SOUTHERN CALIFORNIA RAIN AND FLOOD, FEBRUARY 27 TO MARCH 4, 1938

By LAWRENCE H. DAINGERFIELD

[Weather Bureau, Los Angeles, Calif., June 1938]

The season of 1937–38 (beginning July 1, 1937) has been marked by wide contrasts in rainfall over southern California. Los Angeles was rainless from May 31 to October 2, 1937, inclusive, a period of 125 days, followed by 67 days, or until December 8, 1937, with only two light showers, totaling 0.03 inch. The combined period of 192 days had only 0.03 inch of precipitation. This long dry period is second only to that of 1927, when no measurable rainfall occurred at Los Angeles for the 197-day period from April 13 to October 26, although traces were recorded each month. The recent drought was rather definitely ended by the rain of December 9–12, 1937, and precipitation was ample and approximately normal during the remainder of December and through January 1938.

The closing days of January, however, were marked by intense disturbances over the Gulf of Alaska and adjacent North Pacific waters, with strong southeasterly trends near the Pacific coast of North America, which had been absent or deficient in the earlier depressions of the season. This change in storm development and movement ushered in a period of almost continuous and frequently heavy rainfall over this area of California during the first half of February, during which period the soil became well saturated with moisture.

The tendency to form disturbances near and off the Pacific coast featured the late January, February, and early March period. A storm which developed northeast of Hawaii moved slowly eastward (followed by a well-developed Pacific HIGH) and moved inland near the Bay region on February 9. This was an exceptionally violent disturbance, attended by precipitation throughout California, heavy over the northern part of the State, and high winds and gales over most coastal districts and inland to and beyond Sacramento.

A series of North Pacific and Gulf of Alaska depressions prevailed from February 26 to March 4, 1938, extending their maximum sphere of influence hundreds of miles farther southeastward than normally over the Pacific coast area. On February 27, a rather shallow disturbance moved slowly in over the southern California coast attended by a general light rain on the 27th, and intermittently through the 28th. During the night of February 28–March 1, heavy rain occurred as the result of the passage of a cold front which moved in from the northwest. No general rain occurred after this frontal passage until March 2, with the arrival of a more intense disturbance. This disturbance likewise developed northeast of the Hawaiian Islands and while the center moved to the Oregon coast, the region of greatest intensity took place over southern California. Warm-front action and a pronounced orographic effect produced the greatest intensities and amounts of precipitation of the entire storm period which were directly the cause of the great flood. Showery conditions on the 3rd and 4th were followed by frequent threats of rainfall thereafter for 9 or 10 days and actual rain on several days from a series of depressions appearing off the California coast, which moved slowly inland over the coast to the northward of the Los Angeles region. These were followed, however, by a well-defined anticyclone on the 13th, located over the Pacific Ocean near the thirtieth parallel. The establishment of this high pressure field, and its continuance in modified form during the remainder of March brought relief to the flooded areas, through the attending fair weather.

The saturated condition of the soil in Ventura, Los Angeles, San Bernardino, Orange, and Riverside counties, from mountains to coast, prior to the arrival of the major storm of March 2, 1938, prepared the way for the heavy run-off.

While the rainfall over the area involved, during the cold-front passage of late February 28 to March 1, was generally excessive and the run-off rather marked, damage would have been small if it had not been followed, after the lapse of a few hours, by the second and much heavier rainfall of late March 1 to 2, inclusive, with slight amounts occurring on the 3rd and 4th. The run-off from the March 2 storm was extremely high, bringing with it vast quantities of silt, gravel, boulders, and debris generally.

As in the case of the historic 3-day rainfall (over a lesser part of the area more recently covered) of December 30, 1933–January 1, 1934, inclusive, the orographic influence was a decidedly potential factor. The San Gabriel and the San Bernardino Mountains, with their east-west trend, lying directly across the path of the moisture-laden winds, performed the functions of fixed and permanent "fronts" mechanically accomplishing the chilling of the tropical maritime air and precipitating its moisture during the recent storms as in the case of the great 3-day storm of 4 years ago. Just as the 3-day storm was a record breaker for the period and area involved, so was the recent 5-day rainfall the heaviest known for the period involved—at least since accurate measurements have been generally available.

In the recent storm period, the greatest recorded amount, 32.20 inches, occurred at Kellys Kamp in the San Gabriel Mountains at an elevation of 8,300 feet. Also, in the same mountains, Hoegees Camp, elevation 2,650 feet, reported a total of 30.08 inches; this same station received the greatest amount in the 1934 New Year's storm (19.91 inches). In the San Bernardino Mountains, Lake Arrowhead, near the headwaters of Deep Creek, which will be referred to later, at an elevation of nearly 5,000 feet, reported 30.49 inches. A considerable number of mountain stations received between 20 and 30 inches of rain as shown in table 1.

