UTAH GEOLOGICAL & MINERAL SURVEY

QUARTERLY REVIEW

Vol. 8, No. 3 Service to the State of Utah August 1974

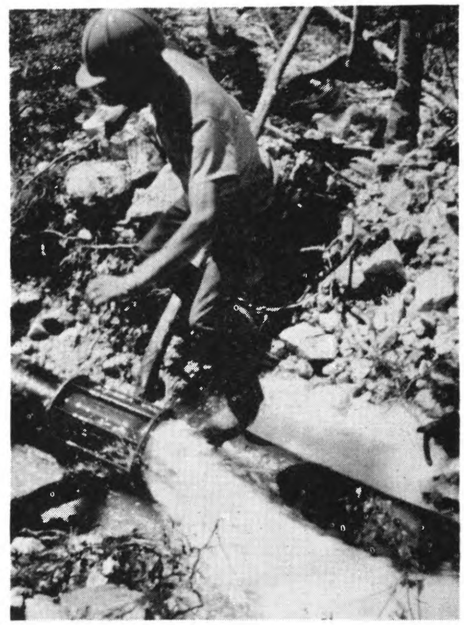
No Water in Town

Landslide Triggers Acute Water Shortage in Manti

Manti's aqueduct from mountain springs to the city was severed in several places by earth movements during the week of May 26th. Continued movement of the ground has greatly hampered repair of the water system and has necessitated emergency actions to provide the city with culinary water.

Mr. Bruce N. Kaliser, Utah Geological and Mineral Survey, was notified of the incident on June 2th and went to Manti in response to an appeal for aid from the State Department of Emergency Services and Manti mayor Frank Wanless. Since then the UGMS has been engaged in on-site assistance to the city and has been working on the problem with the State Department of Emergency Services, Utah National Guard, the U. S. Forest Service, and Manti city.

Earth movements in Manti Canyon east of the city have been a phenomenon occurring over a considerable period of time, on the order of thousands of years. Faults have fractured the bedrock of the canyon walls and have brought weak rocks in juxtaposition to rocks of great strength. Failure of the weak rock zones has led to landslides which have moved as far as the bottom of the canyon. This process of landsliding is not finished; it periodically becomes active depending upon climatologic conditions and/or cycles. This latest episode of movement has affected the waterline laid between 1937 and 1939 across the old unstable earth mass. Movement during this last incident occurred when a weak rock mass became detached from



Above: Scarp formed by earth movement beginning May 26, 1974. View is south, toward head of the slide area. *Right:* Offset in waterline caused by the May, 1974, earth movement.

the higher canyon wall on the south side of Manti Canyon and fell on the old landslide below. Longitudinal cracks have appeared in the old landslide. They are now over a mile long down the course of the two-mile long mass. The direction of movement along these longitudinal cracks has been clearly horizontal. Mudflows have occurred as a result of the liquefaction of recently sliding earth. The flows have transported a mass of boulders, logs, debris, and sediment across the upper reaches of the old landslide surface.

The aqueduct has been threatened by shear cracks, both torsional and compressional, which have developed in the old landslide mass. So far the mudflows have not affected the pipeline itself, but they have contributed appreciable quantities of fine sediment to Manti Creek and downstream to the irrigation systems in town. This fine material has lined ditches so thoroughly, no better job of lining could be provided.

The role of the Utah Geological and Mineral Survey has been to evaluate the landslide activity to determine the likelihood of subsequent movements of earth. Engineering correction of the movement appears to be entirely unfeasible according to Mr. Kaliser. It may be necessary to construct a new aqueduct. If so, the Utah Geological and Mineral Survey will assist in selecting an alternate route to avoid unstable terrain. The replacement of water wells is also being seriously considered. They would be located nearer to town in stable geologic environments likely to produce significant quantities of good quality groundwater.

