DIVISION OF MINES AND GEOLOGY
Ian Campbell, *State Geologist*

STATE OF CALIFORNIA
Edmund G. Brown, *Governor*
THE RESOURCES AGENCY
Hugo Fisher, *Administrator*

DEPARTMENT OF CONSERVATION
DeWitt Nelson, *Director*

EXPLANATORY DATA

SAN JOSE SHEET

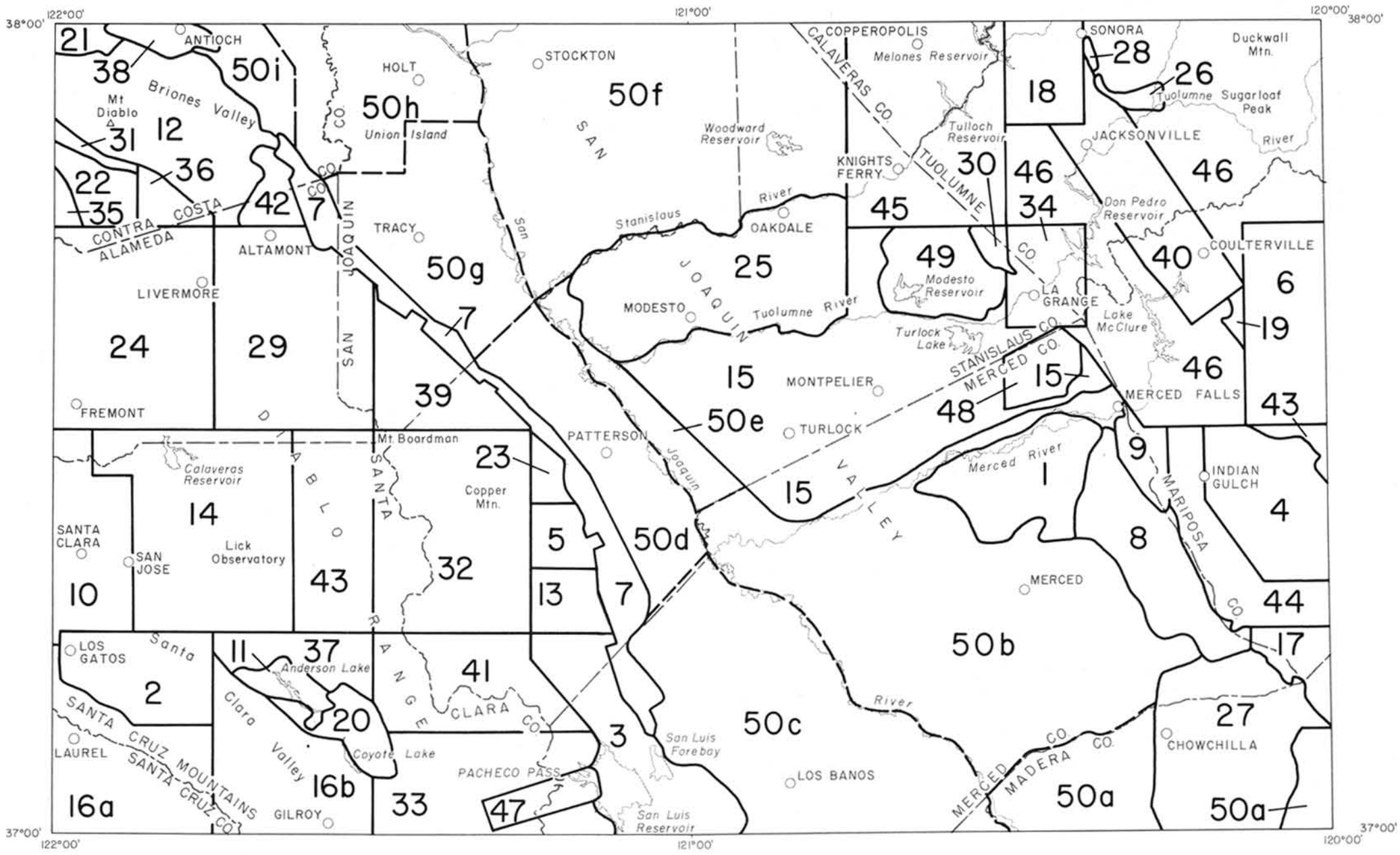
GEOLOGIC MAP OF CALIFORNIA

OLAF P. JENKINS EDITION

Compiled by Thomas H. Rogers 1966

Fourth printing, 1981

INDEX TO GEOLOGIC MAPPING
USED IN THE COMPILATION OF THE SAN JOSE SHEET



1. Arkley, R. J., 1962, The geology, geomorphology, and soils of San Joaquin Valley in the vicinity of the Merced River, California, *in* California Div. Mines Bull. 182, pp. 25–31, Fig. 2, scale 1 in. = 6 miles.

2. Bailey, E. H. and Everhart, D. L., 1964, Geology and quicksilver deposits of the New Almaden District, Santa Clara County, California: U. S. Geol. Survey Prof. Paper 360, Pl. 1, scale 1:24,000.

†3. Bennison, A. P., Geologic mapping in the Pacheco Pass and Los Banos quadrangles, scale 1:62,500, unpublished, 1965.

Schilling, F. A., Jr., The Upper Cretaceous stratigraphy of the Pacheco Pass quadrangle, California, scale 1:31,680, Stanford University, unpublished Ph.D. thesis, 1962.

(Local additions from U.S. Bur. Reclamation, Geologic Map San Luis Dam area, scale 1:24,000, in progress 1965. Concealed faults in San Luis Flat from California Div. Mines and Geology and U.S. Bur. of Reclamation: San Luis Flat gravity profiles, Merced Co., California, April, 1966, on file at California Div. Mines and Geology, San Francisco Office.)

4. Best, M. G., Metamorphic and igneous rocks in the Cathay area, western Mariposa County, California, scale 1:48,000, University California, Berkeley, Ph.D. thesis, 1961 (in part published in Univ. California Pubs. Geol. Sci. Bull., 1963, v. 42, no. 3, pp. 111–158, Fig. 4, scale 1 mi. = approx. 1.75 in.).

