0.110	22.825	0.139
22.843	0.016	22.861	-0.124	22.876	-0.086	22.897	-0.087
22.915	-0.151	22.920	-0.151	22.928	-0.197	22.946	-0.198
22.956	-0.109	22.964	-0.075	22.985	-0.097	23.016	-0.157
23.036	-0.043	23.044	0.059	23.056	0.139	23.062	0.186
23.070	0.211	23.088	0.261	23.105	0.202	23.116	0.074
23.129	-0.019	23.141	0.027	23.152	0.053	23.162	-0.007
23.180	-0.075	23.193	-0.050	23.204	-0.042	23.225	-0.059
23.240	-0.110	23.255	-0.191	23.271	-0.246	23.296	-0.183
23.304	-0.141	23.315	-0.094	23.330	-0.026	23.343	-0.001
23.366	0.130	23.377	0.206	23.390	0.265	23.410	0.244
23.426	0.193	23.441	0.154	23.449	0.103	23.462	0.107
23.486	0.061	23.506	0.009	23.526	-0.033	23.542	-0.004
23.557	0.038	23.566	0.060	23.586	0.030	23.606	-0.005
23.615	0.012	23.630	0.042	23.643	0.075	23.655	0.029
23.669	-0.039	23.682	-0.090	23.703	-0.023	23.715	0.028

23.730	0.079	23.746	0.125	23.754	0.104	23.770	0.142
23.782	0.104	23.798	0.053	23.819	0.061	23.832	0.027
23.844	0.010	23.857	0.036	23.867	0.053	23.885	0.002
23.898	-0.032	23.916	-0.020	23.930	-0.015	23.948	-0.032
23.969	-0.066	23.987	-0.100	24.010	-0.011	24.023	0.065
24.049	0.116	24.066	0.098	24.085	0.052	24.111	0.103
24.133	0.085	24.152	0.107	24.170	0.136	24.191	0.043
24.219	-0.012	24.230	-0.042	24.250	-0.076	24.261	-0.051
24.281	-0.008	24.297	-0.042	24.317	0.004	24.333	0.038
24.348	0.059	24.367	-0.051	24.387	-0.136	24.401	-0.064
24.418	0.102	24.431	0.195	24.444	0.271	24.458	0.216
24.476	-0.004	24.491	-0.204	24.512	-0.144	24.528	-0.051
24.554	0.051	24.566	-0.009	24.576	-0.081	24.589	-0.034
24.602	0.017	24.615	-0.030	24.624	-0.077	24.641	-0.005
24.659	0.076	24.673	0.029	24.695	0.088	24.708	0.135
24.734	0.101	24.758	0.016	24.774	-0.098	24.789	-0.149
24.809	-0.102	24.823	-0.047	24.836	-0.001	24.859	-0.018
24.875	-0.077	24.895	-0.166	24.913	-0.090	24.932	0.042
24.947	0.076	24.960	0.093	24.981	0.050	24.999	-0.043
25.019	0.033	25.037	0.080	25.046	0.109	25.059	0.122
25.082	0.021	25.102	-0.111	25.121	-0.200	25.136	-0.251
25.154	-0.179	25.164	-0.085	25.168	-0.018	25.186	0.042
25.201	0.067	25.221	0.084	25.242	0.020	25.255	0.067
25.268	0.109	25.285	0.033	25.298	-0.035	25.326	-0.018
25.349	-0.018	25.381	-0.082	25.397	-0.154	25.413	-0.091
25.426	0.002	25.443	0.100	25.467	0.002	25.486	0.032
25.507	0.002	25.527	0.048	25.543	0.103	25.561	0.124
25.585	0.073	25.611	-0.003	25.635	0.039	25.648	0.035
25.674	0.052	25.700	0.064	25.725	0.068	25.744	0.026
25.763	-0.030	25.784	0.055	25.799	0.097	25.817	0.123
25.833	0.046	25.847	-0.030	25.862	0.021	25.875	0.046
25.888	0.059	25.907	0.080	25.935	0.029	25.959	-0.035
25.980	0.028	26.006	-0.001	26.038	0.045	26.054	-0.002
26.069	-0.023	26.085	0.011	26.107	0.040	26.130	0.006
26.145	-0.007	26.166	0.036	26.196	0.103	26.216	0.082
26.237	0.082	26.256	0.001	26.271	-0.071	26.289	-0.139
26.321	-0.045	26.334	0.027	26.354	0.077	26.373	0.137
26.399	0.069	26.419	0.043	26.438	0.022	26.459	0.069
26.471	0.115	26.481	0.136	26.492	0.132	26.511	0.064
26.524	-0.016	26.536	-0.088	26.552	-0.148	26.570	-0.067
26.589	0.013	26.607	-0.025	26.615	-0.063	26.632	-0.063
26.648	-0.046	26.667	-0.008	26.687	0.043	26.708	0.030
26.731	0.093	26.747	0.148	26.767	0.034	26.788	0.051
26.801	0.067	26.822	0.038	26.835	-0.022	26.861	-0.124
26.879	-0.031	26.897	0.045	26.920	0.003	26.945	-0.031
26.966	-0.086	26.985	-0.053	26.997	-0.036	27.021	-0.019
27.041	0.023	27.062	0.069	27.083	0.057	27.101	0.073
27.124	0.056	27.144	0.073	27.163	0.073	27.185	0.047
27.206	-0.050	27.235	-0.174	27.248	-0.114	27.256	-0.076
27.271	-0.026	27.289	-0.051	27.315	0.029	27.327	0.067
27.338	0.109	27.353	0.113	27.374	0.075	27.393	0.049
27.418	-0.027	27.436	-0.095	27.465	-0.053	27.496	-0.028
27.512	0.031	27.530	0.095	27.548	0.052	27.561	-0.008
27.574	0.052	27.599	0.094	27.612	0.085	27.628	0.102
27.641	0.115	27.669	0.093	27.687	0.017	27.700	-0.060
27.711	-0.111	27.724	-0.077	27.742	-0.022	27.758	0.033

27.776	0.028	27.794	0.016	27.820	-0.023	27.835	0.041
27.853	0.079	27.869	0.087	27.893	0.121	27.910	0.057
27.926	0.010	27.941	0.027	27.960	-0.007	27.983	0.014
28.006	-0.029	28.022	0.035	28.033	0.098	28.046	0.141
28.071	0.030	28.084	-0.025	28.094	-0.067	28.108	-0.017
28.126	0.017	28.147	-0.030	28.167	0.042	28.178	0.123
28.198	0.173	28.217	0.114	28.227	0.080	28.245	0.008
28.260	-0.005	28.278	-0.077	28.293	-0.183	28.312	-0.099
28.335	0.003	28.350	-0.031	28.369	0.015	28.383	0.070
28.394	0.028	28.404	-0.006	28.428	0.078	28.443	0.108
28.459	0.125	28.476	0.052	28.495	-0.007	28.515	0.005
28.535	-0.016	28.553	-0.003	28.572	-0.029	28.590	-0.038
28.613	-0.025	28.639	0.0	28.657	0.034	28.683	0.034
28.700	0.055	28.710	0.067	28.718	0.084	28.721	0.067
28.726	0.067	28.733	0.067	28.747	0.021	28.777	-0.021
28.800	-0.029	28.823	-0.050	28.877	-0.017	28.920	0.028
28.943	0.045	28.980	0.031	29.016	-0.051	29.061	0.079
29.087	-0.002	29.098	-0.079	29.118	-0.020	29.139	-0.042
29.169	0.068	29.184	0.072	29.205	0.185	29.243	-0.023
29.256	0.015	29.280	0.019	29.310	0.138	29.346	-0.095
29.367	0.019	29.377	0.002	29.408	0.066	29.414	0.078
29.445	-0.036	29.468	-0.011	29.498	-0.108	29.524	-0.024
29.568	0.112	29.605	-0.020	29.654	0.048	29.667	-0.007
29.692	0.026	29.721	-0.046	29.746	-0.020	29.772	-0.105
29.787	-0.046	29.803	0.017	29.816	0.056	29.844	0.170
29.863	0.047	29.878	-0.051	29.902	-0.165	29.917	-0.131
29.946	0.034	29.959	0.008	29.985	0.051	30.006	-0.030
30.031	0.046	30.072	0.164	30.076	0.147	30.094	0.164
30.117	0.015	30.129	-0.053	30.138	-0.053	30.156	-0.015
30.189	0.074	30.200	0.036	30.236	-0.033	30.249	0.027
30.267	0.115	30.280	0.098	30.304	0.022	30.319	-0.008
30.358	-0.004	30.376	-0.030	30.408	-0.140	30.430	-0.039
30.441	0.063	30.456	0.143	30.472	0.054	30.491	-0.090
30.504	-0.014	30.522	0.118	30.538	-0.039	30.560	-0.179
30.574	-0.057	30.597	0.104	30.631	-0.210	30.649	-0.028
30.670	0.086	30.698	-0.054	30.730	-0.025	30.761	-0.080
30.785	-0.038	30.831	0.097	30.845	0.033	30.865	0.020
30.884	-0.005	30.917	-0.090	30.938	0.011	30.956	-0.010
30.983	0.113	31.012	-0.108	31.045	0.027	31.058	-0.041
31.085	0.116	31.092	0.124	31.118	0.035	31.129	0.069
31.148	0.019	31.176	0.112	31.187	0.036	31.229	-0.155
31.239	-0.125	31.254	-0.146	31.279	-0.051	31.291	-0.053
31.312	0.023	31.326	-0.061	31.336	-0.159	31.365	0.066
31.371	0.049	31.394	0.151	31.415	-0.053	31.434	-0.146
31.447	-0.125	31.465	-0.125	31.494	0.125	31.499	0.155
31.518	0.045	31.544	-0.230	31.555	-0.154	31.567	-0.027
31.580	0.028	31.591	0.007	31.609	-0.040	31.633	0.104
31.662	-0.061	31.678	0.053	31.693	0.320	31.706	0.104
31.714	-0.057	31.731	-0.155	31.738	-0.129	31.746	0.027
31.762	0.171	31.770	0.180	31.793	0.044	31.810	0.200
31.822	0.416	31.830	0.522	31.836	0.565	31.851	0.323
31.857	0.225	31.873	0.098	31.893	0.352	31.917	0.034
31.943	-0.055	31.956	-0.009	31.981	-0.221	31.994	0.114
32.002	0.304	32.012	0.402	32.027	0.478	32.039	0.308
32.043	0.045	32.056	-0.349	32.065	-0.701	32.073	-0.841
32.086	-0.765	32.104	-0.969	32.110	-0.706	32.119	-0.168