TABLE 1.—*Precipitation data (inches and hundredths), Feb. 27 to Mar. 4, 1938, inclusive, for Ventura, Los Angeles, Orange, San Bernardino, and Riverside Counties*

[Precipitation for 24 hours ending near sunset unless otherwise indicated]

Station	Latitude	Longitude	Elevation above m. s. l	February		March				Greatest		Storm total
				27	28	1	2	3	4	1 hour	Date	
	° ′	° ′										
Acton (near)	34 30	118 16	3,075	0.54	0.23	0.89	3.05	0.81	0.03			5.55
Aliso, No. 62 (Orange County)[1]	33 43	117 50	62	.30	1.00	.96	1.27	2.40	.10			6.03
Alder Creek	34 20	118 03	4,050	1.24	.93	1.62	7.64	1.42	.17			13.02
Altadena	34 12	118 08	1,328	1.86	2.75	2.18	8.33	.62				15.74
Anaheim (Orange County)[1]	33 50	117 55		(2)	1.57	1.93	2.13	2.98	.02			8.63
Arcadia	34 08	118 01		1.60	2.73	2.35	7.30	.57				14.55
Arroyo Seco	34 13	118 11	1,530	1.26	2.62	2.62	8.10	1.00				15.60
Arroyo Seco County Forestry	34 12	118 11	1,155	1.65	2.83	3.23	8.47	1.36				17.54
Arroyo Sequis	34 05	118 53	1,155	.42	1.89	2.74	5.98	.97				12.00
Avalon (Catalina)[1]	33 21	118 19	30	.49	1.62	1.22	1.45	2.18	.03			6.99
Azusa	34 08	117 54	602	1.33	2.25	2.30	6.72	.84	T			13.44
Azusa Plant	34 09	117 55	675	1.25	2.34	2.41	7.00	.96				13.96
Backus Ranch	34 36	118 12	2,620		.86	.65	1.74	.32				3.57
Baldwin Park No. 182	34 05	117 58	378	1.60	1.60	1.71	5.68	.87				11.46
Banning	33 55	116 53	2,330		1.65	1.27	2.24	2.70	.25			8.11
Beaumont [1]	33 52	116 55	2,580	.63	1.28	1.76	1.01	4.08	.33			9.09
Beaumont (near)[1]	33 55	116 55	3,040	.45	.95	1.75	.90	6.25	.46			10.76
Bell, No. 192	33 59	118 11	160	1.65	1.31	1.85	4.60	.42				9.83
Bell, No. 0 (San Dimas X)	34 11	117 48	2,850	(2)	6.18	.62	9.40	.92	.08	.40	2	17.20
Bell 3100 (San Dimas X)	34 12	117 46	3,100	1.50	4.80	.22	5.43					
Bell-Volfe (San Dimas X)	34 10	117 48	1,880	1.56	6.38	.68	9.32	1.10		.39	2	19.04
Beverly Hills, No. 228B	34 05	118 24	255	1.42	2.24	1.79	6.08	.30				11.83
Bennett Ranch [1]	34 08	117 28	1,750	(2)	5.50	2.15	(2)	(2)	9.75			17.40
Big Bear Lake Dam	34 14	116 59	6,800	4.96	3.39	1.54	15.06	2.00				26.95
Big Dalton Dam, No. 223	34 10	117 49	1,575	1.24	3.66	3.42	6.58	.07				14.97
Big Pines County Park	34 23	117 41	6,860	2.00	2.59	1.68	6.80	4.48	.30			17.85
Big Tujunga Dam no. 1	34 17	118 12	2,050	1.20	3.28	3.00	10.83	2.05		(2 hr.) 2.30	2	20.36
Blum Ranch (near Acton)	34 27	118 09	2,900	1.17	.27	.91	5.82	.48				8.65
Brand Park, No. 210B	34 11	118 16	1,250	1.33	2.08	2.54	7.02	.76				13.73