5. Booth, C. V., Geology of the west central portion of the Orestimba quadrangle, scale 1:20,000, University California, Berkeley, unpublished M.A. thesis, 1950.

6. Bowen, O. E., Geology of the Buckhorn Peak and Bear Valley quadrangles, California, scale 1:24,000, California Div. Mines and Geology work in progress, 1965.

7. California Dept. Water Resources, Areal geology—California Aqueduct, North San Joaquin Division, Intake to San Luis Forebay, geologic mapping by C. F. Bacon, scale 1:24,000, unpublished, 1963. (Local additions in Pacheco Pass quadrangle from A. P. Bennison, ref. 3, and in Byron quadrangle from D. T. Snow, ref. 42.)

Reiche, P., 1950, Geology of a part of the Delta-Mendota Canal near Tracy, California: California Div. Mines Spec. Rept. 2, Fig. 2, scale 1:60,000.

8. California Dept. Water Resources, Areal geology—San Joaquin River basin ground water investigation, geologic mapping by D. R. Schnaible and R. Bisio, scale 1 in. = 8 miles, unpublished, 1961.

U. S. Army Corps of Engineers, Areal geology—Merced County stream group area, geologic mapping by R. C. Treasher, scale 1:62,500, unpublished 1947–1949.

†9. California Dept. Water Resources, Reconnaissance engineering geology of the proposed Merced Falls diversion channel, Mariposa County, California, geologic mapping by T. I. Iwamura, scale 1:24,000, unpublished, 1959.

10. California State Water Board, 1955, Santa Clara Valley investigation: Bull. 7, Pl. C-1, scale 1:156,680, geologic mapping by R. G. Thomas. (Concealed faults in San Jose area from California Dept. Water Resources, Evaluation of ground water resources—South Bay: Bull. 118-1, in preparation, 1965, Fig. 8: Subsurface features interpreted from gravity data, scale 1 in. = approx. 2¼ miles, and S. L. Robbins, U.S. Geological Survey, oral communication, 3/23/66.)

11. Cluff, L. S., Levish, M., and Taylor, C. L., Preliminary engineering geologic map, scale 1 in. = 500 feet, Woodward, Clyde, Sherard, and Associates, Oakland, California, unpublished, 1964.

12. Colburn, I. P., Geology and tectonic history of Mt. Diablo, California Div. Mines and Geology report in preparation, 1965, scale 1:24,000 (revised from I. P. Colburn, Stanford University, Ph.D., thesis, 1961). Also see I. P. Colburn, 1964, The Mesozoic stratigraphy in the vicinity of Mt. Diablo, California, *in* Guidebook and field trip to the Mt. Diablo area: Geol. Soc. Sacramento, pp. 9–23. (Additional faults in Kellogg Creek area from U. S. Bur. Reclamation, Central Valley Project, Delta Div., Kellogg Unit, Engineering Geol. Appendix, Pl. 4, scale 1 in. = 1000 feet, geologic mapping by J. S. Long, Jr., unpublished, 1962.)

Pampeyan, E. H., 1963, Geology and mineral deposits of Mt. Diablo, Contra Costa County, California: California Div. Mines and Geology Spec. Rept. 80, Pl. 1, scale 1:31,680.

13. Collins, D. F., Geology of the southern third of the Orestimba quadrangle, Stanislaus and Merced Counties, California, scale 1:20,000, University California, Berkeley, unpublished M.A. thesis, 1950.

14. Crittenden, M. D., Jr., 1951, Geology of the San Jose-Mt. Hamilton area, California: California Div. Mines Bull. 157, Pl. 1, scale 1:62,500. (Lower Miocene rocks and local faults along foothills from R. L. Rose, unpublished mapping, San Jose State College faculty research, 1964. Earthquake surface ruptures of 1868 from D. H. Radbruch, 1965, Approximate location of fault traces and historic surface ruptures within the Hayward fault zone between San Pablo and Warm Springs, California: U. S. Geol. Survey open file report, scale 1:62,500. Concealed part of Silver Creek fault from California Dept. Water Resources, Evaluation of ground water resources—South Bay: Bull. 118-1, in preparation, 1965, Fig. 8, scale 1 in. = approx. 2¼ miles. Subsurface extension of Hayward fault from California State Water Resources Board, ref. 10.)

†15. Davis, S. N. and Hall, F. R., 1959, Water quality of eastern Stanislaus and northern Merced Counties, California: Stanford University Pubs. Geol. Sci., v. 6, no. 1, Pl. 2, scale 1 in. = approx. 5 miles. (Additions from U. S. Dept. of Agriculture and Univ. Calif. Agricultural Experiment Station, Soil Survey of the Merced Area—1962, California and Soil Survey of the Eastern Stanislaus area—1964.

16a. Dibblee, T. W., Jr., Geologic map of part of the Los Gatos quadrangle, scale 1:62,500, unpublished, 1949. [Geology in the Santa Clara County portion largely from California State Water Resources Board, 1955, ref. 10, and from C. M. Gilbert, unpublished mapping in the New Almaden (Los Gatos) quadrangle, scale 1:62,500, 1940–1941; geology west of Highway 17 in the Laurel quadrangle from unpublished mapping by J. C. Clark, Univ. Calif., Santa Barbara.]

†16b. Dibblee, T. W., Jr., Geologic map of part of the Morgan Hill quadrangle, scale 1:62,500, unpublished, 1947.

California State Water Resources Board, 1955, ref. 10. (Local additions west of Gilroy by U. S. Army Corps of Engineers, Geologic map and sections—Gilroy Reservoir Site, Pajaro River basin, geologic mapping by R. H. Gelnett et al, scale 1 in. = 800 feet, unpublished, 1964.)

