Mount Shasta
Annotated Bibliography

Chapter 30

Science: Geology & Climate

Materials in this section are mostly scientific reports of the 20th Century. The more literary geological exploration accounts by the great 19th geologists, such as Josiah Dwight Whitney and Clarence King, will be found in Section 11. Mountaineering: 19th Century, though James Dwight Dana's 1841 geological observations of Mt. Shasta will be found in Section 9. Early Exploration: American Government Expeditions, 1841- 1860. The pioneering geological studies of 20th Century geologists Joseph Silas Diller and Howel Williams are well- represented here; they set the parameters for future study. Subjects studied by modern geologists on Mt. Shasta include petrology, glaciation, mineralogy, magnetization, ancient avalanches, mud slides, volcanic hazard potentials, soils, geothermal activity, earthquakes, gravity, radiometric dating of the rocks, water resources, and so on. Volcanic activity prediction is of course an important topic, but many of the studies relate more to basic questions of science, such as how plate tectonics work, or how Mt. Shasta lavas give clues to the composition of the inner earth.

Two contemporary geologists, Robert L. Christiansen and C. Dan Miller, have written a considerable amount of material about Mt. Shasta; their work is perhaps the most up-to-date reporting of the geologic evolution of Mt. Shasta. A few books of popular science which discuss Mt. Shasta, such as Stephen L. Harris's 1988 Fire Mountains of the West have been also been included as entries. A few entries concern climate. Note that Mt. Shasta is included in the 1992 Guinness Book of World Records for the greatest snowfall ever recorded from a single storm (the storm date was February 13-19, 1959).

The [MS number] indicates the Mount Shasta Special Collection accession numbers used by the College of the Siskiyous Library.

[MS407]. Anderson, Alfred T. Jr. **Evidence for a Picritic, Volatile-rich Magma Beneath Mt. Shasta, California**. In: Journal of Petrology. 1974. Vol. 15. Part 2. pp. 243-267. The author attempted to determine the magmatic origins of the andesitic lavas of the Mount Shasta region. He studied the mineral olivine found as crystals in many of the region's lavas. Using microphotographs of the crystals to illustrate his ideas, he has concluded that the melted silicate-glass inclusions and vapor halos found within the small olivine crystals themselves indicate a temperature of 1410 degrees Centigrade at the time of crystal growth and that the initial source melt from which the olivine crystals formed was volatile-rich. "Picritic" refers to the olivine-rich composition of the magma. 30. Science: Geology and Climate. [MS407].

[MS408]. Aune, Quintin A. **Glaciation in Mt. Shasta-Castle Crags**. In: California Division of Mines and Geology: Mineral Information Service . July, 1970. Vol. 23. No. 7. pp. 145-148. The author compares the glacial features of Castle Crags with those of Mt. Shasta. Widespread glaciation of the Pleistocene (i.e. ending 10,000 years ago) is clearly evident in the geomorphology of Castle Crags. Glaciers helped erode the softer serpentine type rocks away from the more resistant granitic rocks of Castle Crags. Why does Mt. Shasta not show nearly as much evidence as Castle Crags of widespread glaciation, since both places share similar amounts of rainfall and are so close to each other. The author states that: "The high Mt. Shasta volcano, dominating the skyline today northeast of Castle Crags, has numerous glaciers on its upper slopes today; yet, except for Avalanche Gulch and the Mt. Shasta Ski Bowl area, it is largely devoid of glaciated features. Since the annual rainfall at Mt. Shasta is similar to that in the Trinity Mountains, and it is much higher, how can it be so devoid of evidence of past glaciation? The answer is clearly one involving Holocene (recent, or younger than 10,000 years) volcanism. The present exposed surface of most of Mt. Shasta did not exist during the Pleistocene time" (p. 147). The article contains maps and diagrams to illustrate the various glacial features of Castle Crags and Mt. Shasta.

Note that the author also wrote an excellent review of the geology of Castle Crags in an article entitled "A Trip to Castle Crags" appearing in the same issue of "California Geology" (pp. 139-144). An aerial photograph of Mt. Shasta appears on the cover of this issue. 30. Science: Geology and Climate. [MS408].

[MS637]. Averill, Chas. Volney. **Preliminary Report on the Economic Geology of the Shasta Quadrangle**. In: Mining in California. Jan., 1931. Vol. 27. pp. 3-25. Describes the geology and mineral deposits around Mt. Shasta and half of eastern Siskiyou County. 40. Find List/30. Science: Geology and Climate. [MS637].

[MS444]. Bailey, Edgar H. 1914. **Geology of Northern California**. San Francisco, Calif.: California Division of Mines and Geology, 1966. For over 25 years the standard detailed reference on northern California geology. Several of the chapters help place Mt. Shasta within an historical geology context. Relevant chapters include: State Geologic Maps of California, by C.W. Jennings; Geology of the Klamath Mountains Province, by W.P. Irwin; Metamorphic and Granitic History of the Klamath Mountains, by G.A. Davis; Economic Deposits of the Klamath Mountains, by J.P. Albers; Geology of the Cascade Range and Modoc Plateau, by G.A. Macdonald; Economic Mineral Deposits of the Cascade Range, Modoc Plateau, and Great Basin Region of Northeastern California, by T.E. Gay, Jr.; Geology of the Sierra Nevada, by P.C. Bateman; Geology of the Coast Ranges of California, by B.M. Page; The Gravity Field in Northern California, by R.H. Chapman; Magnetic Data and Regional Structure in Northern California, by A. Griscom; etc. Extensive bibliographies are found at the end of each chapter. 30. Science: Geology and Climate. [MS444].

[MS2196]. Baker, M. B., Grove, T. L., and Price, R. **Primitive Basalts and Andesites from the Mount Shasta Region, N. California: Products of Varying Melt Fraction and Water Content**. Contributions to Mineralogy and Petrology. 1994. v. 118. pp. 111-129. 30. Science: Geology and Climate. [MS2196].

[MS431]. Baker, M. B., Grove, T. L., and Price, R. C. **Petrogenesis of Mt. Shasta, N. California Andesites by Fractional Crystallization and Mixing**. In: Geological Society of America. The Geological Society of America, 97th Meeting, Abstracts with Programs. Sept. 1984. Vol. 16. No. 6. 30. Science: Geology and Climate. [MS431].

[MS278]. Baker, Michael Baldwin. **Evolution of Lavas at Mt. Shasta Volcano, N. California: An Experimental and Petrologic Study**. Massachusetts Institute of Technology, 1988 (Thesis, Ph.D.). 2 vols. 430 pp. Presents a sophisticated mathematical theory of the physical and chemical processes of lava formation. Estimates what different percentages of melting of the assumed constant chemical composition mid-ocean ridge basalts under Mt. Shasta were necessary to explain the formation of various lava types found on Mt. Shasta. The author's conclusions suggest that primary lavas of different compositions have mixed with remelted lavas and with remelted rocks of high magnesium-iron content underlying Trinity ophiolite suite. Comparisons are made to the lavas of other volcanoes. Bibliographies are included: pp. 43-47; pp. 162-174. 30. Science: Geology and Climate. [MS278].

[MS2078]. Beebe, John C. **Report on Investigations for Controlling the Flow of Mud and Debris from the Southeast Slope of Mt. Shasta**. San Francisco, CA: U.S. Forest Service, 1933. 25 pp. The author was senior civil engineer with the Forest Service. Contents: Resume; Location; History of the mud flows; Damage of the mud flows; Causes of the mud flows; Previous Investigations; Possible Preventative Measures; Analyses of Various Projects; Annual Maintenance; Recommendations. During 1924, a large mud flow deposited over 7,000,000 cubic yards of debris on the south slopes of Mt. Shasta, and an estimated 1,000,000 cubic yards of debris entered the McCloud River and muddied the waters of the Sacramento River all the way south to Colusa in the Sacramento Valley. The possibility of future mud flows of significant size called forth the need to study possible countermeasures. The main purpose of the report is to outline the possible means of controlling the Mud Creek summer mud flows. Contains an extensive history of the Mud Creek mud flows. The authors present historical accounts going back to the 1870's, and quote an earlier report that says: "The 1924 outbreak was not the first known flood to do damage. In 1875 Mr. H. B. Ream, a civil engineer from Mt. Shasta City, noted that the entire country from near where McCloud now stands to some distance beyond Mud Creek was covered with sand. There was but very little brush or small trees in the sand covered area. About 1879, Mr. Ream made observations on a mud flow which he thinks was larger than the one of 1924, as sand was deposited as far west as the present site of McCloud. The main body of the flow went through Squaw Creek for about one week and then shifted back to the Mud Creek channel. The flow of 1879 did not contain nearly as many boulders as did the one of 1924. Mr. Ream states that as long as he can remember there has been a flow in Mud Creek during the middle of summer and that Indian tales indicate that it always has been an annual affair." (p. 5). "Nearly everyone at all familiar with the outbreaks is of the opinion that they are due to a winter of but little snowfall and the rapid melting of the Konwakiton Glacier during the following

summer." (p.8) This report summarizes explanations of the causes of the mud flows. 30. Science: Geology and Climate. [MS2078].

[MS270]. Bennett, John H., Sherburne, Roger W., Cramer, Chris H., Chesterman, Charles W., and Chapman, Rodger H. **Stephens Pass Earthquakes: Mount Shasta - August 1978**. In: California Geology. Feb., 1979. Vol. 2. No. 2. pp. 27-34. The report explains that Mount Shasta has historically been a relatively quiescent seismic location. But in August of 1978 a very significant series of multiple earthquakes caused surface fractures and graben-like features to appear on the landscape east of Mount Shasta. Photos of these features are included. Concern was expressed that a new period of volcanic activity was beginning. Using magnetic and gravity studies, a team of geologists concluded that the seismic activity was associated with a north-south trending fault, called the Stephens Pass Fault, and that "there is no evidence to indicate that this current episode is indicative of any impending renewal of volcanic activity associated with Mount Shasta, some 25 km distant" (p. 34). A bibliography is included (p. 34). (see also McNutt "Medicine Lake Highland September 1888 Earthquake Swarm"

Front cover aerial photograph of Mt. Shasta is unusual in that it makes the Mud Creek steam look like a main river flowing from the timberline. 30. Science: Geology and Climate. [MS270].

[MS418]. Bertoldi, Gilbert. L. **Wastewater Infiltration Near the City of Mount Shasta, Siskiyou County, California**. Sept., 1973. Prepared in cooperation with Siskiyou County Flood Control and Water Conservation District, Calif. Outlines the problems to the Mount Shasta City sewage treatment plant caused by A) a liquid inflow rate, probably consisting mostly of unexpected ground water, at a rate nearly three times the expected level, entering into the sewage treatment ponds, and B) the existence of nearly impermeable layers of tuff in the glacial material under the sewage ponds. These impermeable layers lower dramatically the percolation rates of the system. Contains many charts and graphs. 30. Science: Geology and Climate. [MS418].

[MS415]. Blakely, R. J. and Christiansen, Robert L. **The Magnetization of Mount Shasta and Its Implications for Virtual Geomagnetic Poles Determined from Sea Mounts**. In: Journal of Geophysical Research. 1978. Vol. 83. B12. pp. 5971-5978. 30. Science: Geology and Climate/40. Find List. [MS415].

[MS2100]. Blumen, William and Hart, John E. **Airborne Doppler Wind Field Measurements of Waves in the Lee of Mount Shasta**. In: Journal of the Atmospheric Sciences. 1984. v. 45. pp. 1571-1583. A study performed on Aug. 28, 1984. As background for the study, the authors state that for isolated objects, like Mt. Shasta: “There is a tendency for fluid to flow around the obstacle in two dimensional planes up to a certain height that is below the level of the peak. Above the layer where the characteristic horizontal bifurcation of the flow occurs, fluid does tend to flow over the peak in two-dimensional vertical planes. Brighton’s experiments showed that motion in the lee may be quite complex, exhibiting variously shaped eddies, shed and separation.” Using Doppler lidar wind measuring systems the authors present their results as observations compared with theory models. Advanced mathematics are used to discuss the results. Lidar is a light-based radar type technology. 30. Science: Geology and Climate. [MS2100].

[MS401]. Bonham, Harold F. Jr. and Sharp, John Van Alstyne. **Areal Geology of Mount Shasta and Vicinity, California**. In: Geological Society of America. Bulletin of the Geological Society of America . Dec. 1958. Vol. 69. No. 12, pt. 2. p. 1675. An abstract. The authors worked for the Southern Pacific Land Company. They mapped the areal geology of nine townships as part of a mineral exploration program. Note that the word 'areal' denotes 'surface.' 30. Science: Geology and Climate. [MS401].

[MS428]. Bown, T. M., Love, J. D., Crandell, Dwight Raymond, Miller, C. Dan, Glicken, H. X., Christiansen, Robert L., and Newhall, C. G. **Catastrophic Debris Avalanche from Ancestral Mount Shasta Volcano, California: Discussion and Reply**. In: Geology. 1984. Vol. 12. No. 12. pp. 743-744. One of several separately published "Discussion and Reply" articles concerning the original paper from Geology, Vol. 12, p. 143-146. 30. Science: Geology and Climate/40. Find List. [MS428].

[MS429]. Bown, T. M., Love, J. D., Crandell, Dwight Raymond, Miller, C. Dan, Glicken, H. X., Christiansen, Robert L., and Newhall, C. G. **Catastrophic Debris Avalanche from Ancestral Mount Shasta Volcano, California: Discussion and Reply**. In: Geology. 1985. Vol. 13. No. 1. pp. 79-80. Bown and Love suggest a northwest Wyoming "Enos Creek-Owl Creek" debris-avalanche of an estimated 185 cubic kilometers was considerably greater in volume than the Mount Shasta debris-avalanche of an estimated 26 cubic kilometers (p. 79). Crandell et al. reply that it is indeed

possible, though difficult to determine, that one or more episodes of the Enos Creek 'detachment-mass' was larger than the Mt. Shasta debris avalanche (p. 80). 30. Science: Geology and Climate. [MS429].

[MS640]. California Debries Commission. **Table of Precipitation and Temperature at McCloud and Sisson:1901-1926**. San Francisco, Calif.: 1926. Source: Stuhl I 40. Find List/30. Science: Geology and Climate. [MS640].

[MS417]. **Aeromagnetic Map of Mt. Shasta Area [map]**. In: California Department of Conservation, Division of Mines and Geology. **Aeromagnetic Maps (Contours Only) In Five Areas of the State: of the Mt. Shasta Area, California [maps]**. Sacramento, Calif.: California Department of Conservation, Division of Mines and Geology, 1978. The maps in this packet are: A--Modoc Area; B--Mt. Shasta Area; C--Eureka-Cape Mendocino Area; D--North 1/2 of the Great Valley; E--North Coastal Area (Northeast of Ukiah). 30. Science: Geology and Climate. [MS417].

[MS402]. California Department of Water Resources. **Mt. Shasta City-Dunsmuir Area Investigation**. In: California Department of Water Resources Bulletin, Preliminary Edition March 1963. Final edition 1964. Bull. 100. This is a major study on the impacts of the proposed Box Canyon Dam. Contains a copy of a letter explaining the scope of the report: "The bulletin, published in preliminary form in March 1963 summarizes the results of the two year investigation aimed at determining engineering feasibility and economic justification of a water development program, which would include a dam and reservoir on the Sacramento River about two miles southwest of Mt. Shasta City at the Box Canyon site." Contains many maps and charts. 130 pages of text. 30. Science: Geology and Climate. [MS402].

[MS406]. California Division of Mines and Geology. **Bouguer Gravity Map of California: Weed Sheet [map]**. Sacramento, Calif.: California Division of Mines and Geology, 1973. 30. Science: Geology and Climate. [MS406].