Briggs Terrace, No. 373	34 14	118 14	2,616	1.18	3.36	3.15	8.88	1.10	.86			18.53
Burbank (Airport) [1]	34 11	118 18	650	.07	1.26	1.92	.70	2.85	.21			7.01
Burbank, No. 226	34 11	118 18	665	1.41	1.79	2.43	6.43	.71				12.77
Calabasas, No. 5	34 09	118 38	950	.93	.96	1.70	5.07	.46				9.12
California Institute, No. 303	34 08	118 08	763	1.62	2.72	2.27	5.60	2.56				14.77
Camp Baldy	34 14	117 39	4,320	(2)	3.95	4.50	12.00	2.78		1.78	2	23.23
Camp Rincon, No. 349	34 14	117 52	1,500	1.39	3.89	2.65	(2)	14.00	.16			22.09
Carbon Canyon, No. 20 (Orange County)	33 58	117 46	1,150	.15	1.95	1.76	2.80	2.70	.15			9.51
Cemetery (Orange County) [1]				.28	.91	1.61	1.44	3.11	.21			7.56
Chatsworth Patrol Station	34 15	118 37	865	.53	1.19	2.06	6.10	.80				10.68
Claremont	34 07	117 44	1,196	.79	1.25	1.63	5.73	.59				9.99
Clear Creek, No. 47	34 16	118 10	3,200	1.34	3.39	3.61	3.20	10.61	.22	1.87	2	23.37
Coast, No. 48	33 36	117 53	50	.30	1.12	1.18	1.16	1.83				5.59
Corona [1]	33 52	117 35	850	.15	1.35	1.35	1.05	4.30	.60			8.80
Covina	34 05	117 52	575	1.36	1.48	1.86	5.13	1.27				11.10
Crag's Country Club	34 06	118 44	575	(2)	2.75	2.90	6.25	1.48				13.38
Culver City [1]	34 01	118 23	80	.17	1.56	2.25	2.82	3.14	.14			10.08
Curson Canyon, No. 137B	34 07	118 21	1,125	1.48	2.05	1.94	6.25	.45				12.17
Decker's Ranch [1]	33 49	116 45	5,550	.50	1.74	3.00	3.10	6.73	1.32			16.39
Devil Canyon [1]				.19	2.13	2.40	1.91	6.73	.29			13.65
Devil's Gate Dam	34 13	118 11	1,000	1.31	2.38	2.38	9.55	1.08		1.14	2	16.70
Devore [1]	34 14	117 25	2,500	.38	3.40	3.12	1.68	7.35	.25			16.18
Downey (Jordan)	33 56	118 08	132	1.65	.51	1.47	4.01	.41				8.05
Dry Canyon Reservoir [1]	34 28	118 32	1,507	.05	.67	1.21	1.02	2.31	.11			5.37
Dume Canyon, No. 386B	34 05	118 50	1,500	.75	2.90	4.18	6.00	2.20				16.03
East Pine Flat, No. 283A	34 19	117 51	5,742	1.72	5.05	3.31	12.62	3.14		1.69	2	25.84
Eaton Dam	34 14	118 05		1.46	2.83	2.40	7.35	.62				14.66
Echo Mountain [1]	34 13	118 07	3,219	1.78	1.80	2.80	(2)	9.39	.48			16.25
Elizabeth Lake	34 40	118 25	3,400	0.80	1.79	1.22	5.41	.90	.12			10.24
El Monte, No. 108B (city hall)	34 05	118 02	301	(2)	2.65	2.08	6.39	.53				11.65
El Segundo, No. 157E	33 55	118 25	135	1.11	.65	1.23	3.16	.54				6.69
Elsinore [1]	33 40	117 20	1,272	2.18	.32	1.02	4.04	1.88	.19			9.63
Elsinore (Dr. Baer)				1.00	1.43	1.07	.93	4.41	.43			9.27
El Toro C. C. C. camp [1]				.28	1.06	1.63	1.46	2.91	.28			7.62
Fairmont (near) [1]	34 42	118 25	3,036		1.65	1.83	1.15	4.00	.49			9.12