17. Ehrreich, A. L., Metamorphism, migmatization, and intrusion in the foothills of the Sierra Nevada—Madera, Mariposa, and Merced Counties, California, scale 1:24,000, University California, Los Angeles, unpublished Ph.D. thesis, 1965.

18. Eric, J. H., Stromquist, A. A., and Swinney, C. M., 1955, Geology and mineral deposits of the Angels Camp and Sonora quadrangles, Calaveras and Tuolumne Counties, California: California Div. Mines Spec. Dept. 41, Pl. 2, scale 1:24,000.

19. Evans, J. R., Geology of the Coulterville and Hornitos quadrangles, California, scale 1:24,000, California Div. Mines and Geology work in progress, 1966.

20. Frames, D. W., Stratigraphy and structure of the lower Coyote Creek area, Santa Clara County, California, scale 1:24,000, University California, Berkeley, unpublished M.A. thesis, 1955.

21. Fulmer, C. V., 1964, The type Markley and Nortonville formations, *in* Guidebook and field trip to the Mt. Diablo area: Geol. Soc. Sacramento, pp. 54–60, Pl. LVI, scale 1 in. = approx. 1⅛ miles. (Also in C. V. Fulmer, Univ. California, Berkeley, Ph.D., thesis, 1956.) Faults from unpublished Standard Oil Company mapping, 1941.

22. Geological Society of Sacramento, 1964, Guidebook and field trip to the Mt. Diablo area, Geologic map, Mt. Diablo area, scale 1:48,000, mapping compiled from several contributors.

California Dept. Water Resources, 1963, Alameda County Investigation: Bull. 13, Pl. 7, scale 1 in. = approx. 1¼ miles, geologic mapping by R. G. Thomas.

23. Hacker, R .N., The geology of the northwest corner of the Orestimba quadrangle and the northeast corner of the Mount Boardman quadrangle, scale 1:62,500, University California, Berkeley, unpublished M.A. thesis, 1950.

24. Hall, C. A., Jr., 1958, Geology and paleontology of the Pleasanton area, Alameda and Contra Costa Counties, California: Univ. California Pubs. Geol. Sci. Bull. v. 34, no. 1, Map 1, scale 1:39,000. (Faults in Livermore Valley from California Dept. Water Resources, 1964, Alameda Creek watershed above Niles: Chemical quality of surface water, waste discharges, and ground water, Pl. 3, scale 1 in. = approx. 7000 feet, geology by W. R. Hansen. Trace of 1868 earthquake surface rupture within Hayward fault zone from D. H. Radbruch, 1965, see under ref. 14. Fault interpretation south of Pleasanton in part from G. P. Louke, written communication, 12/30/65.)

*25. Hall, F. R., Geology and ground water of a portion of eastern Stanislaus County, San Joaquin Valley, California, scale 1:62,500, Stanford University, unpublished Ph.D. thesis, 1960.

26. Hart, E. W., 1959, Geology of limestone and dolomite deposits in the southern half of Standard quadrangle, Tuolumne County, California: California Div. Mines Spec. Rept. 58, Pl. 1, scale 1:41,625.

27. Helley, E. J., Sediment transportation in the Chowchilla river basin, Mariposa and Madera Counties, California, scale 1:24,000, University California, Berkeley, Ph.D. thesis in progress, 1966.

28. Heyl, G. R. and Wiese, J. H., 1949, Geology of limestone near Sonora, Tuolumne County, California: California Jour. Mines and Geol. v. 45, no. 4, pp. 509–513, Pl. 24, scale 1:15,000.

†29. Huey, A. S., 1948, Geology of the Tesla quadrangle, California: California Div. Mines Bull. 140, Pl. 1, scale 1:62,500.

30. Kelley, F. R., Geologic mapping in the Cooperstown, La Grange, and Keystone qaudrangles, scale 1:24,000, California Div. Mines and Geology mapping in progress, 1965. (Local additions from J. M. Foster, Geologic map of the Cooperstown, Paulsell, Montpelier, and Turlock Lake quadrangles, California, scale 1:61,200, Stanford University, unpublished mapping 1957, copy on file in California Div. Mines and Geology, San Francisco.)

31. Kilmer, F. H., Stratigraphy of the "Diablo" Formation, scale 1:24,000, University California, Berkeley, unpublished M.A. thesis, 1953.

‡32. Maddock, M. E., 1964, Geology of the Mt. Boardman quadrangle, Santa Clara and Stanislaus Counties, California: California Div. Mines and Geology Map Sheet 3, scale 1:62,500.

33. McKee, E. B., Jr., 1964, Geology of the Pacheco Pass—Gilroy Hot Springs area, California, California Div. Mines and Geology open file report, scale 1:24,000. (In part covered by unpublished Ph.D. thesis, by E. B. McKee, Jr., Stanford University, 1958.)

†*34. Mannion, L. E., Geology of the La Grange quadrangle, California, scale 1:24,000, Stanford University, unpublished Ph.D. thesis, 1960.

35. Newton, R. J., The geology northwest of Dublin, California, in the vicinity of Divide Ridge, scale 1 in. = 1736 feet, University California, Berkeley, unpublished M.A. thesis, 1948.

36. Oestereich, E. S., Geology of the Tassajara quadrangle, scale 1:24,000, University California, Berkeley, unpublished M.S. thesis, 1958.

†37. Ortalda, R. A., Geology of the northern part of the Morgan Hill quadrangle, California, scale 1:62,500, University California, Berkeley, unpublished M.A. thesis, 1948.

38. Patten, P. R., The San Pablo Formation north of Mt. Diablo, California, scale 1:62,500, University California, Berkeley, unpublished M.A. thesis, 1948.

39. Pelletier, W. J., Paleontology and stratigraphy of the Clarendonian continental beds west of Tracy, California, scale 1:62,500, University California, Berkeley, unpublished M.A. thesis, 1951. Also in Geology of the Carbona quadrangle, scale 1:62,500, California Div. Mines and Geology open file report, 1961.

