LANDSLIDES
An Expanding Problem for the Puget Lowland

The region of the Puget Lowland is susceptible to many types of slope failures ranging from shallow mudflows to deep-seated massive landslides; yet thousands of residents pass by, work, and live on these unstable areas every day, paying them little notice. Generally, it is only when a slide blocks a highway, causing inconvenience for many people, or destroys a home, creating tragedy for a few, that the individuals involved are suddenly awakened to a natural and never-ending geologic process.

This process is very apparent to residents of Seattle and will soon become apparent to Tacoma residents as population pressure forces the development of the hillside areas along the Narrows of Puget Sound.

The engineering geologist and the engineer are interested in landslides because their job is to build and maintain safe, economical, and useful structures on the earth's surface.

A landslide, unforeseen, or improperly provided for, may destroy a structure or impair its usefulness and may mean injury or death to people.

The purpose of this report is to explain the most general causes of landslides in the Puget Lowland region. It is hoped that planners, architects, ecologists, city, county, and State officials, developers, contractors, home owners, and potential home buyers will read this report and gain some useful knowledge on landslides. Engineering geologists and soils engineers have long been familiar with the problems of landslides, and much work has been done to devise the tools and methods for predicting and controlling them. The difficulty has been in getting controls established.

A landslide is the downward and outward movement of slope materials composed of natural rock, soils, artificial fills, vegetation, or combinations of these materials. Landslides occur when the pull of gravity on slope materials overcomes the frictional resistance of the slope materials to downward movement.
The diverse factors that affect slope stability in the Puget Lowland are:

**Type of earth material.** — Surficial deposits or unconsolidated, soft sediments will move downslope easier than partly consolidated or consolidated sediments.

**Water.** — Landsliding is generally more frequent in areas of seasonally high rainfall because the addition of water to slope materials commonly decreases their resistance to sliding.

**Proximity to areas undergoing active erosion.** — Rapid undercutting and downcutting along stream courses and shorelines makes slopes in these areas particularly susceptible to landsliding.

**Steepness of slopes.** — New landslides would tend to occur more readily on steeper slopes, especially if one of the previous factors are present; however, low natural slopes are often indicative of existing landslides. Some factors affecting slope steepness are:

- Increase in slope gradient (angle). — Through natural and/or manmade methods; for instance, a roadcut which changes a hill slope from 26° to 45° would tend to be less stable than the original hill slope.

- Increase in slope height. — Through natural and/or manmade methods; for instance, by extending the upper portion of a slope by placing fill material on top of the slope.

- Increase in slope load. — Adding structural weight as well as fill and trash materials to the tops of and onto the slopes. Usually through manmade methods; however, normal natural erosional debris may collect on slopes and move downslope.

**Type of vegetation.** — Trees with deep penetrating roots tend to maintain the stability of slopes by mechanical effects and contribute to the drying of slopes by absorbing part of the ground water.

**Ground shaking.** — Strong shaking during earthquakes, from large-scale explosions and vibrations of heavy machinery can jar and loosen surficial materials, and consol-

dated or unconsolidated sediments, thus making them less stable.

Landsliding is usually preceded, accompanied, and followed by perceptible creep deformation along the surface of sliding and/or within the slide mass. In other words, before a slope fails, signs of impending failure can be seen. Residents of buildings on or near slopes should be particularly alert to signs of possible impending failure. Such signs may include any one or more of the following:

1. Doors or windows that stick or jam for the first time.
2. New cracks in plaster, tile, brickwork, or foundations.
3. Outside walls, walks, or stairs pulling away from the building.
4. Slowly developing and widening cracks in the ground or in paved areas.
5. Breakage of underground utility lines.
6. Movement or tilting of fences, retaining walls, utility poles, or trees.
7. New water seeps or bulging of the ground at the base of slopes.

If any of the above conditions begin to develop or if a landslide is suspected, the information should be reported immediately to local authorities and investigated by an engineering geologist or soils engineer.