[MS2188]. Callaghan, Carol J. **Debris Flow Initiation Conditions on Mount Shasta, California**. Reno, NV: University of Nevada, Reno, 2000 Thesis (M.S.) for the degree of Master of Science in Geological Engineering. Entire abstract from author's introduction: "Mount Shasta has experienced frequent, extensive debris flow events throughout its history. Over the last century, the largest events have been documented to occur during warm, heavy rainfall in the late summer, especially following a mild winter. Debris flows have redistributed large quantities of glacial moraine and pyroclastic materials to the lower flanks of the mountain and carved steep, deep canyons on glacier headed drainages. Canyon walls are made up of cohesionless materials and stand at or near their friction values. Slope failures mobilize into flows when the weight of the upper soil layer is increased by the addition of water, to the point where the slope cannot support the additional load, and by pore pressure flashing into positive values as the water penetration rate exceeds the hydraulic conductivity of the soil. Permeablity rates are too variable to reliably predict major debris flows from infall intensity and duration models" (p.i). Contains geographical, geological, and historical background for several drainages. Occasional bits of interesting place-name information; especially mentions a boulder above Caldwell Creek which reads 'H. A. Caldwell Oct. 1895' and is associated with Caldwell Springs and creek. (p.13). Water content data, particle size, soils classification, etc., are given. Stability analysis is given with reference to safety levels. Bibliography pp. 77-79. 30. Science: Geology and Climate. [MS2188].

[MS695]. Carter, Ernest S. **Shastina 1984: A Photographic Essay**. In: California Geology. Dec., 1984. pp. 273-278. Consists of 12 unique and valuable research photographs of Shastina's rock and snow features. Text describes the features in the photographs. Note that the article is preceded by a one page "geologic note," introducing the following article by Carter. The "geologic note" is entitled "Shastina--Volcanic Cone of Mount Shasta" (p. 273). 30. Science: Geology and Climate. [MS695].

[MS272]. Carter, Ernest S. **Mount Shasta: Challenge of the Mountain**. In: California Geology. Sept., 1987. Vol. 40. No. 9. pp. 210-211. Consists of a one-page poetical prose account of a climb to the summit of Mount Shasta, plus photographs by the author. "Dawn! The crest is reached, crampons bite into wind-blown ice" (p.211). 30. Science: Geology and Climate. [MS272].

[MS436]. Chadwick, W. W. Jr., Iwatsubo, E. Y., Swanson, D. A., and Ewert, J. W. **Measurements of Slope Distances and Vertical Angles at Mount Baker and Mount Rainier, Washington, Mount Hood and Crater Lake, Oregon, and Mount Shasta and Lassen Peak, California, 1980-1984**. United States Geological Survey, 1985. From the Abstract: "Personnel of the U. S. Geological Survey's Cascade Volcano Observatory established trilateration networks

at Mount Baker, Mount Rainier, Mount Hood, Crater Lake, Mount Shasta, and Lassen Peak in 1980-1984. These networks are capable of detecting changes in slope distance of several centimeters or more. The networks were established to provide baseline information on potentially active volcanoes and were designed along guidelines found useful at Mount St. Helens. Periodic reoccupation of the networks is planned as a part of the overall monitoring program of Cascade volcanoes. Methodology, slope distance and vertical angle data, maps of the networks, and bench mark descriptions are presented in this report. Written benchmark descriptions are augmented by photographs, which we have found by experience to be very useful in relocating the marks. All repeat measurements at the six volcanoes are probably within measurement error."

In the Introduction the authors explain that "Magma rising beneath a volcano forcefully displaces the surrounding rock, and the resulting deformation can be measured at the ground surface. Since about 1910, attempts have been made to measure this deformation in order to help understand magmatic processes and predict eruptions at active volcanoes..." The benchmarks affixed at many locales about Mount Shasta can be cross-sighted and thus be used to detect bulges and other deformations indicative of internal magmatic forces. 30. Science: Geology and Climate. [MS436].

[MS434]. Champion, D. E. and Christiansen, Robert L. **Occurrence of Self-Reversing Remnant Magnetization in Pyroclastic Deposits of Mt. Shasta, California**. In: Eos: Transactions, American Geophysical Union. 1984. Vol. 65. No. 45. 1984 Fall Meeting Abstracts. 30. Science: Geology and Climate/40. Find List. [MS434].

[MS702]. Chesterman, Charles W. **Volcanism in California**. In: California Geology. Aug., 1971. Vol. 24. No. 8. pp. 138-147. This article contains an overview of California's volcanic past. There is an extensive glossary of volcanic vocabulary. Terms like plug dome, ash flow, and flood basalts are defined for the reader. Mt. Shasta is mentioned several times, and the author lists an eruption of 1857 for "Mt. Shasta or Mt. Lassen" (p. 141). 30. Science: Geology and Climate. [MS702].

[MS274]. Chesterman, Charles W. and Saucedo, George J. **Cenozoic Volcanic Stratigraphy of Shasta Valley**. In: California Geology. Apr., 1984. Vol. 37. pp. 67-74. Summarizes the findings of radiometric dating of the rocks of Mount Shasta and the Shasta Valley. The project was carried out as part of a U.S.G.S. revision of the Weed Quadrangle map for a new Regional Geologic Map Series. The classic studies of the region's rocks had been done in the late 1940s prior to the advent of radiometric dating techniques.

The authors find that: "Mount Shasta is a classical example of a stratovolcano built up by flows and pyroclastics of the high Cascade Group. When viewed from a distance Mount Shasta has the appearance of a simple volcanic cone whose principal vent would be near its summit. However, recent studies show that Mount Shasta is a compound stratovolcano that developed as the result of at least four major episodes of andesitic cone building eruptions (Christiansen and others, 1977; Miller, 1978). The oldest cone, the Sargents Ridge cone, which forms the south flank of Mount Shasta, consists of pyroclastic deposits and flows of dacite, pyroxene andesite, and basalt all of which are probably older than 100,000 years. The next oldest, the Misery Hill cone, includes flows of andesite and basalt, domes of dacite, and pumice flows that issued from vents centered near the present summit of Mount Shasta. The last eruptive deposit of the Misery Hill cone overlies glacial moraines believed to be between 10,000 and 12,000 years old (Christiansen and others, 1977)."

"The formation of Shastina was the third episode in the development of Mount Shasta. Shastina is somewhat distant from the other three cones. It consists largely of dark pyroclastic flows. One pyroclastic flow issued from the west base of Shastina and spread out in a fan-shaped deposit that extends to a point several miles northwest of Weed. On the basis of various age-dating techniques, including relationships with glacial deposits estimated to be between 12,000 and 10,000 years old and carbon fourteen (C 14) dating of charcoal fragments, it is believed that this youngest Shastina pyroclastic flow occurred about 9,230 +/- 300 years ago (Miller, 1978)."

"The most recent cone building episode in the development of Mount Shasta was the formation of the summit cone, and large parts of the north and northeast flanks of the stratovolcano. Hotlum cone is a dome that fills the summit crater from which erupted flows of andesite and pyroclastic rocks. Pyroclastic deposits from Hotlum cone have also been found as narrow flow-like deposits low on the northwestern and northeastern slopes of Mount Shasta. It is estimated that most of the materials from Hotlum cone are less than 3,000 to 4,000 years old. The summit dome, which still has active fumaroles and acidic hot springs, was probably the site of a minor eruption that occurred 200 years ago (Christiansen and others, 1977, p. 19)." 30. Science: Geology and Climate. [MS274].

[MS2197]. Christiansen, R. L. and Miller, C. D. **Mount Shasta and vicinity**. Chapin, C. E. and Zidek J. eds. **Field excursions to volcanic terranes in the western United States, Volume II: Cascades and Intermountain West: New Mexico Bureau of Mines and Mineral Resources Memoir 47**. 1989. pp. 216-223. Part of a chapter by Muffler, L.J.P., Bacon, C.R., Christiansen, R.L., Clynne, M.L., Donnelly-Nolan, J.M., Miller, C.D., Sherrod, D.R., and Smith, J.G.

Excursion 12B: South Cascades arc volcanism, California and southern Oregon. 30. Science: Geology and Climate. [MS2197].

[MS2198]. Christiansen, R. L. and Miller, C. D. Is This a Dangerous Volcano? 1997. http://volcanoes.usgs.gov/Hazards/Where/ShastaDanger/ShastaDanger.html 30. Science: Geology and Climate. [MS2198].

[MS51]. Christiansen, Robert L. **Volcanic Hazard Potential in the California Cascades**. In: Martin, Roger C. and Davis, James F. **Status of Volcanic Prediction and Emergency Response Capabilities in Volcanic Hazard Zones of California: Proceedings of a Workshop on Volcanic Hazards in California, December 3-4, 1981, Sacramento California**. Sacramento, Calif.: California Department of Conservation, Division of Mines and Geology, 1982. pp. 41-59. A study of Mount Shasta, Medicine Lake Volcano, and Mount Lassen. Contains detailed information on the Mount Shasta and Medicine Lake volcanoes, those two volcanoes forming an east-west axis of volcanic activity. One very important and interesting focus of the report is the existence of an earthquake zone halfway between these two mountains, centered in the Stephens Pass region. This zone has seen many unusual swarms of earthquake activity as of 1980. Christiansen is one of the U.S.G.S. geologists who is most familiar with Mount Shasta, and many of the things he has to say about Mount Shasta are the result of his own research. Some of his opinions will not be found published anywhere else but in this publication.

Contains an excellent map showing what parts of present-day Mount Shasta are attributed to remnants of each of the four identified ancestral Mount Shasta cones known to have existed at times during the last 450,000 years (p. 41). Other maps and diagrams of Mount Shasta are included. The article also contains a good bibliography of geological books and reports relevant to the geology of Mount Shasta (pp. 58-59) 30. Science: Geology and Climate. [MS51].

[MS437]. Christiansen, Robert L. **The Mount Shasta Magmatic System**. In: Guffantu, Marianne and Muffler, L. J. Patrick. **Proceedings of the Workshop on Geothermal Resources of the Cascade Range**. United States Geological Survey, 1985. pp. 31-33. Two-page overview of Mt. Shasta's geologic history, with an emphasis on the anomalous magma system characteristics of the Mt. Shasta-Medicine Lake volcanoes vis-a-vis the Cascade Range in general.

The author begins by stating: "The still active compound stratocone of Mount Shasta, 14,162 feet high and more than half a million years old, has grown mainly during several distinct episodes of cone building from single central vents, each of which was active only briefly - possibly only a few hundred years (Christiansen and Miller, 1976; Christiansen and others, 1977; Christiansen, 1982). Four such cone-building episodes younger than about 250,000 years have been recognized, two of them Holocene; major cone building was separated by longer, predominantly erosional periods during which smaller volumes of lava were added to the cones. In addition, an older but similar edifice at the site of Mount Shasta was largely destroyed by a huge volcanic sector avalanche about 300,000 years ago (Crandell and others, 1984). The oldest exposed rocks of Mt. Shasta, on its west flank and having a K/R age of about 590,000 years (G. B. Dalrymple, written commun., 1979), probably are a remnant of that earlier edifice" (p. 31).

The author concludes with a discussion of Mt. Shasta's long-period eruption cycle and the probability of a 'hidden' hydrothermal circulation system feed by extensive snow pack and summer melting. 30. Science: Geology and Climate. [MS437].

[MS412]. Christiansen, Robert L., Kleinhampl, F. J., Blakely, R. J., Tuchek, E. T., Johnson, F. L., and Conyac, M. D. **Resource Appraisal of the Mt. Shasta Wilderness Study Area, Siskiyou County, California**. Menlo Park, Calif.: United States Geological Survey, 1977. 53 pp. 30. Science: Geology and Climate/40. Find List. [MS412].

[MS439]. Christiansen, Robert L. and Miller, C. Dan. **Volcanic Evolution of Mt. Shasta, California** . In: Geological Society of America, Cordilleran Section, 72nd Annual Meeting, Abstracts with Programs. Feb., 1976. Vol. 8. No. 3. pp. 360-361. A summary of the four major mountain-building episodes: "Mt. Shasta consists of four overlapping cones that formed over a period of more than 100,000 years. Each cone was built mainly of pyroxene-andesite lava flows, block and ash flows, and lahars; only late eruptions at each cone were more silicic. The dissected Sargents Ridge cone, the oldest, overlies basaltic andesites. Its last summit eruptions produced hornblende-pyroxene andesite and a hornblende dacite dome and flow. An old till and strongly developed soils indicate a pre-Tahoe age for the Sargent's Ridge cone. Building of the Misery Hill cone on the north flank of the Sargents Ridge cone culminated with emplacement of a hornblende-pyroxene andesite dome at the summit. The cone formed after the Tahoe Glaciation but was eroded by Tioga glaciers; rock-glacier deposits of early post-Tioga(?) age are overlain by pumice flows of the Red Banks, the youngest Misery Hill deposit. After these pumice flows, the Shastina cone formed on the west flank of the Misery Hill cone. At least five pyroxene-hornblende dacite domes erupted at Shastina's summit, and at least four of them produced block-and-

ash flows to the west, the oldest of which has a C 14 age of 9,230 plus or minus 300 years. The Hotlum cone, forming Mount Shasta's summit and undissected north and northeast flanks, postdates early neoglacial deposits and is overlain by no glacial deposits older than a few centuries; weak soil oxidation and lack of cirques also indicate an age of less than a few thousand years. Solfataric activity suggests that the hornblende-pyroxene andesite dome at the summit is still cooling. Flank vents, some along a linear north-south zone, have erupted dacite domes and olivine-andesite flows and cinder cones. Most are of Sargent's Ridge age, but some are younger." 30. Science: Geology and Climate. [MS439].

[MS427]. Christiansen, Robert L. and Tuchek, E. T. **Mount Shasta Wilderness Study Area, California**. In: **Wilderness Mineral Potential: Assessment of Mineral-Resource Potential in U.S Forest Service Lands Studied 1964-1984**. United States Geological Survey, 1984. pp. 309-311. 30. Science: Geology and Climate. [MS427].

[MS409]. Condie, K. C. and Swenson, D. H. **Compositional Variation in Three Cascade Stratovolcanoes; Jefferson, Rainier, and Shasta**. In: Bulletin Vulcanologique. 1974. Vol. 37. No. 2. pp. 205-230. This study concludes that some melting of the underlying mafic rocks of the subduction zone might explain why each mountain exhibits a number of individual compositionally coherent eruptive lava groups. 30. Science: Geology and Climate. [MS409].

[MS936]. Cooke, William Bridge 1908-1991. **Snow Bridge Covers Stream in Mud Creek for over One Mile**. In: Mount Shasta Herald. Mt. Shasta, Calif.: Aug. 17, 1939. p. 1. During the course of a botanizing excursion Cooke confirms the reported existence of a snow bridge covered with tons of rock and sand: "The bridge is so deep that it completely muffles the sound of the creek. It may have resulted from the heavy snows of the past several years, but, in any event, a few hot days in the canyon with a few warm nights may start the melting which will produce another mud flow..." 30. Science: Geology and Climate. [MS936].

[MS469]. Cooke, William Bridge 1908-1991. **Cooke Finds Upper Mud Creek Canyon Bridged**. In: Mount Shasta Herald. Mt. Shasta, Calif.: Sept. 11, 1941. Not so much about the Mud Creek snow bridge as it is about Cooke's adventurous descent down a ridge between Mud Creek and Squaw Valley. 30. Science: Geology and Climate. [MS469].

[MS2148]. Cooper, A. W. and P. D. Kelleter. **The Control of Forest Fires at McCloud, California**. [Washington, D. C.]: United States Department of Agriculture, 1907. Forest Service, Circular 79. 16pp. This is a study made in 1904 of fire protection planning for the lands of the McCloud River Company. The object of the study was to devise a practical scheme of fire protection, particularly for the logged lands, on which fire is most prevalent. This was a cooperative agreement between the Forest Service and the company. Fire lines, patrols, tool stations, and other measures, were recommended. General applications of the results of this study as applied to other forests are discussed. Important study because it resulted from the perception that logged lands on Mt. Shasta (as a trial location), needed to be dealt with in new ways 30. Science: Geology and Climate. [MS2148].

[MS2199]. Crandell, D. R. **Gigantic Debris Avalanche of Pleistocene Age from Ancestral Mount Shasta Volcano, California, and Debris-Avalanche Hazard Zonation. U.S. Geological Survey Bulletin 1861**. 1989. 32p. 30. Science: Geology and Climate. [MS2199].

[MS404]. Crandell, Dwight Raymond. **Hot Pyroclastic-Flow Deposits of Probable Holocene Age West of Mount Shasta Volcano, California: Abstract**. In: Geological Society of America Bulletin. 1973. Vol. 5. No. 1. p. 28. In Cordilleran Section, 69th Annual Meeting 30. Science: Geology and Climate/40. Find List. [MS404].