AT HOME WITH GEOLOGY

"Great Views" Cause Blindness in Building

by B. N. Kaliser
UGMS Engineering Geologist

In recent years subdividers and construction companies throughout Utah and the entire Mountain West have displayed a tendency to develop subdivisions and residential lots at higher elevations: on foothills or mountain slopes, and on alluvial fans at the mouths of canyons. People should instinctively know such construction sites are less than ideal, yet they deliberately choose a "beautiful view" enhanced by sunsets or sunrises as their primary criterion in selecting the location of a building site and ignore such obvious problems as difficult access, heavy snowpack, scattered boulders, evidence of mudflows, etc. Little, if any, thought is given to simple terrain features and their relevance to the safety and economics of the structure to be erected.

Higher elevations experience greater quantities of precipitation, both rain and snowfall. Runoff, particularly spring snowmelt, is likely to be greater and orographic effects of the foothills and mountains also lead to more intense cloudburst activity during the rainy season. Intense runoff could mobilize enough mud and debris to create a mudflow which could sweep down a drainage course and destroy everything in its path. If snowmelt and rain runoff is not properly accommodated, it can destructively erode under pavements, along footings, across unvegetated reaches, etc. Drainage around the property, therefore, must be considered of primary importance. Higher precipitation may also mean higher water infiltration into the ground. Geologic materials normally comprising this environment may vary widely and cause the infiltrated water to come to the ground surface in a spring or seep area somewhere on the slope, near its base or in one's basement! In some places the resurfacing of water may not necessarily occur every year, only when there is sufficient moisture to saturate the subsurface mass.

Decomposition and weathering of shales, limestones, and certain volcanic rocks can lead to the formation of an impermeable layer of clayey material which will reject water and sewage effluent infiltration. Even such impermeable layers, however, are subject to slow saturation of the clayey material which eventually reduces the layer's stability and causes the overlying mass to move downslope in a creeping or faster, sliding motion. Gradual saturation of foundation materials can cause softening and loss of bearing strength and lead to a readjustment of footings and a differential settlement of the structure.

Boulders on the site may indicate debris left by a past mudflow or flood, or a rockfall from ledgerock above the property. In either case, the process may still be active and the possibility of similar events occurring in the future should be considered.

Site exploration for a city sewage lagoon uncovered jointed volcanic rock beneath an irregular veneer of fanglomerate material. A water injection test into the volcanic horizon was readily accepted. This indicated the terrain was unsuitable for its intended use. This is an example of a problem which can arise if the geologic setting is ignored.

New apartments are under construction on an old landslide at mouth of Ogden Canyon. Such developments have prompted solicitation of an opinion from the Utah Attorney General's office on the state's responsibility. Note active sliding in foreground on recently created cut-slope.

While firm subsurface foundation conditions are safer for construction, they can mean greater expenditure for blasting to remove resistant rock from the foundation, basement area, and utility line trenches. The soil and rock profile may show that proper grading is not economically feasible. If economics prevail and the lot is improperly graded, one may be left with steeper slopes than desirable on driveways, sewage drain fields, etc. The latter case may result in effluent resurfacing on the slope.

Hillside slopes may also complicate water supply efforts if an individual well is necessary. Drilling problems may include greater depth to the water table, greater hazard from neighboring sewage disposal systems, and greater costs for drilling through bedrock.

With higher elevations come lower temperatures and the accompanying problem of frost-heaving. Deeper burial of footings and utility lines will be necessary to offset this particular hazard.

Most hillside lots require the removal or cutting of some earth material and/or deposition on or off the site of fill materials. Lack of close supervision of this phase of construction has proven to be, in my opinion, the single greatest cause for problems and for economic loss in residential hillside development. Modification of terrain, particularly on hillsides, requires complete appraisal of all the superficial geologic factors:

(continued on page 4)

High Water Marks Rising Trend on Lake

The Great Salt Lake is a dynamic body of water. The lake level annually varies 2 to 3 feet within longer cycles of high and low water. During historic times five high water peaks have been recorded: 1855, 1873, 1886, a series from 1909 through 1930, and 1952. When Utah became a state in 1896, the level of the lake was 4,200.8 feet (statehood level). The general trend since that time has been lower water levels, the only exceptions being the 1909-1930 high water period and the 1952 peak.