The danger of landsliding is expected to be greatly lessened in areas where grading ordinances, building regulations, and geologic and engineering advice have been available and complied with in the construction of hillside and hillcrest development. Engineering geologists have increasingly tried to search out and map existing landslides and potentially unstable slopes, especially in urban areas. Such mapping is an essential basis for intelligent planning of land use and for formulating adequate building ordinances and regulations.

The Division of Mines and Geology has continued to expand the state landslide inventory file and has begun environmental geology mapping programs, which will include landslides and landslide problem areas. However, landslide hazards generally cannot be eval-
asured adequately or reduced in specific areas without detailed site studies by qualified geologists and soils engineers.

Ernest R. Artim

"When an inch of rain falls on 160 acres, it amounts to 4,324,000 gallons and weighs more than 28,000 tons."

The Geological Society of the Oregon Country, 1972

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TOWER ROCK

A Southwestern Washington Landmark

Tower Rock is located on the south side of the Cispus River valley about eight miles southeast of the Lewis County community of Randle. It can be reached by taking paved Forest Service Road No. 123 from Randle to Cispus Environmental Center, which is located in the Cispus River valley about one mile northeast of Tower Rock. Facilities for campers are available at Tower Rock recreation site, near the base of Tower Rock.

The top of Tower Rock is 3,335 feet above sea level and about 2,000 feet above the Cispus River valley. This elevation is not particularly high when compared with other peaks in the area, but the side of Tower Rock that faces the Cispus River valley is an imposing 1,000-foot nearly vertical cliff. Beneath this cliff is a steep slope covered by loose rock that accounts for an additional 1,000 feet of elevation above the valley floor.

About 17 million years ago, a mass of molten igneous rock formed in the earth's crust in this part of Washington. The hot, fluid rock forced its way up through the crust until it was only a few hundred feet below the earth's surface, where it began to cool and crystallize. This magma came to rest where Tower Rock now stands, and the cooled, solid rock now makes up Tower Rock. This once-liquid rock is more resistant to erosion than the lava flows and other volcanic rocks that surround it.

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Tower Rock as seen from the opposite side of the Cispus River valley. View is toward the southeast.

Over a period of several million years, erosion removed the several hundred feet of rock that covered Tower Rock, and the Cispus River began to construct the valley in which it now flows. About 3 million years ago, Tower Rock was probably a rounded, tree-clad hill that projected slightly into the Cispus River valley. The vertical face of Tower Rock was yet to be created.

Then, beginning about 2.5 million years ago, climatic changes caused a glacier to form in the upper part of the Cispus River valley. This glacier gradually grew and moved down the valley until it extended beyond Tower Rock. The passing glacier plucked, plowed, and abraded rock from the flank of Tower Rock. When glaciation ended about 10,000 to 15,000 years ago, Tower Rock was left with almost its present form. The rock probably
had a fairly smooth, polished face shaped like one-half of the letter "U". The lower part of Tower Rock's face sloped outward toward the valley floor, while the upper part was left as a vertical or nearly vertical cliff.

During the last 10,000 years or so, the lower part of Tower Rock's face has been covered by rock debris that has broken away from the upper part, and forests have grown over the more gently sloping areas. This has softened the profile of Tower Rock but not erased the grandeur that makes it a unique landmark in southwestern Washington.

J. Eric Schuster

METEORITES

Occasionally, geologists of Washington Division of Mines and Geology are called upon to identify meteorites and meteorite craters. However, in almost all cases the meteorites turn out to be nothing more than furnace or smelter slag, concretions, odd-shaped rocks, or fragments of manufactured iron. The meteorite craters are usually nothing more than natural depressions such as kettles or shallow man-dug pits.

