

Landslide-Prone Bench Reactivated

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In late February or early March, major activity resumed in a pre-existing landslide area on the bluff immediately south of the Ogden Municipal Golf Course (see *Quarterly Review*, May 1970, p. 4).

The typical rotational slump-block landslide involves deltaic sediments, chiefly sand and silt, laid down in Pleistocene Lake Bonneville. Fresh exposures of the permeable material indicate it is moist or nearly saturated throughout. Scarplets

and crevasses criss-cross the upper portion of the landslide mass. Movement in nearly all directions, which tends to indicate the presence of a highly irregularly shaped slippage plane, has produced scarps and fractures.

On April 3, the height of the uppermost scarp measured almost 17 feet. Downslope motion below the highest scarp appears to be slowing, while the horizontal displacement at the toe of the slide continues at an average rate of one inch per day. Attempts to correlate precipitation and temperature change with the recorded daily slide motion appeared to be unsuccessful.

UGMS TO HOST STATE GEOLOGISTS

The annual Meeting of the Association of State Geologists will be held in Utah for the first time this year. UGMS will host the activities in Moab, May 14 to 17.

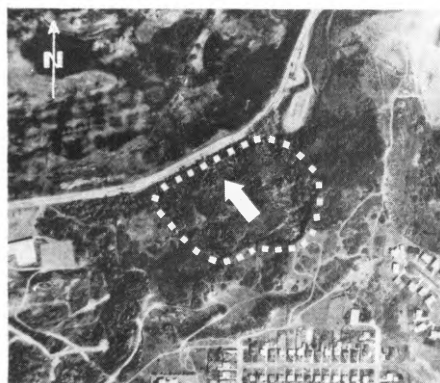
The Association consists of the directors of 49 state geological surveys (Rhode Island is the exception) and of the Commonwealth of Puerto Rico.

Attending as guests of the Association will be representatives from the U. S. Geological Survey, U. S. Bureau of Mines and the Environmental Protection Agency.

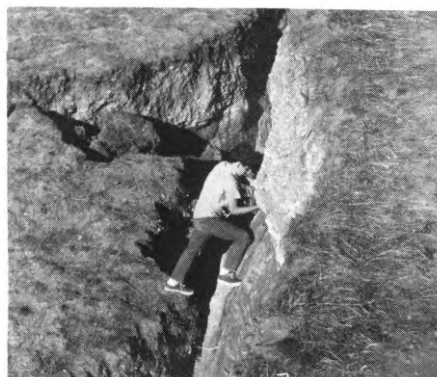
These meetings provide an opportunity for members to discuss internal affairs as well as topics of mutual concern to both state surveys and the Federal bureaus. They are, for the most part, closed sessions.

Meetings will be interspersed with field trips, followed by an excursion across the San Rafael Swell and brief visits to areas of geologic importance in Salt Lake City.

Moab has graciously extended its hospitality.



Aerial view of the landslide area. The Ogden Municipal Golf Course is at upper left.



March 16. A large scarp and several deep crevasses were evident at the top of the bluff.



March 17. Uppermost scarp was planed off and crevasses filled in; scarp grew 16 inches the next 24 hours and averaged 18 inches per day the next week.



March 21. The scarp attained a height of 6 feet.



March 27. Nine days after the scarp area had been bulldozed to a flat surface, the scarp height measured 14½ feet.

WGMAC REPORT: PART III

Note: The following report of the Western Governor's Mining Advisory Council was made to the Western Governor's Conference by A. C. Harding, WGMAC chairman, on July 14, 1971, at Jackson Lake Lodge. It has been presented in the *Quarterly Review* in three parts. Reprinted by permission.

Optimism

Miners are, by vocation, optimistic, putting their faith and their dollars into tomorrow. This Council believes that an improved environment is both necessary and possible, but it also believes that where no substantial, immediate or irreparable hazard or damage is involved, that improvement must come in an orderly fashion, that the rule of reason must prevail, so that in apparently solving one problem we do not create others of equal magnitude, that consideration must be given to preventing local economic disasters, and to preclude the national possibility of what one news writer has termed an "environmental recession."