[MS426]. Crandell, Dwight Raymond, Miller, C. Dan, Glicken, H. X., Christiansen, Robert L., and Newhall, C. G. **Catastrophic Debris Avalanche from Ancestral Mount Shasta Volcano, California**. In: Geology. Mar. 1984. Vol. 12. No. 3. pp. 143-146. The publication of this paper represents a milestone in the understanding of the geology of Mt. Shasta and of the Shasta Valley. The authors state that: "The mounds and hills of Shasta Valley have puzzled geologists for more than half a century." The puzzle of the origin of the mounds has for the most part been solved by the authors. They state in their abstract that: "A debris-avalanche deposit extends 43 km northwestward from the base of Mount Shasta across the floor of Shasta Valley, California, where it covers an area of at least 450 square kilometers. The surface of the deposit is dotted with hundreds of mounds, hills, and ridges, all formed of blocks of pyroxene andesite and unconsolidated volcaniclastic deposits derived from an ancestral Mount Shasta. Individual hills are separated by flat-topped lahar like deposits that also form the matrix of the debris avalanche and slope northwestward about 5 m/km. Radiometric ages of

rocks in the deposit and of a postavalanche basalt flow indicate that the avalanche occurred between about 300,000 and 360,000 years ago. An inferred average thickness of the deposit, plus a computed volume of about 4 cubic km for the hills and ridges, indicate an estimated volume of about 26 cubic km, making it the largest known Quaternary landslide on earth." Note that subsequent published comments to this paper suggest that there have been larger landslides on earth (see Bown et al. 1984, and Wolfe 1984). Note that James Dwight Dana in 1841 questioned the origin of these mounds (see Dana 1849, "Notes..." p. 248). 30. Science: Geology and Climate. [MS426].

[MS141]. Crandell, Dwight Raymond and Nichols, D. R. **Volcanic Hazards at Mount Shasta, California**. Washington, D.C.: U.S. Geological Survey, Department of the Interior, 1987. U.S. GPO: 1987 #194-389. 21pp. Public information pamphlet. Designed to explain how to prepare for and cope with an eruption of Mount Shasta. States that: "Studies by geologists show that Mount Shasta has erupted 10 or 11 times during the last 3,400 years and at least 3 times in the last 750 years. Mount Shasta does not erupt at regular intervals, but its history suggests that it erupts at an average rate of roughly once per 250 to 300 years. If the behavior of the volcano has not changed, the chance is 1 in 25 to 30 that it will erupt in any one decade and 1 in 3 or 4 that it will erupt within a person's lifetime" (p. 3).

Contains one of the best photographs available illustrating the modern theory that the small hills between Weed and Montague were formed by a very large mud and rock slide from an ancient eruption of Mount Shasta (p. 12).

Contains colorful maps of the zones most likely to be affected by future ash hazards, pyroclastic flows and blasts, and mud flows (pp. 14-18). This pamphlet is based on the more complete study, U.S.G.S. Bulletin 1503, entitled Potential Hazards from Future Eruptions in the Vicinity of Mount Shasta Volcano, northern California, by C. Dan Miller. 30. Science: Geology and Climate. [MS141].

[MS2200]. Crowley, J. K. Zimbelman D. R. and Mars J. C. **Mapping Hydrothermally Altered Rocks with AVIRIS Imagery of Mount Shasta, California**. EOS, Transactions American Geophysical Union. 1999. v. 80. no. 46. p. F1151-F1152. 30. Science: Geology and Climate. [MS2200].

[MS177]. Dawson, Paul. **National Association of Geology Teachers, Northern California Field Trip**. 1974. Unpublished typewritten manuscript. Short paper outlining some of the general geological features of Mount Shasta and the region around Mount Shasta, including Castle Crags, Pluto Cave, and Pythian Cave. Includes an itinerary for a field trip group during the Fall of 1974. Paul Dawson was the geology instructor at the College of the Siskiyous for more than twenty years. 30. Science: Geology and Climate. [MS177].

[MS2152]. de la Fuente, Juan and Stephen Bachmann. **Whitney debris flow of August 20, 1997: Triggering mechanisms, transport processes, and debris sources**. In: Hirt, William H. editor. **Across the Klamath/Cascade Frontier: A Guidebook prepared for the National Association of Geoscience Teachers Far Western Section Fall Field Conference Sept. 17-19, 1999**. Weed, CA: College of the Siskiyous, Division of Natural and Applied Sciences, 1999. pp. 54-68. The guidebook as a whole contains four field trips. Field Trip 1A: E. Timothy Wallin: Geological overview of a mid-Paleozoic intraoceanic convergent margin, eastern Klamath Mountains, California. pp. 1-31. Field Trip 1B:William H. Hirt. Quaternary volcanism of Mount Shasta and vicinity, Siskiyou County, California pp. 32-53. Field Trip 2A: Juan de la Fuente and Stephen Bachmann. Whitney debris flow of August 20, 1997-Triggering mechanisms, transport processes, and debris sources pp. 54-68. Field Trip 2B: Susan M. Cashman, Don Elder, and Harlan Goldstein. Detachment faulting in the Klamath Mountains, northern California pp. 69-87. Field trip itinerary for each trip included in page numbers. An historical and geological analysis of the major debris flow on Mt. Shasta, includes maps, photographs, and a field trip itinerary. The debris flow buried a 600 m section of California Highway 97 about 1,500 meters west of the Whitney Creek culvert to a depth of about 1.5 meters. Includes historical information on the advance of the Whitney glacier. Includes a beautiful color map of deposits from the 1985, 1994, and 1997 debris flows in Whitney and Bolam Creeks on the northern flanks of Mount Shasta (p. 57) 30. Science: Geology and Climate. [MS2152].

[MS951]. Dickson, Bruce Anderson 1917. **A Chronosequence of Soil and Vegetation on Recent Mud-flow Deposits on the Lower Slopes of Mount Shasta California**. Berkeley, Calif.: University of California, Berkeley, June, 1952 (Thesis, Ph.D.). Source of citation: Melvyl. 30. Science: Geology and Climate/40. Find List. [MS951].

[MS396]. Diller, Joseph Silas 1850-1928. **Rocks of Mount Shasta and Vicinity**. In: Science: An Illustrated Journal. May 2, 1884. Vol. 3. No. 65. pp. 551-552. Contains a summary of J. S. Diller's study of thin sections of Mt. Shasta's rocks. Diller collected rock samples on Mt. Shasta in 1883. 30. Science: Geology and Climate. [MS396].

[MS267]. Diller, Joseph Silas 1850-1928. **Mount Shasta, A Typical Volcano**. In: National Geographic Society. **The Physiography of the United States**. New York: American Book Co., 1896. pp. 237-268. First published in 1895, National Geographic Society Monographs. Vol. 1, No. 8. This is one of the acknowledged 19th century classics of Mount Shasta geologic studies. But the report, written for the general public, is generalized, and by modern standards its analysis of lava types and glaciers is very simple. What perhaps best characterizes Diller's report is his insistence on explaining the basics. Thus he begins his report with an analogy to the passage of trees and animals from birth to death and around again: "As with living things, so also with the glades and the hills, the valleys and the mountains. All are ever changing in course either of construction or of destruction, or of both. Each has its history more or less complete, embracing a beginning stage, a stage of maturity, and a stage of decadence. Mount Shasta, a typical large volcano, is beyond the prime of its life. It is in the decline of its maturity. It has passed from a stage of vigorous growth into one of decadence, and it is just beginning to show clearly the ravages of time" (p. 237).

The report covers the mountain's location, shape and size, composition and structure, coulees, lava types, lava caves, meteorology, glaciers, springs, streams, falls, and more. J. S. Diller was one of the giants of West Coast geology. In 1898 C. Hart Merriam named the great canyon on Shastina as "Diller Canyon," in honor of Diller's contributions to the geology of Mount Shasta. 30. Science: Geology and Climate. [MS267].

[MS559]. Diller, Joseph Silas 1850-1928. **Description of the Redding Quadrangle**. In: United States Geological Survey. **Geologic Atlas of the United States: Redding Folio, California**. Washington, D. C.: United States Geological Survey, 1906. Department of the Interior. U.S.G.S. Charles D. Walcott, director. Contains fourteen folio-size pages of text, three folio maps, and one columnar section. Numerous mentions of Mt. Shasta as the source of rivers, creeks, and lava flows. Although the Redding Quadrangle as mapped by the U.S.G.S. technically lies to the south of the Mt. Shasta region, Diller's commentary is nonetheless relevant to the rocks which lie under the present base of Mt. Shasta. This is a very interesting folio-size book on the local geology, written by the man who did the first modern geologic studies of Mt. Shasta. Diller Canyon on the Shastina cone of Mt. Shasta was named in honor of J. S. Diller by C. Hart Merriam in 1898 (see Merriam 1899). 30. Science: Geology and Climate. [MS559].

[MS180]. Diller, Joseph Silas 1850-1928. **Guidebook of the Western United States; part D.: The Shasta Route and Coast Line**. Washington, D. C.: Government Printing Office, 1915. J. S. Diller was one of the eminent geologists of the Pacific states; 'Diller Canyon' on the west side of Mount Shasta's Shastina cone was named by C. Hart Merriam in honor of the geologist. The "Shasta Route" was the name of the inland railroad route between Seattle and San Francisco. The guidebook was written for the railroad tourist. Each section of the route is discussed town by town, or landmark by landmark, and is accompanied by a fold-out topographic sheet map. Sheet Number 8 covers from Hornbrook to Castle Crags, and includes Mount Shasta. A full page of text (p. 62) is devoted to Mount Shasta and "Sugar Loaf" [Black Butte]. Excellent photographs of Mount Shasta are included. The entire discussion of the Mount Shasta region is worthwhile, and includes details not readily available in other books. The reader benefits from Diller's long and detailed familiarity with the region. For example, Diller mentions that a salt well was once operated near the Shasta River, and he mentions the little known Oxone Springs, near Shasta Springs. The following headings are used for the discussions: Hornbrook; Ager; Montague; Gazelle; Edgewood; Weed; Summit; Sisson; Shasta Springs; Dunsmuir; Castella; Sims; and Lamoine. 30. Science: Geology and Climate. [MS180].

[MS560]. Diller, Joseph Silas 1850-1928. **Mount Shasta - Some of its Geologic Aspects**. In: Mazama: A Record of Mountaineering in the Pacific Northwest. Dec., 1915. Vol. 4. No. 4. pp. 11-16. A brief and general account of Mt. Shasta's geology, with excellent full-page photographs of the mountain's features. Diller worked with a party led by C. E. Dutton in 1883, though note that another group led by Gilbert Thompson was also working at Mt. Shasta that year. Diller states that: "In 1883 Capt. C. E. Dutton ...made a reconnaissance of the range, beginning with Lassen Peak and Mount Shasta in California. We spent two days on the slopes of the latter visiting Shastina and the Whitney glacier.....The following summer (1884) Eugene Ricksecker of the U.S. Geological Survey made a special topographic contour map of the mountain and the writer studied its geology for a model to be sent to the New Orleans Exposition. The model was later exhibited at the National Museum in Washington..." (p. 13).

The eminent geologist J. S. Diller has written more fully on the subject of Mt. Shasta's geology (see Diller 1896). 30. Science: Geology and Climate. [MS560].

[MS395]. Donnelly-Nolan, Julie M., Evans, John R., and Walter, Stephen R. **Crustal Subsidence, Seismicity, and Structure Near Medicine Lake Volcano, California**. In: Journal of Geophysical Research. Sept. 10, 1991. Vol. 96. No. B.10. pp. 16,319-16,333. Note that Medicine Lake Volcano is a very large shield volcano located about 50 kilometers east-north east of Mt. Shasta. According to the authors, the volume of the volcano is estimated to be at least 600 cubic

kilometers, making it the largest volcano by volume in the Cascade Range. The summit caldera alone is about 7 by 12 kilometers in dimension. Medicine Lake Volcano is so large and gradually sloped that one does not even realize when one is on it. Also, the body of water known as Medicine Lake is only a small part of the summit caldera.

This paper presents evidence that the Medicine Lake volcano is sinking. Between 1954 and 1989 the summit of the volcano subsided about four-tenths of a meter. Recent earthquakes in 1978, 1981 and 1988 are explained as a function of Basin and Range pulling-apart tectonics, extreme weight of the volcano's mass pushing down, and the loss of underlying magma to past eruptions. The authors state that both the flanks and the summit are subsiding. 30. Science: Geology and Climate. [MS395].

[MS433]. Driedger, Carolyn L. and Kennard, Paul M. **Ice Volumes on Cascade Volcanoes: Mount Rainier, Mount Hood, Three Sisters, and Mount Shasta**. Washington, D. C.: United States Geological Survey, 1986. Contains detailed ice radar measurements of glaciers and snow patches on Mt. Shasta (pp. 20-23) and other Cascade volcanoes. Table 5 (p. 23) for Mt. Shasta records glacier area and volume at 1000 foot vertical intervals. By way of comparison: "Mt. Rainier's size is reflected in its large snow and ice volume (156.2 billion cubic ft), when compared to those of Mount Hood (12.3 billion cubic ft), Mount Shasta (4.7 billion cubic ft), and the Three Sisters (5.6 billion cubic ft.)" (p.23). Photos of Mt. Shasta are included. 30. Science: Geology and Climate. [MS433].

[MS1230]. Drygalski, Erich von and Machatschek, Fritz. **Gletscherkunde**. Wien: Franz Deuticke, 1942. Contains descriptions of thousands of important glaciers and glacier localities of the world. Includes Mt. Shasta: "....So hat der Mt. Shasta (4330 m) fŸnf steile, in EisbrŸche aufgelšste Gletscher, von denen als der gršsste der Whitney Glacier 3,4 km lang ist; die Schneegrenze liegt auf der Nordseite bei 3750 m, auf der SŸdseite wohl schon bei 4000 m, die tiefsten Gletscherenden bei 2500 m.' (p. 170). Sources for the North American data are given in a bibliography (pp. 193-197). 30. Science: Geology and Climate. [MS1230].

[MS2015]. Duran, David L. **Aspects on Remote Sensing of the Northwest Slope of Mount Shasta** . 1980 Typescript. Senior thesis (Geology 181)--Humboldt State University. Bibliography: leaf 38. "Mount Shasta is a composite volcano in the southern Cascade chain which is composed of four stages of volcanic events (Sargents Ridge, Misery Hill, Shastina, and Hotlum), and is differentiated through interpretation of three platforms (Landsat, U-2 aircraft, and low-altitude aircraft)." 30. Science: Geology and Climate. [MS2015].

[MS420]. Dzurisin, D., Johnson, D. J., Murray, T. L., and Myers, B. **Tilt Networks at Mount Shasta and Lassen Peak, California**. Vancouver, Wash.: United States Geological Survey, 1982. This report outlines the position of survey monuments on Mt. Shasta and discusses the theoretical framework for their placement. Contains photographs and diagrams. Any relative tilt or movement of the monuments reflects expansion or contraction of the mountain, indicating the internal changes associated with any particular stage of volcanism. These monuments were emplaced in 1981 on Mt. Shasta shortly after the Mt. St. Helens eruption warned geologists of the need for a monitoring program for all of the Cascade volcanoes. 30. Science: Geology and Climate. [MS420].

[MS411]. Eichelberger, J. C. and Gooley, R. **Banded Andesitic Bombs of Mt. Shasta, California**. In: Geological Society of America. Abstracts with Programs. Sept., 1975. Vol. 7. No. 7. pp. 1065-1066. A summary explaining the possible origin of light and dark banding exhibited in the fresh glassy bombs found at high elevations on Mt. Shasta. Rapid eruption of magma probably caused incomplete mixing of materials resulting in the banding. 30. Science: Geology and Climate. [MS411].

[MS756]. Eliot Allen and Associates (Salem, Ore.). **Geothermal Element to the Siskiyou County General Plan**. Salem, Ore.: Eliot Allen and Associates, Feb., 1984. Draft edition. Contains an extensive discussion of several regions of varying geothermal potentials in Siskiyou County. The authors discuss the underlying rocks of the Shasta Valley and of the Medicine Lake Highlands, but they do not much discuss Mt. Shasta itself. One fact of interest: "With the exception of the summit springs on Mt. Shasta, and a fumarole at Glass Mountain, the Klamath Hot Springs are the highest temperature geothermal resource identified in the county" (p. 45). Contains an extensive bibliography (pp. 163-201). 30. Science: Geology and Climate. [MS756].