To date there have been only three authenticated discoveries of meteorites in Washington; however, other meteorites have no doubt been found but have never been reported to any scientific institution. The authenticated discoveries in Washington are as follows:

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
<th>Wt. (lbs.)</th>
<th>Date of Discovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Washougal</td>
<td>Stone</td>
<td>0.5</td>
<td>1939</td>
</tr>
<tr>
<td>Waterville</td>
<td>Iron</td>
<td>72.5</td>
<td>1927</td>
</tr>
<tr>
<td>Ephrata</td>
<td>Iron</td>
<td>7.5</td>
<td>1915</td>
</tr>
</tbody>
</table>

Meteorite finds in other western states are as follows:

<table>
<thead>
<tr>
<th>State</th>
<th>Number</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Montana</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Utah</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Nevada</td>
<td>4</td>
<td></td>
</tr>
</tbody>
</table>

The largest of these finds was the Willamette meteorite of Oregon that was found in 1902. The meteorite, which is composed of iron and weighs 14 tons, is at the American Museum of Natural History in New York.

Throughout the world, over 1,500 well-authenticated meteorites (using the term meteorite for a single occurrence) have been discovered. Some occurrences may have many individual pieces. As an example, tens of thousands of fragments have been collected from Meteor Crater in Arizona. The greatest recovery from observed meteorite falls occurred between 1930 and 1940; seventy-nine meteorites throughout the world were recovered.

The oldest authenticated fall is that of Ensisheim in Alsace when on November 16, 1492, a stone weighing 406 pounds fell to earth. The largest meteorite was found in southwest Africa and weighs 60 tons (9.7 ft. x 9.3 ft.); at the time it fell it probably weighed around 100 tons.

There is only one authenticated case of a person being struck by a meteorite. On November 30, 1954, a woman in Alabama was struck on the upper thigh by a 12.8-pound stone meteorite that caused a minor bruise. It is more common for buildings and animals to be struck by meteorites.

About 500 meteorites fall on the earth each year. Since 70 percent of the surface of the earth is covered by water, only about 150 meteorites fall on land. Most meteorite falls occur during June. The largest number of observed falls occur between 3:00 p.m. and 4:00 p.m. and drops to a minimum between 3:00 a.m. and 4:00 a.m. The fall of a meteorite is accompanied by light and sound effects. It appears as a fiery mass and passes across the sky, leaving behind a trail that appears as a luminous streak by night and a cloud of dust by day. The sound has been described as resembling cannon fire, thunder, or the passing of an express train.
On impact, small and medium-sized meteorites (up to 1 ton) leave a hole or pit in soft ground about the size of the meteorite. A 2,205-pound stone that fell in Kansas in 1948 made a hole 3 feet deep. Whereas small meteorites tend to form impact craters, large meteorites (10 tons or larger) form explosion craters. The most spectacular crater in the United States is Meteor Crater in Arizona. The crater is 4,260 feet across and 575 feet deep.

A meteorite is a natural occurring solid body that has arrived on earth from outer space. They range in size from microscopic particles to masses weighing many tons. Meteorites consist essentially of nickel-iron alloys or silicate minerals. When composed chiefly of iron and nickel, they are called siderites; when composed mostly of silicate minerals (mainly olivine and orthopyroxene) they are called aerolites. Meteorites that are a mixture of stone and iron are called siderolites.

Stone meteorites tend to be roughly equidimensional. Iron meteorites tend to be more irregular and many have sharp protuberances. The surfaces of many freshly fallen meteorites are comparatively smooth and featureless. Some meteorites, however, show furrows, shallow depressions, and sometimes deep cavities. The commonest surface irregularities are shallow depressions resembling the impressions of fingerprints on soft clay. Also, most meteorites are heavier than ordinary rocks.

In order to add to the list of authenticated meteorites in Washington, the Division of Mines and Geology would appreciate hearing about meteorite discoveries in the state. The division will examine, free of charge, any specimen believed to be a meteorite and the specimen will be promptly returned. The addition of new meteorites for recording and research depends largely on the ability of the general public to recognize meteorites when they see them and their willingness to report them to a scientific organization.

Wayne S. Moen

"A mine is a hole in the ground owned by a liar."