The Prospector

Despite all threats to and problems of the industry, we can probably predict that large, well established mining companies will survive simply because they have to, because the nation needs them. We can further predict that any unnecessary controls will cause unnecessary expenditures with increased costs, which the public will pay, either through higher taxes, higher prices or both. It is the small operator who is most vulnerable, the man who lacks either the money or talent to cope with innumerable problems, but we need to consider him, for we need him too, as we also need the present nonproducer, who may have only his dreams and little capital to contribute immediately to the nation's future. The prospector still exists. He looks through more knowledgeable eyes than did most of his predecessors and often uses more sophisticated tools, but his dream is still part of the American Dream. The mountaineer climbs, "because it is there"; the prospector seeks because it might be there—or there—or there. To him every rock is potentially a new frontier. He still hears the voice that whispered in Kipling's poem, "The Explorer"... "Something hidden... Go and find it... Go and look behind the Ranges... Something lost behind the Ranges... Lost and waiting for you... Go!"... Kipling also quoted his usual unmaterial reward, "My price was paid me

ten times over by my Maker," and said of the occasional success, "It's God's present to our nation... I've found it and it's yours!" If our environmental fears result in banishing from our western mountains and deserts the prospector with his dream, something good and necessary will vanish from our way of life.

Safety

Appended hereto, for the attention of state officials and organizations especially concerned with mine health and safety, is a brief report. It urges more state control, under federal guidelines, for coal, metal and nonmetallic mines, plants and smelters and consolidation of federal responsibility within the Bureau of Mines. Also, there is a chart relating for many nations their energy consumption and national income, which may be of interest.

With the exception of a specific recommendation we would like to make, requesting Conference approval of a plan to secure more abundant economic information about western mining for next year's Conference, this concludes our report.

Mine Safety

Federal responsibility for mine health and safety should be vested solely in the U. S. Bureau of Mines, and should include mines, plants and smelters, to

avoid confusion, duplication of effort, and to provide continuity and qualified inspectors.

Metal and Nonmetallic Mines

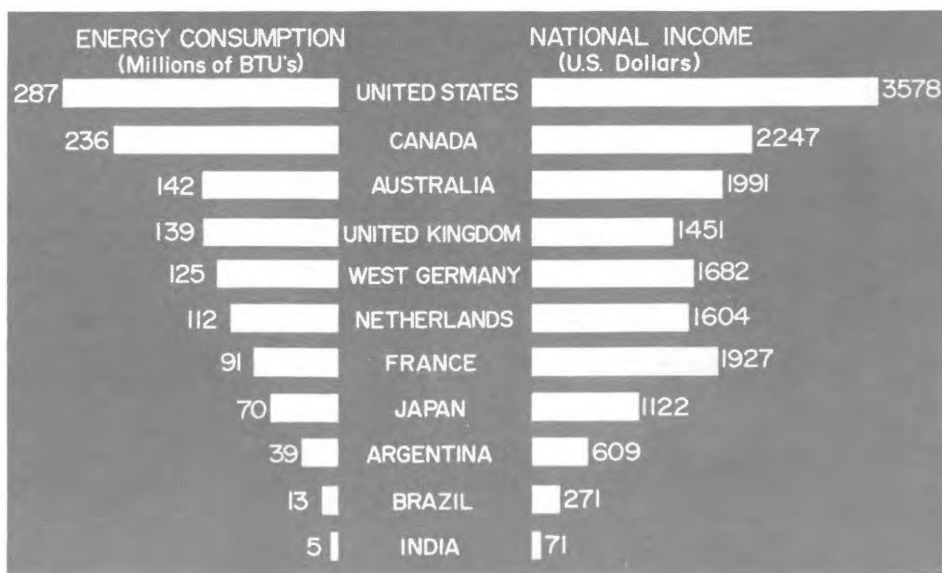
Arizona and Colorado have entered into State Plan Agreements with the Department of the Interior to retain state responsibility for the enforcement of metal and nonmetallic mine health and safety standards. It is recommended that the remaining states review their administrative policies and health and safety standards with the objective of determining the advisability of qualifying for a state plan, whereby the state will assume its right and responsibility for the enforcement of health and safety standards.