32.125	0.319	32.133	0.446	32.144	0.089	32.152	-0.207
32.159	-0.360	32.170	-0.479	32.181	-0.187	32.189	0.063
32.202	0.228	32.230	0.185	32.243	0.265	32.267	0.476
32.282	0.408	32.303	0.488	32.317	0.310	32.327	-0.021
32.338	-0.360	32.351	-0.492	32.360	-0.441	32.372	-0.200
32.395	-0.136	32.397	-0.111	32.411	-0.090	32.432	0.142
32.444	0.350	32.455	0.460	32.467	0.625	32.475	0.608
32.488	0.455	32.499	0.357	32.512	0.107	32.520	-0.109
32.528	-0.244	32.539	-0.409	32.552	-0.206	32.564	0.048
32.569	0.214	32.573	0.252	32.593	0.175	32.612	0.294
32.630	0.121	32.642	-0.070	32.653	-0.201	32.663	-0.172
32.687	0.138	32.702	0.087	32.721	0.201	32.739	0.163
32.758	0.252	32.775	0.062	32.788	-0.248	32.797	-0.634
32.812	-0.769	32.820	-0.574	32.830	-0.108	32.838	0.438
32.845	0.633	32.851	0.713	32.869	0.408	32.882	0.192
32.895	0.043	32.910	-0.143	32.927	-0.419	32.936	-0.681
32.952	-0.936	32.963	-0.762	32.975	-0.368	32.980	-0.127
32.986	0.060	32.993	0.174	33.004	0.288	33.015	0.445
33.020	0.606	33.028	0.712	33.035	0.716	33.046	0.623
33.054	0.296	33.059	0.008	33.067	-0.327	33.077	-0.484
33.085	-0.378	33.105	-0.297	33.119	-0.107	33.126	0.113
33.132	0.329	33.139	0.486	33.152	0.266	33.163	0.113
33.171	-0.044	33.181	-0.277	33.189	-0.413	33.201	-0.510
33.209	-0.600	33.227	-0.744	33.235	-0.414	33.241	-0.037
33.246	0.158	33.250	0.565	33.254	0.802	33.259	0.866
33.267	0.755	33.272	0.569	33.279	0.395	33.285	0.327
33.300	0.259	33.308	0.013	33.318	-0.326	33.321	-0.521
33.329	-0.729	33.339	-0.445	33.349	-0.144	33.357	0.296
33.365	0.580	33.370	0.652	33.373	0.707	33.378	0.724
33.385	0.690	33.395	0.579	33.399	0.401	33.406	0.223
33.411	0.105	33.413	-0.052	33.419	-0.247	33.424	-0.349
33.432	-0.489	33.450	-0.362	33.471	-0.558	33.479	-0.333
33.488	-0.134	33.491	0.074	33.497	0.239	33.507	0.260
33.515	0.230	33.535	0.340	33.554	0.594	33.567	0.339
33.576	0.047	33.598	-0.382	33.620	-0.213	33.631	-0.408
33.639	-0.619	33.647	-0.738	33.664	-0.560	33.673	-0.276
33.683	-0.001	33.690	0.105	33.703	0.224	33.709	0.435
33.716	0.580	33.722	0.694	33.730	0.753	33.743	0.596
33.750	0.355	33.756	0.168	33.761	0.007	33.773	-0.111
33.778	-0.005	33.789	0.084	33.799	0.147	33.807	0.160
33.818	0.100	33.825	-0.001	33.836	-0.116	33.848	-0.205
33.866	-0.260	33.870	-0.234	33.893	-0.171	33.911	-0.196
33.919	-0.116	33.927	-0.027	33.940	0.070	33.957	-0.048
33.970	-0.175	33.991	-0.222	34.007	-0.112	34.019	0.070
34.035	0.261	34.054	0.269	34.084	0.392	34.102	0.189
34.108	-0.027	34.118	-0.163	34.129	-0.269	34.139	-0.121
34.155	0.032	34.173	0.061	34.188	0.108	34.201	0.044
34.206	-0.125	34.224	-0.256	34.232	-0.223	34.254	-0.083
34.269	0.074	34.277	0.171	34.292	0.231	34.304	0.108
34.322	-0.045	34.337	-0.151	34.346	-0.189	34.359	-0.193
34.369	-0.125	34.379	0.006	34.393	0.137	34.419	0.010
34.440	0.057	34.455	0.044	34.485	0.239	34.501	0.141
34.509	-0.028	34.529	-0.236	34.560	-0.329	34.576	-0.207
34.597	0.035	34.605	0.081	34.622	0.035	34.653	0.064
34.663	0.026	34.677	0.068	34.685	0.182	34.700	0.275
34.718	0.233	34.740	0.139	34.755	0.004	34.778	-0.098

34.786	-0.077	34.813	-0.124	34.846	0.033	34.860	-0.001
34.893	0.083	34.904	0.045	34.937	0.150	34.972	0.032
34.990	0.108	35.008	0.154	35.019	0.150	35.034	0.095
35.052	-0.045	35.076	-0.126	35.099	-0.092	35.122	-0.058
35.156	-0.059	35.186	-0.127	35.190	-0.139	35.221	-0.123
35.237	-0.059	35.248	0.047	35.260	0.119	35.275	0.165
35.293	0.229	35.312	0.186	35.340	0.063	35.361	-0.064
35.379	-0.132	35.391	-0.128	35.422	-0.048	35.432	-0.035
35.443	-0.048	35.473	-0.124	35.482	-0.086	35.496	-0.006
35.510	0.142	35.518	0.189	35.541	0.159	35.556	0.091
35.577	-0.112	35.594	-0.070	35.636	-0.176	35.685	-0.040
35.721	-0.007	35.738	0.006	35.759	-0.011	35.824	0.099
35.864	-0.020	35.910	0.078	35.934	-0.020	35.960	-0.079
35.991	-0.130	36.041	-0.105	36.063	-0.041	36.085	0.039
36.111	0.043	36.141	0.081	36.167	0.174	36.175	0.191
36.204	0.157	36.225	0.060	36.253	0.009	36.285	-0.131
36.311	-0.063	36.332	0.030	36.348	0.098	36.361	0.102
36.371	0.038	36.390	-0.034	36.402	-0.009	36.423	-0.013
36.461	0.041	36.504	-0.035	36.538	-0.099	36.575	0.002
36.591	-0.015	36.628	0.040	36.656	0.057	36.687	0.023
36.708	0.010	36.738	-0.016	36.769	0.005	36.784	-0.007
36.811	0.035	36.841	0.047	36.868	0.043	36.893	0.005
36.914	-0.016	36.933	0.051	36.953	0.102	36.984	0.064
37.018	0.051	37.055	0.0	37.089	0.038	37.109	0.033
37.148	-0.026	37.178	0.008	37.191	0.003	37.227	-0.022
37.260	0.020	37.281	0.066	37.310	0.070	37.333	-0.036
37.352	-0.113	37.368	-0.155	37.383	-0.032	37.406	0.082
37.423	-0.003	37.448	-0.139	37.466	-0.046	37.485	0.047
37.511	0.012	37.531	0.054	37.563	-0.111	37.574	-0.078
37.602	0.049	37.630	0.125	37.648	0.065	37.662	-0.049
37.693	0.065	37.725	-0.024	37.745	0.014	37.785	0.082
37.805	0.044	37.834	0.133	37.855	0.018	37.875	-0.045
37.881	-0.041	37.904	-0.016	37.938	0.124	37.969	0.082
37.990	0.103	38.004	0.052	38.032	-0.100	38.033	-0.088
38.084	-0.024	38.120	-0.020	38.176	-0.003	38.207	-0.032
38.251	0.023	38.262	0.018	38.304	-0.092	38.315	-0.075
38.340	-0.037	38.367	0.031	38.406	-0.029	38.443	-0.017
38.464	0.0	38.490	0.029	38.524	0.075	38.569	-0.052
38.598	0.002	38.627	0.083	38.656	0.023	38.682	-0.015
38.703	0.044	38.727	0.133	38.755	0.056	38.781	-0.016
38.798	0.001	38.821	-0.025	38.845	0.005	38.858	-0.004
38.877	0.034	38.905	-0.072	38.942	0.055	38.956	0.038
38.973	0.089	38.992	0.165	39.000	0.144	39.013	0.063
39.037	-0.090	39.055	-0.009	39.077	0.109	39.087	0.114
39.108	-0.009	39.140	-0.056	39.161	0.008	39.189	-0.056
39.216	0.012	39.232	0.050	39.263	0.067	39.283	0.029
39.304	-0.039	39.355	0.025	39.401	-0.073	39.428	-0.030
39.445	-0.043	39.459	-0.022	39.472	-0.039	39.484	-0.018
39.509	-0.056	39.529	-0.026	39.555	0.041	39.595	0.028
39.616	-0.010	39.641	0.024	39.681	-0.048	39.723	0.028
39.733	0.007	39.757	0.006	39.785	-0.078	39.811	0.019
39.853	0.108	39.887	-0.054	39.906	-0.041	39.925	-0.062
39.952	0.052	39.987	-0.046	40.023	-0.135	40.050	-0.008
40.079	0.0	40.120	0.199	40.142	0.093	40.165	-0.001
40.185	0.080	40.193	0.105	40.210	0.113	40.225	0.071
40.235	-0.065	40.247	-0.179	40.264	-0.209	40.280	-0.137

40.294	-0.091	40.315	-0.142	40.333	-0.159	40.347	-0.065
40.370	0.155	40.391	0.129	40.412	0.159	40.434	0.134
40.454	0.129	40.475	0.019	40.491	0.023	40.520	-0.146
40.545	-0.112	40.570	-0.049	40.594	0.070	40.615	0.002
40.647	0.014	40.663	0.006	40.686	0.082	40.713	-0.066
40.731	-0.007	40.750	0.078	40.769	0.052	40.779	0.031
40.816	0.090	40.829	0.065	40.848	-0.012	40.866	-0.046
40.884	-0.012	40.906	0.013	40.926	-0.029	40.947	-0.114
40.977	-0.029	41.010	0.072	41.042	-0.017	41.081	0.110
41.108	0.042	41.144	-0.022	41.177	-0.077	41.213	-0.009
41.223	-0.009	41.263	0.029	41.296	0.024	41.322	-0.010
41.353	0.079	41.383	0.015	41.411	-0.002	41.437	-0.036
41.465	-0.036	41.494	0.006	41.505	0.010	41.520	0.015
41.546	-0.007	41.582	0.061	41.604	0.031	41.624	0.052
41.648	-0.011	41.671	-0.037	41.686	-0.054	41.694	-0.083
41.728	0.018						

IC041

71.001 2/9/71 0600PST PACCIMA DAM CAL. DOWN

2839 POINTS 41.772 SECONDS

SCALED DATA, WITH THE DIGITIZED FIXED TRACE SMOOTHED
AND SUBTRACTED, THE TIMING MARKS SMOOTHED BEFORE USE,
AND A HORIZONTAL ZERO LINE FIXED FOR ZERO MEAN VALUE,
WHICH SIMULTANEOUSLY MINIMIZES THE RMS ACCELERATION.