Fern S. R. E. Plots (San Dimas X)	34 10	117 44	4,900	1.58	6.06	.62	9.72	.70		.48	2	18.68
Fontana	34 06	117 25	1,325	.68	1.11	1.30	3.62	3.30	.12			10.13
Franklin Reservoir (upper), No. 11	34 08	118 25		1.42	2.14	2.26	4.62	.45				10.89
Fullerton (Orange County) [1]	33 52	117 55		1.47	.85	1.39	2.21	2.60	.62			9.14
Gage Canal Headgate [1]				.16	1.62	1.00	.92	3.95	.70			8.35
Girard	34 10	118 36	892	.40	1.16	2.01	5.33	.48	.09			9.47
Glendale, No. 216	34 10	118 15	620	2.34	2.45	2.45	4.00	.21				11.45
Glendale (Lytle) [1]	34 09	118 16	526	.55	2.78	2.50	3.35	4.87	.29			14.34
Glendale (Opid), No. 404	34 10	118 14	653	1.39	3.64	1.90	3.15	3.84	.08			14.00
Glendora, No. 73	34 09	117 50	950	2.59	1.48	2.44	8.17	.52	.13			15.33
Griffith Park Nursery, No. 257	34 07	118 17	750	(2)	2.20	2.00	2.60	1.89				8.69
Haines Canyon (upper)	34 16	118 15	3,450	1.57	3.31	2.95	10.39	1.16	.02			19.40
Haines Canyon (lower)	34 16	118 16	2,250	1.27	2.70	2.36	7.80	.85	.02			15.00
Hamilton Bowl (Southwest Sig Hill)	33 48	118 10	25	1.10	.36	1.14	3.15	.42				6.17
Harkle Road, No. 54 (Orange County) [1]	33 41	117 48	100	.12	1.18	1.19	1.06	2.47	.01			6.03
Henninger Flat	34 12	118 05	2,600	1.30	4.03	3.15	9.50	1.28				19.26
Headlee's Camp, No. 51	34 18	117 50	4,650	1.55	4.17	3.35	12.76	.44	.10			22.37
Headwork's Power Plant, No. 272, Burbank	34 09	118 18	473	1.44	2.09	2.46	7.31	.55				13.85
H. C. Citrus Station (Riverside County) [1]				.21	.52	1.10	.71	2.56	.18			5.28
Hemet (Riverside County) [1]	33 45	116 57	1,700	.65	.22	1.65	.78	2.07	.13			5.50
Hemet Lake Dam (Riverside County) [1]			5,000	(2)	.68	1.55	.82	5.38	.51			8.94
Hoegees Camp	34 12	118 02	2,750	1.71	7.82	4.06	13.95	2.54		1.58	2	30.08
Home, No. 61 (Orange County) [1]	33 43	117 47	130	.30	1.15	1.18	1.30	2.45	.05			6.43
Hurley Flat [1]	33 52	116 47	3,600	.29	2.00	1.80	.74	6.26	.96			12.05
Idlewild (Riverside County)			5,300	(2)	1.36	2.07	1.42	5.73	1.54			12.12
Irvine, No. 55 (Orange County)[1]	33 40	117 45	200	.32	.97	1.54	1.35	4.23	.07			8.48
Irvine, No. 125 (Orange County)[1]	33 41	117 46	197	(2)	1.45	1.30	1.26	(2)	4.02			8.03
Johnson, No. 56 (Orange County)[1]	33 39	117 43	320	.32	1.06	1.90	1.87	3.85				9.00
Johnson Ranch, No. 22, Canoga Park	34 13	118 39	930	.75	1.26	1.52	5.41	.54				9.48
Kellys Kamp	34 14	117 36	8,300	1.80	3.05	4.00	17.55	4.90	.90			32.20
La Crescenta	34 14	118 14	2,264	1.18	3.76	3.05	9.42	.94				18.35
La Crescenta, No. 251	34 14	118 14	1,565	1.21	3.35	3.08	10.27	.89				18.80