Coal Mines

The Federal Coal Mine Health and Safety Act of 1969 has pre-empted the field of Coal Mine Health and Safety to the extent that no meaningful enforcement function is left to the states. Punitive and indiscriminate federal regulations have closed many mines, threaten bankruptcy to others, and have and will continue to raise the price of coal unnecessarily without measurably increasing coal mine safety. The cause of coal mine health and safety would be better served by amending the law to permit state enforcement under federal standards and guidelines, as has been done in various areas of pollution control, in metal mine safety and in the Occupational Safety and Health Act of

(continued on page 4)

Per capita national income compared with per capita energy consumption, 1968 (United Nations Statistical Yearbook).



Summer Field Work in Utah

The geologists who plan to work in Utah during the 1972 field season are listed below. The reference numbers in the left column correspond as far as possible with the location numbers on the accompanying map.

- | | | |
|---|--|--|
| 1 Anderson, J. J.
Kent State Univ. | Detailed mapping of the structure and volcanic stratigraphy, Sevier Plateau (Piute Co.), Markagunt Plateau (west Garfield Co.), Tushar Mountains (east Iron Co.) and Black Mountains (east Beaver Co.). | |
| 2 Averitt, P.
USGS | Areal geologic map, Cedar City 7½-minute quadrangle. | |
| 3 Baer, J. L.
Brigham Young Univ. | Geology of the Sterling 7½-minute quadrangle, Sanpete County. | |
| 4 Biesinger, J. C.
Utah State Univ. | Mineral assemblages in core samples and their geochemical significance, Bear Lake. | |
| 5 Bilbey, S. A.
Utah State Univ. | Geochemistry and petrography of the Morrison Fm., Dinosaur Quarry quadrangle. | |
| 6 Blau, J. G.
Utah State Univ. | Geology of south part of James Peak quadrangle. | |
| 7 Burton, S. M.
Utah State Univ. | Structural geology of part of the Malad Range, Utah and Idaho. | |
| 8 Bushman, A. V.
Brigham Young Univ. | Pre-Needles Range silicic volcanism in west Millard County. | |
| 9 Chappelle, J. C.
Utah State Univ. | Mineralization in the Bear River Range, Utah-Idaho. | |
| 10 Doelling, H. H.
UGMS | (a) Minerals inventory, Box Elder County, (b) minerals inventory, Garfield County and (c) potash investigation project. | |
| 11 Engel, René
Kern County, Calif. | Geochemistry of tungsten. | |
| 12 Fallstrom, V. R.
Brigham Young Univ. | Geology of the Joy area, Drum Mountains, Millard and Juab counties. | |
| 13 Francis, G. G.
Utah State Univ. | Environmental analysis of the Swan Peak Formation in Wellsville Mountain and the Promontory Range, north central Utah. | |
| 14 Fuller, R. H.
Utah State Univ. | Chemical exchange at the sediment-water interface, Bear Lake. | |
| 15 Gray, W. E.
Utah State Univ. | Structural geology of Clarkston Mountain, Malad Range. | |
| 16 Hintze, L. F.
Brigham Young Univ. | Geology of the Fish Spring NW and SW 7½-minute quadrangles, Tooele and Juab counties. | |
| 17 Hintze, L. F. and M. Best
Brigham Young Univ. | Geology of the Needles Range, Millard and Beaver counties. | |
| 18 Hogg, N.
Brigham Young Univ. | Basaltic andesites of west Juab County. | |
| 19 Hoover, J.
Brigham Young Univ. | Late Cenozoic volcanic rocks of the Sevier Desert, Millard County. | |
| 20 Howes, R. C.
Utah State Univ. | Geology of the Wildcat Hills, Box Elder County. | |
| 21 James, W. C.
Utah State Univ. | Environmental analysis of the Kinnikinic and Swan Peak formations, Idaho and Utah. | |
| 22 Jones, R. L.
Utah State Univ. | Clay-water systems and cation-exchange equilibria in three forest soils, Bear River Range. | |
| 23 Lawyer, G.
Brigham Young Univ. | Paleoecology of Dakota Sandstone near Hanksville, Wayne County. | |
| 24 Mecham, B. H.
Utah State Univ. | Petrography and geochemistry of the Fish Haven and Laketown dolomites, north central Utah and southeast Idaho. | |
| 25 Melton, R.
Brigham Young Univ. | Paleoecology of Rico-Hermosa fms., Moab Canyon area, Grand Co. | |
| 26 Newman, G.
Brigham Young Univ. | Conodonts of Joana Limestone (Mississippian), Millard and Beaver counties. | |
| 27 Palmer, J. O., J. Cranor
and S. Anderson
Brigham Young Univ. | Contact metamorphic effects of Sunset Peak area, south of Brighton. | |
| 28 Pierce, C. and S. Leedom
Brigham Young Univ. | Geology of the Little Drum Mountains, Millard County. | |
| 29 Rigby, J. K.
Brigham Young Univ. | Paleoecology of Ordovician reefs, Confusion Range, southwest Millard County. | |
| 30 Ritzma, H. R.
UGMS | (a) Oil-impregnated sandstone study, Raven Ridge and Nine Mile Canyon areas, (b) oil field study, Boundary Butte area, (c) fractures and jointing, north Uinta Basin and (d) stratigraphic study, Kaibab Lower Moenkopi, Circle Cliffs area. | |
| 31 Rockaway, J. D.
Univ. of Missouri, Rolla | Engineering of the Cedar City area. | |
| 32 Rowley, P. D.
USGS | Mapping of the structure and stratigraphy, Iron Springs mining district, Iron Co. | |
| 33 Sandson, I.
Brigham Young Univ. | Paleoenvironment of the Navajo Sandstone in San Rafael Swell, Emery County. | |
| 34 Summers, P. L.
Utah State Univ. | Surficial geology of intermontane valleys, Mount Pisgah quadrangle. | |
| 35 Terrell, F.
Brigham Young Univ. | Paleoecology of Honaker Trail (Penn.) Formation near Moab, Grand Co. | |
| 36 Wengerd, S. A.
Albuquerque, New Mex. | Petroleum potential of southeast Utah (Paradox Basin). | |
| 37 Woodfill, R. D.
Purdue Univ. | Geologic and petrographic investigation, north Kettley volcanic field, Summit and Wasatch counties. | |
| 38 Wright, B. C.
Utah State Univ. | Farmington Canyon Fm. between Willard Canyon and Ben Lomond Peak, Wasatch Mtns. | |
| 39 Young, G.
Brigham Young Univ. | Geology of Billies Mountain 7½-minute quadrangle, Utah County. | |