UNITS ARE SEC, G/10.

THE RMS ACCELERATION OF THIS COMPLETE RECORD, MINIMIZED
IN THE ABOVE ALIGNMENT CORRECTION, IS 0.8332 G/10.

TIME	ACCLN	TIME	ACCLN	TIME	ACCLN	TIME	ACCLN
0.0	-0.396	0.018	-0.547	0.031	-0.711	0.041	-0.589
0.054	0.159	0.063	0.835	0.069	1.302	0.082	0.663
0.091	-0.421	0.104	-1.384	0.112	-1.010	0.124	0.301
0.129	0.940	0.137	1.242	0.143	0.700	0.155	-0.275
0.162	-0.749	0.170	-0.170	0.181	0.595	0.190	1.250
0.198	0.574	0.209	-0.729	0.221	-1.498	0.234	-0.384
0.242	0.658	0.254	1.112	0.262	0.628	0.274	-0.662
0.279	-1.158	0.287	-1.540	0.295	-1.082	0.303	-0.065
0.310	0.855	0.323	1.951	0.336	1.309	0.350	-1.116
0.361	-1.700	0.376	-0.431	0.389	0.707	0.401	1.459
0.411	1.098	0.426	0.241	0.439	-0.297	0.457	-1.095
0.473	-1.377	0.483	-1.251	0.500	-0.465	0.506	0.837
0.518	2.408	0.528	2.971	0.538	2.072	0.551	0.156
0.564	-0.877	0.571	-1.445	0.574	-1.701	0.605	-1.491
0.617	-0.949	0.630	-0.256	0.643	0.286	0.653	0.996
0.666	1.647	0.676	1.286	0.696	-0.466	0.704	-0.752
0.712	-0.551	0.722	-0.118	0.729	0.164	0.739	0.117
0.749	0.185	0.757	0.239	0.770	-0.038	0.777	-0.315
0.785	-0.572	0.790	-0.290	0.305	0.458	0.816	0.844
0.823	0.508	0.829	-0.521	0.837	-1.353	0.847	-1.849
0.857	-1.408	0.867	-0.462	0.870	0.429	0.880	0.714
0.890	0.219	0.895	-0.231	0.907	-0.563	0.915	0.109
0.930	1.273	0.939	2.030	0.953	1.084	0.966	-0.676
0.979	-1.962	0.985	-2.206	1.000	-1.239	1.012	0.152
1.020	0.635	1.027	0.950	1.038	0.870	1.050	1.038
1.051	1.290	1.058	1.454	1.073	0.879	1.083	-0.403
1.092	-1.390	1.104	-1.054	1.112	-0.348	1.124	0.236
1.130	0.492	1.145	0.181	1.163	-0.491	1.173	-1.172
1.191	-1.541	1.203	-1.087	1.217	0.413	1.226	1.228
1.237	1.707	1.252	0.967	1.262	-0.411	1.274	-0.659
1.285	-0.445	1.299	0.084	1.308	0.353	1.318	0.420
1.332	0.474	1.343	0.264	1.358	-0.093	1.370	-0.203
1.381	-0.467	1.391	-0.661	1.406	-0.762	1.416	-0.569
1.429	0.049	1.438	0.297	1.446	0.103	1.458	-0.326
1.469	-0.616	1.477	-0.364	1.489	0.262	1.496	0.594
1.501	0.783	1.509	0.859	1.522	0.602	1.532	-0.003
1.544	-0.453	1.552	-0.633	1.564	-0.697	1.575	-0.571
1.588	-0.340	1.595	-0.105	1.607	0.219	1.613	0.454
1.622	0.093	1.633	-0.765	1.642	-1.063	1.653	-0.727
1.665	-0.047	1.673	0.554	1.681	0.794	1.686	0.604

1.696	0.268	1.708	0.112	1.714	-0.051	1.723	-0.484
1.731	-0.930	1.739	-1.073	1.753	-0.640	1.759	0.515
1.768	1.200	1.774	1.422	1.781	1.115	1.790	0.602
1.803	-0.079	1.813	-0.424	1.820	-0.453	1.836	-0.063
1.846	1.193	1.855	1.622	1.866	1.180	1.873	-0.274
1.881	-0.879	1.890	-1.144	1.902	-0.888	1.908	-0.523
1.913	-0.464	1.922	-0.523	1.927	-0.708	1.935	-0.725
1.943	-0.528	1.955	-0.095	1.963	0.316	1.973	0.454
1.987	0.236	2.002	-0.403	2.014	-0.698	2.025	-0.152
2.035	0.949	2.047	1.541	2.062	-0.019	2.070	-1.275
2.082	-1.738	2.094	-1.179	2.102	-0.919	2.117	-0.793
2.134	-0.655	2.142	-0.470	2.156	-0.025	2.167	0.495
2.184	1.461	2.194	2.415	2.201	2.671	2.216	1.738
2.229	0.460	2.241	-0.137	2.248	-0.599	2.258	-0.120
2.276	1.157	2.284	2.081	2.294	2.287	2.304	1.782
2.316	1.332	2.324	1.265	2.339	1.723	2.349	2.260
2.356	2.500	2.376	2.012	2.382	1.243	2.391	0.970
2.401	1.508	2.409	2.495	2.421	3.024	2.427	3.146
2.436	2.801	2.444	2.116	2.454	1.326	2.462	1.124
2.469	1.553	2.474	1.813	2.482	2.132	2.499	1.821
2.529	0.346	2.542	-0.339	2.550	-0.558	2.564	-0.499
2.577	-0.643	2.600	-1.256	2.607	-1.500	2.614	-1.563
2.624	-1.404	2.630	-0.820	2.655	0.587	2.669	1.608
2.682	3.095	2.689	3.515	2.702	4.082	2.714	3.586
2.737	1.914	2.750	-0.032	2.775	-2.044	2.783	-3.250
2.796	-3.612	2.814	-2.683	2.832	-1.364	2.845	0.023
2.858	1.350	2.862	1.502	2.881	0.644	2.891	-0.175
2.906	0.035	2.914	0.233	2.924	0.115	2.937	-0.175
2.959	-1.175	2.974	-2.524	2.985	-2.915	2.998	-2.637
3.006	-2.389	3.020	-2.184	3.031	-1.553	3.046	-0.562
3.057	0.690	3.072	1.005	3.084	1.299	3.095	1.652
3.107	2.110	3.122	3.085	3.133	3.804	3.146	3.072
3.158	2.287	3.176	1.211	3.182	0.976	3.191	0.421
3.204	-0.587	3.215	-1.839	3.222	-2.180	3.230	-2.562
3.248	-2.474	3.263	-2.592	3.270	-2.432	3.279	-2.264
3.289	-2.781	3.306	-4.377	3.321	-5.394	3.334	-4.667
3.349	-3.319	3.355	-2.760	3.365	-2.554	3.375	-1.970
3.388	-1.243	3.406	-0.441	3.421	0.698	3.437	1.740
3.449	2.643	3.457	2.937	3.470	2.685	3.485	1.677
3.498	0.971	3.503	0.631	3.510	0.483	3.523	0.504
3.531	0.122	3.549	-1.340	3.559	-3.349	3.571	-4.277
3.584	-4.685	3.602	-3.777	3.612	-2.252	3.627	-0.290
3.636	0.492	3.648	1.323	3.653	1.504	3.661	1.353
3.668	1.197	3.676	1.122	3.687	1.189	3.702	0.970
3.714	0.756	3.725	0.655	3.735	0.248	3.743	-0.042
3.760	-0.253	3.768	-0.110	3.777	-0.005	3.790	-0.249
3.800	-0.648	3.815	-0.825	3.826	-0.749	3.835	-0.674
3.841	-0.712	3.853	-0.741	3.869	-0.166	3.881	0.557
3.891	1.036	3.901	1.405	3.906	1.510	3.913	1.527
3.921	1.460	3.932	1.371	3.941	1.018	3.951	0.388
3.959	0.106	3.966	0.043	3.979	0.173	3.987	0.354
4.000	0.719	4.009	1.005	4.019	1.131	4.022	1.211
4.030	1.030	4.044	0.425	4.057	-0.084	4.068	-0.479
4.083	-0.635	4.093	-0.366	4.102	-0.160	4.115	0.050
4.130	0.243	4.140	0.579	4.151	0.885	4.161	0.515
4.173	-0.636	4.185	-1.153	4.196	-1.552	4.204	-1.750