[1] Precipitation measured near sunrise.
[2] Included in next following measurement.

TABLE 1.—*Precipitation data (inches and hundredths), Feb. 27 to Mar. 4, 1938, inclusive, for Ventura, Los Angeles, Orange, San Bernardino, and Riverside Counties*—Continued

[Precipitation for 24 hours ending near sunset unless otherwise indicated]

Station	Latitude	Longitude	Elevation above m. s. l	February		March				Greatest		Storm total
				27	28	1	2	3	4	1 hour	Date	
	° ′	° ′										
Laguna Beach	33 32	117 46	205	.98	.61	1.44	2.32	1.06	.01			6.42
Lake Arrowhead [1]	34 15	117 12	5,000	.35	7.40	4.33	3.40	14.51	.50	(2 hrs.) 3.80	2	30.49
Lambert, No. 57 (Orange County)[1]	33 42	117 43	400	.30	1.12	1.65	1.35	3.65	.47			8.54
Lecheeza Patrol Station, No. 352	34 05	118 53	1,530	.60	2.42	2.85	5.84	1.25	.08			13.04
Leffingwell Ranch, No. 266 (East Whittier)[1]	33 56	118 00	253	(3)	1.95	1.98	2.53	3.03	.26			9.75
Limestone, No. 74	33 46	117 43	1,000	.31	1.27	1.81	1.43	4.75	.11			9.68
Lytle Creek P. H. (Southern California Edison Co.)	34 12	117 27	2,225	1.75	4.10	2.45	9.10	2.55	.53			20.48
Lytle Creek (Base Line St.)[1]	34 08	117 20		.30	1.60	1.72	1.60	5.04	1.26			11.52
Live Oak (Sycamore Canyon)[1]	34 07	117 45	1,530	.97	1.84	1.85	5.51	1.68	T			11.85
Llano	34 30	117 47	3,400	1.27	.47	.58	1.75	.45				4.52
Long Beach [1]	33 46	118 12	70	.02	1.38	1.63	.58	3.30	.47			7.38
Los Angeles [1]	34 03	118 15	417	1.47	2.85	.48	5.88	.38		.90	2	11.06
Los Angeles (Municipal Airport)[1]	33 56	118 23	97	.30	1.15	1.71	2.03	1.96	.11			7.26
Malibu headquarters	34 05	118 36	747	1.27	3.03	3.08	7.98	.35	.03			15.74
Mill Creek, No. 3 (Southern California Edison Co.)[1]	34 05	117 03	2,950	1.16	.92	1.31	3.57	3.40	.56			10.92
Monrovia Canyon [1]	34 10	118 00	975	.26	3.47	3.81	(2)	(2)	5.65			13.19
Monrovia Falls, No. 150	34 11	117 59	1,450	1.20	4.74	3.24	(2)	8.00				17.18
Morro, No. 49 (Orange County)[1]	33 34	117 49	100	.50	1.62	1.12	1.53	2.65				7.42
Mount Wilson	34 13	118 04	5,850	2.16	5.93	3.99	11.83	2.32		1.32	2	26.23
Mouth of Lopez Canyon, No. 421 (Fillmore Station)	34 17	118 24	1,173	T	1.41	2.41	1.80	2.96	.41			8.99
Mouth of San Antonio Canyon	34 10	117 40	2,500	.98	3.34	2.35	(2)	10.17				16.84
Newark (San Bernardino, 42d St. at reservoir)[1]				.23	1.93	1.93	1.65	6.02	.81			12.57
Neenach (Lake Tweedy)	34 44	118 34	3,905	1.17	1.87	.58	4.78	.25	.10			8.75
Newhall	34 23	118 32	1,245	1.05	1.40	1.85	5.22	.94				10.46
Newport Beach [1]	33 36	117 54	8	.40	.95	1.39	1.23	1.98				5.95
North Hollywood	34 10	118 24	630	1.40	1.30	1.83	5.32	.28				10.13
North Hollywood, No. 222	34 12	118 23	732	.50	1.52	1.92	2.07	2.27				8.28
Norwalk	33 56	118 05		1.36	.52	1.58	4.22	.82	.02			8.52
Oake Wilde, No. 48	34 15	118 11	2,000	1.60	3.14	1.91	(2)	12.50				19.15
Ontario (Power House)	34 12	117 41	991	.98	3.34	2.35	(2)	10.17				16.84
Ojai	34 29	119 12	900	.28	.73	1.93	7.90	.72				11.36
Opid's Camp	34 15	118 06	4,254	1.79	4.89	3.21	14.92	2.44	.02	1.82	2	27.27
Oxnard	34 12	119 11	51	.70	1.89	3.30	1.66	.01				7.56
Pacoima, No. 219A (Forestry Warehouse)	34 15	118 24	955	.96	1.44	1.58	4.97	.76				9.71
Pacoima Dam	34 20	118 24	1,700	.88	1.94	2.01	5.38	1.27				11.48
Palmdale [1]	34 34	118 07	2,654		1.41	.87	.76	2.39	.14			5.57
Palm Springs (Riverside County) [1]	33 50	116 34	584	.49	.10	.70	.58	4.00	.09			5.96
Palos Verdes, No. 436	33 48	118 22	450	(2)	2.10	1.52	2.00	1.10				6.72
Pasadena	34 09	118 08	865	1.72	2.53	2.18	7.70	.68				14.81
Pasadena, No. 413 (Central Fire House)	34 09	118 09	852	.44	3.53	2.70	3.64	4.59	.05			14.95
Perris (Riverside County) [1]	33 48	117 14	1,466	1.00	.55	1.15	1.10	2.63	.12			6.55