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1970. This will require an active program by the states, preferably utilizing federal grants under Section 503 of the Federal Coal Mine Health and Safety Act of 1969, to include:

(a) Amendment of the Coal Mine Health and Safety Act to authorize state enforcement under federal guidelines.

(b) Research and investigation by the states and enactment of amendments to state coal mine statutes, specifically adapted to assure maximum coal mine safety, according to varying regional differences and the elimination of requirements that are unnecessary or that are not conducive to coal mine safety.

(c) A cooperative study among the Rocky Mountain States of amendments to Workmen's Compensation Laws to meet "Black Lung" requirements under Section 421 of the Federal Coal Mine Health and Safety Act.

(d) A cooperative program among the states for education and dissemination of information concerning coal mine health and safety.

Recommendation

Mr. Chairman, Honorable Governors, Honored Guests:

The Western Governors' Mining Advisory Council has tried over the years to fulfill the purposes for which the Western Governors Conference created it. We have, year to year, counceled with individual governors, met together with delegates from the various states, and, finally, each year, have made a report in one form or another to the assembled governors.

This year we have recognized that for all this time we have been conducting our activities on a two-part assumption: that the governors, separately and collectively, recognized the value of the mining industry of the western states to each individual state, to the region, and to the nation; and, second, that this importance was recognized, at least broadly, by the people of each state and by the nation as a whole.

Today, in the volatile context of current concern for environmental controls, we recognize that quite the opposite may be true. While we in the mining industry do not question the essentiality

of the industry, we have suddenly become aware of the fact that nobody, no individual, no agency, ever has prepared a comprehensive analysis of the several roles of western mining.

This year our report endeavors to emphasize some important economic aspects of western mining. We also considered the possibility of submitting a detailed analysis of its dollar impact on the various states, on the region and on the nation, but have been forced to recognize that such a labor is beyond the time capacity of this body, and perhaps beyond our collective expertise.