4.211	-1.889	4.223	-1.994	4.233	-1.301	4.248	0.283
4.259	1.069	4.267	1.535	4.274	1.834	4.286	1.997
4.292	1.573	4.301	1.316	4.307	1.102	4.314	1.312
4.320	1.606	4.327	1.757	4.339	1.577	4.354	-0.226
4.363	-0.940	4.372	-1.310	4.390	-0.474	4.400	0.446
4.403	0.921	4.418	1.126	4.426	0.975	4.431	0.782
4.438	0.681	4.448	0.614	4.454	0.664	4.463	0.744
4.476	0.349	4.489	-0.177	4.503	-0.286	4.517	-0.345
4.526	-0.753	4.539	-1.076	4.549	-1.253	4.564	-0.850
4.579	-0.085	4.595	0.579	4.602	0.356	4.608	0.142
4.623	0.091	4.635	-0.106	4.643	-0.317	4.652	-0.018
4.660	0.288	4.670	0.481	4.683	0.124	4.693	-0.477
4.708	-0.632	4.716	-0.595	4.729	-1.044	4.744	-1.624
4.757	-0.826	4.773	1.216	4.783	1.880	4.801	0.704
4.808	-0.914	4.821	-1.280	4.832	-0.901	4.844	-0.397
4.858	-0.023	4.866	0.355	4.878	0.746	4.888	0.372
4.899	0.082	4.911	0.346	4.919	0.531	4.930	0.662
4.935	0.771	4.946	0.863	4.964	0.183	4.981	-1.036
5.004	-1.822	5.022	-2.927	5.033	-1.578	5.051	0.552
5.067	1.779	5.075	2.262	5.089	0.720	5.103	-1.011
5.110	-2.229	5.121	-1.124	5.133	0.683	5.139	1.019
5.147	0.897	5.157	-0.044	5.167	-0.813	5.180	-1.338
5.191	-1.263	5.206	-0.969	5.214	0.111	5.224	0.746
5.240	1.716	5.252	1.464	5.269	-0.019	5.284	-1.112
5.295	-2.133	5.308	-2.591	5.323	-2.019	5.336	-0.969
5.349	-0.091	5.360	0.636	5.375	-0.393	5.394	-1.309
5.405	-0.566	5.414	0.224	5.422	0.581	5.433	0.300
5.444	-0.032	5.451	-0.146	5.462	0.241	5.472	0.522
5.480	0.564	5.491	0.665	5.493	0.896	5.504	1.127
5.511	0.867	5.519	0.295	5.527	-0.305	5.533	-0.558
5.538	-0.835	5.541	-0.919	5.545	-1.192	5.548	-1.444
5.551	-1.511	5.556	-1.549	5.558	-1.797	5.563	-1.658
5.566	-1.058	5.571	-0.520	5.572	0.089	5.579	0.610
5.585	1.068	5.587	1.493	5.595	1.552	5.605	1.123
5.611	0.854	5.616	0.799	5.621	0.518	5.629	0.224
5.634	-0.096	5.637	-0.407	5.642	-0.587	5.644	-0.839
5.648	-0.890	5.652	-0.986	5.656	-1.028	5.661	-0.944
5.666	-0.886	5.673	-0.747	5.682	-0.638	5.694	-0.751
5.699	-0.961	5.702	-1.155	5.707	-1.356	5.713	-1.629
5.715	-1.655	5.720	-1.936	5.721	-1.995	5.728	-2.226
5.733	-2.335	5.737	-2.457	5.744	-2.533	5.750	-2.491
5.759	-2.310	5.765	-2.054	5.778	-1.558	5.785	-0.722
5.791	0.059	5.798	0.933	5.806	1.463	5.811	1.870
5.812	1.979	5.822	2.219	5.824	2.315	5.832	2.139
5.837	1.845	5.848	1.580	5.850	1.282	5.855	1.172
5.863	0.933	5.869	0.958	5.874	1.433	5.881	1.781
5.882	1.929	5.894	2.113	5.897	2.504	5.910	3.735
5.915	4.508	5.920	5.231	5.926	5.365	5.929	4.911
5.936	3.382	5.942	1.760	5.952	0.516	5.960	-0.253
5.965	-0.639	5.972	-0.883	5.980	-1.160	5.994	-2.677
6.004	-4.530	6.007	-5.862	6.017	-6.808	6.024	-7.098
6.027	-7.182	6.032	-7.140	6.040	-6.678	6.048	-6.140
6.056	-5.825	6.069	-5.165	6.079	-4.569	6.084	-3.926
6.090	-3.535	6.102	-3.056	6.110	-1.510	6.121	-0.153
6.129	1.141	6.142	2.192	6.152	3.242	6.159	4.280
6.163	5.313	6.172	5.960	6.176	6.460	6.183	6.628

6.188	6.670	6.194	6.107	6.214	4.779	6.229	1.796
6.242	-1.570	6.248	-4.486	6.255	-5.330	6.261	-5.360
6.264	-5.246	6.268	-2.935	6.278	-0.923	6.284	1.085
6.287	2.754	6.294	3.590	6.302	3.997	6.304	3.342
6.313	2.362	6.317	1.858	6.323	1.724	6.327	1.644
6.330	1.602	6.333	1.345	6.343	0.425	6.351	-0.831
6.356	-1.823	6.363	-2.638	6.366	-3.230	6.371	-3.294
6.385	-2.147	6.394	-0.697	6.410	0.521	6.415	1.109
6.418	1.521	6.428	1.681	6.434	0.916	6.443	-0.046
6.449	-0.807	6.451	-1.198	6.459	-1.492	6.465	-0.761
6.472	-0.064	6.483	0.420	6.488	0.806	6.500	1.369
6.506	1.873	6.510	2.251	6.516	2.423	6.519	2.453
6.526	2.238	6.534	1.503	6.542	1.104	6.546	0.814
6.552	0.751	6.555	0.822	6.559	1.036	6.562	1.091
6.568	1.196	6.575	0.431	6.586	-0.561	6.593	-0.960
6.598	-1.283	6.601	-1.014	6.606	-0.994	6.611	-0.720
6.617	-0.502	6.624	-0.586	6.635	-0.494	6.639	-0.069
6.645	0.338	6.647	0.657	6.652	0.909	6.655	1.027
6.662	1.090	6.670	0.628	6.673	0.359	6.679	0.123
6.684	0.106	6.688	0.254	6.693	0.363	6.696	0.522
6.701	0.526	6.714	-0.066	6.719	-0.335	6.725	-0.524
6.732	-0.776	6.737	-0.894	6.745	-1.323	6.750	-1.684
6.753	-2.045	6.756	-2.121	6.760	-2.226	6.765	-2.348
6.773	-1.596	6.784	-0.046	6.793	1.425	6.801	2.349
6.809	2.681	6.816	2.114	6.822	1.134	6.830	0.210
6.835	-0.210	6.842	-0.336	6.848	-0.122	6.858	0.121
6.860	-0.063	6.870	-0.190	6.875	-0.206	6.881	0.361
6.888	0.714	6.894	0.911	6.901	1.033	6.906	1.087
6.914	1.037	6.919	0.663	6.922	0.478	6.927	0.373
6.939	0.276	6.942	0.121	6.947	0.028	6.952	-0.106
6.955	-0.241	6.960	-0.279	6.965	-0.191	6.968	0.032
6.978	0.259	6.986	0.036	6.991	-0.191	6.998	-0.258
7.006	-0.006	7.011	0.284	7.018	0.729	7.021	0.926
7.026	1.116	7.031	1.027	7.037	0.918	7.040	0.859
7.049	0.926	7.055	0.960	7.063	0.825	7.067	0.577
7.080	-0.234	7.086	-0.889	7.096	-1.368	7.098	-1.696
7.103	-1.835	7.106	-1.965	7.116	-1.579	7.124	-0.902
7.131	-0.192	7.139	0.619	7.146	1.177	7.151	1.753
7.157	2.602	7.164	3.038	7.165	3.328	7.170	3.501
7.177	3.097	7.185	1.803	7.190	1.282	7.196	0.500
7.205	-0.046	7.210	-0.399	7.215	-0.777	7.221	-1.000
7.224	-1.265	7.231	-1.508	7.241	-1.597	7.242	-1.269
7.249	-0.845	7.254	-0.261	7.260	0.252	7.264	0.664
7.272	0.928	7.275	1.151	7.277	1.248	7.288	1.311
7.295	0.857	7.300	0.445	7.303	0.214	7.313	0.0
7.316	0.134	7.331	0.248	7.341	-0.017	7.346	-0.672
7.352	-1.147	7.359	-1.530	7.364	-1.731	7.369	-1.916
7.372	-1.925	7.375	-1.769	7.382	-0.908	7.393	-0.042
7.401	1.155	7.413	1.954	7.423	2.664	7.429	3.180
7.439	3.403	7.446	3.664	7.450	2.243	7.462	0.777
7.470	-0.567	7.477	-1.563	7.480	-2.273	7.486	-2.513
7.500	-2.773	7.501	-2.635	7.509	-1.702	7.516	-1.210
7.524	-0.904	7.532	-0.870	7.539	-0.651	7.545	-0.240
7.554	0.050	7.562	0.328	7.567	-0.025	7.572	-0.614
7.578	-0.929	7.583	-1.156	7.590	-1.299	7.601	-1.315
7.609	-1.080	7.611	-0.983	7.621	-0.870	7.634	-0.614