Peter's, No. 72 (Orange County) [1]	33 47	117 46	550	.31	1.30	1.23	1.35	2.18	.09			6.46
Picken's Canyon	34 15	118 13	4,250	1.43	3.60	3.14	8.12	1.06		1.12	2	17.35
Piru, No. 593 (Newhall Ranch)	34 24	118 44	675	(3)	1.33	1.53	5.39	.93	.05			9.23
Pomona [1]	34 03	117 45	870	.12	1.45	2.11	2.17	4.21				10.06
Pomona, No. 256, Southern Pacific Ry.[1]	34 04	117 45	857	.10	1.55	1.87	2.45	3.52	.24			9.73
Power House, No. 1 (L. A. C. P. & L.)	34 35	118 27	2,100	.95	1.64	1.50	3.82	.31				8.22
Power House, No. 2 (L. A. C. P. & L.) [1]	34 32	118 31	1,580	T	.87	1.78	1.62	3.63	.18			8.08
Power House, No. 3 (L. A. C. P. & L.) [1]	34 19	118 30	1,248	T	1.22	3.21	1.97	3.62	.21			10.23
Puddingstone Dam, No. 96	34 06	117 48	1,030	1.09	1.64	1.68	5.45	1.15				11.01
Puente, No. 254	34 00	117 56	466	.25	2.00	2.05	2.85	2.95	.14			10.24
Radium Hot Springs	34 36	118 33	2,041	.44	1.79	1.79	8.30	.80				13.12
Raywood Flat [1]	34 03	116 50	7,200	.50	4.00	3.50	1.85	13.50	.88			24.23
Redlands [1]	34 04	117 12	1,360	1.10	.44	1.05	1.66	3.08	.38			7.71
Riverside	33 58	117 26	895	.12	.93	.96	1.72	1.46	.07			5.26
Roscoe, No. 14 [1]	34 14	118 22	1,000	.15	1.71	1.91	1.37	3.33	.04			8.51
Rossmoyne Fire Area (Glendale)				1.13	2.14	2.07	6.83	.77	.06			13.13
San Bernardino (near)	34 07	117 16	1,172	1.36	1.10	1.34	4.46	1.56				9.82
Salt Works X (Orange County)[1]	33 38	117 53	40	.37	.90	1.04	1.14	2.02	T			5.47
San Bernardino (2d and D Sts.)[1]	34 07	117 18	1,048	.41	1.67	1.38	1.04	4.84	.56			9.90
Sandberg	34 44	118 43	4,250	(3)	1.65	1.59	(2)	4.33				7.57
San Dimas	34 06	117 48	960	1.12	1.67	1.90	6.20	1.04				11.93
San Dimas Dam, No. 89 [1]	34 09	117 46	1,350	1.14	2.22	2.90	7.18	1.24				14.68
San Fernando [1]	34 17	118 27	960	.03	1.31	2.64	1.86	3.03	.06			8.93
San Fernando Reservoir, No. 293 (lower)	34 17	118 29	1,150	1.30	2.65	2.10	3.25	.07				9.37
San Gabriel Camp, No. 1, No. 76	34 13	117 51	1,600	1.43	3.75	3.12	12.52	1.17				21.99
San Gabriel Canyon, No. 379 (east fork)	34 14	117 49	1,500	1.48	3.36	2.88	10.90	1.60	.03			20.25
San Gabriel Dam, No. 1 [1]	34 13	117 51	1,251	.15	2.83	5.30	1.92	8.16	.13			18.49
San Gabriel Dam, No. 2, No. 334	34 15	117 58	2,335	1.90	4.53	3.52	13.42	1.18		1.61	2	24.55
San Gabriel Dam RS, No. 76	34 13	117 51	1,600	1.36	3.67	3.07	12.19	1.55				21.84
San Gabriel Divide (San Dimas X)	34 12	117 45		1.34	4.48	.78	8.82					
San Gabriel Power House	34 09	117 54	850	1.37	2.80	2.60	6.47	1.61				14.85
San Jacinto	33 47	116 57	1,550	.85	.32	1.28	2.15	1.15	.18			5.93
San Pedro [1]	33 43	118 17	90	.09	.85	1.53	.90	1.28	.45			5.10
San Juan Capistrano (Orange County)[1]	33 31	117 40	103	.30	1.13	1.77	1.43	3.03	.30			7.86
Santa Ana [1]	33 46	117 51	133	1.38	.84	1.03	2.90	3.26	.08			9.49
Santa Ana (Orange County)[1]	33 45	117 52	130	.37	1.31	1.38	1.43	2.00	.02			6.51
Santa Ana No. 1 ((intake) Southern California Edison Co.)[1].			3,517	1.05	1.56	1.27	3.10	Gauge washed away.				
Santa Ana, No. 3 (Southern California Edison Co.)[1]	34 02	117 06	2,000	1.38	.84	1.03	2.90	3.26	.51			9.92
Santa Anita Dam, No. 63A [1]	34 11	118 01	1,400	1.30	4.06	3.53	6.76	.73				16.38
Santa Anita Ranger Station	34 12	118 01	1,703	.47	7.12	7.41	(2)	14.00				29.00
Santa Monica	34 02	118 28	140	.80	1.90	1.56	4.11	.85				9.22
Santa Paula [1]	34 21	119 04			.88	2.10	3.24	2.25				8.47
San Gorgonio (Nevada, Calif. plant)				2.50	3.50	1.50	12.15	.75	.25			20.65
Santiago, No. 102 (Orange County)[1]	33 48	117 44	600	.32	1.47	1.75	1.47	4.43	.05			9.49
Saugus, No. 200 (substation Southern California Edison Co.).	34 25	118 34	1,093	.58	.77	1.05	3.27	.55	.16			6.38