Trask, P. D., et al, 1950, Geologic description of the manganese deposits of California: California Div. Mines Bull. 152, Pl. 4: Geologic map of the Ladd-Buckeye area, San Joaquin and Stanislaus Counties, scale 1 in. = 2000 feet.

San Jose State College student mapping under the direction of M. E. Maddock, Geologic maps of parts of the Lone Tree Creek and Solyo quadrangles, scale 1:24,000, unpublished, 1960–61.

*40. Ransome, F. L., 1899, Mother Lode District folio, California: U. S. Geol. Survey, Geol. Atlas of U. S., folio 63, Map: Economic geology, sheet 2, sections 3 and 4, scale 1:63,360. (Additions and modifications in the southern part from J. R. Evans, ref. 19.)

‡41. Rice, S. J. and Kundert, C. J., Reconnaissance geologic mapping of parts of the Gilroy Hot Springs and Pacheco Pass quadrangles, scale 1:62,500, California Div. Mines reconnaissance mapping for the State Geologic Map, 1955.

42. Snow, D. T., The geology of the northeast corner of Alameda County and adjacent portions of Contra Costa County, scale 1:12,000, University California, Berkeley, unpublished M.A. thesis, 1957.

‡43. Soliman, S. M., 1966, Geology of the east half of the Mt. Hamilton quadrangle, California, California Div. Mines and Geology Bull. 185, Pl. 1, scale 1:62,500.

†44. Taliaferro, N. L., (and field geology classes), Geologic map of the Indian Gulch quadrangle, scale 1:62,500, University California, Berkeley, ca. 1930.

*45. Taliaferro, N. L. and Solari, A. J., 1948, Geology of the Copperopolis quadrangle, California: California Div. Mines Bull. 145, Pl. 1, scale 1:62,500, no text. (Local additions at Melones Dam site from U. S. Army Corps of Engineers, Areal geology—New Melones Dam Site, scale 1 in. = 200 feet, unpublished, 1964.)

†*46. Turner, H. W. and Ranosme, F. L., 1897, Sonora folio, California: U. S. Geol. Survey Geol. Atlas of U. S., folio 41, Map: Economic geology sheet, scale 1:125,000

47. U. S. Bureau of Reclamation, 1962, 1964, San Felipe Division—Engineering Geology Appendix, Part 1—Pacheco Tunnel, Pl. II, scale 1 in. = 1000 feet, geologic mapping by I. E. Klein, C. Messinger, and J. S. Long, Jr., Map and geologic report on open file at the California Div. Mines and Geology library, San Francisco.

48. U. S. Bureau of Reclamation, Central Valley project—East Side Division, California, Montgomery dam site and reservoir—preliminary geology, scale 1 in. = 2000 feet, unpublished mapping by W. R. Cooke, 1959.

49. U. S. Bureau of Reclamation, Central Valley project—East Side Division, California, Cooperstown dam site and reservoir—preliminary geology, scale 1:24,000, unpublished mapping by R. J. Farina, M. D. Binkley, H. E. Richardson, and I. E. Klein, 1957–1958.

†50. U. S. Dept. of Agriculture and University California Agricultural Experiment Station Soil Surveys: a) Madera Area—1962; b) Merced Area—1962; c) Los Banos Area—1952; d) Newman Area—1948; e) Eastern Stanislaus Area—1964; f) Stockton Area—1951; g) Tracy Area—1943; h) Sacramento-San Joaquin Delta Area—1941; i) Contra Costa County—1939. (Interpreted for State Map use by California Div. Mines and Geology. Additions in the Stockton area from U. S. Army Corps Engineers, Farmington Project, Regional Geology, geologic mapping by R. C. Treasher, unpublished, 1949. Midland and Tracy [Stockton] fault zones from A. Safonov, 1962, The challenge of the Sacramento Valley, California, *in* California Div. Mines and Geol. Bull. 181, pp. 79–99, and written communication 1/10/1966. Upper Cretaceous rocks on northern border of San Jose sheet from D. B. Slemmons, University of Nevada, written communication, 2/2/66.)

† Local additions or modifications by T. H. Rogers, California Division of Mines and Geology reconnaissance geologic mapping for the State Geologic Map, 1965, 1966.

* Fault additions and local modifications by L. D. Clark, 1964, Stratigraphy and structure of part of Western Sierra Nevada metamorphic belt: U. S. Geol. Survey Prof. Paper 410, Pl. 1, 3, 4 and 5.

‡ Aerial photo fault (?) linaments in Diablo Range southeast of Livermore Valley interpreted by California Division of Mines and Geology, 1966, from Aero Service Corp. aerial mosaic of the central Coast Ranges, 1954, scale 1:120,000.

For a complete list of published geologic maps of this area see Division of Mines and Geology Special Reports 52 and 52-A.