Mark Twain

COAL MINE SUBSIDENCE INVESTIGATION

Coal has been continually mined in the State of Washington from the 1870's to the present day. The majority of mining activity flourished and died out by the 1930's. In the subsequent forty years, most surface traces of the once vast coal mining operations have vanished.

Dangerous surface subsidence in areas of extensive underground workings has occurred in Bellingham, Issaquah, Renton, Ravensdale, and Newcastle. In Issaquah, two young boys were overcome by mine gas when they entered a freshly caved subsidence crater. The father of one of the boys and two Issaquah city policemen were also rendered unconscious by the gas in their attempts to rescue the boys. Issaquah City firemen with breathing devices were finally successful in removing and reviving all five persons from the subsidence crater.

A hunter walking through a field in Whatcom County had the ground cave out from under him. He stated he might have fallen possibly 60 feet, but he was saved because his rifle became jammed in the crater and enabled him to scramble to the surface.

As the population of the Puget Lowland has increased, suburban sprawl has expanded over previous coal mining centers. Identifying the location of these old coal mine workings is necessary in order to define areas of potential subsidence hazard, thereby avoiding damage to property and injury to person.

To determine the location of coal mine workings, all original mine maps available were collected by the Division of Mines and Geology for mined areas in Washington. These maps were sorted, cataloged, and photographically reduced or enlarged as necessary to print copies on a uniform scale of 1 in. = 400 ft.

The uniform mine maps were compiled as a composite and reproduced as individual maps of the mine workings within one section of land. These sectional maps are organized in book form with 160 individual maps covering King, Kittitas, Lewis, Pierce, Thurston, and Whatcom Counties. While the maps are not presently published, information concerning potential coal mine subsidence hazard in
any part of the state is available to the public through the Department of Natural Resources, Division of Mines and Geology, Olympia, Washington, 98504.

Mackey Smith

 Depths of Ore Bodies

"All mines become completely exhausted at some point in depth. Therefore the actual distance to which ore can be expected to extend below the lowest level grows less with every deeper working horizon."

Herbert C. Hoover, 1909

EARTHQUAKES

The Department of the Interior reports that the most injuries as the result of an earthquake are caused by:

Partial building collapse, such as toppling of chimneys, falling brick from wall facings and roof parapets, collapsing walls, falling ceiling plaster, light fixtures, and pictures.

Flying glass from broken windows.

Overturned bookcases, fixtures, and other furniture and appliances.

Fires from broken chimneys, broken gas lines, and similar causes. The danger may be aggravated by the lack of water due to broken mains.

Fallen power lines.

Drastic human actions resulting from panic.

Precautionary actions that can be taken to reduce the potential danger to people and property before an earthquake are:

In earthquake-prone areas, citizens should support local safe building codes with efficient inspection and firm enforcement.

School building programs should be supported which provide for the strengthening of old, weak buildings or their replacement with earthquake-resistant structures.

Homeowners or tenants should bolt down or provide other strong support for water heaters and other gas appliances since fire damage can result from broken gas lines and appliance connections.

Sites for construction should be selected and engineered to reduce the hazard of damage from an earthquake.

A flashlight and a battery-powered transistor radio should be ready for use at all times.

Immunizations should be kept up-to-date for all family members.

During an earthquake, the following advise should be heeded:

If indoors, watch for falling objects. Stay away from windows, mirrors, and chimneys. If shaking is severe, get under a table, desk, or bed. Usually, it is best not to run outside.

If in a high-rise office building, get under a desk. Do not dash for exits, since stairways may be broken and jammed with people.

If in a crowded store, do not rush for a doorway since many others may have the same idea.

If outside, avoid high buildings, walls, power poles, and other objects which could fall. Do not run through streets.

After an earthquake occurs, the following precautions should be followed:

Do not attempt to move seriously
injured persons unless they are in immediate danger of further injury.

Do not touch downed power lines or objects touched by the downed wires.