Therefore, assembled in Salt Lake City last month, we unanimously agreed that we would recommend that this Western Governors' Conference direct its Mining Advisory Council to transmit to the Secretary of the Interior the request of the Western Governors that:

1. The U. S. Bureau of Mines Office of Economic Analysis undertake at the earliest possible time a study which will determine objectively:

- (a) The current products of the mining industry of these 13 states, their volumes, their values;

- (b) The number of people directly employed by those mines, the number of their dependents, and the total payroll divided among them;

- (c) The number of people supported entirely or in major part by enterprises serving the mining industry and mining communities;

- (d) The taxes, local, county, state and federal, generated by the dollars flowing from western mining industry, through at least the first four turnovers of those dollars;

- (e) The disposition of the newly created wealth from the mines into payroll, in-state purchases, out-of-state purchases, dividends, exploration, development and environmental control;

- (f) The total acreage used by the mining industry of each state, its proportion of each, the per-acre yield by product class, the proportion of the nation's total con-

sumption of products produced by western acreage and the percentage of the total land of the nation occupied by western mining and

- (g) As accurate an estimate as possible of the total number of individual Americans who, as stockholders, are the owners of western mining enterprises.

2. To request the U. S. Bureau of Mines also to delineate the final destinations and uses of the products of western mining and to apply as many accurate economic indices as possible to evaluate the national impact of western mining in terms of jobs elsewhere dependent upon its products, payrolls accruing from such jobs, the number of people effected and the consequences to the nation were it denied the products of western mining;

3. To request the U. S. Bureau of Mines to project, with the cooperation of whatever federal agencies are appropriate, the effects on the United States' balance of payments that would accrue from the slow-down or cessation of the production of metals and minerals from western mines;

4. To act as the coordinating agency for this study and to use the abilities of individual members of WGMAC to elicit the cooperation of state and regional financial institutions, state universities and other appropriate organizations to their fullest and

5. To use every means available to assure that the study be completed in time for the individual governors to study it prior to the 1972 Western Governors' Conference, so as to constitute a contextual base for our next year's report to you.

We suggest that the request to the Secretary of the Interior be based upon the instructions to the Secretary contained in P. L. 91361, The National Mining and Minerals Policy Act of 1970. We feel the objectivity of the study would best be assured and accepted were the study made by the Department of the Interior, rather than by some vested interest or combination of interests or even by an individual state.

UGMS Publications Available

Utah Geological Survey published the following during the last eight months:

Bulletin 92, "Gravity Base Station Network in Utah—1967," by K. L. Cook, T. H. Nilsen and J. F. Lambert, \$3.00. The study shows 46 base stations scattered throughout Utah with photographs and descriptive maps of each station. The base stations establish elevation and gravity value at each site. At each point a monumented bench marker gives pertinent data useful for all exploration companies involved in mineral exploitation as well as helpful to surveyors.

Bulletin 93, "Geologic Hazards in Morgan County with Applications to Planning," by B. N. Kaliser, \$2.50. The geology, cloudburst flood hazard, erosion potential, landsliding and slope stability, earthquake effects, settlement potential and health hazards in Morgan County are examined.

Bulletin 94, "Oil and Gas Production in Utah to 1970," compiled by Carlton Stowe, \$3.50, reviews Utah's petroleum and natural gas history and gives oil, gas and water production statistics. Maps of the oil and gas fields and analyses of crude oil and natural gas are included.

Special Studies 37, "Instrumental Analysis of Tars and their Correlations in Oil-impregnated Sandstone Beds, Uintah and Grand Counties, Utah," by J. W.

Gwynn, \$3.00. Tars extracted from oil sands are analyzed for their physical and chemical characteristics. The origin and economic geology of the tars also are discussed.

Special Studies 38, "Engineering Geology of the City and County Building, Salt Lake City, Utah," by B. N. Kaliser, \$1.00. Foundation settlement factors, earthquake effects, kind and source of construction materials and weathering effects on the building are investigated. Historic photos illustrate the text.

Special Studies 39, "Analyses of Oil Extracted from Oil-impregnated Sandstone Deposits in Utah," by H. R. Ritzma and R. E. Wood, \$1.50. The report describes (1) physical and chemical analyses of tar-sand samples, (2) sampling procedures and evaluation and (3) significance of analyses.