STRATIGRAPHIC NOMENCLATURE—SAN JOSE SHEET

AGE	STATE MAP SYMBOL	STATE MAP UNIT State Map Units listed here are not necessarily in stratigraphic sequence; the sequence used has been standardized for all sheets of the Geologic Map of California	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGIES Formally named formations grouped in sequence (separated by semicolons) are listed from youngest to oldest.
QUATERNARY – Recent	Qs	**RECENT DUNE SAND**	Wind blown sand, including dune sand, in the San Joaquin Valley derived from Pleistocene alluvial fan deposits (includes the Oakley and Delhi soil series).
QUATERNARY – Recent	Qal	**RECENT ALLUVIUM**	Stream alluvial deposits. Tideland deposits near San Jose. Alluvial fan and flood-plain deposits in Livermore and Santa Clara Valleys.
QUATERNARY – Recent	Qsc	**RECENT RIVER AND MAJOR STREAM CHANNEL DEPOSITS IN THE GREAT VALLEY**	Sediments along river channels and major streams including adjacent natural levees.
QUATERNARY – Recent	Qb	**RECENT BASIN DEPOSITS IN THE GREAT VALLEY**	Sediments deposited during flood stages of major streams in areas between natural stream levees and alluvial fans. San Joaquin-Sacramento River delta deposits west of Stockton, including muck, peat, and other organic soils.
QUATERNARY – Recent	Qf	**RECENT ALLUVIAL FAN DEPOSITS IN THE GREAT VALLEY**	Sediments deposited during flood stages of major streams in the areas between natural stream levees and fans. Modesto Formation—*brown to gray sand and silt, with an even westward-sloping surface* (eastern Stanislaus and Merced Counties; probably of late Pleistocene age according to Davis and Hall, 1959).
QUATERNARY – Pleistocene	Qt	**QUATERNARY NONMARINE TERRACE DEPOSITS**	Stream terrace deposits of cobble and pebble gravel, sand, and silt, locally cemented (contain late Pleistocene vertebrate fauna in Livermore Valley).
QUATERNARY – Pleistocene	Qm	**PLEISTOCENE MARINE DEPOSITS AND MARINE TERRACE DEPOSITS**	Marine terrace deposits (southwest slope of the Santa Cruz Mountains).
QUATERNARY – Pleistocene	Qc	**PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Riverbank Formation—*brown to gray sand, locally pebbly, minor silt and clay* (forms low slightly dissected hills; east side of San Joaquin Valley; south of Le Grand includes rocks mapped by E. J. Helley as Turlock Lake Formation and North Merced Gravel, both considered to be Pleistocene). Aromas Red Sands—*red to yellow, friable, cross-bedded sand* (Santa Cruz Mountains). Unnamed Pleistocene river gravels (in part auriferous) and older dissected alluvium in the Sierra Nevada.
QUATERNARY – Pleistocene	Qpv	**PLEISTOCENE VOLCANIC ROCKS: UNDIFFERENTIATED**	Olivine basalt flows, dikes, basaltic scoria and agglomerate, vitric tuff, and tuff-breccia interbedded within the San Benito Gravels in Santa Clara Valley (may be in part Pliocene).
QUATERNARY – Pleistocene	Ql	**QUATERNARY LAKE DEPOSITS**	Corcoran Clay—*olive gray, firm, massive clay and silt* (south of Los Banos).[1]
QUATERNARY – Pleistocene / CENOZOIC – Pliocene	QP	**PLIOCENE-PLEISTOCENE NONMARINE SEDIMENTARY DEPOSITS**	Turlock Lake Formation—*fluvial pebbly sand and gravel, interbedded silt and lacustrine clay* (forms dissected rolling hills; east side of San Joaquin Valley; includes blue diatomaceous Corcoran Clay in subsurface according to R. J. Arkley, 1962. North Merced Gravel—*unconsolidated pediment gravel* (north of Merced). China Hat Gravel—*unconsolidated pediment gravel* (north of Merced). Tulare Formation—*unconsolidated, cross-bedded sand, silt, and minor gravel, conglomerate lenses, diatomaceous silt, and clay* (west side of San Joaquin Valley; includes Corcoran Clay). Livermore Gravel—*loosely consolidated sand, gravel, clay, and local tuff beds* (contains Pliocene fresh water invertebrate fauna and Pleistocene vertebrate fauna). Irvington Gravel—*poorly consolidated, cross-bedded, stream sand and gravel, including possible lake deposits* (contains early Pleistocene vertebrate fauna). Packwood Gravel—*poorly consolidated gravel, pebbly sand, silt, clay, and well consolidated cross-bedded sandstone and sandy conglomerate* (near San Jose). Santa Clara Formation—*unconsolidated poorly sorted gravel, pebbly sand, silt, clay, and local lenses of fresh water limestone.* San Benito Gravel—*lenticular sandy gravel, sand, and minor clay, locally cemented.*
CENOZOIC – Pliocene	Pc	**UNDIVIDED PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Oro Loma Formation—*cobble to pebble conglomerate, interbedded sandstone and claystone* (contains vertebrate fauna of early Pliocene age near Patterson equivalent to the Black Hawk Ranch fauna of the Green Valley Formation).
CENOZOIC – Pliocene		**PLIOCENE VOLCANIC ROCKS:**	
CENOZOIC – Pliocene	Pv^r	**RHYOLITIC**	Leona Rhyolite—*rhyolite flow* (north of Fremont; may be Pleistocene).
CENOZOIC – Pliocene	Pv^a	**ANDESITIC**	Table Mountain Latite—*dark gray to black latite containing large euhedral labradorite phenocrysts* (Copperopolis quadrangle).
CENOZOIC – Pliocene	Pv^p	**PYROCLASTIC**	Volcanic rocks of the Sierra Nevada commonly referred to the Mehrten Formation—*andesitic tuff, tuff breccia, and interbedded andesitic gravel and sandstone.* Lawlor Tuff—*white massive tuff with large pumice fragments and angular fragments of vesicular lava* (northeast flank of Mt. Diablo). Pinole Tuff(?)—*white, soft, pumiceous tuff* (southwest flank of Mt. Diablo).