7.637	0.075	7.649	1.147	7.650	1.928	7.658	2.857
7.668	3.781	7.675	4.311	7.680	4.601	7.683	4.361
7.693	3.117	7.701	2.084	7.708	1.382	7.714	0.689
7.721	-0.109	7.726	-0.383	7.739	-0.878	7.745	-1.021
7.750	-1.975	7.758	-2.618	7.766	-2.891	7.771	-3.164
7.776	-3.307	7.786	-3.416	7.788	-3.778	7.792	-4.173
7.797	-4.425	7.801	-4.076	7.815	-1.521	7.830	0.289
7.832	1.483	7.835	4.197	7.838	4.958	7.840	4.756
7.845	3.899	7.851	2.344	7.862	1.134	7.869	0.584
7.871	0.151	7.877	-0.051	7.884	-0.202	7.889	-0.240
7.892	-0.261	7.898	-0.236	7.908	-0.185	7.910	0.062
7.916	0.445	7.921	0.777	7.926	0.983	7.929	1.155
7.934	1.243	7.942	1.117	7.947	0.793	7.954	0.730
7.960	0.588	7.963	0.554	7.970	0.663	7.976	1.092
7.981	1.440	7.988	1.756	7.996	1.953	8.003	1.075
8.007	0.386	8.014	-0.047	8.020	-0.152	8.032	-0.282
8.045	-1.329	8.053	-3.808	8.060	-4.316	8.068	-4.757
8.074	-3.988	8.084	-2.619	8.090	-1.270	8.097	-0.505
8.099	-0.026	8.108	0.381	8.115	0.365	8.118	0.012
8.125	-0.354	8.131	-0.522	8.139	-0.106	8.144	0.583
8.149	0.806	8.152	1.633	8.159	2.465	8.164	3.453
8.170	3.675	8.177	3.562	8.183	2.701	8.190	1.965
8.198	0.684	8.204	-0.031	8.211	-0.829	8.216	-1.262
8.218	-1.413	8.221	-1.804	8.227	-2.060	8.231	-2.421
8.234	-2.745	8.237	-2.989	8.240	-3.102	8.242	-3.182
8.252	-3.161	8.259	-2.951	8.262	-2.632	8.268	-2.069
8.275	-0.527	8.282	1.040	8.288	2.250	8.293	2.939
8.301	3.481	8.314	3.145	8.321	2.838	8.326	2.577
8.329	2.938	8.336	3.615	8.341	3.867	8.344	4.043
8.347	4.215	8.351	4.236	8.357	4.127	8.360	4.098
8.365	3.908	8.367	3.862	8.372	2.648	8.380	1.652
8.392	0.353	8.400	-1.785	8.406	-2.235	8.413	-2.475
8.420	-2.752	8.428	-2.025	8.438	-0.811	8.439	0.395
8.446	1.231	8.459	1.529	8.464	0.071	8.472	-1.631
8.477	-2.392	8.484	-2.862	8.485	-3.161	8.494	-3.421
8.498	-3.325	8.505	-3.106	8.507	-3.090	8.513	-2.846
8.526	-2.880	8.528	-2.670	8.538	-2.300	8.543	-1.851
8.549	-1.330	8.556	-0.981	8.564	-0.023	8.569	0.586
8.577	1.048	8.584	0.430	8.592	-0.423	8.595	-1.171
8.599	-1.490	8.604	-1.663	8.607	-2.087	8.615	-2.167
8.618	-2.247	8.628	-2.327	8.635	-2.428	8.638	-2.306
8.643	-2.306	8.650	-1.983	8.661	-0.697	8.668	0.050
8.679	0.937	8.682	1.798	8.687	2.722	8.694	3.247
8.697	3.844	8.706	4.172	8.707	4.403	8.709	4.415
8.714	4.613	8.717	4.512	8.720	4.541	8.724	4.339
8.727	4.314	8.733	3.743	8.737	2.709	8.747	1.860
8.752	0.889	8.757	0.003	8.763	-0.602	8.770	-1.081
8.773	-1.182	8.780	-1.434	8.783	-1.430	8.786	-1.561
8.790	-1.552	8.793	-1.783	8.796	-1.771	8.803	-2.149
8.806	-2.141	8.808	-2.178	8.813	-0.792	8.816	0.057
8.821	0.452	8.828	0.830	8.831	1.187	8.836	1.246
8.839	1.300	8.848	1.136	8.849	0.951	8.861	0.876
8.873	0.796	8.892	0.850	8.899	0.783	8.912	0.686
8.919	0.400	8.922	0.035	8.927	-0.154	8.929	-0.457
8.934	-0.907	8.942	-0.940	8.947	-1.146	8.954	-1.066
8.955	-1.079	8.962	-0.911	8.964	-0.844	8.967	-0.474

8.974	-0.214	8.977	-0.050	8.980	0.097	8.983	0.244
8.988	0.076	8.998	-0.466	9.005	-1.214	9.007	-1.655
9.012	-1.639	9.015	-1.777	9.022	-1.739	9.025	-1.609
9.030	-1.353	9.033	-1.231	9.046	-0.887	9.053	-0.526
9.060	-0.198	9.071	0.130	9.078	0.340	9.084	0.420
9.088	0.470	9.099	0.432	9.108	0.369	9.118	0.478
9.123	0.801	9.128	1.150	9.131	1.549	9.134	1.822
9.142	2.129	9.146	2.415	9.154	2.663	9.161	2.557
9.166	2.230	9.171	1.864	9.177	1.658	9.185	1.465
9.190	0.687	9.199	-0.309	9.205	-1.670	9.210	-2.325
9.219	-3.157	9.224	-3.968	9.227	-4.082	9.235	-3.805
9.245	-1.817	9.252	-0.939	9.258	-0.317	9.263	-0.015
9.270	0.048	9.280	-0.108	9.283	-0.318	9.286	-0.381
9.293	-0.616	9.298	-0.633	9.304	-0.704	9.318	-0.566
9.326	-0.423	9.337	-0.230	9.342	-0.179	9.344	0.195
9.351	0.249	9.357	1.069	9.359	1.678	9.365	1.783
9.372	1.997	9.382	1.871	9.388	1.573	9.397	1.060
9.403	0.316	9.408	-0.171	9.415	-0.776	9.418	-1.474
9.423	-2.003	9.428	-2.419	9.435	-2.755	9.441	-3.108
9.453	-2.726	9.458	-1.583	9.461	-0.919	9.464	-0.293
9.471	0.135	9.476	0.387	9.479	0.560	9.486	0.669
9.491	0.543	9.496	0.421	9.499	0.299	9.502	0.076
9.506	-0.142	9.509	-0.192	9.519	-0.281	9.524	-0.184
9.529	-0.155	9.534	0.118	9.537	0.433	9.543	0.454
9.547	0.576	9.550	0.530	9.557	0.358	9.567	0.139
9.570	-0.020	9.580	-0.247	9.583	-0.466	9.588	-0.508
9.595	-0.726	9.601	-0.806	9.608	-0.823	9.614	-0.613
9.621	-0.353	9.639	-0.096	9.641	0.156	9.644	0.320
9.651	0.408	9.656	0.441	9.665	0.286	9.669	0.004
9.677	-0.214	9.685	-0.366	9.692	-0.303	9.702	-0.210
9.713	-0.118	9.718	0.025	9.726	0.151	9.733	0.214
9.741	0.147	9.751	0.029	9.758	-0.026	9.766	-0.051
9.773	0.071	9.779	0.201	9.791	0.541	9.799	0.743
9.807	0.915	9.811	0.949	9.825	0.919	9.830	0.671
9.837	0.511	9.847	0.066	9.853	-0.590	9.867	-1.149
9.872	-1.384	9.878	-1.414	9.886	-1.296	9.898	-0.826
9.905	-0.607	9.909	-0.490	9.916	-0.355	9.918	-0.254
9.924	-0.137	9.931	-0.024	9.933	0.111	9.942	0.178
9.956	0.211	9.979	0.236	9.995	0.140	10.002	0.072
10.012	-0.046	10.022	0.022	10.027	0.135	10.030	0.295
10.036	0.379	10.043	0.454	10.053	0.353	10.058	0.181
10.061	0.013	10.064	-0.050	10.081	-0.147	10.083	-0.109
10.097	-0.034	10.111	-0.169	10.116	-0.299	10.140	-0.438
10.144	-0.367	10.153	-0.207	10.160	-0.216	10.168	-0.325
10.183	-0.447	10.188	-0.262	10.200	0.078	10.206	0.271
10.211	0.477	10.216	0.679	10.221	0.847	10.231	0.926
10.239	0.947	10.246	0.792	10.253	0.540	10.256	0.426
10.263	0.355	10.279	0.287	10.281	0.178	10.287	-0.066
10.299	-0.314	10.306	-0.499	10.307	-0.583	10.319	-0.537
10.327	-0.386	10.334	-0.113	10.341	0.076	10.346	0.324
10.356	0.404	10.364	0.362	10.380	0.281	10.389	0.193
10.395	0.143	10.405	0.239	10.414	0.319	10.420	0.382
10.445	0.516	10.455	0.528	10.464	0.461	10.478	-0.031
10.487	-0.224	10.500	-0.531	10.508	-0.775	10.513	-0.876
10.520	-0.910	10.532	-0.809	10.542	-0.410	10.552	0.031
10.557	0.321	10.562	0.455	10.567	0.535	10.580	0.594