Map 30, "Structural Map of the Escalante Area, Garfield County, Utah," by C. C. McFall and P. Peterson, \$1.00.

Map 32, "Generalized Structure of Kaiparowits Basin, Garfield and Kane Counties, Utah," by R. Graham and P. Peterson, \$1.00.

These publications may be purchased in person or by mail from Publications Office, 103 Utah Geological Survey Bldg., University of Utah 84112. If purchased by mail, add 10 percent for handling and postage.

EARTHQUAKE EPICENTERS

General earthquake epicenters in or near Utah for July to December 1971 and January 1972, with dates of occurrence and approximate magnitudes, are listed below. Unless otherwise indicated, localities are in Utah.

July	Magnitude
2 South of Kanab in Arizona	<2.0
5 West of Castle Dale	2.3
5 South of Farmington	1.8
6 Near Bear Lake	2.2
6 South of Mona	2.3
7 East of Bear Lake	2.1
7 East of Bear Lake	2.5
9 East of Bear Lake	2.4
9 East of Bear Lake	2.4
10 Northeast of Randolph, Utah, in Wyoming	2.4
10 Red Wash oil field	3.3
13 Northeast of Vernal	2.6
13 Near Nephi	1.9

16 South Idaho—felt from Lake-town, Utah, to Montpelier, Idaho	3.0
19 Promontory Point	1.8
19 South of Howell	2.0
21 Near Salt Lake City	2.4
25 South of Randolph, Utah, in Wyoming	2.3
27 Near Lehi	3.0
27 Near Lehi	2.3
27 Near Ferron	2.3

August	
2 South of Sunnyside	<2.0
4 North of Morgan	2.2
6 North of Bear Lake in Idaho	3.1
6 North of Bear Lake in Idaho	2.8
8 Promontory Mountains	2.3
10 South of Sunnyside	<2.0
10 North of Bear Lake in Idaho	2.3
13 South of Sunnyside	<2.0
14 Near Soldier Summit	1.8
14 Near Soldier Summit	1.5
14 Near Soldier Summit	2.8
14 Near Soldier Summit	1.5
14 Near Soldier Summit	1.3
16 East of Salt Lake City (possible quarry blast)	1.8
17 Near Scipio	2.0
19 Fifty miles southeast of Manila	3.4
20 Near Leamington	2.7
20 North of Green River	3.1

22 Near Scipio	2.6
22 Near Scipio	1.8
22 South of Paradise	1.8
22 South of Paradise	1.5
22 South of Paradise	2.7
22 South of Paradise	2.0
24 East of Salt Lake City (possible quarry blast)	1.3
26 North of Cedar Springs	2.6
31 South of Sunnyside	<2.0
31 North of Bear Lake in Idaho	2.0

September	
1 East central Nevada	3.0
2 North of Manila, Utah, in Wyoming	2.7
5 Near Promontory Point	1.8
5 Near Promontory Point	1.5
7 South of Sunnyside	<2.0
7 Utah-Wyoming-Idaho border (possible blast)	2.3
8 Rangely, Colorado	1.7
8 Rangely, Colorado	3.1
8 West of Bear Lake on Utah-Idaho border	1.9
10 Near Cedar City (possible blast)	<2.0
10 East of Salt Lake City	1.8
12 East of Hanksville	2.5
13 East of Salt Lake City	2.7
15 Near Castle Gate	2.0
17 Near Alta	1.2
17 Near Alta	1.9
17 Near Alta	1.8
17 Near Alta	3.2
18 Near Alta	1.4
18 Near Alta	3.1
18 Near Alta	1.3
18 Near Alta	1.5
18 Near Alta	2.7
19 Near Alta	3.3
23 East of Huntsville	3.1
24 Near Moore	2.4
25 Nine events near Mona	1.6 to 2.6
25 Near Mexican Hat	3.5

October	
2 Near Alta	1.1
2 Near Alta	0.6
2 Near Alta	1.6
2 Near Alta	1.6
2 Near Alta	0.8
2 Near Alta	1.2
2 Near Alta	1.5
2 Near Alta	2.3
2 Near Alta	2.0
5 East central Nevada	2.5
7 North of Randolph	3.4
12 South of Kanab, in Arizona	2.5
12 South of Sunnyside	2.3
14 Parley's Canyon (blast)	2.3
20 Great Salt Lake, west of Promontory Point	2.1
26 Near Logan	2.3
29 Near Price	2.0