CENOZOIC – Pliocene	Pmlc	**MIDDLE AND/OR LOWER PLIOCENE NONMARINE SEDIMENTARY ROCKS**	Mehrten Formation—*fluvial, andesitic sand, sandstone, gravel, conglomerate, siltstone, claystone, and interbedded altered rhyolitic ash near base, locally includes hornblende andesite, basaltic agglomerate, tuff, and tuff breccia* in the Sonora quadrangle (may be late Miocene in part). Orinda Formation[2]—*red, gray, or brown, loosely consolidated sandstone and conglomerate, subordinate amounts of shale, claystone, limestone lenses, and tuffaceous bentonitic clay.* Tassajero Formation—*brown to gray mudstone, andesitic sandstone, conglomerate, and minor bentonitic and pumiceous tuff* (south of Mt. Diablo; contains vertebrate fauna of middle Pliocene age). Green Valley Formation—*similar to Tassajero Formation except for a greater percentage of coarse clastic rocks* (south of Mt. Diablo; contains early Pliocene Black Hawk Ranch vertebrate fauna and flora). "Neroly Formation" (of Huey)—*blue andesitic sandstone, conglomerate, clay, and brown unconsolidated sand in upper part* (contains a vertebrate fauna of early Pliocene age and a flora of Mio-Pliocene age).[3]
CENOZOIC – Pliocene	Pml	**MIDDLE AND/OR LOWER PLIOCENE MARINE SEDIMENTARY ROCKS**	Purisima Formation—*cross-bedded sand, sandstone, siltstone, and siliceous mudstone* (Santa Cruz Mountains; in part late Miocene).
CENOZOIC – Miocene	Mu	**UPPER MIOCENE MARINE SEDIMENTARY ROCKS**	San Pablo Group (includes Neroly, Cierbo, and Briones Formations)—*blue andesitic sandstone and conglomerate, white quartzose sandstone and claystone, and massive conglomeratic sandstone*[4] Cierbo Formation—*white, friable, pebbly sandstone, interbedded conglomerate, tuff, carbonaceous brown shale, and siltstone* (Tesla and Carbona quadrangles). Santa Margarita Formation—*unconsolidated white sand* (Santa Cruz Mountains; in part early Pliocene).
CENOZOIC – Miocene	Mc	**UNDIVIDED MIOCENE NONMARINE SEDIMENTARY ROCKS**	Valley Springs Formation—*dominantly fluvial sequence of white tuffaceous sand, sandy clay, and siliceous gravel; interbedded rhyolitic tuff partly altered to bentonitic clay.*
CENOZOIC – Miocene	Mm	**MIDDLE MIOCENE MARINE SEDIMENTARY ROCKS**	Monterey Formation—*sandstone, siliceous shale, rhythmically interbedded chert and siliceous shale, local limestone lenses.* (Includes Hambre Sandstone, Tice Shale, Oursan Sandstone, Claremont Shale, and Sobrante Sandstone Members. In part late Miocene.)
CENOZOIC – Miocene	Ml	**LOWER MIOCENE MARINE SEDIMENTARY ROCKS**	Temblor Formation—*sandstone and conglomerate, locally glauconitic, minor shale and thin dacitic tuff-breccia* (south of San Jose; in part middle Miocene). Vaqueros Formation—*interbedded sandstone, conglomerate, siltstone, and siliceous shale* (Santa Cruz Mountains). Unnamed sandstone, interbedded conglomerate and shale (east of San Jose; contains early Saucesian fauna).
CENOZOIC – Miocene		**MIOCENE VOLCANIC ROCKS:**	
CENOZOIC – Miocene	Mv^r	**RHYOLITIC**	Tuff, perlitic dacite, and massive dacite within the Temblor Formation (Lone Hill, south of San Jose).
CENOZOIC – Miocene	Mv^a	**ANDESITIC**	Andesitic pyroclastic and intrusive rocks on Pacheco Peak (probably equivalent to the Quien Sabe Volcanics to the south).
CENOZOIC – Oligocene	Φ	**OLIGOCENE MARINE SEDIMENTARY ROCKS**	Kirker Formation—*tuffaceous sandstone, massive white reworked tuff, and minor conglomerate* (northeast of Mt. Diablo). San Lorenzo Formation—*mudstone, clay shale, and sandstone* (Eocene in part; Santa Cruz Mountains). Unnamed white claystone, siltstone, and micaceous sandstone, stained red, brown, and purple in the Orestimba quadrangle (contains a possible Oligocene fauna and shown on the map as Φ?).
CENOZOIC – Eocene	Ec	**EOCENE NONMARINE SEDIMENTARY ROCKS**	Ione Formation—*pink, yellow, red, and gray, quartzose, anauxite-bearing sandstone and conglomerate; white sandy clay at base* (Sierran foothills; includes marine fossiliferous sandstone near Merced Falls).
CENOZOIC – Eocene	E	**EOCENE MARINE SEDIMENTARY ROCKS**	Kreyenhagen Formation—*white platy diatomite, gypsiferous shale, clayey sand, and sandstone* (south of Patterson). Butano Sandstone—*sandstone, conglomeratic sandstone, and clay shale* (Santa Cruz Mountains). Tolman Formation—*highly fossiliferous sandstone and conglomerate* (north of Fremont; contains fauna of possible Eocene age; shown on the map as E?). Markley Formation—*massive, friable sandstone with interbedded carbonaceous mudstone, siltstone and white diatomaceous shale;* "Nortonville Formation"—*mudstone, shale, siltstone, and sandstone;* Domengine Formation—*white, red, and brown, quartzose sandstone, with interbedded glauconitic mudstone, siltstone, lignite, and carbonaceous shale;* Meganos Formation—*interbedded sandstone and mudstone, minor conglomerate and coquina* (in part Paleocene). Telsa Formation—*interbedded white quartzose sand, dark carbonaceous shale, siltstone, and clay* (Tesla and Carbona quadrangles; lower part possibly Paleocene).
CENOZOIC – Paleocene	Ep	**PALEOCENE MARINE SEDIMENTARY ROCKS**	Laguna Seca Formation—*glauconitic sandstone, micaceous or anauxitic cross-bedded sandstone, and sandy shale* (Pacheco Pass and Orestimba quadrangles; in part non-marine; in part Eocene; locally referred to as the Tesla Formation). Martinez Formation—*mudstone and sandstone, locally pebbly and glauconitic* (northeast of Mt. Diablo). Unnamed quartzose sandstone and calcareous clay shale (Morgan Hill quadrangle; possibly early Eocene in part).