[MS974]. Emmons, G. F. **The Volcanoes of the United States Pacific Coast**. In: Journal of the American Geographical Society. 1877. pp. 45-65. 'Albany, 1979.' Source of Citation: Haines, Aubrey L. 'Mountain Fever,' p. 221. Mentions "fulgurite" found on Mt. Shasta. Fulgurite is an unusual mineral and is defined in the American Geological Institute dictionary, 1970, as: "...from the Latin 'fulgur' = lightning. Little tubes of glassy rock that have been

fused from all sorts of other rocks by lightning strokes. They are especially frequent in exposed crags on mountain tops." 30. Science: Geology and Climate/40. Find List. [MS974].

[MS140]. Fairbanks, Harold W. **Geography of California**. Sacramento, Calif.: California State Board of Education, 1927. p. 32. Contains an unusual close-up photographic illustration of a c.1920 glacier on the north slope of Shastina (p. 32). The picture is useful for comparison with the same scene today. Also contains a picturesque color photographic illustration of Mount Shasta with the Joaquin Miller quotation "Lone as god and white as a winter moon" (facing p. 65). Chapter 9, 'The Klamath Mountains,' (pp. 220-227) briefly describes the Sacramento River Canyon and McCloud River Origins. Chapter 10, 'The Volcanic Plateau, describes Mt. Shasta (pp. 227-232). Mt. Shasta is called 'The queen of the great volcanoes' (p.231). Today the 'Volcanic Plateau' is generally referred to as the 'Modoc Plateau.' 30. Science: Geology and Climate. [MS140].

[MS1260]. Finch, R. A. and Anderson, Charles Alfred. **Wing Dam to Divert Mud Creek Flow, Recommended by U.S. Dept. Engineers' ('Report of the United States Geological Survey on the 1924 and 1926 Mud Flows of Mud Creek on Mount Shasta')**. In: Mount Shasta Herald. Mt. Shasta, Calif.: Aug, 2, 1928. Lengthy report outlining the history of mud flows and the remedy of wing dams. 30. Science: Geology and Climate. [MS1260].

[MS419]. Finn, C. **Principal Facts for Gravity Stations Near Medicine Lake and Mt. Shasta, California**. United States Geological Survey, 1981. Consists mostly of charts listing gravity values. There is no text presenting conclusions from the data. 30. Science: Geology and Climate. [MS419].

[MS2050]. Freeman, Linda. Scanning Shasta from Space. ???? http://www.snowcrest.net/satellite/shasta/ "This World Wide Web page prepared for Earth Science 775 Advanced Image Processing taught by James S. Aber at Emporia State University." Includes bibliographical references. . Bound photocopy version: 1 v.; ill. (photos and maps); 29 cm. A virtual tour of Mount Shasta: ...through maps, photos, DEMs, and satellite imagery: The setting, The Cascade Range, Mount Shasta, Mount McLoughlin, Goosenest, The Whaleback, Black Butte, Medicine Lake Highlands -- Processing multispectral scanner data with Idrisi -- Examining the 1987-1992 drought in Siskiyou County. 30. Science: Geology and Climate. [MS2050].

[MS2013]. Freeman, Linda. The Glacial History of Mount Shasta.
1997. http://www.snowcrest.net/geography/shasta/index.html 'This World Wide Web page prepared for Earth Science 767, Quaternary Geology, taught by James S. Aber at Emporia State University.' Includes bibliographical references. Contents: Location -- A brief geologic history -- Pleistocene glaciation -- Holocene glaciation -- Existing glaciers -- Konwakiton Glacier jökulhaups -- Bibliography -- Glossary. Bound photocopy version:1 v. : ill. (photos. and maps) ; 29 cm.30. Science: Geology and Climate. [MS2013].

[MS2160]. Freeman, Linda. Parks Creek Patterned Ground.
1997. http://www.snowcrest.net/geography/parks/index.html World Wide Web site. This presentation prepared for Earth Science 767 taught by James S. Aber at Emporia State University. Includes bibliographical references. The setting -- What is patterned ground? -- Patterned ground in northern California -- Parks Creek stone circles -- Bibliography -- Glossary. "Large, stone-rimmed mounds surface the ground on either side of Interstate 5 near the airport north of Weed, California in Siskiyou County... This brief web presentation describes the overall setting of Parks Creek and Shasta Valley, discusses patterned ground and its formation, identifies where patterned ground is found in northern California, and describes the patterned ground dissected by Parks Creek in southern Shasta Valley. A glossary is provided... " 30. Science: Geology and Climate. [MS2160].

[MS2154]. Glauser, Rudolf. **The Ecosystem Approach to the Study of the Mt. Shasta Mudflows (dissertation)**. Berkeley, CA: University of California, 1967 Reprinted by University Microfilms, Inc. Ann Arbor, Michigan, 1973. PhD. dissertation for a degree in Soil Science. 289 pp. An ecological study. Mudflows by their very nature create new barren areas which then gradually acquire plant and animal life. They offer a natural experiment in ecological change; in this study the author measures the changes to the soil in carbon, nitrogen, calcium, and litterfall accretion over time. Also, because these mudflows are easily dated either by known date of occurrence, or dated by the age of trees growing on them, there are therefore mudflow surface soils of various lengths of development: for example one flow is seventy years old and its soil is thus the result of seventy years of ecological change. Contains nearly 300 tables and illustrations of chemical and physical changes to the soil. 30. Science: Geology and Climate. [MS2154].

[MS2104]. Grenci, Lee. **Billow Talk: Our Intrepid Columnist Explores These Unusual Cloud Formations [Mount Shasta had an unusual event of wave-like clouds in Oct., 1997, clouds very different in character than the always entertaining lenticular clouds]**. In: **Weatherwise**. No. 6. A professional meteorologist explains these rare and amazing waves as being billow clouds (which he explains as similar to the ripples on a flag, where the ripples are perpendicular to the wind direction). In the case of the Mount Shasta cloud wavelets, it was vertical windshear between atmospheric layers of different relative movements that created the waves. Thus the waves were not similar to ocean waves, albeit to the eye it would appear the clouds were like ocean waves.[See Siskiyou County Scene of Fall 1998 for photographs of this cloud formation, one of the most interesting clouds ever seen on Mount Shasta. See also the Siskiyou County Scene Winter 1998, p. 7, for a Mr. Pupator's vorticity explanation, which compares these special wave clouds to the similar waves often seen in a steaming pot of water.] 30. Science: Geology and Climate. [MS2104].

[MS2201]. Guffanti, M. and Weaver C. S. **Distribution of Late Cenozoic Volcanic Vents in the Cascade Range: Volcanic Arc Segmentation and Regional Tectonic Considerations**. Journal of Geophysical Research. 1988. v. 93. no. B6. pp. 6513-6529. 30. Science: Geology and Climate. [MS2201].

[MS2014]. Guyton, Bill 1932. **Glaciers of California : Modern Glaciers, Ice Age Glaciers, Origin of Yosemite Valley, and a Glacier Tour in the Sierra Nevada**. Berkeley, CA: University of California Press, 1998. xvi, 197 p. : ill. (some col.), maps ; 24 cm. Includes bibliographical references (p. 187) and index.
Partial contents: Mount Shasta (p. 88-89) -- Medicine Lake Volcano (p. 89-90) -- Klamath Mountains: Trinity Alps, Marble Mountains (p. 90-92) -- Discovery on Mount Shasta (p. 102-103) -- Glaciers of Mount Shasta (p. 115-120). 30. Science: Geology and Climate. [MS2014].

[MS2016]. Habiger, Frank J. **Natural Hazard Potential Associated with a Volcanic Eruption of Mt. Shasta**. 1982. ix, 72 leaves : ill. ; 28 cm. Includes abstract. Thesis (M.A.)--California State University, Chico. Bibliography: leaves [70]-72. 30. Science: Geology and Climate. [MS2016].

[MS447]. Hague, Arnold 1840-1917 and Iddings, Joseph Paxson 1857-1920. **Notes on the Volcanoes of Northern California, Oregon, and Washington Territory**. In: American Journal of Science. Sept. 1883. Vol. 26. No. 153. pp. 222-235. A petrological study of rocks collected in 1870 by members of Clarence King's Geological Exploration of the Fortieth Parallel; one of the authors was a member of the 1870 exploration team. Only rocks from Mt. Shasta, Mt. Lassen, Mt. Hood, and Mt. Rainier were examined for this study. The authors write" "As the rocks brought back may be considered as representing the principal types of the ejected lavas from the different flows, a large number of thin sections have recently been prepared for the purpose of comparative study with the volcanic rocks of the great basin, and their microscopic examination has been followed up by chemical investigation....These four great cones, which may be taken as typical of the chain, are all andesitic volcanoes, with extrusions of basalt breaking out upon their slopes and along the edges, of the plain extending in all directions for long distances" (p. 224). The results of the chemical analysis of the rocks are presented in several tables and charts, and the discussion of the rocks includes descriptions of the crystalline structure. Mt. Shasta is singled out for its variety of rocks. Note that the authors mention "Sisson's Cone and Black Butte" (p. 234) as two collecting locations in Strawberry Valley near Mt. Shasta. "Sisson's Cone" is an unusual place-name [and perhaps refers to present-day Spring Hill?]. 30. Science: Geology and Climate. [MS447].

[MS145]. Harris, Stephen L. 1937. **Fire & Ice: The Cascade Volcanoes**. Seattle, Wash.: The Mountaineers/Pacific Search Press, 1980. pp. 64-77; pp. 269-279. Revised edition of the 1976 original. Contains two chapters about Mount Shasta- Chapter 5: "Mt. Shasta - 'The Mystery Mountain' of California," and Chapter 20: "When Mt. Shasta Erupts." The author is a not a professional geologist by training, but his life-long fascination with volcanoes has given this professor of English and Humanities the background to write one of the best-selling scientific accounts of the Cascade volcanoes. Topics in the first chapter about Mount Shasta include: Mysteries of Mt. Shasta (The Secret Commonwealth, UFOs, etc.); How Mt. Shasta was built (four distinct overlapping cones from four distinct eruptive cycles are recognized); Post-glacial activity (glacial period ended 10-12,000 years ago); Black Butte (Howel William's theory that Black Butte is a plug dome); Mt. Shasta's Glaciers; the Medicine Lake Highlands; and How to see Mount Shasta.

The second chapter about Mt. Shasta consists of a blow by blow scenario about a future eruption of an ever growing large dark mass in the Shastina crater. After the blast and the burning cloud, the avalanche of lava and seething gas, nothing remains of Mt. Shasta City and Weed. "The formerly green country around Mt. Shasta is also changed: eastward, in a swath 100 miles across, stretch miles of gray ashen desert; westward lies the path of the fiery hurricane which carbonized the two doomed towns" (p. 279).

Bibliographies for each volcano in the Cascade Range are given; Mount Shasta bibliography on pp. 286-28). 30. Science: Geology and Climate. [MS145].

[MS754]. Harris, Stephen L. 1937. **Fire Mountains of the West: The Cascade and Mono Lake Volcanoes**. Missoula, Mont.: The Mountain Press Publishing Company, 1988. pp. 81-103; pp. 302-310. Revised edition of the 1976 'Fire and Ice.' From the back cover: "Steve Harris' revision of the classic FIRE AND ICE turned into a new book that deserves a new title, FIRE MOUNTAINS OF THE WEST. Here are the Cascade volcanoes, major peak by major peak, from one end of the range to the other. Harris carefully portrays each of the big volcanoes, reviews its history, and apprises its prospects for future eruption."

This 1988 book is very similar to the author's 1980 revised edition of the 1976 "Fire and Ice." Two chapters are devoted to Mt. Shasta. There are bibliographies for each chapter. The 1988 book now contains information about Mt. Shasta which was unavailable until the 1980s. For example, the author can now state that: "The oldest rocks known to have come from Shasta are andesites exposed low on the western flank near McBride Spring. These lavas, dated at about 593,000 years, record a Pleistocene volcano ancestral to the present Shasta" (p. 85).

This book finishes with a completely rewritten chapter (pp. 302-310) about a fictional 1990s Mt. Shasta eruption. After a first eruption, and a subsequent lull in eruptive activity, political and economic forces push for allowing the populace to return to the local towns. Caution is abandoned, the people return, and then both Weed and Mount Shasta are incinerated in the inevitable second round of eruptions and pyroclastic flows. New and colorful illustrations of the theoretical path of the destruction are included. 30. Science: Geology and Climate. [MS754].

[MS755]. Harris, Stephen L. 1937. **Agents of Chaos**. Missoula, Mont.: The Mountain Press Publishing Company, 1990. From the preface: "Agents of Chaos explains where and why Americans can expect their lives to be disrupted by natural disasters and what they can do to mitigate their effects."

This book is divided into three parts: earthquakes; volcanoes; and melting waters. Mt. Shasta is mentioned several times and used as an example of potential disaster. The author discusses many areas of the North American continent. Harris is the author of the popular books "Fire and Ice" and "Fire Mountains of the West." 30. Science: Geology and Climate. [MS755].

[MS895]. Hill, Mary 1923. **A California Jokulhlaup**. In: California Geology. July, 1976. pp. 154-158. The author writes: "...within historic time there have been glacial outburst floods, or jškulhlaups, that have caused enough damage to be reported in local newspapers. All of those in California originated in the break up of the Konwakiton glacier on Mt. Shasta" (p. 155). Article consists of a day by day account of the 1924 Mud Creek canyon flow of a "liquid mass of mud and rocks." Contains a chart of jškulhlaups from 1924 to 1931 all from the same glacier. Illustrated with photographs. 30. Science: Geology and Climate. [MS895].

[MS269]. Hill, Mary 1923. **Glaciers of Mt. Shasta**. In: California Geology. Apr., 1977. Vol. 30. No. 4. pp. 75-80. Contains only five paragraphs by the author. The bulk of the article consists of page-long quotations from Clarence King's 1871 "Mountaineering in the Sierra Nevada" and from J. S. Diller's 1896 "Mount Shasta, a Typical Volcano." Contains a bibliography of writings relevant to the glaciers of Mount Shasta (p. 23). 30. Science: Geology and Climate. [MS269].

[MS413]. Hill, Mary 1923. **Whitney Glacier: Record of a Climb**. In: California Geology. Jan., 1978. Vol. 31. No. 1. pp. 10-14. Photographs by Ernest Carter. This is an account of Ernest Carter's July, 1960 climb of the Whitney Glacier. Contains 12 excellent photographs of this glacier's ice fields. Includes excerpts from Clarence King's Mountaineering in the Sierra Nevada and compares King's observations in 1870 with Carter's climb. 30. Science: Geology and Climate. [MS413].

[MS445]. Hinds, Norman Ethan A. 1892. **Cascade Range**. In: Hinds, Norman Ethan A. 1892. **Evolution of the California Landscape**. San Francisco, Calif.: California Division of Mines and Geology, Dec., 1952. pp. 119-142. A detailed geologic account of Mount Shasta as of 1952. Contains some impressive full-page photographs of Mt. Shasta in illustration of the mountain's geologic features (pp. 123-126).