November	
3 South of Sunnyside	1.9
4 South of Sunnyside	<2.0
6 Near Cedar City	2.4
9 Near Cedar City	3.1
9 Near West Water	2.9
10 Cedar City	3.1
10 Cedar City	3.1
10 Cedar City	3.1
10 Cedar City	3.1
10 Cedar City	1.0
10 Cedar City	3.7
10 Cedar City	3.5
10 Cedar City	3.2
10 Cedar City	2.8
10 Cedar City	3.2
10 Cedar City	1.0
10 Cedar City	3.4
10 Cedar City	2.3
10 Cedar City	1.1

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10 Cedar City	2.9	1 South of Sunnyside	<2.6
10 Cedar City	3.3	1 South of Sunnyside	<2.0
10 Cedar City	3.0		
11 Cedar City	1.4		
11 Near Bear Lake in Idaho	1.9		
12 Near Grand Junction, Colorado	3.4		
15 Cedar City	1.2		
15 Rangely, Colorado	3.1		
December			
3 Central Utah-Colorado border	2.9		
4 Near Fish Lake	<2.0		
8 South Utah-Nevada border	2.9		
8 Near Hiko, Nevada	4.7		
8 Near Green River	2.6		
9 Hansel Valley	2.0		
10 South of Sunnyside	<2.0		
10 Red Wash oil field	<2.0		
11 South of Sunnyside	<2.0		
11 South of Sunnyside	<2.0		
11 South of Sunnyside	<2.0		
11 South of Sunnyside	<2.0		
11 South of Sunnyside	<2.0		
11 South of Sunnyside	2.2		
13 Promontory Mountains	2.3		
15 North of Lake Powell	3.0		
19 Promontory Point	1.0		
25 South of Sunnyside	1.7		
28 Rangely, Colorado	3.0		
28 South of Sunnyside	2.0		
31 West central Colorado	3.2		
January			
1 South of Sunnyside	<2.6		
1 South of Sunnyside	<2.0		
1 South of Sunnyside	<2.0		
3 Near Farmington	2.7		
3 South of Richfield (slight damage)	4.3		
3 South of Richfield (felt)	3.1		
6 San Rafael Swell	<2.0		
6 North of Bear Lake in Wyoming	2.6		
7 North of Scipio	2.0		
9 South Wyoming	2.9		
13 Utah-Idaho border near Cedar Creek	2.4		
14 Near Pineview	2.0		
17 North of Peoa	2.0		
19 South of Castle Dale	2.4		
20 East of Mount Pleasant	2.2		
23 Near Cedar City	3.1		
24 Utah-Idaho border near Cedar Creek	<2.0		
26 Near Eureka	2.1		
29 Near Indianola	1.6		
29 Near Hanna	1.4		

These earthquakes were recorded by the University of Utah seismograph stations under the direction of Kenneth L. Cook. All locations and magnitudes are preliminary determinations; the final determinations will be printed in the University of Utah Seismological Bulletin, issued quarterly.

Utah Geology in Print

A list of papers appearing in 1971 which pertain to the geology and mineral industry in Utah has been prepared and printed below.

The staff of the University of Utah Engineering and Physical Sciences Library, under the direction of Edith Rich, generously provided the *Quarterly Review* staff with the list of papers. Sylvia Goeltz, UGMS, compiled the subject index.

The papers are listed alphabetically by author and by subject.

The following sources were used to provide information:

Abstracts of North American Geology.

Applied Science and Technology Index.

Engineering Index Monthly 1970.

Geological Society of America, Bibliography and Index of Geology.

Miscellaneous.

University of Utah and Brigham Young University theses.

U. S. Geological Survey Publications, 1971.

Utah Geological and Mineralogical Survey Publications, 1971.

AKERS, J. P. and others, 1971, Hydrogeology of the Cenozoic igneous rocks, Navajo and Hopi Indian Reservations,

Arizona, New Mexico and Utah: U. S. Geol. Survey Prof. Paper 521-D, 18 p., illus.