STRATIGRAPHIC NOMENCLATURE—Continued

AGE	STATE MAP SYMBOL	STATE MAP UNIT State Map Units listed here are not necessarily in stratigraphic sequence; the sequence used has been standardized for all sheets of the Geologic Map of California	STRATIGRAPHIC UNITS AND CHARACTERISTIC LITHOLOGIES (The formally named formations grouped within an individual State Map Unit, are listed in stratigraphic sequence from youngest to oldest.)
CENOZOIC – TERTIARY – Undivided	Tc	**TERTIARY NONMARINE SEDIMENTARY ROCKS**	Quartzose river gravels (in the Sierra Nevada; in part auriferous).
		TERTIARY INTRUSIVE (HYPABYSSAL) ROCKS:	
	Ti	**UNDIFFERENTIATED**	Felsic intrusive at Loma Prieta (Santa Cruz Mountains).
	Tir	**RHYOLITIC**	Alum Rock Rhyolite—*fine grained rhyolite plug* (northeast of San Jose). Rhyodacite dikes east of Mt. Diablo.
	Tia	**ANDESITIC**	Black glassy andesite dikes intruding serpentine southeast of San Jose.
	Tib	**BASALTIC**	Diabase dikes east of Mt. Diablo.
		TERTIARY VOLCANIC ROCKS:	
	Tv	**UNDIFFERENTIATED**	Olivine basalt, scoria, agglomerate, interbedded red fluvial sedimentary rocks and minor andesite (near San Luis Dam).
	Tvb	**BASALTIC**	Basalt in Clayton quadrangle. Basalt in east half of Mt. Hamilton quadrangle.
MESOZOIC – CRETACEOUS – UNDIVIDED	K	**UNDIVIDED CRETACEOUS MARINE SEDIMENTARY ROCKS**	Niles Canyon Formation—*sandstone, sandy shale, local conglomerate, abundant carbonaceous fragments* (Early Cretaceous according to C. A. Hall, Jr., 1958; may be all or in part Late Cretaceous according to D. L. Jones, U. S. Geol. Survey, oral communication 11/2/65; contains Late Cretaceous pollen according to W. R. Evitt, Stanford University, written communication 12/8/65). Berryessa Formation—*siltstone, shale, and massive sandstone* (contains both Late Cretaceous and Early Cretaceous fossils). Rocks mapped as Oakland (?) Conglomerate—*massive cobble and boulder conglomerate in coarse sand matrix* (contains both Late Cretaceous and Early Cretaceous fossils). Undifferentiated silty shale, thin arkosic sandstone, and minor conglomerate (northeast of Gilroy; may include some Tertiary rocks in the Mt. Sizer quadrangle). Undifferentiated sandstone and mudstone, minor conglomerate, white porcelaneous shale, limestone, and tuff (contains both Early and Late Cretaceous fossils, near Mt. Diablo).
	Ku	**UPPER CRETACEOUS MARINE SEDIMENTARY ROCKS**	Moreno Formation—*chocolate brown organic shale with limestone concretions, interbedded massive concretionary sandstone and siltstone, abundant gypsum, local sandstone dikes;* Panoche Formation—*massive, locally cavernous-weathering, concretionary sandstone, shale, siltstone, and conglomerate lenses;* Adobe Flat Shale Member of Panoche Formation—*brittle silty shale, minor interbedded sandstone, local limestone lenses* (east flank of Diablo Range). Rocks mapped as Garzas Sandstone (east flank of Diablo Range). Del Valle Formation—*massive concretionary sandstone, interbedded siltstone, shale, and conglomerate* (Livermore quadrangle). "Sedimentary rocks in the Sierra Azul"—*rhythmically-bedded graywacke, conglomerate, and shale,* and "Sedimentary rocks in the Santa Teresa Hills"—*massive concretionary sandstone and minor shale* (Santa Cruz Mountains).
	Kl	**LOWER CRETACEOUS MARINE SEDIMENTARY ROCKS**	"Horsetown Formation"—*hard nodular shale and friable sandstone, local thin sandy fossiliferous limestone* (Carbona and Tesla quadrangles; partly Late Cretaceous in Hospital Canyon). Unnamed shale and siltstone, minor sandstone and limestone lenses (Pacheco Pass quadrangle; in part Late Jurassic).
	Jk	**KNOXVILLE FORMATION**	Knoxville(?) Formation—*black shale and siltstone, abundant ellipsoidal concretions of aphanitic gray limestone, local sandstone, and fossiliferous conglomerate* (Diablo Range).
	KJf	**FRANCISCAN FORMATION**	Franciscan Formation—*graywacke, locally abundant red and green thin-bedded chert, siltstone and silty shale, minor conglomerate, limestone, blue-gray glaucophane-bearing schist and related metamorphic rocks* (graywacke extensively jadeitized in Pacheco Pass, Mt. Boardman, and Mt. Hamilton areas). The Franciscan Formation in the Diablo Range is generally considered to be of Jurassic and possibly pre-Jurassic age.
	KJfv	**FRANCISCAN VOLCANIC AND METAVOLCANIC ROCKS**	Pillow basalt, andesite, and mafic metavolcanic rock (greenstone), local quartz porphyry, intrusive diabase, and diorite. Lotta Creek Tuff Member—*white, crystal, lithic tuff, interbedded dark siliceous shale;* Del Puerto Keratophyre Member—*keratophyre and quartz keratophyre flows* (Mt. Boardman quadrangle).
		MESOZOIC GRANITIC ROCKS	
	gr	**UNDIFFERENTIATED**	Various granitic rocks in the Sierra Nevada, including granodiorite, quartz diorite, diorite, pegmatite, aplite, and some gabbro (not differentiated into separate cartographic units). Albitite dikes along Melones Fault Zone. Granodiorite(?) in Los Gatos quadrangle.
	gra	**GRANITE AND ADAMELLITE (QUARTZ MONZONITE)**	Quartz monzonite, granite, granophyre and dikes of leucogranite and pegmatite.
	grt	**TONALITE (QUARTZ DIORITE) AND DIORITE**	Tonalite and diorite.
	bi	**MESOZOIC BASIC INTRUSIVE ROCKS**	Gabbro, hornblende gabbro, olivine gabbro, norite, troctolite, diabase dikes and sills, and meta-diabase in Sierra Nevada.
	ub	**MESOZOIC ULTRABASIC INTRUSIVE ROCKS**	In Sierra Nevada: massive serpentine, hornblendite, silica-carbonate rock associated with serpentine, peridotite, and gabbro (highly sheared along Melones Fault Zone). In Coast Ranges: massive serpentine, peridotite, dunite, pyroxenite, olivine gabbro, norite, and silica-carbonate rock derived from highly sheared and altered serpentine along fault zones.
	Ju	**UPPER JURASSIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS**	Mariposa Formation—*slate, locally tuffaceous metasandstone, metagraywacke, metaconglomerate, metasiltstone, and minor sandy metatuff; local chiastolite slate* in Indian Gulch (15′) quadrangle. Agua Fria Formation—*quartzose and volcanic metasedimentary rocks, minor mafic metatuff, meta-agglomerate, and metachert.* Hunter Valley Cherts—*varicolored banded metachert interbedded in metavolcanic rocks.* Merced Falls Slate—*slate and metasiltstone, interbedded metagraywacke and minor metaconglomerate.* Salt Spring Slate—*slate, metagraywacke, and metaconglomerate, minor metatuff.* "Cosumnes Formation"—*slate and metatuff, minor metachert and metaconglomerate.*
	JRv	**JURASSIC AND/OR TRIASSIC METAVOLCANIC ROCKS**	Logtown Ridge Formation—*massive metavolcanic rocks including local metamorphosed tuffaceous sediments and metachert, associated intrusive quartz porphyry.* Penyon (Peñon) Blanco Volcanics—*massive metavolcanic rocks, including local mafic pillow lava and metachert.* Peaslee Creek Volcanics—*metamorphosed mafic pyroclastic rocks and metamorphosed massive porphyritic felsic lava; includes hypabyssal intrusive rocks.* Copper Hill Volcanics—*metamorphosed mafic pyroclastic rocks and pillow lava; some metamorphosed massive felsic flows and pyroclastic rocks.* Gopher Ridge Volcanics—*metamorphosed mafic pyroclastic rocks, metamorphosed pillow lava and massive felsic flows.* Unnamed metadiabase and intrusive metarhyolite in Indian Gulch (7½′) and La Grange (7½′) quadrangles. Dark green massive to schistose metavolcanic rocks (east of Melones Fault Zone).
PALEOZOIC – UNDIVIDED	m	**PRE-CRETACEOUS METAMORPHIC ROCKS UNDIFFERENTIATED**	Metasedimentary and metavolcanic rocks undifferentiated (Sonora quadrangle).
	ls	**LIMESTONE AND/OR DOLOMITE**	Crystalline limestone lens in Mariposa Formation (north of Hornitos).
	ms	**PRE-CRETACEOUS METASEDIMENTARY ROCKS**	Phyllite, stretched conglomerate, thin-bedded tuff and slate (Sonora quadrangle).
	mv	**PRE-CRETACEOUS METAVOLCANIC ROCKS**	Dark green fibrous amphibolite schist and sericite schist (Sierra Nevada).
	gr-m	**PRE-CENOZOIC GRANITIC AND METAMORPHIC ROCKS**	Hornblende-quartz-plagioclase gneiss, locally associated with gabbro, gneissic quartz monzonite, migmatite, and flaser gabbro (Indian Gulch 15′ quadrangle).
	ℙ	**PALEOZOIC MARINE SEDIMENTARY AND METASEDIMENTARY ROCKS,**	Calaveras Formation—*quartz-mica schist, slate, quartzite, and metachert; minor metaconglomerate, phyllite, crushed conglomerate, and local lenses of amphibolite schist.* ("Calaveras" is applied as a general name for Sierra Nevada Palezoic rocks.) Some areas shown as ℙ may be Mesozoic.
	ls	**LIMESTONE AND/OR DOLOMITE**	Recrystallized limestone, dolomite, and dolomitic limestone in the Calaveras Formation, locally brecciated and sheared (contains fossils of possible "Late Paleozoic" age in Sonora quadrangle).