Immediately clean up spilled medicines, drugs, and other potentially harmful materials.

Emergency water may be obtained from water heaters, toilet tanks, melted ice cubes, and canned vegetables or fruits.

Telephones should not be used except for genuine emergencies.

Do not go "sightseeing" immediately, particularly in beach and waterfront areas where seismic waves could strike.

Be prepared for additional earthquake shocks called "aftershocks." Although most of these are smaller than the main shock, some may be large enough to cause additional damage.

Be prepared to respond to requests for help from police, fire-fighting, civil defense, and relief organizations.

If you would like to know more about safety and survival in an earthquake, an 11-page pamphlet on the subject is available from the U.S. Geological Survey, Washington, DC, 20242, and 345 Middlefield Road, Menlo Park, CA, 94025, or from the Office of Engineering Preparedness, Executive Office Building Annex, 17th and "F" Street N.W., Washington, DC, 20504, and from Region 9, OEP, 120 Montgomery Street, San Francisco, CA, 94104.

FRUITS OF LABOR

When Dr. W. A. G. Bennett, former geologist for Washington Division of Mines and Geology, published his report on the dolomite resources of Washington in 1944, little did he realize that he was laying the groundwork for a new metal industry in the state.

After investigating the dolomite deposits of the Addy area, which had been described in Dr. Bennett's report, the Aluminum Company of America announced plans to begin construction this spring on a $50 million magnesium plant at Addy in Stevens County. Using dolomite as a raw material, the plant will produce up to 40,000 tons of magnesium metal per year, and provide work for 300 to 400 people. At current metal prices this will add around $30 million per year to the metal production of Washington. In addition to magnesium, silicon and ferrosilicon will be extracted from the dolomite and other minerals of the Addy area.

Events such as this point out that minerals can change in importance from year to year, and the results of geologic work can be just as important to future generations as they are to the present one.

DIVISION OF MINES AND GEOLOGY STAFF

We would like the public to have an opportunity to learn something about the staff members of the division. Perhaps, some of the geologists have corresponded or talked on the telephone with you, others may be personal acquaintances, or their names may be familiar as authors of some of our publications. This issue will feature Ted Livingston, Wayne Moen, and Weldon Rau.

VAUGHN E. LIVINGSTON, JR. (TED)

Ted is our State Geologist, Oil and Gas Supervisor, and the Supervisor of the Division of Mines and Geology. He received his B.S. and M.S. (geology) from Brigham Young University, and also did graduate work at Washington State University. Ted and his wife Nancy have 4 children, Leann, Jay, Robert, and David. His work with our division began in 1956, and his work specialties, along with admin-
istration, are environmental geology, economic geology, stratigraphy, and paleontology. Several of our most popular reports including "Geologic History and Rocks and Minerals in Washington" and "Fossils in Washington" were written by him. Ted has also written bulletins on geology and mineral resources of our state. He is a sports enthusiast and enjoys watching his sons participate in track, football, and wrestling. Fishing is a wonderful way to relax and you might find him in his spare time trying to catch a bigger fish than our other "experts." Ted also spends a great deal of time working for his church.

WAYNE S. MOEN

Wayne graduated from the University of Washington and worked for an oil company and the Atomic Energy Commission before joining our staff as a minerals geologist in 1960. His work areas are economic geology, petrology, mining law, and mineralogy. Besides identifying minerals, rocks, and ores for the public and government agencies, he answers many inquiries related to mines, mineral deposits, land status, mining law, geology, and prospecting in the state. Wayne appraises mineralized areas of Washington relative to land withdrawals and multiple-use purposes. He has written several reports that have very wide distribution in the state: "Mineral Rights and Land Ownership in Washington," and the pamphlet, "Mining Claims—Questions and Answers." His bulletins include "Geology and Mineral Deposits of the North Half of the Van Zandt Quadrangle, Whatcom County, Washington," "Barite in Washington," "Building Stone in Washington," and "Mines and Mineral Deposits of Whatcom County, Washington." When he is not busy with minerals or writing, Wayne can usually be found out on Puget Sound in his sailboat, Lapis II, or at his wilderness retreat on Hood Canal.