[1] Precipitation measured near sunrise.
[2] Included in next following measurement.
[3] Precipitation midnight to midnight.

TABLE 1.—*Precipitation data (inches and hundredths), Feb. 27 to Mar. 4, 1938, inclusive, for Ventura, Los Angeles, Orange, San Bernardino, and Riverside Counties*—Continued

[Precipitation for 24 hours ending near sunset unless otherwise indicated]

Station	Latitude	Longitude	Elevation above m. s. l	February		March				Greatest		Storm total
				27	28	1	2	3	4	1 hour	Date	
	° ′	° ′										
Saw Pit Dam, No. 68	34 10	117 59	1,150	1.05	3.81	2.91	7.51	4.33				19.61
Seven Oaks	34 10	116 55	5,000	1.42	.98	2.10	8.47	4.69	.56			18.22
Sepulveda, No. 9 [1]	34 14	118 28	815	.39	1.22	2.33	1.71	3.17				8.82
Shady, No. 51 (Orange County) [1]	33 38	117 48	300	.48	1.20	1.72	1.25	2.99	.08			7.72
Sierra (Southern California Edison Co.)				1.25	4.51	3.45	Gauge washed away.					
Sierra Madre	34 12	118 01	1,050	1.54	4.18	2.18	7.89	.58				16.37
Sierra Madre Dam, No. 144	34 11	118 02	1,400	.56	3.54	2.69	9.18	1.03				17.00
Sleepy Hollow (Colby Ranch)	34 18	118 07	2,950	2.13	1.70	2.45	10.95	1.52	.06	1.33	2	18.8
Snow Creek [1]	33 53	116 41	1,300	(2)	1.50	(2)	(2)	(2)	11.00			12.50
Soledad, No. 409 (Mitchell)	34 25	118 26	1,472	.85	1.61	1.40	4.60	.40	.10			8.96
Squirrel Inn	34 15	117 13	5,700	2.15	5.10	3.15	10.97	4.70	.10			26.17
Sturtevant's Camp, No. 58	34 13	118 02	3,375	2.00	6.07	2.98	12.12	1.96				25.13
Summit Topango	34 08	118 36	1,520	(2)	2.70	1.95	(2)	6.02				10.67
Sunset Canyon (Burbank No. 39)	34 12	118 17	1,650	1.29	2.01	2.44	6.78	.73				13.25
Switzerland, No. 52	34 16	118 09	3,000	1.20	2.69	2.02	12.41	1.46				19.78
Sylmar, No. 30	34 19	118 28	1,250	(2)	2.32	1.43	4.35	.68				8.78
Table Mountain	34 23	117 41	7,500	1.80	1.40	.88	4.59	1.71				10.38
Tanbark Flat, No. 158	34 12	117 46	2,700	1.26	3.66	3.25	11.24	1.38	.31			21.10
Tanbark Laboratory (San Dimas X)	34 11	117 46	2,675	1.23	6.34	.73	11.47	.96		.82	2	20.73
Topanga Canyon R. S., No. 6	34 05	118 36	747	1.27	3.03	3.17	6.70	.16		1.09	2	14.33
Torrance, No. 268	33 51	118 19	57	1.32	.45	1.23	3.05	.21				6.26
Tribuca C. C. C. camp (Orange County) [1]				.25	1.20	2.19	1.70	3.12	.24			8.70
Tujunga	34 15	118 17	1,850	1.01	2.12	2.07	6.02	1.88				13.10
Tustin (near) [1]	33 43	117 48	125	.32	.97	1.54	1.35	4.23				8.41
University of California at Los Angeles	34 04	118 26		.27	2.49	2.66	4.60	1.51	.03			11.56
Upland [1]	34 09	117 39	1,740	.10	1.42	1.98	2.45	5.09	.22			11.26
Valyermo	34 26	117 51	3,800	1.00	.98	1.17	3.28	.32				6.75
Van Nuys [1]	34 11	118 27	695	.17	1.53	2.46	2.24	3.29	.02			9.71
Venice, No. 126	33 59	118 28	7	(2)	2.96	1.38	4.19	.51				9.04
Vicente Point, No. 44	33 44	118 25	125	.78	.39	1.27	2.59	.49				5.52
Ventura	34 20	119 14	50	(2)	1.08	3.74	.82					5.64
Vincent Patrol Station	34 29	118 08	3,250	1.00	.30	.78	3.37	.48				5.93
Victorville (A. S. Amaral) [1]	34 30	117 21	2,713	.21	.73	.68	.17	1.10	.27			3.16
Villabrook No. 70 (Orange County) [1]	33 48	117 50		.40	1.45	1.90	1.95	3.00	.30			9.00
West Fork San Dimas Experiment	34 10	117 47	2,100	1.14	5.34	.82	8.94	1.00		.38	2	17.24
West Los Angeles (Sawtelle City Hall) No. 140	34 03	118 27	232	(2)	3.50	1.77	5.21	.62				11.10
Whittier Narrows No. 220 (Rivera)	34 01	118 04	195	1.16	1.13	1.73	4.75	.61				9.38
Whittier	33 59	118 02	365	1.28	.67	1.65	4.50	.73				8.83
Walnut	34 00	117 52	475	(2)	2.29	1.89	(2)	6.59				10.77
West Pine Flat	34 19	117 50	5,369	1.65	5.02	3.35	12.32	3.34				25.68
Wilmington No. 118B	33 47	118 16	40	1.39	1.49	.15	3.67	.63				7.33
Yorba Linda [1]	33 52	117 48	405	.70	.84	1.77	2.43	3.34	.13			9.21

[1] Precipitation measured near sunrise.
[2] Included in next following measurement.

The accompanying rainfall table lists 224 gaging stations [1] throughout the excessive rainfall areas of the 5 counties affected—Ventura, Los Angeles, San Bernardino, Orange, and Riverside. The table shows the latitude, longitude, and elevation of the stations listed; also the daily rainfall, and the total catch for each of the several stations. Hourly intensities are shown also for stations exceeding an inch per hour or more. It will be noted that the hourly intensities were not phenomenal, generally—the highest analyzed being Clear Creek station with 1.87 inches. It is probable, however, that not over 10 to 15 percent of the stations possessed recording gages. It is interesting to note, that Opids Camp in the San Gabriel Mountains received 10.89 inches in 8 hours on March 2, 1938, and that the following 24-hour amounts, all on March 2, were recorded:

	Inches
Kellys Kamp, San Gabriel Mountains	17.55
Big Bear Lake Dam, San Bernardino Mountains	15.06
Opids Camp, San Gabriel Mountains	14.92
Lake Arrowhead, San Bernardino Mountains	14.51