NOTES

[1] Early Pleistocene vertebrate fauna reported in the San Luis Canal excavations south of the San Jose sheet (C. E. Hall, 1965, Las Aguilas land surface *in* Guidebook for Field Conference I, INQUA, VIIth Congress, p. 145).

[2] The rocks mapped as Orinda south of Mt. Diablo are younger (early to middle Pliocene) than the rocks mapped as Orinda in the Berkeley Hills (Mio-Pliocene). Locally this formation has been subdivided into the Tassajero and Green Valley Formations.

[3] In the Tesla quadrangle, Huey (1948) considers these rocks to be flood plain or coastal plain deposits which are marginal to and transitional into the marine facies of the "Neroly" Formation in the Mt. Diablo area.

[4] On the southwest flank of Mt. Diablo, the uppermost part of the "Neroly" Formation, sometimes referred to as the "Diablo Formation," contains a late Miocene invertebrate marine fauna and an early Pliocene flora and vertebrate nonmarine fauna. These rocks are believed to represent an estaurine-deltaic environment transitional between Miocene marine deposition and Pliocene continental deposition (Webb, S. D., and Woodburne, M. O., 1964, Geol. Soc. of Sacramento Guide Book and Field Trip to the Mt. Diablo Area, p. 76).

TOPOGRAPHIC QUADRANGLES

WITHIN THE SAN JOSE SHEET

AVAILABLE FROM THE U.S. GEOLOGICAL SURVEY

FEDERAL CENTER, DENVER, COLORADO 80225

1966

View southwest along the sinuous flat-topped Tuolumne Table Mountain. This mountain can be traced for more than 40 miles across the Mother Lode gold belt, gradually descending through the Sierra Nevada foothills at a gentle slope of approximately one degree.

The mountain is capped by ancient lava (approximately 10 million years old) which erupted from volcanoes then existing high in the Sierra Nevada. The lava flowed southwestward down a meandering river channel carved in soft sand and gravel. Erosion since that event has removed the surrounding soft sediments, leaving the relatively resistant lava standing high above the present landscape.

Photo by John S. Shelton.