WELDON W. RAU

Weldon is a nationally known authority on Tertiary micropaleontology and biostratigraphy of the west coast. He conducts advanced research in these fields and the results have been published in state, federal, and other scientific journals. In addition, he has become our authority on the geology
of the Grays Harbor Basin and the Olympic Peninsula and has written several of our bulletins on this area. Weldon received his B.S. from the University of Puget Sound and his M.S. and Ph.D. from the University of Iowa. He worked for the U.S. Geological Survey for 10 years before coming to our division in 1960. Weldon and his wife Jane have one son, Greg, who is doing graduate work in biology at the University of Washington. Weldon likes to spend his leisure time working or relaxing at his log cabin, fishing up in the mountains with his son, or enjoying the ocean beach at Kalaloch with his wife.

WHERE ARE THEY NOW?

Dr. W. A. G. BENNETT

"Ben," who was a staff geologist for Mines and Geology, retired in September 1970. He first started work for the division in 1931. Since his retirement, he has been busy with his favorite pastimes that include gardening, hiking, traveling, and photography. Ben still retains his interest in rocks and minerals and has purchased a petrographic microscope to study the many rocks that he has collected over the years. Ben and his wife Maude make their home at 3277 South Quince, Olympia, when they are not out traveling in their camper.

The staff of the Division of Mines and Geology would like to thank all of you who have written to us in regard to our Newsletter. We were surprised and pleased at the amount of interest generated by our first issue. We hope that as time goes on we will be able to bring a varied and informative paper to you and that it will serve the purpose for which it is intended - contact and communication with the people in the state. For those of you who have written in requesting the Directory of Washington Mining Operations, we will send it to you as soon as it is off the press. We will be pleased to send future issues of our Newsletter to all of you who have written to us and asked to be placed on the mailing list.

WHAT IS URBAN AND ENGINEERING GEOLOGY?

In the past, I have been asked "what does an engineering geologist or an urban geologist do?" These questions were not asked by carpenters or doctors but by other geologists; therefore, for purposes of clarification I would like to explain what engineering and urban geology encompass.

Engineering geology is the profession that deals with the application of geology to the works of man. As defined by the Association of Engineering Geologists in 1969, it is the application of geologic data, techniques, and principles to the study of naturally occurring rock and soil materials or ground water for the purpose of assuring that geologic factors affecting the location, planning, design, construction, operation, and maintenance of engineering structures, and the development of ground-water resources are properly recognized and adequately interpreted, utilized, and presented for use in engineering practice.

Engineering geology also involves the recognition and study of artificially placed rock and soil materials. The field of engineering geology has become a very specialized field, and was one of the first fields to break away from the academic-orientated trend of geology. In this regard, it paved the way for other branches of
geology that produce material usable by the public, rather than for use only by other geologists.

Urban geology is the profession that deals with the application of geologic knowledge and principles for future planning and management of high-density urban and urbanizing areas and their surroundings. It includes geologic studies for physical planning, waste disposal, land use, water-resource management, and the full range of usable raw materials.

Urban geology involves studies of hydrogeology, topography, engineering geology, economic geology, and land planning and is concerned with earth processes, earth resources, engineering properties of earth materials, and human needs. As such, it involves the development and management of water and land resources, evaluation and mapping of rock and mineral resources, and the overall long-range physical planning and development for the most efficient and beneficial use of the land.

The two basic philosophies in both fields are:

1. Geologic maps be keyed to the needs of the user.
2. Geologic language be keyed to the needs of the user.

In this regard, there is an attempt to avoid "geologese" which is a highly technical literary style practiced by many geologists that involves the construction of sentences in such a way that the meaning is not apparent on first reading. The layman might well refer to this literary style as double-talk, a snow-job, or various other descriptive phrases.