Deep Creek, mentioned above, one of the main headwater tributaries of the Mojave River, rises in the San Bernardino Mountains between Big Bear Lake and Lake Arrowhead. It was the floodwaters of this stream that caused the Mojave River to flood out through the desert of the same name, resulting in much damage and overflowing from Soda Lake through Baker to Silver Lake for the first time since 1922, filling the latter at its center to a depth of probably 22 feet. Both of these lakes are usually merely dry beds. So far as known the floodwater caught in Silver Lake in January 1916 was the previous greatest amount, at least back to the sixties. It is with this thought in mind that the following is quoted from page 381 of the Mojave Desert Region of California, U. S. G. S. Water Supply Paper No. 578:

> After heavy rains in January 1916 so much water flowed down to the Mojave River that it not only reached Soda Dry Lake, but continued across the Playa to Silver Lake, which filled it to a depth of about 10 feet. It is said that practically all the water in Silver Lake, when the Playa of that name is flooded, comes from Mojave River, particularly the headwater region, and not from the desert land immediately adjacent to the Playa.

As Silver Lake reached a depth of only 10 feet during the 1916 phenomenal flood it is easy to see how much more water passed down the Mojave River during the recent flood to bring a depth of 20 feet or more to the said dry lake bed, and causing much flood damage in the vicinity of Victorville, Barstow, and Baker, including destruction of highways and railway beds.

An attempt has been made to obtain accurate survey data on extent of areas overflowed by the floods in the several streams affected, the amount of damage, and the number of lives lost as a result of the floods. The surveys are incomplete at the present time and may not be completed for several weeks. It is impossible to even approximate the total areas flooded, but they will run into hundreds of square miles. The Los Angeles County agent has made a study of damage in this county alone to agriculture, from which we quote:

Damage from flood waters in orchards	$130,000
Damage to vegetables and berries	41,000
Damage to tilled crops	97,300

[1] Including, besides the Weather Bureau cooperative stations, gages operated by the Los Angeles and Orange County Flood Control Districts, by the various counties and cities in the region involved, by power companies, by the Forest Service, Soil Conservation Service, and by other agencies, public and private. The operators of the gages are indicated to some extent in the table.

Damage to nursery stock	$30,000
Damage from rain and wind to oranges	232,000
Damage from rain and wind to strawberries	125,000
Damage from rain and wind to cut flowers	35,000
Total	690,300

The damage listed above is only a fraction of the entire loss in Los Angeles County alone, when highways, railways, buildings, soil erosion, livestock, poultry, automobiles, farm equipment, power lines, telegraph and telephone lines, etc., are all considered. Extend this loss to the other four counties involved and the loss becomes tremendous. A rough estimate, at the close of the flood period for southern California, was placed at $24,500,000. It is unlikely that any close approximation of the intangible losses, such as soil erosion can ever be made. It is known that millions of tons of soil and subsoil were removed by floodwaters from the mountains, valleys, and lowlands; much of the eroded material was deposited over areas to become a burden or a real menace; large portions were actually washed into the ocean; large quantities filled the many storm debris basins and are being removed; untold tons were deposited in the bottoms of southern California artificial lakes and reservoirs.

Data obtained from the American Red Cross show deaths from the great flood as follows:

Los Angeles County	29
Orange County	20
San Bernardino County	11
Riverside County	15
Ventura County	4
Total	79

NOTES AND REVIEWS

Monthly Observed Sunspot Relative Numbers for 1937, by CHARLES M. LENNAHAN.—The sunspot relative numbers for 1937 have recently been published in the Astronomische Mitteilungen, Nr. 136, Zurich 1938, by W. Brunner. These numbers are based not only upon observations made at Zurich and Arosa but also upon those made at 55 other stations distributed throughout the world; they therefore differ somewhat from the provisional numbers published regularly in the MONTHLY WEATHER REVIEW.

Sunspot relative numbers for 1937

January	132.5	August	137.7
February	128.5	September	100.7
March	83.9	October	124.9
April	109.3	November	74.4
May	116.7	December	88.8
June	130.3		
July	145.1	Year	114.4

No day during the year was free of sunspots.

The same issue of Astronomische Mitteilungen gives the mean relative number for 1936 as 79.7 and not 80.4 as incorrectly published in Astronomische Mitteilungen No. 135, page 197, and as republished in the MONTHLY WEATHER REVIEW, volume 65: 338, September 1937.

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[RICHMOND T. ZOCH, *in Charge of Library*]

By AMY D. PUTNAM

RECENT ADDITIONS

The following have been selected from among the titles of books recently received as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies:

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Further evidence on the dependence of terrestrial temperatures on the variations of solar radiation. Washington. 1936. 4 p. figs. 24½ cm. (Smithsonian miscellaneous collections. Arthur fund.)

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Baldwin, Henry I., & Brooks, Charles F.

Forests and floods in New Hampshire. Boston, Mass. 1936. 28 l. tables, maps. 28 cm. Mimeographed. (New England regional planning commission. Publication. no. 47. December 1936.)

Barth, Richard.

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