30. Science: Geology and Climate. [MS445].

[MS2151]. Hirt, William H. **Quaternary Volcanism of Mount Shasta and Vicinity, Siskiyou County, California**. In: Hirt, William H. editor. **Across the Klamath/Cascade Frontier: A Guidebook Prepared for the National Association of Geoscience Teachers Far Western Section Fall Field Conference Sept. 17-19, 1999**. Weed, CA: College of the Siskiyous, Division of Natural and Applied Sciences, 1999. pp. 32-68. The guidebook as a whole

contains four field trips. Field Trip 1A: E. Timothy Wallin: Geological overview of a mid-Paleozoic intraoceanic convergent margin, eastern Klamath Mountains, California. pp. 1-31. Field Trip 1B:William H. Hirt. Quaternary volcanism of Mount Shasta and vicinity, Siskiyou County, California pp. 32-53. Field Trip 2A: Juan de la Fuente and Stephen Bachmann. Whitney debris flow of August 20, 1997-Triggering mechanisms, transport processes, and debris sources pp. 54-68. Field Trip 2B: Susan M. Cashman, Don Elder, and Harlan Goldstein. Detachment faulting in the Klamath Mountains, northern California pp. 69-87. Field trip itinerary for each trip included in page numbers. William Hirt, Ph.D., is the geology instructor at the College of the Siskiyous (1999). Author presents maps and photos about: the eruptive history of Mount Shasta (four main eruptive episodes associated with features=Sargents Ridge 200,000 to 100,000 years Before Present; Misery Hill 30,000 to 9,700 years B.P.; Shastina 9,700 to 9,500 years B.P.; Hotlum 9,500 to 200 years B.P.); the origins of Mount Shasta's lavas, potential volcanic hazards at Mount Shasta. Contains many interesting diagrams, including a block diagram of earthquake foci beneath the area between August 1979 and June 1999. Includes a field trip road log to dozens of specific locations on and about Mt. Shasta. The Wagon Camp turnoff at mile 91.2 of the trip, for example, is said to contain an exposure 'of the oldest known andesites from the ancestral Mount Shasta. Samples from this outcrop yielded whole rock K/Ar ages of 593,000 years (Kelley et al., 1987) and are characterized by platy jointing developed during magmatic flow.' 30. Science: Geology and Climate. [MS2151].

[MS432]. Holliday, J. **The Bedrock Geology of the Southeast Part of Shasta Valley, Siskiyou County, California [thesis, Master's]**. Corvallis, Ore.: Oregon State University, 1983. 30. Science: Geology and Climate/40. Find List. [MS432].

[MS2071]. Holliday, Joseph. **The Bedrock Geology of the Southeast Part of Shasta Valley, Siskiyou County, California**. Oregon State University, 1982 Photocopy, 165 pages, bound, ill. 29 cm. References pp. 161 - 165. Thesis for a Masters of Science in Geology at Oregon State University. "Approximately 25 square miles of the southeast part of Shasta Valley are included in the thesis area, which lies about 12 miles north east of Weed, California. The rocks exposed in the area range from Paleozoic to Recent." (author's summary abstract.) Relates in part to Mount Shasta; especially relevant are chapters on the geology of local cinder cones, the geology of Yellow Butte [note that Yellow Butte, just off highway 97 on the north slope of Mount Shasta, which was at one time mined for molybedinum and copper, is the oldest known rock formation underlying Mount Shasta]; Pluto Cave; Haystack Dome. Maps and photographs are included. This is a fairly technical paper but understandable to the layman nonetheless. Rock sequence, depositional environments, deformations, rock chemistry, and so on are discussed. 30. Science: Geology and Climate. [MS2071].

[MS273]. Hupp, Cliff R. and Osterkamp, W. R. **Mud and Debris Flows: Geobotanical Evidence of Debris Flows on Mount Shasta, California**. In: Glysson, G. Douglas. Proceedings of the Advanced Seminar on Sedimentation. Denver, Colorado. August 15-19, 1983. 1987. pp. 12-14. U. S. Geological Survey Circular No. 953. (See also Hupp and Osterkamp. Dating and Interpretation of Debris Flows by Geologic and Botanical Methods at Whitney Creek Gorge, Mount Shasta, California. In: Geological Society of America: Abstracts with Programs 16:6 1984, GSA 97th Annual Meeting, Reno, Nevada. This 1983 report explains the methods used to date the large number of variously aged debris flows about Mount Shasta. The authors state that: "Floods and debris flows can have various effects on woody vegetation, including partly felling trees, scarring stems, and creating bare areas where seedlings can become established. The effects are recorded in the wood, and the age of the geomorphic event is measured in years by the annual growth increments" (p. 12). About 425 trees were analyzed for debris flows at sites on Whitney Creek, Bolam Creek, Mud Creek, and Ash Creek. Each site exhibited numerous debris flow events. 30. Science: Geology and Climate. [MS273].

[MS2080]. Hupp, Cliff R., Osterkamp, W. R., and Thornton, John L. **Dendrogeomorphic Evidence and Dating of Recent Debris Flows on Mount Shasta, northern California**. Washington, D.C.: United States Geological Survey, 1987. iv.; 39 pp. ill. 29 cm. U.S. Geological Survey Professional Paper 1396-B. Mud flows as far back as 1580 AD are discussed. 30. Science: Geology and Climate. [MS2080].

[MS571]. Iddings, Joseph Paxson 1857-1920. **The Problem of Volcanism**. New Haven, Conn.: 1914. pp. 116-125, 255. Contains a chart labeled "Fig. 44. Molecular Proportions of Alkalies and Alumina in Analyses of Igneous Rocks of Mount Shasta and Lassen Peak, California (facing p. 118). The author's research revolves around determining the truthfulness of the concept that: "The significance of differences in petrographical provinces is of fundamental importance in the problem of volcanism. For if igneous magmas have been erupted from considerable depth within the earth, and have reached their positions as solidified rocks without material addition of substance from the rocks through which they have passed, as appears to be the case, then they represent the composition of that portion of the earth from which they flowed. Differences in the composition of rock series in various regions should indicate differences in the composition of the earth

beneath these regions, that is, heterogeneity of the body of the earth; not as to kinds of elements present, but as to their relative amounts" (p. 118). 30. Science: Geology and Climate. [MS571].

[MS423]. Jachens, R. C., Dzurisin, D., Elder, W. P., and Saltus, R. W. **Precision Gravity Networks at Lassen Peak and Mount Shasta**. United States Geological Survey, 1983. 30. Science: Geology and Climate. [MS423].

[MS1096]. Jackson, T. H., Ridley, C. S., and Schulz, J. W. N. **Report on Preliminary Examination, Sacramento River and Tributaries, Calif., with View to Protecting the Navigable Channel of the Sacramento River from Melting Glaciers on Mount Shasta**. no date. California Debries Commission report. Source of Citation: Stewart #25. 40. Find List/30. Science: Geology and Climate. [MS1096].

[MS398]. Jenkins, Olaf Pitt 1889. **Compilation of the Geology of the Mount Shasta Quadrangle, California: Abstracts**. In: Geological Society of America, Bulletin. Mar., 1932. Vol. 43. No. 1. p. 226. Also published in Pan-Am Geologist, Vol. 55, No. 5, June 1931, p. 361 30. Science: Geology and Climate/40. Find List. [MS398].

[MS2202]. Katz, B. **The Petrology and Rate of Magma Ascent at Black Butte, California [B.S. thesis]**. Providence: Brown University, 1997 29pp.30. Science: Geology and Climate. [MS2202].

[MS1004]. Kelley, F. R., Wagner, D. L., and Saucedo, George J. **Radiometric Ages of Rocks in the Weed Quadrangle, California**. In: **Geologic Map of the Weed Quadrangle**. Sacramento, Calif.: California Department of Conservation, Division of Mines and Geology, 1987. Packet of maps and booklet. Booklet 'to accompany the Regional Geologic Map series Weed Quadrangle-Map No. 4A (Geology), Sheet 4.' Gives ages of rock sampled from different locations around the base of Mt. Shasta, and from other places in Siskiyou county. 30. Science: Geology and Climate. [MS1004].

[MS707]. Kerr, Richard A. **Landslides from Volcanoes Seen as Common**. In: Science. April 20, 1984. Vol. 224. pp. 275-276. This is an excellent account of the Mt. Shasta origin for the Shasta Valley hills. The author says: "For 50 years geologists have been walking the valley of northern California's Shasta River, climbing its curious mounds, hillocks, and ridges that number in the hundreds, and chipping at the rock where streams or quarrying have revealed what lies beneath. And they wondered what it all meant. Some said the hummocks are individual little volcanoes that popped up during ancient eruptions in the Cascades, nearby Mount Shasta representing more productive though younger activity. Another geologist suggested that any feature rising above the flat floor of the valley had been left there by glaciers or carved out of volcanic rock by streams. Another included volcanic eruptions, glaciers, and stream deposits in his explanation. Others continued to wonder. Then Mount St. Helens gave a graphic lesson in how a volcano can fall apart catastrophically, leaving a gaping hole in its side and transforming the surrounding landscape into a hummocky plain. With that unforgettable example in mind, a brief inspection of the Shasta Valley was enough to convince most geologists of its true nature--it is the largest known landslide of the past 2 million years" (p. 275). Note that several geologists have stated that larger landslides have occurred elsewhere (see Bown, et al.,1985). 30. Science: Geology and Climate. [MS707].

[MS710]. Kilbourne, R. T. and Anderson, C. L. **Volcanic History and 'Active' Volcanism in California**. In: California Geology. Aug., 1981. Vol. 34. pp. 159-168. The authors discuss the four active volcanic regions of California, namely: Mt. Shasta Region; Lassen Peak Region; Medicine Lake Highlands Region; and the Mono Basin-Long Valley Region. The Mt. Shasta geological studies of C. Dan Miller are relied upon for the discussion of this region. C. Dan Miller is quoted at length. 30. Science: Geology and Climate. [MS710].

[MS410]. Kim, Chong Kwan. **A Gravity Investigation of the Weed Sheet, northwestern California**. New Mexico M. and T., Sept., 1974 (Thesis, Ph.D.). Mt. Shasta gravity data are presented in Table 4. The author states that: "It is interesting to note that most of the prominent volcanic centers in the High Cascades of the Weed sheet, such as Mount Shasta....are located on the margins of this anomaly. The positions of these young volcanic eruptive centers may possibly be arcuate faults associated with the margins of a large scale volcano-tectonic subsidence structure.

Most of the paper consists of a detailed analysis of the gravity data for the Klamath mountains and the entire Weed quadrangle. The region is defined in terms of terranes created from accreted sections of the oceanic crust. Gravity data allow the geologist to infer the probable extent to which exposed rocks may lie hidden under neighboring overlying rocks. The author suggests that for the eastern-most terrane: "...the Trinity ultramafic complex, which in places consists of a relatively undisturbed ophiolite sequence, may be the exposed portion of a much larger ultramafic mass that comprises the

basement of the eastern Klamath plate, against which the younger western Paleozoic and Triassic plate collide" (p. 105) Using a cross-section illustration of how an upended basement rock sheet can be thrust dismembered, the author suggests that the middle terrane called western Paleozoic and Triassic plate, and the more westerly Jurassic plate, contain ultramafic bodies thrust dismembered from the basement of the western Paleozoic and Triassic plate (p. 103). 30. Science: Geology and Climate. [MS410].

[MS1116]. Kirkbride, W. H. **Engineering Report Covering Mud Flow and Washout at Graham, California. Exploration of the Northerly Slopes of Mt. Shasta, Necessity for and Proposed Improvements.** 1935. Unpublished Report. Bound with: Melhase, John. 'Report of the Flood at Graham Siding, Siskiyou County.' Extensive engineering report. Graham was a railroad place-name designation on the north side of Mt. Shasta. Report begins : "On Wednesday, August 28, 1935, sometime between 3:45 and 4 P. M. C. W. Bennett, an employee of W. D. Miller Construction Co., operating a commercial sand plant at Graham, heard a loud roar coming from the direction of Mt. Shasta; a few minutes later a deluge of water, mud, sand and boulders rushed out of the mouth of Whitney Creek, and as stated by Mr. Bennett, completely filled the valley above the railroad embankment in a period of about five minutes. The survey indicated that this first rush of debris, amounted to somewhere between 350,000 and 400,000 cubic yards of material." 30. Science: Geology and Climate. [MS1116].

[MS456]. LaFehr, T. R. **Gravity, Isostasy, and Crustal Structure in the Southern Cascade Range**. In: Journal of Geophysical Research. no date. Vol. 70. No. 22. pp. 5581-5597. Source: Harris 30. Science: Geology and Climate/40. Find List. [MS456].

[MS578]. Le Conte, Joseph 1823-1901. **The Autobiography of Joseph Le Conte**. New York: D. Appleton and Company, 1903. pp. 278-279. Joseph Le Conte was one of the most distinguished geologists of California. He writes of one trip to Mt. Shasta as follows: "During 1884 and 1885 I wrote many papers, but as they were short, they may be passed over without particular attention. In June 1885, I received from Captain Dutton, of the United States Geological Survey, an invitation to join him in his summer camp in northern California and Oregon, and was delighted to accept. I met him at Mount Shasta, and we were together for two months and a half. But on account of some delay in receiving the necessary funds nearly half of this time was spent in camp at Sisson's, a good illustration of the necessary waste in government methods. The time was not wholly wasted, however, for we took daily rides to explore the country and made a trip of four days around Mount Shasta, enjoying the splendid view of the mountain from the east and observing the five glaciers still living on its slopes and characteristic milkiness of the water of the streams issuing from their snouts. The money having at last arrived, we took regretful leave of the kind friends we had met at Sisson's, who had done much to relieve the tedium of our waiting, and started on our way northward to examine the great lava flow and especially to visit Crater Lake" (pp. 278-279). 30. Science: Geology and Climate. [MS578].

[MS442]. MacDonald, Gordon A. **Geology of the Cascade Range and Modoc Plateau**. In: Bailey, Edgar H. 1914. **Geology of Northern California**. San Francisco, Calif.: California Division of Mines and Geology, 1966. pp. 65-96. MacDonald's report is one of the standard and most often consulted references on the geology of Mt. Shasta and on the surrounding northeastern California region. The report is primarily useful as an in-depth overview of the regional geology, and actually contains very little information on Mt. Shasta itself. Nonetheless, for over 25 years this article has been a great help to thousands of people who have tried to understand the complexity of the mountainous regions of northeastern California.

Subjects covered in this article include the "Lassen Straight" between Lassen and the Klamath mountains, the Western Cascade Range and the High Cascade Range, sedimentary rocks of the region, and mountains near Mt. Shasta (including Deer Mountain, Willow Creek Mountain, the Whaleback, Miller Mountain, Sheep Rock, and Yellow Butte). Many of the different types of lava rocks in the region are described. More than anything else, this article stresses the impressive extent of recent vulcanism in this region. 30. Science: Geology and Climate. [MS442].

[MS449]. Masson, Peter H. **Circular Soil Structures in Northeastern California**. In: Williams, Howel 1898 and Masson, Peter H. **Geology of the Macdoel Quadrangle; and Circular Soil Structures in Northeastern California**. San Francisco, Calif.: California Division of Mines and Geology, Nov. 1949. pp. 61-71 Ten-page report on "Circular Soil Structures in Northeastern California", by Peter H. Masson (pp. 61-71). These circular soil structures in Shasta Valley have long been the subject of curiosity. As the author says: "In the Fall of 1946 attention was called to several areas containing low mounds encircled by rings of loose stones in Central Siskiyou County, California. It was thought that the rings were the work of early Indians and popular interest was aroused" (p. 61). The probable cause of these rings, according to the author, can be attributed to the action of frost and ground ice. Diagrams of the mechanism

involved are included. Comparisons are made to similar rings found in Alaska and Maine. 30. Science: Geology and Climate. [MS449].

[MS581]. McAllister, Matthew Hall. **New Survey of Shasta's Glaciers**. In: Mount Shasta Herald. Mt. Shasta, Calif.: Sept. 9, 1926. Consists of a review of the measurements of five Mount Shasta glaciers as of 1884, and requests funds for a new survey. 30. Science: Geology and Climate. [MS581].

[MS1288]. McFarlan, Donald. **The Guinness Book of Records, 1992**. New York: Bantam Books, 1992. Mt. Shasta holds the record for a single snowstorm: "Greatest snowfall....The record for a single snowstorm is 189 in. at Mt. Shasta Ski Bowl, CA from 13-19 Feb., 1959..." (p. 44). 30. Science: Geology and Climate. [MS1288].

[MS414]. Miller, C. Dan. **Holocene Pyroclastic-Flow Deposits from Shastina and Black Butte, West of Mount Shasta, California**. In: Journal of Research. 1978. Vol. 6. No. 5. pp. 611-623. The author summarizes his findings by stating: "A broad apron of pyroclastic-flow deposits derived from dacite domes of Holocene age at Black Butte and Shastina covers an area of more than 110 square km on the west flank of Mt. Shasta volcano."