10.591	0.551	10.601	0.513	10.611	0.492	10.625	0.522
10.641	0.572	10.646	0.597	10.665	0.534	10.673	0.403
10.681	0.306	10.693	0.235	10.699	0.235	10.716	0.327
10.728	0.159	10.738	0.058	10.746	0.045	10.766	0.398
10.774	0.423	10.786	0.293	10.806	-0.065	10.814	-0.170
10.826	-0.233	10.831	-0.153	10.841	0.032	10.857	0.343
10.861	0.275	10.881	-0.078	10.889	0.065	10.901	0.342
10.917	0.401	10.926	0.569	10.937	0.691	10.947	0.716
10.959	0.581	10.977	0.283	11.020	0.144	11.063	-0.113
11.080	-0.104	11.093	-0.117	11.110	0.055	11.122	0.244
11.125	0.290	11.138	0.223	11.150	-0.067	11.157	-0.248
11.165	-0.466	11.173	-0.546	11.180	-0.609	11.187	-0.596
11.193	-0.399	11.203	-0.248	11.210	-0.034	11.215	0.101
11.223	0.160	11.236	0.231	11.241	0.223	11.256	0.172
11.264	0.180	11.284	0.126	11.309	0.017	11.330	-0.097
11.358	0.029	11.371	-0.034	11.401	0.054	11.424	-0.021
11.447	-0.122	11.473	-0.105	11.485	-0.130	11.506	-0.105
11.518	-0.118	11.537	-0.097	11.547	-0.114	11.560	-0.034
11.573	0.105	11.580	0.256	11.587	0.353	11.597	0.307
11.606	0.193	11.618	0.371	11.626	0.017	11.648	0.050
11.659	0.025	11.674	-0.055	11.692	-0.126	11.712	-0.051
11.723	-0.063	11.745	-0.034	11.766	-0.160	11.782	-0.156
11.812	-0.219	11.842	-0.089	11.853	-0.018	11.863	-0.018
11.896	-0.178	11.922	-0.390	11.929	-0.098	11.962	-0.006
11.988	-0.111	12.009	-0.053	12.032	-0.162	12.054	-0.352
12.072	-0.247	12.085	-0.209	12.106	-0.062	12.131	0.081
12.148	-0.012	12.157	-0.155	12.171	-0.201	12.184	-0.168
12.217	0.101	12.225	0.092	12.251	-0.004	12.266	-0.152
12.278	-0.240	12.298	-0.299	12.326	-0.132	12.333	-0.115
12.372	-0.023	12.399	-0.395	12.426	-0.026	12.460	-0.159
12.490	-0.012	12.522	0.218	12.537	0.071	12.557	-0.114
12.578	-0.387	12.595	-0.413	12.607	-0.354	12.618	-0.191
12.635	0.045	12.645	0.158	12.655	0.153	12.694	-0.103
12.711	-0.078	12.728	-0.108	12.739	-0.049	12.758	0.097
12.768	0.135	12.776	0.085	12.802	-0.109	12.814	-0.096
12.836	-0.017	12.865	-0.105	12.874	-0.042	12.894	0.252
12.909	0.302	12.917	0.264	12.948	-0.030	12.960	0.079
12.972	0.193	12.980	0.239	12.987	0.197	12.997	0.079
13.005	-0.076	13.021	-0.173	13.035	-0.127	13.043	-0.035
13.055	0.159	13.073	0.255	13.081	0.276	13.121	0.108
13.153	0.318	13.163	0.234	13.199	-0.057	13.202	0.019
13.232	0.078	13.252	0.052	13.282	0.216	13.295	0.115
13.306	-0.086	13.321	-0.112	13.339	0.006	13.351	-0.007
13.376	0.090	13.401	0.052	13.419	0.073	13.452	0.001
13.478	0.111	13.491	0.081	13.509	-0.057	13.559	-0.154
13.579	-0.062	13.599	0.115	13.618	0.224	13.628	0.199
13.641	0.077	13.661	0.081	13.681	-0.163	13.696	-0.243
13.701	-0.247	13.729	-0.108	13.744	0.005	13.757	0.068
13.767	0.026	13.795	-0.121	13.821	-0.121	13.847	-0.138
13.864	-0.054	13.882	0.063	13.900	0.046	13.915	0.063
13.930	-0.008	13.944	-0.118	13.966	-0.147	13.997	-0.059
14.018	-0.059	14.063	0.029	14.071	0.008	14.096	-0.181
14.130	0.029	14.163	-0.152	14.171	-0.140	14.188	-0.005
14.201	0.184	14.209	0.238	14.242	-0.110	14.255	-0.048
14.283	0.007	14.314	-0.048	14.324	-0.052	14.359	-0.137
14.387	-0.200	14.433	0.144	14.448	0.081	14.461	0.094

14.487	0.043	14.510	-0.096	14.533	-0.222	14.558	-0.189
14.584	-0.109	14.609	0.113	14.638	-0.063	14.678	0.155
14.701	-0.039	14.721	-0.190	14.762	0.028	14.777	0.036
14.808	0.103	14.836	-0.052	14.852	-0.031	14.880	0.074
14.905	-0.053	14.933	-0.137	14.952	-0.082	15.003	-0.032
15.031	-0.100	15.056	0.014	15.075	-0.007	15.103	0.013
15.138	0.026	15.162	0.063	15.203	-0.143	15.215	-0.143
15.231	-0.071	15.272	0.185	15.305	0.0	15.338	0.059
15.366	0.005	15.379	0.009	15.420	0.169	15.458	-0.083
15.471	-0.062	15.509	-0.226	15.517	-0.167	15.550	0.279
15.556	0.304	15.574	0.166	15.589	-0.036	15.607	-0.099
15.642	-0.015	15.661	-0.006	15.687	0.049	15.704	0.040
15.727	0.078	15.765	-0.048	15.811	0.234	15.858	0.036
15.867	0.040	15.891	0.002	15.931	0.032	15.951	0.019
15.975	0.107	16.015	0.023	16.041	0.090	16.071	0.010
16.100	0.128	16.131	0.056	16.143	0.064	16.158	0.031
16.173	-0.007	16.184	-0.041	16.204	-0.007	16.222	0.039
16.242	0.102	16.260	0.186	16.275	0.148	16.299	0.009
16.360	0.147	16.404	-0.030	16.432	0.087	16.477	-0.040
16.506	0.056	16.534	-0.129	16.556	-0.146	16.588	0.005
16.600	-0.008	16.639	0.139	16.682	-0.017	16.699	-0.005
16.735	-0.056	16.751	-0.056	16.790	-0.102	16.836	0.053
16.882	-0.027	16.915	0.019	16.925	-0.010	16.963	-0.191
16.989	-0.145	17.017	-0.178	17.053	0.107	17.102	-0.019
17.116	-0.019	17.153	-0.183	17.198	0.082	17.260	-0.011
17.308	0.073	17.364	-0.168	17.388	0.042	17.405	0.126
17.428	0.222	17.446	0.008	17.461	-0.211	17.475	-0.287
17.498	-0.152	17.536	0.200	17.561	0.179	17.581	-0.061
17.607	-0.217	17.658	0.127	17.696	-0.096	17.704	-0.121
17.738	-0.063	17.771	0.092	17.797	-0.085	17.823	-0.018
17.850	-0.110	17.881	0.007	17.907	-0.048	17.946	0.112
17.971	-0.006	17.976	0.027	18.007	-0.011	18.046	-0.103
18.067	-0.015	18.080	-0.011	18.111	0.144	18.143	-0.033
18.157	-0.046	18.190	0.026	18.237	0.013	18.288	-0.063
18.319	-0.013	18.339	0.063	18.352	0.126	18.373	0.059
18.407	-0.118	18.417	-0.139	18.427	-0.113	18.440	-0.008
18.456	0.097	18.477	-0.029	18.495	-0.126	18.516	-0.037
18.541	0.076	18.570	0.0	18.601	-0.012	18.619	-0.037
18.653	0.093	18.673	0.022	18.681	0.038	18.704	0.005
18.711	0.022	18.737	-0.058	18.766	0.022	18.784	-0.016
18.824	0.139	18.861	-0.009	18.909	-0.123	18.923	-0.073
18.941	0.108	18.968	0.246	18.987	0.124	19.000	-0.090
19.007	-0.116	19.023	0.061	19.028	0.090	19.079	0.169
19.092	0.106	19.104	-0.012	19.110	-0.079	19.127	-0.121
19.138	-0.075	19.149	0.042	19.164	0.088	19.202	-0.009
19.225	-0.089	19.238	-0.156	19.258	-0.056	19.269	0.125
19.286	0.175	19.313	0.057	19.331	0.120	19.374	-0.179
19.407	0.077	19.453	0.014	19.489	0.114	19.532	-0.041
19.576	-0.084	19.605	0.034	19.623	0.0	19.661	-0.084
19.697	0.041	19.724	-0.018	19.748	0.011	19.769	-0.026
19.795	0.058	19.821	-0.115	19.836	-0.144	19.872	0.058
19.888	-0.014	19.913	-0.165	19.927	-0.052	19.948	-0.052
19.994	0.133	20.015	-0.001	20.040	-0.094	20.072	0.016
20.121	-0.068	20.147	0.007	20.162	-0.005	20.193	0.091
20.238	-0.039	20.250	-0.001	20.279	-0.010	20.295	0.011
20.332	-0.077	20.347	0.015	20.360	0.082	20.378	0.132

20.413	0.061	20.443	0.090	20.475	-0.019	20.516	0.073
20.555	-0.037	20.585	0.030	20.605	-0.016	20.624	-0.025
20.653	0.038	20.671	0.005	20.679	0.013	20.705	-0.008
20.744	0.025	20.759	0.004	20.786	0.058	20.808	0.012
20.871	0.015	20.894	-0.035	20.911	-0.002	20.926	-0.002
20.942	0.036	20.962	0.103	20.976	0.044	20.997	-0.007
21.014	-0.049	21.030	-0.016	21.041	0.009	21.078	-0.025
21.096	0.0	21.108	0.084	21.151	-0.072	21.164	-0.072
21.202	0.050	21.221	0.045	21.257	-0.031	21.290	-0.119
21.317	-0.040	21.343	0.065	21.356	0.069	21.386	0.006
21.399	0.048	21.436	0.089	21.470	0.009	21.506	0.030
21.522	0.017	21.560	0.054	21.596	-0.034	21.622	0.066
21.638	0.142	21.667	-0.027	21.677	-0.106	21.690	-0.149
21.698	-0.145	21.713	-0.065	21.724	0.006	21.749	0.103
21.762	0.153	21.783	0.039	21.803	-0.087	21.834	-0.028
21.865	-0.091	21.916	0.097	21.933	0.076	21.969	-0.050
21.989	0.0	22.000	-0.004	22.031	0.042	22.059	-0.043
22.087	-0.001	22.107	-0.022	22.156	0.003	22.192	-0.052
22.223	-0.023	22.243	-0.040	22.269	0.014	22.287	0.039
22.302	0.022	22.330	-0.079	22.361	0.047	22.374	0.017
22.400	-0.071	22.428	-0.004	22.446	-0.026	22.473	0.029
22.499	0.104	22.519	0.024	22.530	-0.073	22.553	-0.107
22.573	-0.057	22.596	0.035	22.630	-0.041	22.670	-0.150
22.694	-0.067	22.729	0.017	22.760	-0.046	22.778	-0.017
22.812	-0.093	22.845	0.020	22.874	-0.128	22.907	-0.027
22.932	-0.061	22.959	-0.032	22.997	-0.070	23.025	-0.020
23.049	-0.050	23.095	0.033	23.128	-0.030	23.157	-0.022
23.199	-0.035	23.227	0.002	23.247	-0.061	23.279	-0.023
23.299	-0.036	23.335	0.027	23.368	-0.057	23.402	0.090
23.425	0.064	23.446	0.043	23.479	-0.003	23.516	0.068
23.532	0.026	23.558	0.022	23.586	0.026	23.632	-0.021
23.671	0.025	23.723	0.004	23.753	0.084	23.795	0.0
23.306	-0.017	23.836	0.067	23.852	0.059	23.883	0.092
23.929	-0.012	23.976	0.063	24.012	0.017	24.035	0.009
24.074	0.072	24.095	0.059	24.144	-0.020	24.185	0.043
24.204	0.043	24.229	0.068	24.261	0.001	24.283	0.034
24.320	-0.109	24.364	0.072	24.392	0.004	24.411	-0.008
24.480	0.097	24.516	-0.101	24.543	-0.101	24.581	0.020
24.607	-0.022	24.620	0.020	24.646	-0.005	24.672	0.020
24.700	-0.039	24.740	0.016	24.763	0.020	24.775	0.007
24.809	-0.078	24.822	-0.053	24.861	0.027	24.869	-0.011
24.889	0.005	24.934	-0.050	24.973	0.046	24.998	0.004
25.038	0.054	25.073	-0.002	25.110	0.036	25.149	-0.057
25.162	-0.036	25.190	0.043	25.240	0.051	25.253	0.042
25.300	-0.038	25.320	-0.013	25.346	-0.064	25.355	-0.043
25.381	0.070	25.414	-0.006	25.446	0.090	25.487	-0.011
25.501	0.023	25.513	-0.003	25.532	-0.070	25.538	-0.075
25.579	0.034	25.598	0.009	25.621	0.025	25.649	0.008
25.679	-0.038	25.701	-0.022	25.722	0.020	25.764	-0.026
25.804	0.007	25.823	0.011	25.854	0.010	25.896	-0.040
25.928	0.043	25.949	-0.007	25.974	-0.071	25.998	0.017
26.025	0.004	26.048	0.013	26.064	-0.013	26.088	-0.080
26.119	0.003	26.158	-0.026	26.190	-0.023	26.231	-0.036
26.252	0.006	26.283	-0.045	26.291	-0.036	26.305	-0.007
26.344	-0.113	26.378	0.072	26.419	-0.063	26.434	-0.047
26.456	0.020	26.482	0.032	26.515	-0.019	26.541	-0.032