The highest level, recorded in 1873, was 4,211.65 feet. At this level Antelope and Stansbury Islands were completely isolated. The lowest lake level recorded was 4,191.35 feet in 1964. Much construction around the lake in the past 10 years was predicated on continuing low water, but the yearly levels are now climbing steadily in what appears to be a major rising cycle. In late March, 1974, the statehood level was reached, and this year's maximum level was 4,201.30 feet on June 1, higher than any recorded in the past 44 years. Millions of dollars of unforeseen expenditures have already been necessary to protect and move evaporating ponds, dikes, causeways, roadways, and beach and harbor installations.

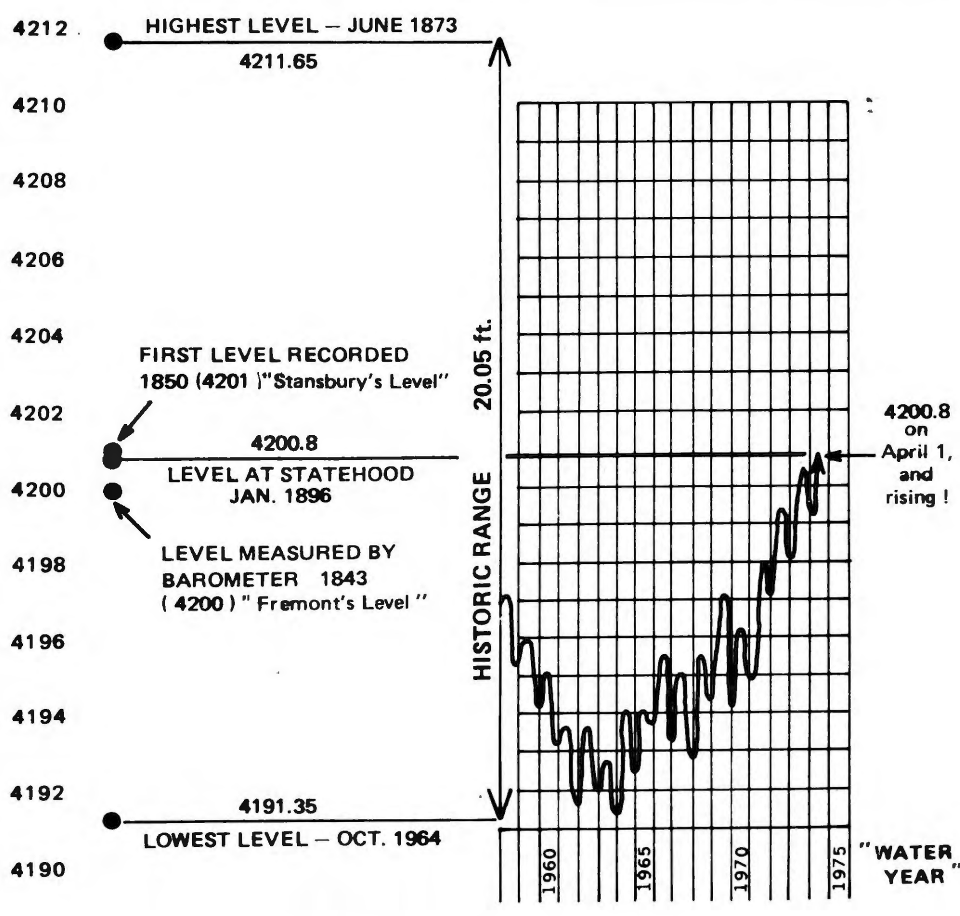
The current rising cycle appears to be triggered by generally wetter weather, heavy mountain snowpacks, and recharged groundwater tables. The graph (opposite) illustrates this dramatically. If this rising trend continues many more shoreline facilities will be affected. Should the level continue to rise over the next several years until it equals the record high (4,211.65 feet), the Southern Pacific Railroad and Antelope Island causeways will be completely inundated and peripheral freeways, railroads, and industrial establishments will be severely damaged.