This article contains a wealth of information not readily found in other sources. For example, there are descriptions, photographs, and diagrams of the formation of some mounds near Black Butte. These mounds have formed from the disintegration of single immensely huge rocks. As another example of information about unusual formations, there is a map which shows the "moat" around Black Butte. The author considers the moat is an explosion crater which predates the four successive plug domes which today comprise Black Butte. This is a highly recommended article for those interested in the local geography. 30. Science: Geology and Climate. [MS414].

[MS200]. Miller, C. Dan. **Potential Hazards from Future Eruptions in the Vicinity of Mount Shasta Volcano, Northern California**. Washington, D. C.: United States Geological Survey, 1978. This is a preliminary report which was filed with the U.S.G.S. under the Open File Report classification. Most of the material in this report was published in 1980 as Geological Survey Bulletin 1503 with the exact same title as the 1977 open file Report. However, the unpublished typewritten 1978 Open File Report contains maps, drawings, and text not found in the later published edition. The published version was one of the most important and detailed reports about the geology of Mount Shasta, and the 1978 open file preliminary version might hold additional valuable information on minor topics of Mount Shasta's geology. 30. Science: Geology and Climate. [MS200].

[MS199]. Miller, C. Dan. **Potential Hazards from Future Eruptions in the Vicinity of Mount Shasta Volcano, Northern California**. Washington, D. C.: United States Geological Survey, 1980. An important geological report about Mount Shasta's past and future eruptions. Contains detailed and specific information on dozens of geological features of Mount Shasta. Persons curious about the background of the eruptions which caused the formation of 'Red Banks' or the 'Shastina cone', for example, will find answers in this study.

This study concludes that "Mount Shasta has erupted on more than 13 separate occasions during the last 10,000 years and at least 8 times during the last 4,500....Thus, Mount Shasta has erupted on the average, at least once per 800 years for the last 10,000 years and once per 600 years during the last 4,500" (p. 41). Plate 1, "Events at Mount Shasta during the Last 10,000 Years," is a large folding sheet which charts known mudflows, pyroclastic flows, ash flows, lava flows, eruptions, etc., for each of six directions around the flanks of Mount Shasta, as determined from the geological record; this is a very useful though fairly technical chart. Plates 2 & 3 superimpose upon a topographic map the assumed zones of hazard from various scenarios of future eruptions. The study as a whole contains many excellent photographs illustrating geological features of Mount Shasta.

Contains the statement: "Mount Shasta erupted last about 200 radiocarbon years ago (pl.1). The eruption may have been observed from the Pacific Ocean by La Perouse in 1786 (Finch, 1930)" (p. 41). Note that Plate 1 contains only two records citing evidence of volcanic activity less than 1000 years old on Mount Shasta. One event is dated at approximately 700 years ago, and the other event, from evidence of a pyroclastic flow at Ash Creek, is dated at approximately 200 years ago." Note that this latter pyroclastic flow date would correspond with the LapŽrouse sighting in 1786, but that this single piece of evidence does not necessarily indicate that a large eruptive event took place. 30. Science: Geology and Climate. [MS199].

[MS438]. Miller, C. Dan and Crandell, Dwight Raymond. **Postglacial Pyroclastic-Flow Deposits and Lahars from Black Butte and Shastina, West of Mt. Shasta, California**. In: Geological Society of America, Cordilleran Section. Annual Meeting. Abstracts with Programs. Feb., 1975. Vol. 7. No. 3. pp. 347-348. A summary of the author's research on the rock and soil profile of the northwest flanks of Mt. Shasta. 30. Science: Geology and Climate. [MS438].

[MS1186]. Miller, Ray. **A Volcano Called Mount Shasta**. Mt. Shasta, Calif.: Sisson Museum, 1987. A four-page introductory guide to the geology of the Universe, including Mt. Shasta, Shastina, and Black Butte. Contains a page, with answers, of most-often-asked questions including: "Do earthquakes or volcanic eruptions elsewhere effect Mount Shasta?" and "Is Shastina hot? The northwest side is usually free from snow."

The author, an accomplished cave explorer and expert on regional geography, has also prepared dozens of guide sheets with inset maps for travel to Mt. Shasta regional sites of interest, including a tour "Around the mountains: 77 mile - 4 to 6 hours. Suitable for passenger cars with caution," "Black Butte Climb," and "Shastina Lava Caves: 15 miles from Weed Passenger car road." These guide sheets are available from the Sisson Museum in Mt. Shasta City. 30. Science: Geology and Climate. [MS1186].

[MS25]. Morford, Lee. **100 Years of Wildland Fires in Siskiyou County**. [Yreka, Calif.]: [the author], [1984]. Book contains no copyright page, no date of publication, and no name of the publisher. Contains historical records of fires on and near Mt. Shasta. Especially noteworthy is a brief account by C. Hart Merriam (author of the 1899 Biological Survey of Mount Shasta) of a series of major fires raging on the mountain from July 15 to Sept. 30, 1898. Merriam's personal account of the fires contains sentences such as "One burned from McCloud Mill up the Panther Creek slope consuming the greater part of the only area of P. attenuata on Mt. Shasta and extending great fiery tongues into the handsome fir forest on both sides of Wagon Camp" (p. 9).

The book contains many other stories of Mt. Shasta fires, including an account by Ralph Bangsberg of a group of at least 16 fires on July 24, 1950, all set along the railroad line in and north of Mount Shasta City, all being set by a defective steam engine. The author understates the fact "Efforts were being made to stop the engine" (p. 110). Note that many of these accounts also contain much interesting weather information. 30. Science: Geology and Climate. [MS25].

[MS703]. Moxham, R. M. **Thermal Features at Volcanoes in the Cascade Range**. In: Bulletin Volcanologique. 1970. Vol. 34. No. 1. pp. 77-106. Photocopy; this photocopy lacking fig. 16. The article contains a brief paragraph on Mt. Shasta (pp. 101-102). The author mainly presents historical references to the summit springs as investigated by Pierce in 1854, Whitney in 1862, Colonna in 1878, and Williams in 1932. The author also states that: "Two thermal anomalies on Mount Shasta are clearly evident on the infrared image (fig. 16) and doubtless correspond to the thermal springs or solfataras described by other workers" (p. 102). 30. Science: Geology and Climate. [MS703].

[MS648]. Newberry, John Strong 1822-1892. **Geology of the Route**. In: **Reports of Explorations and Surveys to Ascertain the Most Practicable and Economical Route for a Railroad from the Mississippi River to the Pacific Ocean. Made under the Direction of the Secretary of War, in 1854-1855, According to Acts of Congress of March 3, 1853, May 31, 1854, and August 5, 1854. Volume VI. 33rd Congress. 2d Session. House Document 91**. Washington, D. C.: A.O.P. Nicholson, Printer, 1857. Part 2, pp. 28-33. J. S. Newberry, namesake of the Newberry Crater volcano in southern Oregon, wrote the geological, botanical, and zoological reports for the 1854-1855 Abbot and Williamson Railroad Survey (see Abbot 1857). It is assumed that Newberry was a member of the expedition.

Note that there is also a chapter on the geology of the Pit River and Klamath Basins which makes frequent reference to Mount Shasta (Part III, pp. 34-39). 30. Science: Geology and Climate. [MS648].

[MS2203]. Osterkamp, W. R. Hupp C. R. and Blodgett J. C. **Magnitude and frequency of Debris Flows, and Areas of Hazard on Mount Shasta, Northern California: U.S. Geological Survey Professional Paper 1396-C**. 1986. p. C1-C21. 30. Science: Geology and Climate. [MS2203].

[MS709]. Peacock, Martin A. **The Modoc Lava Field, Northern California**. In: Geographical Review. 1931. Vol. 21. pp. 259-275. This paper discusses the different formations of lava rocks which together comprise the hundreds of square miles of the Modoc Lava Fields east of Mt. Shasta. One of the rock formations is called the Shasta Lavas Highland. The author states; "Because of the lithological and physiological similarities with the actual products of Mt. Shasta, they are here termed the Shasta Lavas" (p. 267). 30. Science: Geology and Climate. [MS709].

[MS421]. Peterson, J. A., Caress, M. E, and Quick, J. E. **Geochemical Analyses of Rock and Stream-Sediment Samples from Mount Eddy and Castle Crags Roadless Areas, Shasta, Siskiyou, and Trinity Counties, California**. United States Geological Survey, 1983. Consists primarily of charts showing the results of analysis. The two regions surveyed are perhaps representative of the rocks underlying the western flanks of Mt. Shasta. 30. Science: Geology and Climate. [MS421].

[MS802]. Petit, Charles. **Eruption: Not If, But When**. In : San Francisco Chronicle. San Francisco, Calif.: May 28, 1989. p. 16. In 'This World,' a news magazine of the San Francisco Chronicle, May 28, 1989. This was a special issue 24 pages long entitled 'A Mountain 'Lonely as God': Tales of Mount Shasta' and contains eight separate feature articles by seven authors. Contains a review of present geological knowledge concerning the potential for an eruption of Mt. Shasta. The author states that: "Twenty years ago, Congress commissioned a survey of volcanoes along the West Coast, Mount St. Helens, which erupted in 1980, was considered the most likely to erupt. Lassen Peak, which last blew in 1921, was considered the next most likely. Mount Shasta was determined to be the third most likely....There is evidence that the volcano has erupted 10 or 11 times during the past 3,400 years, including three blasts in the past 750 years, which suggests a more recent average of an eruption every 250 to 300 years." 30. Science: Geology and Climate. [MS802].

[MS74]. Poeschel, K. R., Rowe, T. G., and Blodgett, J. C. **Water-resources Data for the Mount Shasta Area, Northern California**. Sacramento, Calif. United States Geological Survey, 1986. The authors set out to provide "complete areal coverage of the flanks of Mount Shasta" (p. 2). A map provided with the report shows approximately 50 water sampling sites (springs, creeks, lakes, and wells) up to and including the summit region of the mountain. Samples were collected between March 1981 and August 1984. The Mount Shasta sites included the summit Sulfur Springs, Clear Creek Springs, Brewer Cr., Cold Cr., Ash Cr., Widow Springs, McGinnis Springs, MacBride [sic] Springs, Big Springs, and Black Butte Springs. In addition, the study sampled other sites which were inside an 800 square mile region around Mount Shasta, including sites at Lake Siskiyou, Lake McCloud, and Lake Shastina. Actual data recorded for each site includes, where appropriate, such things as water depth, temperature, ph, oxygen content, hardness, etc. Extensive charts of chemical analysis are given for nitrogen, phosphorus, boron, magnesium, potassium, carbon, etc. 30. Science: Geology and Climate. [MS74].

[MS271]. Rhodes, Philip T. **Historic Glacier Fluctuations at Mount Shasta**. In: California Geology. Sept., 1987. Vol. 40. No. 9. pp. 205-209. Contains evidence that in addition to the five main glaciers of Mount Shasta there are five additional masses of moving ice which deserve to be called glaciers. Some of these minor glaciers have historically been recognized as glaciers. Snowfall accumulations have varied greatly over the decades, and both major and minor glaciers undergo significant growth or diminution. Names are proposed for the five minor glaciers and derivation of the names is given. The five proposed names are: Stuhl glacier; Chicago glacier; Upper Wintun glacier; Watkins glacier [for R.H. Watkins]; and Olberman glacier. A map of the glaciers is provided. Contains 3 photographs of glaciers, and contains a very comprehensive bibliography (p. 209).

There is also an important list of historical photographs of the glaciers including listings for U.S. Army aerial photos (p. 209). 30. Science: Geology and Climate. [MS271].

Rec# 1215. Map of Mount Shasta. Ricksecker, Eugene, topographer1884.'Surveyed by U. S. Geological Survey.' Seen as a photocopy only, original source not known. One of the first topographic maps of Mt. Shasta. Only the Gilbert Thompson 1883 'hachure' topographic map is of an earlier date (In U.S.G.S. Fifth Annual Report, facing p. 330). 1884 map labels present Black Butte as "Cone Mountain" (see Whitney 1865) and depicts a different "Black Butte" northeast of Mt. Shasta.30. Science: Geology and Climate.

[MS1097]. Ridley, C. S. **Report of California Debries Commission on Deposits from Melting Glaciers of Mt. Shasta**. Dec. 1, 1926. One page notification of the decision by the Board of Engineers for Rivers and Harbors (in Washington D.C.) to take no action on expenditures to protect the Sacramento River from the effects of melting glaciers of Mount Shasta. "The principal grounds upon which the adverse conclusions are based are: That the deposits from the melting glaciers from Mt. Shasta have little or no effect on the navigable portions of the Sacramento River and that any expenditure with a view to protecting such navigable channels therefrom would be unwarranted" 30. Science: Geology and Climate. [MS1097].

[MS230]. Russell, Israel Cook 1852-1906. **Existing Glaciers of the United States**. In: Powell, John Wesley 1834-1902. **Fifth Annual Report of the United States Geological Survey to the Secretary of the Interior 1883-84**. Washington, D.C.: Government Printing Office, 1885. pp. 303-355; plates 43-50. Contains the first topographic map of Mount Shasta (facing p. 330). The northern California discussion contains a general account of Mount Shasta's glaciers. Most of the Mount Shasta related text is actually composed of lengthy quotations by Clarence King (pp. 329-331; 1870 ascent), and Gilbert Thompson (pp. 332-334; 1883 ascent). The illustrations of Mount Shasta are : "Topographical Sketch of Mt. Shasta, California, 1883, by Gilbert Thompson" and the following engravings made from the 1870 40th parallel Survey photographs shot by the renowned photographer Carlton Watkins: "Mount Shasta, California" (p. 329), "Sketch Map of Mount Shasta" (p. 330), "Konwakiton Glacier, Mount Shasta" (p. 332), "Wintun Glacier, Mount Shasta" (p. 333),

"Hotlum Glacier, Mount Shasta" (p. 334), "Bolam Glacier, Mount Shasta" (p. 335), "Head of Whitney Glacier, Mount Shasta" (p. 336), "Foot of Whitney Glacier, Mount Shasta" (p. 337). Note that elsewhere in the book (p. 13) there is a brief but important introduction to the problems of weather encountered by Thompson's Mount Shasta topographic mapping survey in 1883. 30. Science: Geology and Climate. [MS230].

[MS604]. Russell, Israel Cook 1852-1906. **Climatic Changes Indicated by the Glaciers of North America**. In: American Geologist. May, 1892. Vol. 9. No. 5. pp. 322-366. Contains only the following mention of Mt. Shasta: "Observations by J. S. Diller, of the U. S. Geological Survey, on Mt. Shasta, indicate that the glaciers in northern California, like those farther south, are retreating. Evidence of this is furnished by barren areas about the ends of several of the glaciers and by a conspicuous lateral moraine on the side of the Whitney glacier, which in 1887 was about twenty-five feet above the level of the adjacent ice" (p. 325). 30. Science: Geology and Climate. [MS604].

[MS605]. Russell, Israel Cook 1852-1906. **Volcanoes of North America: A Reading Lesson for Students of Geography and Geology**. New York: 1924. pp. 125, 225-228. First published 1897. Mt. Shasta is a mountain composed of andesitic lavas, and the author mentions that both Mt. Shasta and Mt. Rainier are representative of the variety of andesite which contains large-sized crystals of hornblende. This variety is "common in the Cordilleras from Central America to Alaska" (p. 125). The author, although somewhat inconsistent with his earlier statement, states that: "The most abundant rock on Mount Shasta as hypersthene andesite--a lava containing little or no hornblende, but much hypersthene" (p. 228). He adds that "Basalt occurs only on the lower slopes of the mountain, but forms nearly all of the numerous cinder cones on the adjacent plain" (p. 228).

The author explains under the heading "Andesite" that "The rocks of this widely distributed group were first studied in the Andes, whence the name..." (p. 124).

Contains a full page photograph of Mount Shasta from the east (facing p. 224). 30. Science: Geology and Climate. [MS605].

[MS300]. [San Francisco Chronicle]. **Shasta Glacier Mud Flow Cause: River Rise and Bad Roads Follow Obstruction**. In: San Francisco Chronicle. San Francisco, Calif.: Aug. 19, 1924. Col. 7. p. 2. "Redding, August 18. - That a glacier on the eastern slope of Mount Shasta slipped down the mountain side two weeks ago and since has been dissolved by the heat of the sun is the explanation given in McCloud for an unprecedented flow of mud and ashes from the north ....It is considered certain that the four-inch rise in the Sacramento river here last week was caused by the melting glacier." 30. Science: Geology and Climate. [MS300].