26.557	-0.082	26.580	-0.099	26.609	-0.007	26.629	-0.033
26.648	-0.016	26.658	-0.033	26.687	0.012	26.718	-0.034
26.723	-0.034	26.762	0.016	26.790	-0.014	26.821	0.011
26.849	-0.018	26.873	-0.023	26.909	-0.006	26.945	0.015
26.982	-0.006	26.994	-0.019	27.033	0.023	27.061	-0.015
27.093	0.014	27.124	-0.020	27.155	0.001	27.169	-0.011
27.214	0.039	27.252	-0.020	27.273	0.009	27.304	-0.029
27.338	0.005	27.351	0.013	27.376	0.030	27.403	-0.020
27.423	-0.037	27.434	-0.033	27.457	0.030	27.469	0.009
27.493	-0.054	27.522	0.009	27.558	-0.037	27.591	0.009
27.623	-0.020	27.653	-0.003	27.693	-0.033	27.715	-0.020
27.747	-0.024	27.775	0.026	27.819	0.017	27.850	-0.025
27.892	-0.012	27.920	0.009	27.959	-0.029	27.998	0.0
28.024	-0.030	28.035	-0.017	28.050	0.012	28.061	0.046
28.099	-0.034	28.126	-0.017	28.157	-0.064	28.165	-0.035
28.196	0.033	28.219	-0.051	28.255	0.053	28.262	0.045
28.291	-0.039	28.337	-0.039	28.358	-0.048	28.394	0.019
28.415	-0.031	28.433	-0.031	28.463	0.036	28.474	0.045
28.497	0.019	28.515	0.019	28.546	-0.019	28.566	0.007
28.590	0.036	28.602	0.032	28.620	-0.031	28.631	-0.037
28.651	-0.044	28.675	0.010	28.695	-0.027	28.716	-0.036
28.726	0.002	28.739	0.010	*28.747	0.010	28.757	-0.006
28.793	-0.011	28.828	0.013	28.844	-0.008	28.852	-0.008
28.882	0.024	28.887	0.020	28.900	-0.002	28.928	-0.016
28.952	0.013	28.982	0.016	29.005	0.078	29.012	0.037
29.023	0.032	29.046	-0.129	29.049	-0.137	29.053	-0.133
29.066	0.009	29.072	0.127	29.082	0.202	29.090	0.185
29.100	0.088	29.110	-0.005	29.121	-0.043	29.128	-0.018
29.148	0.057	29.164	-0.027	29.169	-0.082	29.184	-0.134
29.194	-0.083	29.210	0.085	29.220	0.131	29.236	0.072
29.258	-0.017	29.266	-0.001	29.280	0.033	29.287	0.011
29.313	-0.090	29.320	-0.056	29.331	0.049	29.346	0.036
29.360	0.010	29.385	-0.074	29.396	-0.053	29.413	0.035
29.421	0.060	29.444	0.001	29.462	-0.041	29.476	-0.016
29.503	0.042	29.514	0.021	29.535	-0.025	29.550	-0.013
29.573	0.054	29.576	0.041	29.601	0.003	29.617	0.037
29.625	0.015	29.651	-0.077	29.661	-0.044	29.681	0.040
29.691	0.061	29.702	0.015	29.723	-0.019	29.731	-0.002
29.751	0.023	29.769	0.002	29.783	0.006	29.793	0.023
29.814	0.006	29.827	-0.011	29.854	-0.024	29.868	0.010
29.886	0.056	29.888	0.056	29.906	0.022	29.940	-0.012
29.951	0.005	29.968	0.030	29.995	0.021	30.007	0.038
30.026	0.076	30.036	0.046	30.057	0.004	30.075	0.029
30.098	0.046	30.108	0.041	30.127	0.016	30.143	-0.009
30.165	-0.026	30.181	0.016	30.196	0.058	30.209	0.045
30.231	0.057	30.246	0.028	30.261	-0.014	30.272	-0.018
30.285	0.003	30.305	0.053	30.319	0.007	30.335	-0.010
30.363	0.011	30.381	-0.006	30.397	0.015	30.410	0.044
30.430	0.011	30.448	-0.044	30.456	-0.057	30.465	-0.040
30.488	0.061	30.501	0.069	30.508	0.035	30.529	-0.032
30.547	0.006	30.561	0.048	30.591	-0.011	30.605	-0.003
30.617	-0.007	30.631	0.006	30.654	0.136	30.657	0.140
30.677	0.039	30.683	0.022	30.696	0.022	30.721	0.076
30.729	0.064	30.747	0.022	30.755	-0.012	30.773	-0.034
30.784	0.009	30.792	0.097	30.802	0.168	30.807	0.185
30.818	0.143	30.828	0.063	30.842	-0.050	30.849	-0.042

30.862	-0.004	30.873	0.054	30.891	-0.001	30.917	0.058
30.935	0.091	30.941	0.057	30.953	-0.065	30.962	-0.195
30.969	-0.233	30.979	-0.200	30.993	-0.028	31.004	0.027
31.024	0.001	31.040	0.035	31.047	0.077	31.060	0.165
31.069	0.143	31.077	0.005	31.084	-0.075	31.092	-0.147
31.097	-0.197	31.103	-0.160	31.115	0.059	31.123	0.218
31.129	0.298	31.142	0.205	31.150	-0.118	31.162	-0.198
31.168	-0.177	31.192	-0.064	31.212	0.032	31.235	0.002
31.246	0.107	31.257	0.187	31.265	0.153	31.278	0.069
31.291	-0.011	31.298	0.002	31.312	0.102	31.319	0.191
31.330	0.123	31.343	0.069	31.356	-0.053	31.367	-0.154
31.375	-0.213	31.386	-0.134	31.394	0.009	31.407	0.118
31.425	0.022	31.435	0.093	31.446	0.173	31.457	0.236
31.470	0.185	31.478	0.067	31.486	-0.059	31.501	-0.139
31.512	-0.063	31.522	0.092	31.528	0.218	31.536	0.256
31.543	0.176	31.554	-0.084	31.561	-0.219	31.569	-0.316
31.575	-0.265	31.586	-0.097	31.596	0.029	31.619	-0.038
31.633	0.075	31.640	0.222	31.645	0.302	31.649	0.369
31.656	0.319	31.664	0.159	31.672	-0.026	31.678	-0.198
31.690	-0.329	31.693	-0.228	31.699	0.003	31.706	0.180
31.711	0.301	31.716	0.386	31.725	0.348	31.730	0.230
31.737	-0.026	31.743	-0.236	31.749	-0.434	31.756	-0.526
31.762	-0.480	31.769	-0.283	31.775	-0.077	31.780	0.087
31.787	0.175	31.793	0.150	31.799	-0.090	31.808	-0.355
31.816	-0.577	31.819	-0.737	31.825	-0.775	31.832	-0.620
31.838	-0.380	31.845	-0.120	31.851	0.191	31.856	0.300
31.859	0.359	31.866	0.258	31.875	0.115	31.880	-0.028
31.885	-0.103	31.891	-0.116	31.898	-0.057	31.906	0.090
31.911	0.241	31.917	0.333	31.924	0.392	31.935	0.325
31.941	0.135	31.948	-0.045	31.954	-0.163	31.961	-0.201
31.967	-0.113	31.975	-0.008	31.983	0.068	31.995	-0.004
32.001	-0.206	32.006	-0.365	32.011	-0.512	32.016	-0.643
32.025	-0.517	32.033	-0.202	32.041	0.029	32.051	0.168
32.061	0.340	32.070	0.432	32.077	0.432	32.085	0.352
32.093	0.226	32.099	0.054	32.106	-0.169	32.119	-0.257
32.130	-0.215	32.145	-0.043	32.153	0.146	32.156	0.280
32.162	0.381	32.169	0.431	32.174	0.335	32.180	0.112
32.187	-0.073	32.206	-0.233	32.216	-0.200	32.233	-0.221
32.240	-0.133	32.248	0.002	32.253	0.027	32.259	-0.040
32.271	-0.154	32.279	-0.255	32.292	-0.301	32.311	-0.154
32.323	0.152	32.331	0.413	32.339	0.534	32.350	0.383
32.358	0.123	32.370	-0.121	32.371	-0.180	32.391	-0.260
32.397	-0.226	32.413	-0.020	32.420	-0.025	32.431	0.043
32.442	0.072	32.454	0.059	32.462	-0.021	32.475	-0.143
32.481	-0.256	32.489	-0.206	32.498	-0.054	32.502	0.101
32.507	0.223	32.512	0.252	32.520	0.177	32.528	0.076
32.538	0.013	32.545	0.0	32.553	0.097	32.562	0.164
32.572	0.218	32.588	0.269	32.596	0.235	32.608	0.105
32.624	-0.025	32.635	-0.168	32.650	-0.244	32.656	-0.219
32.669	-0.051	32.687	0.075	32.702	0.033	32.737	-0.013
32.744	-0.080	32.750	-0.181	32.755	-0.219	32.768	-0.164
32.773	-0.004	32.780	0.105	32.786	0.180	32.796	0.159
32.807	-0.055	32.816	-0.126	32.830	-0.210	32.850	-0.269
32.864	-0.215	32.881	-0.118	32.890	-0.088	32.903	0.004
32.916	0.105	32.926	0.159	32.933	0.138	32.944	0.063
32.954	-0.009	32.962	-0.034	32.972	0.029	32.983	0.083