ANDERSON, J. J., 1971, Geology of the southwestern High Plateaus of Utah; Bear Valley Formation, an Oligocene-Miocene volcanic arenite: Geol. Soc. Am. Bull., v. 82, no. 5, p. 1179-1205, illus.

ARNOW, T., 1971a, Geologic framework, in Environmental geology of the Wasatch Front: Utah Geol. Assoc. Publ. 1, sec. B, B1-B6.

——— 1971b, Hydrologic framework, in Environmental geology of the Wasatch Front: Utah Geol. Assoc. Publ. 1, sec. C, C1-C7.

BAARS, D. L. and D. M. Molenaar, 1971, Geology of the Canyonlands and Cataract Canyon: Four Corners Geol. Soc., 6th Ann. Field Conf., 99 p., illus.

BAER, J. L. and R. L. Rollins, 1971, Foundation problems in the Provo-Orem area, Utah, in Environmental geology of the Wasatch Front: Utah Geol. Assoc. Publ. 1, sec. M, M1-M2.

BAER, J. L., 1971, An occurrence of Ophiomorpha in Permian strata, southeastern Utah (abs.): Geol. Soc. Am., Abs., v. 3, no. 6, p. 388.

BAILEY, G. B. and G. R. McCormick, 1971, Chemical halos as a guide to lode deposit ore in the Park City district, Utah (abs.): Geol. Soc. Am., Abs., v. 3, no. 7, p. 497.

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Magna quadrangle, Salt Lake County: Tooker (c).

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Great Salt Lake: Greer.

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High Plateaus, volcanic arenite: Anderson.

Recognition of lacustrine and fluvial sandstone: Picard (b).

Tintic quartzite, Willard thrust, north Utah: Hammond.

Volcanic petrology, southwest Utah: Lowder.

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Bear Valley Formation, High Plateaus: Anderson.

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Depositional processes, Navajo Sandstone: Visser.

Eocene Lake, Uinta Basin: Picard and High (b).

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Pennsylvanian rocks, east Green Basin: Rich.

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Bear Valley Formation, Oligocene-Miocene volcanic arenite: Anderson.

Cambrian sequences, nomenclature and correlation: Crittenden and others.

Cretaceous, Ferron Sandstone: Cotter.

Geologic framework, Wasatch Front: Arnow (a).

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Colorado Plateau, Basin and Range: Bucher.
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Calderas, Juab County: Shawe.

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Survey Staff Address Meets

H. R. Ritzma, UGMS petroleum geologist, addressed the Mineral Economics Symposium of the American Association of Petroleum Geologists, April 19, in Denver, Colorado. His topic was "Exploration and Development of Oil Shale and Oil-impregnated Rock, 1970-1975." The symposium was part of the 57th annual meeting of the AAPG.

An exhibit at the meeting showed Utah's mineral resources and the work of the Survey and a second displayed selected portions of an oil-shale core from a western Uintah County hole.

Ritzma also represents the Survey on the AAPG Committee for Preservation of Cores and Samples and will represent the Utah Geological Association as delegate to the Rocky Mountain Section of the AAPG.

Survey geologists also will participate at the Associated Intermountain Universities' Conference on Policy Formulation in the Development of Energy Resources, May 24-25, 1972, Salt Lake City.

H. H. Doelling, economic geologist, will present "Geography of Utah's Coal Deposits," and H. R. Ritzma will talk on "Extent and Environmental Aspects of Oil Shale Deposits."

Guidebook On Sale

"Environmental Geology of the Wasatch Front, 1971," edited by L. S. Hilpert, is now available at the Survey offices. The compilation of papers, the first publication of the Utah Geological Association formed by the merger of the Utah Geological Society and the Intermountain Association of Geologists, investigates regional and local environmental problems associated with the Wasatch Fault zone, earthquakes and seismicity, urban development, pollutants and several other problems.

The guidebook consists of more than 219 illustrated pages and sells for \$6.75 over-the-counter or \$7.50 mailed; a supplementary roadlog is available for \$1.00. Quantity discounts do not apply.

Order from the Utah Geological Survey, 103 UGMS Building, University of Utah, Salt Lake City, Utah 84112.

QUARTERLY REVIEW

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