[MS301]. [San Francisco Chronicle]. **Fear of Flood at McCloud Quieted: Mud Flow Caused by Mt. Shasta Glacier**. In: San Francisco Chronicle. San Francisco, Calif.: Aug. 20, 1924. Col. 6. p. 11. "McCloud, Aug. 19 - Excitement over the flood from the melting glacier which threw this district into a panic yesterday was slowly subsiding today, although some fears were felt that another chunk of the glacier might break loose....Observers declared the flood was undoubtedly caused when part of the glacier broke loose from its moorings and slid four miles down the mountain into Mud Canyon." 30. Science: Geology and Climate. [MS301].

[MS302]. [San Francisco Chronicle]. **McCloud Battles Mt. Shasta's Mud Torrent to Save Its Water Supply: With Railway Inundated and Main in Danger of Being Snapped, Situation Serious**. In: San Francisco Chronicle. San Francisco, Calif.: Aug. 29, 1924. Col. 6. p. 4. "McCloud, Aug. 28 - While Mount Shasta continues to spew an unstoppable torrent of mud and bowlders and icebergs from her glacier-clad peak into the vast mud-sea formed in the valley below, the citizenry of McCloud is waging a fight to save its water supply....The mud river has inundated the McCloud River Railroad, thus cutting off the possibility of water supply by rail....Continued hot weather gives no hope for a cessation of the mud torrent. With the mud great bowlders are crashing down the slopes and occasionally icebergs break off and come tumbling down the mountain side. It is these great masses that break the McCloud water ...[missing]." 30. Science: Geology and Climate. [MS302].

[MS303]. [San Francisco Chronicle]. **Mount Shasta Mud Flow Halts: Melting Glacier's Torrent Suddenly Dries, McCloud Is Saved Isolation**. In: San Francisco Chronicle. San Francisco, Calif.: Aug. 30, 1924. Col. 6. p. 4. "McCloud, Aug. 29 - The flow of glacial mud from Mt. Shasta's melting glacier halted abruptly late today and Mud canyon was almost dry, according to a report from a point four miles north of here. The news was received with some alarm at McCloud, as it is believed the channel has been choked higher up the mountain and that the viscous flood is being damned up only to break loose later with added force....The mud flow, which has about the texture of pouring

concrete, has been practically continuous now for two weeks. The mud-covered flat east of the mountain is now more than a mile wide and from eight to twelve miles long." 30. Science: Geology and Climate. [MS303].

[MS304]. [San Francisco Chronicle]. **Shasta Glacier Mows Forest**. In: San Francisco Chronicle. San Francisco, Calif.: Sept. 11, 1924. Col. 5. p. 9. "Yreka, Sept. 10 - The Mount Shasta glacier, dislodged by the long continued drought and warm weather, has slipped from its ancient resting place on the north side of the mountain, and is moving down the slope at a rate of five miles an hour, snapping of big trees in its path and thrusting immense boulders before it.

The movement began a short time after dawn, and at noon the huge mass of ice was well within the timberline. Huge clouds of vapor are arising as the moraines of the glacier are being broken up by its movement and these clouds are forming one big cloud over the head of the moving mass. The journey of the glacier can be seen from a distance of twenty miles. It is accompanied by a distant roar, which also can be heard over a considerable distance.

The glacier movement is evidently not related to the phenomenon of a heavy mud flow on the opposite side of the mountain recently. This flow is believed to have started from other ice deposits melting under many days of hot sunshine." 30. Science: Geology and Climate. [MS304].

[MS305]. [San Francisco Chronicle]. **MT. SHASTA CAVE-IN CRUSHES CANYON: Towns at Base of Hills Fear New Mud Flow, Terrific Roar of Collapse Startles Residents for Many Miles, Fear Expressed Dammed-Up Waters May Overflow and Inundate Valleys** . In: San Francisco Chronicle. San Francisco, Calif.: Sept. 19, 1924. Col. 1. pp. 1-2. "Dunsmuir, Cal. Sept. 18 - Approximately fifteen acres of the top southeastern section of the top of Mount Shasta caved in today, causing the collapse of Mud Creek canyon, which has recently overflowing with mud and rock. The walls of the canyon for a distance of eight miles crumbled with a terrific roar, which was immediately followed by a great cloud of dust and volcanic ash that hung over the mountain for several hours." Maps and photos on page 2.

Note that on Sept. 19, Mount Lassen went into eruption, and the maps and photos accompanying the article are of both mountains. The Mount Shasta cave-in story was the front page headline in big type. 30. Science: Geology and Climate. [MS305].

[MS306]. [San Francisco Chronicle]. **Mt. Shasta Towns Saved: Cave-in Dams Flood of Lava, Glacier Mud, Sudden Cold Spell Sets Natural Formation, Saving McCloud From Torrent, Danger is Increasing, Lake Forming on Mountainside as Snow Waters are Impounded**. In: San Francisco Chronicle. San Francisco, Calif.: Sept. 20, 1924. Col. 3. p. 1. "Sacramento, Sept. 19 - Freezing temperatures at the base of Mount Shasta early today checked the stupendous flow of ashes, mud and lava formation, which poured down the sides of the mountain before a torrent of flood waters, imperilling the lumber town of McCloud, five miles distant." 30. Science: Geology and Climate. [MS306].

[MS780]. Schrader, Isabel. **Black Butte**. In: The Siskiyou Pioneer in Folklore, Fact and Fiction and Yearbook. Siskiyou County Historical Society. 1964. Vol. 3. No. 7. p. 5. Contains a brief discussion of the geography and history of Black Butte, the dark volcanic cone on the western base of Mt. Shasta. The names of Black Butte, Wintoon Butte, Cone Mountain, and Muir's Peak were all at one time or another applied to the small mountain. The author states that: " A more romantic version is the legend that the butte is the tip of Mt. Shasta, blown off centuries ago in a volcanic explosion and settling into its original shape in its transplanted position." 30. Science: Geology and Climate. [MS780].

[MS440]. SEAN. **Volcano-Seismic events Shasta (California) earthquake swarm: Maximum Magnitude 4.2** . In: SEAN Bull [Washington D.C.]. 1978. Vol. 3. No. 7. pp. 12-13. 30. Science: Geology and Climate/40. Find List. [MS440].

[MS441]. SEAN. **Volcano-Seismic Events Shasta (California) Earthquakes Decline to Few a Day**. In: SEAN Bull [Washington, D.C.]. 1978. Vol. 3. No. 8. pp. 11-12. 30. Science: Geology and Climate/40. Find List. [MS441].

[MS2149]. [Sisson Mirror]. **A Threating Fire**. In: Sisson Mirror. June 3, 1897. Col. 4. p. 3. 'A fire to the east of Sisson in the timber and brush has been creating some alarm during the last few days. It started near Neal's camp on the McCloud River railroad and burned for two or three days until a strong south wind spread it up the mountain slope as far north as Black Butte.' An account of a large fire on Mt. Shasta. 30. Science: Geology and Climate. [MS2149].

[MS2204]. Smith, A. L. and Carmichael, I. S. E. **Quaternary Lavas from the Southern Cascades, Western U.S.A.** Contributions to Mineralogy and Petrology. 1968. v. 19. pp. 212-238. 30. Science: Geology and Climate. [MS2204].

[MS705]. Snow, I. C. **Recent Activity of Mount Shasta's Glaciers**. In: Shasta: the Journal of the Mt. Shasta Resource Council. Sept., 1976. Vol. 1. No. 3. pp. 7-8. I. C. Snow (I see snow) is possibly a pseudonym of Philip Rhodes. 30. Science: Geology and Climate. [MS705].

[MS425]. Sollins, P., Spycher, G., and Topik, C. **Processes of Soil Organic-Matter Accretion at a Mud Flow Chronosequence, Mt. Shasta, California**. In: Ecology. 1983. Vol. 64. No. 5. pp. 1273-1282. A soil study using Mt. Shasta as a site because of the conveniently recently buried soil layers available at flood locations on the mountain. The study attempts to answer fundamental theoretical problems of time-linked soil deterioration. 30. Science: Geology and Climate. [MS425].

[MS2102]. Southern, May Hazel. **A Record Snowfall 1890 Northern California**. In: Record Searchlight, April 7, 1932. April 7, 1932. Hazel May Southern was the daughter of Sacramento River canyon pioneer Simeon Southern, for whom 'Sims' on I-5 is named. She was also a co-founder of the Shasta Historical Society. Miss Southern grew up in the Sacramento upper canyon area and tells the story of the amazing 12 foot deep snows in Dunsmuir and southward in 1889-1890. This 1930's article begins: "The balmy spring weather now prevailing in this section, following the winter storms which brought bounteous snowfall to Shasta County and the rest of northern California, makes Miss May Southern of the Shasta Historical Society reminiscent. She declared yesterday that last winter was as mild as a zephyr when compared to that of 1889-90."

"Miss Southern was a Southern Pacific telegrapher stationed at Sims, on the Shasta division, that winter. Excerpts from her dairy follow:"

[She writes:] "Winter set in October 20, with heavy rains. October 30, train service irregular, landslides numerous, large forces clearing track. By the middle of November unusual amount of rain would have caused great damage by high water if there had been any snow on the ground.

Snow in December

December 10, high crests of mountains mantled with deep snow, lower levels white with a promise of what was yet to come. Torrential rains caused washouts and slides, travel unsafe and uncertain. Next few weeks brought terrific rains all through northern California. Railroad bridge at Cottonwood greatly damaged, delayed trains three days. Great damage to bridges and trestles around Colusa, Chico and Marysville, one-third of the 242 miles of track between Cottonwood and San Francisco washed away or badly damaged, several persons drowned.

Real Storm Starts

January 15, 1890, bumper crop of snow began arriving - snowing furiously, like twilight, two feet on the ground this morning. Train 15 crept northward in the teeth of the fiercest snow storm that ever roared down the Sacramento canyon; stalled at tunnel 11, mile and half north of Sims; 116 passengers on board, Vice-President C. F. Crocker's private car, 'Mishawauka,' attached to rear. Snowed incessantly for over 60 hours, fell so fast and furious river covered over; reached a depth of eight feet on level, much deeper in drifts.

Food in diner and Crocker car soon exhausted. Pullman porters carried food on their backs from Sims to feed women and children. My mother started to bake bread day and night as long as flour lasted. Brakeman in Crocker car with pneumonia.

Nights Were Dismal

Problem of heat serious, wood water logged and buried under snow, coal oil and candles soon exhausted, darkness made more dismal by howling of panthers, coyotes and other night animals driven by the snow to seek food lower down. Deer often seen some in low cut shoes and shirt sleeves. For lack of rubber boots men bind their legs with gunny sacks held in place by bale rope or wire, this soon caked with mud and snow, to the weight of already over developed feet, so the toilers soon played out.

Their complaint was not so much of the scarcity of food as the lack of whisky and the money to buy it.

At Dunsmuir 12 feet of snow, freight shed crashed in, burying the bodies of William Whiting and a brakeman, killed on the road. Building total loss. Every man engaged in shoveling snow off buildings; church fell in, some houses collapsed and families had to move out. Citizens let nature take its course in clearing premises. Town short of provisions.

Bounding into river pursued by a panther.

Food becoming scarce, my father slaughtering stock and killing off chickens; complaints of passengers loud and long, cursing the country, the company and Mr. J. Pluvius. Wires dead, cut off from world. Linemen coming in speechless and half frozen.

Snow traps Relief Train

Depot only hot spot, men in overalls crowding in, drying their garments, smoking strong tobacco and expectorating copiously on red hot stove. An attempt made from Dunsmuir to rescue train, relief party snowed in at Castle Crag. Relief train on way from Sacramento encountered two feet of snow at Redding, bumped into work train

north of there and commissary car badly wrecked, did not expect to meet anything coming down the line except snow, scooped out slides all the way to Delta, where snow is four feet deep. Way cleared with pick and shovel to Sims. Arrived, January 20, with 300 men, who had been without food 30 hours; they struck, stormed the depot and threatened violence.

Mob Storms Depot

Assistant Superintendent Pratt and other officials barricaded the doors.

I was just a young girl and badly frightened by the sight of the starving men who surrounded us; through a crack in the door negotiations opened with leaders resulting in my father butchering his milk cows; men tore off hunks of meat with their hands and ate it raw like animals. Took whole day's work to exhume buried train which left Sims, January 22 south bound and packed high with snow, attracting much attention on its way down the valley. Passengers sent to Portland by water.

(Continued)

River Dammed by Slide

Just north of Upper Soda springs, Alpine avalanche slid down mountain, carrying everything before it; section crossed the Sacramento dammed the river so completely that no water went through or over the dam for 20 minutes. Snowplow and engine buried out of sight. Took 8 days excavating to uncover them.

Sisson Herald, January 25 - Inventory of losses by storm - Three large two stories buildings crushed, porches and awnings strewn in ruins on sidewalk. Town looks like it had been bombarded by hostile army and badly wrecked by exploding shells. Snow packed on sidewalks to second story, every man pressed into service to save cracking roofs; several horses killed; people going in and out of windows. Horses fitted with snowshoes.

Planned to Eat Horses

Sisson Herald, January 26 - "We are here, well blockaded, situation worse, provisions to last three weeks, not many cattle, will kill fat horses if necessary." (Paper printed on cloth and old posters.)

Ten to 15 feet of snow between Sisson and Edgewood; 123 men at Black Butte without food for 24 hours. Dead engines and strings of box cars crushed in by weight of snow strewn all along line from Sims to Edgewood and over Siskiyous. Blockade complete. Greatest depth of snow deposited in Sacramento canyon.

January 29 - General Superintendent Fillmore gave out the following summary of railroad situation:

"Few trains blockaded between Blue canyon and Shady Run; 1800 men with picks and shovels cutting away snow banks 12 to 15 feet high; snow on sheds at Summit and tunnel 13 from 50 to 250 feet deep and in isolated places 500 feet. Three hundred men between Sims and Edgewood, with provisions scarce between these points; 3500 men employed extra, of these 2500 men on Central Pacific. Railroad estimates its loss since trouble began 14 days ago at $75,000 a day over $1,000,000 to January 29."

Sierra Line Opened

January 1 - Seventeen days blockade lifted in the Sierra; Emigrant Gap out of food, great suffering; 500 loaded freight cars snowed in on sidings, great damage, buildings crushed, lives lost; still snowing.

Sacramento valley flooded. Coast towns under water. Persons suffering for food; death rate high from pneumonia and la grippe. Business at complete standstill.

At tunnel 9, between Sims and Delta, probably biggest slide that ever swooped down mountain side filled tunnel and river; north end of tunnel buried 100 feet.

Lake Is Formed

February 11 - Railroad situation going from bad to worse. Slide in Cow creek canyon, Oregon, formed a lake three miles long and 75 feet deep, besides filling a tunnel. Estimated loss to railroad $1,500,000. All hopes given up for clearing track, Ashland to Portland, for many weeks. Oregon towns under water: great loss of livestock; terrific rains all through northern California.

Central Pacific again blockaded; snow sheds toppling over with snow. Sacramento river at Red Bluff 25 feet above high water mark; still rising. Fills in Siskiyous sinking, banks and high sides caving, cuts filled. Downpour leveled snow from nine to four feet at Sisson. Literally speaking, the road is gone in.

The road finally was opened in the middle of April after 15 miles of new track was laid.

(The end)

by: May Hazel Southern . 30. Science: Geology and Climate. [MS2102].

[MS2103]. State of California Department of Water Resources Division of Resources Planning. **Summary of California Snow Survey Measurements through 1959**. State of California Department of Water Resources Division of Resources Planning, 1959. Includes data sheets for Mount Shasta at 7900 feet elevation for 1930-1959;Sand Flat (6800 feet elev.: 1945-1959); Brewer Creek (6250 feet elev.:1945-1959); Ash Creek (5000 feet elev.: 1945-1959). 30. Science: Geology and Climate. [MS2103].