32.993	-0.001	33.001	-0.127	33.009	-0.207	33.019	-0.241
33.029	-0.215	33.043	-0.102	33.053	0.028	33.063	0.209
33.066	0.347	33.071	0.427	33.077	0.490	33.089	0.419
33.097	0.297	33.105	0.137	33.116	-0.060	33.129	-0.166
33.146	-0.250	33.155	-0.187	33.168	-0.010	33.175	0.103
33.185	0.170	33.189	0.187	33.199	0.132	33.207	-0.011
33.225	-0.162	33.238	-0.125	33.250	-0.217	33.264	-0.293
33.273	-0.087	33.284	0.131	33.292	0.257	33.305	0.320
33.310	0.303	33.318	0.244	33.339	0.176	33.352	0.012
33.364	-0.101	33.372	-0.202	33.378	-0.295	33.385	-0.257
33.393	-0.148	33.398	-0.014	33.403	0.095	33.409	0.179
33.411	0.188	33.421	0.167	33.427	0.074	33.436	-0.040
33.442	-0.103	33.450	-0.111	33.462	-0.095	33.483	-0.003
33.501	-0.032	33.515	0.039	33.527	0.140	33.528	0.144
33.541	0.051	33.551	-0.050	33.563	-0.159	33.566	-0.193
33.572	-0.180	33.585	-0.071	33.599	0.017	33.605	0.092
33.621	0.117	33.631	0.096	33.639	0.049	33.649	-0.063
33.657	-0.144	33.670	-0.199	33.677	-0.161	33.685	-0.039
33.695	0.057	33.703	0.137	33.711	0.170	33.724	0.115
33.734	0.010	33.740	-0.061	33.753	-0.116	33.771	-0.024
33.783	0.051	33.792	0.076	33.812	0.055	33.827	0.097
33.840	0.155	33.853	0.138	33.874	0.075	33.893	0.017
33.903	-0.021	33.913	0.012	33.926	0.096	33.942	0.168
33.963	0.025	33.975	-0.080	33.998	-0.147	34.014	-0.097
34.029	0.0	34.047	0.172	34.060	0.256	34.074	0.252
34.094	0.218	34.117	0.117	34.133	0.042	34.152	-0.055
34.161	-0.080	34.170	-0.059	34.190	0.009	34.203	-0.012
34.222	-0.024	34.245	-0.003	34.266	-0.020	34.282	0.023
34.292	0.065	34.303	0.099	34.314	0.082	34.326	0.044
34.334	0.023	34.352	0.045	34.365	0.007	34.384	-0.064
34.400	-0.051	34.406	-0.055	34.423	-0.005	34.432	0.067
34.442	0.109	34.455	0.097	34.468	0.034	34.487	0.009
34.490	0.026	34.503	0.034	34.534	0.123	34.557	0.044
34.582	-0.002	34.611	-0.102	34.626	-0.043	34.655	0.117
34.670	0.079	34.689	0.059	34.710	0.021	34.726	0.067
34.747	0.135	34.760	0.135	34.775	0.089	34.807	0.026
34.830	0.022	34.862	0.073	34.877	0.065	34.892	0.073
34.930	-0.045	34.940	-0.032	34.973	0.039	34.986	0.026
35.012	-0.042	35.033	0.009	35.067	0.033	35.085	0.016
35.099	0.029	35.117	0.007	35.140	0.016	35.154	0.003
35.162	0.015	35.193	0.074	35.206	0.023	35.240	-0.100
35.262	-0.029	35.294	0.046	35.312	0.016	35.345	0.091
35.358	0.045	35.376	-0.027	35.393	-0.053	35.406	-0.045
35.425	-0.015	35.456	-0.071	35.494	0.009	35.517	-0.034
35.551	0.016	35.579	0.012	35.605	0.028	35.622	-0.013
35.645	-0.056	35.668	-0.035	35.690	-0.069	35.730	-0.044
35.743	-0.044	35.756	-0.040	35.783	0.027	35.798	-0.011
35.824	-0.053	35.845	-0.044	35.860	-0.045	35.868	-0.032
35.894	-0.040	35.920	-0.011	35.944	-0.036	35.973	-0.016
35.986	-0.032	36.011	-0.083	36.032	-0.033	36.045	0.005
36.077	-0.054	36.115	0.021	36.147	-0.034	36.155	-0.039
36.188	0.024	36.217	0.048	36.250	-0.032	36.258	-0.024
36.292	0.060	36.303	-0.008	36.321	-0.071	36.337	-0.021
36.355	0.038	36.387	-0.042	36.412	0.004	36.441	-0.064
36.452	-0.043	36.481	0.045	36.492	0.037	36.522	-0.010
36.536	0.007	36.562	-0.039	36.575	-0.035	36.601	0.003
36.629	-0.018	36.641	-0.009	36.666	0.034	36.674	0.062
36.703	0.016	36.711	0.021	36.744	0.075	36.774	-0.013
36.787	-0.013	36.807	0.054	36.839	0.015	36.872	0.036
36.899	0.010	36.933	0.039	36.945	0.022	36.989	0.059
36.998	0.042	37.024	0.016	37.057	0.028	37.067	0.028
37.099	0.044	37.120	-0.003	37.133	0.005	37.167	-0.017
37.201	-0.013	37.226	0.011	37.245	0.015	37.274	-0.006
37.294	-0.027	37.308	0.011	37.333	0.053	37.360	0.036
37.396	0.002	37.422	-0.032	37.450	0.057	37.464	0.048
37.477	0.052	37.505	-0.044	37.529	0.027	37.547	0.099
37.567	0.035	37.586	-0.002	37.606	0.019	37.622	0.010
37.640	0.019	37.654	0.023	37.679	0.019	37.692	0.014
37.722	-0.019	37.757	0.031	37.789	0.014	37.823	0.023
37.854	0.006	37.873	0.023	37.894	0.006	37.914	0.027
37.943	0.057	37.984	0.069	38.011	0.027	38.050	0.027
38.074	0.023	38.102	0.057	38.125	0.027	38.147	0.031
38.177	-0.028	38.178	-0.015	38.209	0.051	38.248	-0.007
38.271	0.010	38.280	0.010	38.319	0.031	38.334	0.019
38.367	-0.028	38.403	0.002	38.419	-0.002	38.456	0.082
38.469	0.027	38.493	-0.074	38.502	-0.061	38.524	0.010
38.542	0.086	38.571	0.039	38.592	-0.024	38.611	-0.099
38.631	-0.032	38.657	0.073	38.691	0.001	38.703	-0.007
38.713	0.010	38.734	0.001	38.765	0.022	38.792	0.009
38.805	0.018	38.824	-0.003	38.850	0.005	38.871	-0.004
38.887	0.017	38.902	0.051	38.913	0.042	38.941	-0.008
38.962	0.0	38.992	-0.042	39.000	-0.034	39.026	0.071
39.036	0.058	39.071	-0.022	39.086	0.003	39.100	-0.009
39.123	0.024	39.155	-0.026	39.181	-0.014	39.205	0.028
39.229	-0.014	39.255	0.019	39.275	-0.002	39.304	0.056
39.315	0.023	39.343	-0.045	39.359	0.009	39.380	0.030
39.398	0.017	39.427	0.0	39.447	-0.050	39.466	-0.004
39.481	0.017	39.529	0.033	39.542	0.020	39.555	0.011
39.570	-0.010	39.607	-0.002	39.646	-0.049	39.657	-0.024
39.678	0.047	39.691	0.018	39.716	-0.037	39.737	-0.013
39.756	-0.025	39.774	0.004	39.793	0.024	39.832	-0.056
39.855	-0.002	39.898	0.044	39.932	-0.020	39.966	0.017
39.984	0.021	40.015	0.021	40.042	0.004	40.060	0.0
40.086	0.025	40.107	-0.005	40.130	0.012	40.156	-0.031
40.175	-0.006	40.196	-0.014	40.222	-0.044	40.248	0.053
40.262	0.069	40.275	0.040	40.306	-0.061	40.338	-0.006
40.375	0.015	40.415	-0.006	40.459	0.028	40.473	0.015
40.504	0.024	40.539	-0.006	40.572	0.020	40.604	-0.035
40.618	-0.026	40.652	0.028	40.668	0.045	40.699	0.012
40.726	0.050	40.763	-0.009	40.784	0.024	40.792	0.025
40.815	0.004	40.849	0.037	40.873	-0.005	40.892	0.008
40.918	-0.004	40.950	0.067	40.963	0.042	40.994	-0.026
41.002	-0.009	41.033	0.054	41.066	-0.022	41.078	-0.030
41.112	0.053	41.142	-0.018	41.174	0.028	41.210	-0.010
41.234	0.027	41.249	0.002	41.276	-0.036	41.293	-0.023
41.314	0.044	41.327	0.035	41.358	-0.020	41.385	0.022
41.411	-0.007	41.447	0.005	41.486	-0.012	41.497	0.005
41.527	-0.021	41.553	0.0	41.579	-0.038	41.597	-0.034
41.619	0.004	41.649	0.017	41.683	-0.021	41.699	-0.021
41.720	-0.042	41.741	-0.030	41.772	0.046		