A Great Success

Basement Tectonics Conference

The first International Conference on the New Basement Tectonics, held at the Tri-Arc Travelodge June 3-7, 1974, was a tremendous success. More than sixty-four papers were presented in 10 sessions and some 200 persons attended the five-day sessions. Topics included: (1) studies of lineaments in the U. S. A., Canada, Mexico, Bolivia, Western and Central Europe, North Africa, the Middle East, U. S. S. R., and Australia; (2) techniques of observing and analyzing lineaments; (3) discussions about the origin of linear features, both on Earth and other planets; and (4) relationships between ore deposits, petroleum, and lineaments. Howard Ritzma, Assistant Director, UGMS, presented a paper, "Towanta lineament, Northern Utah." Several individuals from Salt Lake City gave presentations. On two evenings round table discussion groups were held and both had excellent attendance. Two field trips visited areas of interest in the Salt Lake region.

Janet Benjamins, geologist for Mountain Fuel Supply, was general chairwoman of the conference and Parker Gay, Jr., American Stereo Map Co., was program chairman. The Utah Geological Association sponsored the conference with participation from the National Aeronautics and Space Administration and the U. S. Geological Survey. The Utah Geological and Mineral Survey was represented by Carlton Stowe who was also publicity chairman of the conference committee and session chairman during one of the daily sessions.



Great Salt Lake levels (south arm) 1958 to present.

BRAND-NEW UGMS SERIES

In the fall of this year the Utah Geological and Mineral Survey will introduce a new publication series, *Utah Geology*. Beginning next year it will be a biannual publication, one issue in the spring and the other in the fall.

Each issue of *Utah Geology* will contain a number of short papers in geology about areas of local to statewide interest formerly presented through our Special Studies series.

The publication will be sold on a subscription basis at the rate of $6.00 per year, or on an individual copy basis for $3.50 per issue.

Contributions of short articles (20 to 60 manuscript pages, plus figures and tables) about geologic studies in Utah are welcomed. Anyone wishing to submit a manuscript for publication in *Utah Geology* should contact:

Mrs. Gloria Kerns, Editor
205 UGS Building
Univ. of Utah
Salt Lake City, Utah 84112,

for a copy of our "Instructions to Authors" leaflet.

(continued from page 2)

surface water, soil moisture, groundwater, soil and rock subsurface profiles, degree of uniformity of earth materials and the subsurface structures, surface contours, and conditions surrounding the lot, particularly above it topographically. Changes in land use anywhere in the vicinity must not be neglected both during and following the development.

Careful study of the terrain features of a hillside dwelling lot before purchase and/or construction may prevent a lot of mental anguish and economic loss.

New Bibliography of Utah Geology

The Utah Geological and Mineral Survey is proud to announce the long-awaited *Bibliography of Utah Geology* is finally ready for sale as UGMS Bulletin 103 for $6.50. This volume by W. R. Buss and N. S. Goeltz begins where Bulletin 40 ended, January 1, 1951, and is a comprehensive list of all publications on Utah geology through December 31, 1970. Publications are listed alphabetically by author and cross-indexed by subject matter.

Copies of the earlier *Bibliography of Utah Geology* by W. R. Buss are still available as UGMS Bulletin 40 for $4.00. This volume covers the years 1943 through 1950. As long as copies of Bulletin 40 last, both volumes may be purchased at a special discount rate of $8.00. Orders should be addressed to the UGMS Publications Office, 103 UGS Building, University of Utah, Salt Lake City, Utah 84112. Please indicate whether you wish Bulletin 103 by itself ($6.50), or both Bulletins 103 and 40 for $8.00. There is a 10% postage and handling charge for mail orders.

QUARTERLY REVIEW
State of Utah . . . . . . *Calvin L. Rampton, Governor*
Department of Natural Resources . . . . *Gordon E. Harmston, Executive Director*
Utah Geological and Mineral Survey . . . . *Donald T. McMillan, Director*
UTAH GEOLOGICAL AND MINERAL SURVEY
103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah 84112

State of Utah—Department of Natural Resources
UTAH GEOLOGICAL AND MINERAL SURVEY
103 Utah Geological Survey Building
University of Utah
Salt Lake City, Utah 84112

Nonprofit Org.
U. S. Postage Paid
Permit No. 1529
Salt Lake City, Utah