[MS435]. Stauber, D. A. and Berge, P. A. **Comparison of the P-Velocity Structures of Mt. Shasta, California, and Newberry Volcano, Oregon**. In: Eos: Transactions, American Geophysical Union. Jan. 15, 1985. No. 66. p. 25. 31st Annual Pacific Northwest Meeting No. 3. Authors conclude that "Mt. Shasta is an andesitic stratovolcano which is typical of Cascade Range stratovolcanoes except for its large size. The P-velocity of the material above sea level in Mt. Shasta is higher in the core than in the flanks. We attribute this difference in P-velocity to a variation in porosity; low porosity may result from intrusion and hydrothermal alteration in the core and the average porosity may be high in the flanks because of the abundance of clastic debris. Between sea level and 25 KM depth the P-velocity of the crust beneath Mt. Shasta is 1 to 2 percent lower than in the surrounding crust. This result suggests either that mafic intrusions are not lodging in the upper 25KM of the crust below Mt. Shasta, as at Newberry Volcano, or that a larger fraction of the intrusions below Mt. Shasta are hot enough to contain magma or to cause partial melting in the surrounding crust."

Note that P-waves are compressional waves, like sound waves, and travel straight through material at a rate dependent on the density and/or porosity of the material. 30. Science: Geology and Climate. [MS435].

[MS477]. Stuhl, Edward 1887-1984. **California's Volcanoes**. In: Santa Barbara Museum of Natural History. Museum Leaflet. Feb., 1937. Vol. 12. No. 2. Stuhl describes four major volcanic regions of California: Inyo area, Mono area, St. Helena area, and the Cascade area. Describes different types of volcanic activity, from the liquid basalt flows of the Modoc Plateau to the violent explosive eruptions of Cascades volcanoes such as Mt. Shasta.

Also contains the notice that a "Story of Mt. Shasta" exhibit "will be built around Mr. Edward Stuhl's collection of lavas from Mount Shasta, representing every form, from earliest to most recent, arranged to demonstrate the geological history of California's sublimest sentinel of the Cascades" (p. 19). 30. Science: Geology and Climate. [MS477].

[MS2205]. Trehu, A. M. and the Mendocino Working Group. **Pulling the Rug out from Under California: Seismic images of the Mendocino Triple Junction Region**. EOS. 1995. v. 76. no. 38. pp. 369-381. 30. Science: Geology and Climate. [MS2205].

[MS2207]. Ui, T. and Glicken, H. **Internal Structural Variations in a Debris-Avalanche Deposit from Ancestral Mount Shasta, California, USA**. Bulletin of Volcanology. v. 48. pp. 189-194. 30. Science: Geology and Climate. [MS2207].

Rec# 1193. Mt. Shasta. United States Department of Commerce, Coast and Geodetic Survey Washington D.C: United States Department of Commerce, Coast and Geodetic Survey; 61.45th edition.30. Science: Geology and Climate.

[MS139]. United States National Oceanic and Atmospheric Administration: Environmental Data ServiceÐNational Climate Center. **Climate of California**. Asheville, N. C.: National Oceanic and Atmospheric Administration: Environmental Data Service, National Climate Center, 1978. Reprint of the 1977 edition. Contains an extensive chart of climatological data for Mount Shasta City, California (p. 33). Compiled over a period of 100 years or more. Data listed includes temperatures, precipitation, wind, cloud cover, etc. Several footnotes contain interesting highlights; e.g. in Feb., 1902 the recorded precipitation for Mt. Shasta City (then named Sisson) was the equivalent of 21.73 inches of rain. 30. Science: Geology and Climate. [MS139].

[MS1161]. United States Weather Bureau. **The Climate of Siskiyou County**. Yreka, Calif.: Farm Advisors Office of Siskiyou County, 1976. 'Revised 1976.' Contains sections on terrain, effect of terrain on climate, temperature, freezes, heating degree days, precipitation, snow fall, evaporation, relative humidity, wind, sunshine and cloudiness, acknowledgements, glossary. There is data from one station on the slopes of Mt. Shasta, and one station in Mt. Shasta City, in addition to the numerous Siskiyou reporting stations. 30. Science: Geology and Climate. [MS1161].

[MS397]. Wadsworth, Marshman Edward 1847-1921. **[mineral 'picotite' from Mt. Shasta]**. In: Boston Society of Natural History. 1882. Pr. 21. pp. 314-315. 30. Science: Geology and Climate/40. Find List. [MS397].

[MS2208]. Wagner, D. L. and Saucedo G. J. **Geologic map of the Weed quadrangle: California Division of Mines and Geology, Regional Geologic Map Series Map No. 4A, Scale 1:250,000.** California Division of Mines and Geology, 1987. 30. Science: Geology and Climate. [MS2208].

[MS1072]. Walter, S. R. **Ten Years of Earthquakes at Lassen Peak, Mount Shasta, and Medicine Lake volcanoes**. no date. 30. Science: Geology and Climate/40. Find List. [MS1072].

[MS422]. Walter, S. R., Kollman, A., Dawson, P., and Iyer, H. M. **Seismicity of the Mount Shasta and Lassen Peak Areas, California**. In: Long, T. **Seismological Society of America, 78th Annual Meeting. Earthquake Notes, 54: 1**. 1982. 30. Science: Geology and Climate/40. Find List. [MS422].

[MS299]. [Watkins, Harry. **Eight Glaciers?** In: Tourist Guide Winter 1989-90. 1989. pp. 6-7. Contains extensive quotations from Harry Watkins about the history of glacier discoveries on Mount Shasta. The Sierra Club's research from 1933 to 1936, carried out by Oliver Kehrlein, positively confirmed that there were more than the six known glaciers. At about the same time Mark Meier of the U.S.G.S. recognized eight glaciers. Contains a history of the naming and location of the 'newer' glaciers. 30. Science: Geology and Climate. [MS299].

[MS133]. Watson, E. B., Wank, M. E., and Smith, A. **Soil Survey of the Shasta Valley Area, California**. Washington, D. C.: U.S. Department of Agriculture, Bureau of Soils, 1923. Advance Sheets-Field Operations of the Bureau of Soils, 1919. Excellent study of the soils of Shasta Valley. Names and gives mechanical analysis of the soils in the outwash alluvial fans on the northern foot of Mount Shasta; e.g., the Delaney gravelly fine sand. Also contains a general account of the glacial "bowlders" and pebbles embedded in some of the subsoils at the foot of Mount Shasta (p. 111). Contains one photograph of Mount Shasta (facing p. 111). 30. Science: Geology and Climate. [MS133].

[MS2092]. [Weed Press]. **Huge Avalanches Draw Attention to Shasta (1995)**. In: Weed Press. February 15, 1995. A. p. 1. Vol. 70, No. 7 During the winter of 1995 several large avalanches cut long and wide swathes through the forests on the upper slopes of Mt. Shasta, resulting in major permanent changes to the appearance of the mountain. This article is one of many similar newspaper articles documenting the changes. Excerpts from this article follow: “The deepest snow levels recorded in the past 20 years and the largest avalanches on record are drawing tourists and outdoor recreationists to the winter wonders of Mt. Shasta.....One of the largest avalanches covered the area where a parking lot and a small ski lodge would go under the ski park proposal...150 foot wide path of ice and snow at depths of 14 to 25 feet.....New scars from a second mammoth avalanche can be seen at the flank of Shastina, where sliding snow created a six-fingered cut through old-growth forestlands. In addition, VanSusteren said avalanches have also occurred this year at Avalanche Gulch, Diller Canyon, Cascade Gulch, The Ski Bowl, and numerous other sites on the mountain. ....It’s obvious by the age of some of the destroyed forestlands that some of these areas haven’t seen avalanches in over 300 years.' 30. Science: Geology and Climate. [MS2092].

[MS704]. Wharton, R. A. and Vinyard, W. C. **Summit Life: A Preliminary Report**. In: Shasta: the Journal of the Mt. Shasta Resource Council. 1977. Vol. 2. pp. 10-12. 30. Science: Geology and Climate. [MS704].

[MS416]. Wharton, R. A. and Vinyard, W. C. **Summit Thermal Springs, Mount Shasta, California**. In: California Geology. 1979. Vol. 32. No. 2. pp. 38-41. The authors state that "Mount Shasta's summit thermal springs consist of a main spring and numerous adjacent subsidiary springs. These springs are located west of Mount Shasta's summit at an elevation of approximately 4,267 meters. The thermal area is about 30m (98 feet) long by 15m (49 feet) wide. The existence of a small thermal spring north of the summit area has been noted also (Harris, 1977)." Physical characteristics of the summit thermal springs are noted. The waters are "extremely acidic" due to sulfuric acid formation. 30. Science: Geology and Climate. [MS416].

[MS626]. Whitney, Josiah Dwight 1819-1896. **The Climatic Changes of Later Geologic Times**. In: Memoirs of the Museum of Comparative Zoology of Harvard University. 1882. Vol. 7. No. 2. pp. 27-30. Source of Citation: Stewart 1929 #121. See also Whitney's personal accounts of climbing Mt. Shasta. 40. Find List/30. Science: Geology and Climate. [MS626].

[MS268]. Williams, Howel 1898. **Mount Shasta: A Cascade Volcano**. In: Journal of Geology. July-Aug., 1932. Vol. 40. No. 5. pp. 417-429. One of the first geological studies to explain the kind of bedrock upon which Mount Shasta rests. To the south, mudstones, slates, and limestones. To the west, gabbros, peridotites, and serpentines. To the north, quartzites and monzonites. But to the east, no one knows, for the bedrock is entirely concealed (p. 418). In a summary of the main geological history of Mount Shasta Williams explains the structure and composition of the north-south fissure, part of which is Gray Butte. The numerous parasitic cones, including Spring Hill, Black Butte, Bear Butte, and Shastina, are also discussed. Williams mentions that Edward Stuhl took readings of the summit hot springs seven summers in a row and that the temperature varied between 162 and 184 degrees. F. Howell Williams was one of the most accomplished geologists of the west coast, and this paper is often cited as a classic of Mount Shasta's geology. Written in 1932, it is a bit

dated, but one can still get a good overview of the mountain's geology from reading this report (See also Williams 1934). 30. Science: Geology and Climate. [MS268].

[MS430]. Williams, Howel 1898. **Mount Shasta**. In: Zeitschrift fŸr Vulkanologie. Sept., 1934. Vol. 37. No. 15. pp. 225-253. German language journal; this article was published in English and untranslated into German. One of the most comprehensive studies of the mountain ever produced. Williams's report, the most definitive report he ever published about the mountain, marks the beginnings of the modern era of geologic study of Mt. Shasta. Subject titles include: Location; History of Exploration [including discussion of Ogden, Emmons, Pearce, Whitney, Brewer, King, and Diller]; Bedrock; Age; Volume and Form of the Volcano; Growth of the Volcano [including discussion of the main cone, north-south fissure, plug domes, cinder cones, Bear Butte, cinder cone shield volcano, Shastina, and Black Butte]; Solfataric Activity; Petrography of the lava [lengthy and detailed physical descriptions]; Chemical Composition of the lavas; and Glaciers, Mud Flows and Avalanches. Acknowledgements are made to three well-known Mt. Shasta resident mountaineers who helped the author in his mountain studies: Hall M. McAllister, J. M. Olberman, and E. Stuhl (p. 253).

Note that this study is found only in this German journal; one should not assume that Williams's other Mt. Shasta reports are as complete. 30. Science: Geology and Climate. [MS430].

[MS399]. Williams, Howel 1898. **The Geology of Crater Lake National Park, Oregon, with a Reconnaissance of the Cascade Range Southward to Mount Shasta**. Washington, D. C.: Carnegie Institution, 1942. This large and elegantly produced 1942 Carnegie Institution scientific report is entirely different from the author's general interest book of a similar title, Crater Lake: The Story of its Origins, published in 1941 by the University of California Press.

Williams mentions the similarity of Mount Mazama to Mount Shasta: "Finally, at the south end of the belt rises the magnificent Mount Shasta, a composite cone built up, like Mount Mazama, chiefly of hypersthene andesite and, like the latter, containing far more pyroclastic ejecta than any of the volcanoes that lie between. The similarity between the two is accentuated by the fact that both, in the later stages of activity, erupted viscous flows and domes of dacite and cones of basaltic scoria. At Shasta, these culminating eruptions took place mainly from a north-south fissure traversing the summit, parallel to the main axis of the High Cascades." Williams also includes charts and profiles comparing Mount Mazama to many other Cascade volcanoes, including Mount Shasta. A folding map of the entire geologic province from Mount Shasta to Crater Lake appears facing p. 10.

Mt. Shasta is mentioned only occasionally as a comparison to the ancient now collapsed Mount Mazama volcano. The collapse of Mazama, says Williams, "was probably as cataclysmic as that which produced the caldera of Krakatau in 1883." The southern Oregon Mount Mazama location is now Crater Lake National Park. 30. Science: Geology and Climate. [MS399].

[MS448]. Williams, Howel 1898. **Geology of the Macdoel Quadrangle**. In: Williams, Howel 1898 and Masson, Peter H. **Geology of the Macdoel Quadrangle; and Circular Soil Structures in Northeastern California**. San Francisco, Calif.: California Division of Mines and Geology, Nov., 1949. pp. 1-60 The Macdoel Quadrangle includes parts of the northern base of Mt. Shasta. Williams's report includes a discussion of the "Last Flows of Shasta and Shastina" (pp. 49-50). Another section discusses "Eruptions near the Base of Mount Shasta" (pp. 41-42). Includes discussions of the Goosenest Volcano, Deer Mountain, Sheep Rock, and Yellow Butte in moderate detail. The emphasis throughout the book is on petrology and macroscopic description of the rocks, mostly lavas, found in the study area. A color-coded map (in pocket) accompanies the report. Several photographs included.

Note that book includes a separate report: "Circular Soil Structures in Northeastern California," by Peter H. Masson (pp. 61-71). 30. Science: Geology and Climate. [MS448].

[MS400]. Williams, Howel 1898. **Geology of Shasta Valley and the Adjacent Cascades, Northeastern California**. In: Geological Society of America Bulletin. Dec., 1949. Vol. 60. No. 12, pt. 2. p. 1947. 30. Science: Geology and Climate/40. Find List. [MS400].

[MS446]. Williams, Howel 1898. **The Ancient Volcanoes of Oregon**. Eugene, Ore.: Oregon State System of Higher Education, 1976. First Condon Lecture, delivered January 1948. Sixth edition. Howel Williams was one of the foremost vulcanologists of the West Coast, and was one of the first of the modern era scientists to study Mt. Shasta. In this well-known lecture on the ancient volcanoes of Oregon he makes only occasional references to Mt. Shasta (e.g., p. 42). But the overall concepts he presents of geologic time in Oregon are for the most part applicable to Mt. Shasta and northern California. 30. Science: Geology and Climate. [MS446].

[MS883]. Wolfe, J. A. **Catastrophic Debris Avalanche from Ancestral Mount Shasta Volcano, California: Comment**. In: Geology. 1985. Vol. 13. No. 1. p. 80. The author states that "While not wishing to detract from an interesting paper, I described a landslide on Samar Island with an estimated volume of 135 cubic kilometers (Wolfe, 1977). This large limestone block, 18 by 25 km..." (p. 80). 30. Science: Geology and Climate. [MS883].

[MS2209]. Yamashita, K. M. and Weiprecht, D. E. **Benchmark Descriptions and Photographs for Global Positioning System (GPS) Stations in the Vicinity of Mt. Shasta and Medicine Lake, California: U.S. Geological Survey Open-File Report 95-811**. U.S.G.S., 1995. 27pp. 30. Science: Geology and Climate. [MS2209].

[MS2101]. [Yreka Journal]. **Shasta Butte (weather)**. In: Yreka Journal. Aug. 12, 1869. col. 3. p. 3. "Shasta Butte is almost bare of snow this year, on the north side, more so than has been known since the settlement of our county by white people. This is due to the unusual hot weather, and the fact that the past winter covering it lighter than generally." 30. Science: Geology and Climate. [MS2101].

[MS424]. Zucca, J. J., Catchings, R. D., Fuis, G. S., and Mooney, W. D. **Preliminary Report on a Seismic Refraction Study of the Mt. Shasta Region of Northern California**. In: Eos: Transactions, American Geophysical Union. 1981. Vol. 62. No. 45. 1981 Fall Meeting 30. Science: Geology and Climate/40. Find List. [MS424].