Although urban geology has been practiced for some time, only after the rapid growth of the use of engineering geology has the field of urban geology begun to expand. The two fields are closely associated with the major difference being in the application of urban geology for future planning and management.

Ernest R. Artim

PROPOSED FEDERAL LEGISLATION
SURFACE MINING

Senate Bill 425 has been introduced by Senator Henry M. Jackson to "counteract the environmental abuses of surface mining, while recognizing the critical dependence of the nation on its products." It is claimed that the five major goals of the bill are to (1) prohibit strip mining when full reclamation is not possible; (2) establish national standards to reduce inequities among states and to protect the national interest if a state fails to implement its own act; (3) impose social and environmental costs, such as erosion, slope failure, and water pollution, on the mining companies; (4) restore all areas to a use at least as high as that of pre-mining; and (5) develop administrative procedures that are fair and flexible enough to cope with the varied conditions that exist in different areas of the United States.

Senate Bill 425 deals with all minerals that can be mined by open pit or surface methods. As introduced, the bill will require mine operators to meet tough reclamation goals, but does not impose the arbitrary slope limitations.

Senate Bill 923, an administration bill also introduced by Senator Jackson, covers all minerals and does not make any distinction between coal mining and the mining of other minerals as has been made in other bills. Coverage of surface and underground mining is provided. Primary responsibility for regulation is placed with the states. State regulations must meet federal standards. The determination of "unsuitability for mining" is tied in with existing mining and reclamation techniques rather than to the judgment of any one individual or agency as has been the case of other proposals.

The American Mining Congress has indicated that it considers S. B. 923 to be a more reasonable and realistic approach to the control of mining than S. B. 425. S. B. 425 has the potential of forcing the closure of many coal surface mining operations at a time when energy requirements appear critical.

Donald M. Ford
THE MINERAL INDUSTRY IN WASHINGTON IN 1972

The U.S. Bureau of Mines reports that the value of minerals produced in the state increased 13 percent to $107.6 million in 1972. Increases were shown in the production of coal and sand and gravel. Production of gold, silver, lead, and uranium declined, whereas the production of zinc increased slightly. The production of sand and gravel, stone, coal, and cement accounted for almost 70 percent of the total mineral production. Around 95 percent of the coal was mined by Washington Irrigation & Development Company for use in their coal-fired steam electric plant near Centralia. The state produced nearly 26 percent of the total U.S. aluminum production. However, almost all raw material used in the production of aluminum came from foreign sources.

The minerals that were produced in Washington in 1972 came from 474 privately owned pits, quarries, and mines. Three companies produced metallic minerals, 120 companies produced nonmetallic minerals, 240 companies produced sand and gravel, and more than 200 pits and quarries were operated by or for cities, counties, and the Washington State Department of Highways.

MINERAL PRODUCTION IN WASHINGTON 1972*

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Quantity</th>
<th>Value</th>
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<tbody>
<tr>
<td>Cement</td>
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<td>$23,680,000</td>
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<tr>
<td>Clay</td>
<td>263</td>
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<tr>
<td>Coal</td>
<td>3,150</td>
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<td>NA</td>
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<tr>
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<td>4,000</td>
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<tr>
<td>Lead</td>
<td>2,350</td>
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<tr>
<td>Peat</td>
<td>18</td>
<td>81,000</td>
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<tr>
<td>Sand and gravel</td>
<td>23,383</td>
<td>27,990,000</td>
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<td>Stone</td>
<td>11,789</td>
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<tr>
<td>Zinc</td>
<td>6,450</td>
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</tr>
</tbody>
</table>

Value of items that cannot be disclosed:
Abrasives, diatomite, gold, lime, olivine, fire clay, silver, talc, uranium, and coal

Total: XX 32,363,000

XX $107,624,000P


NA - not available. W - withheld to avoid disclosing individual company data. XX - not applicable. P - preliminary.

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Geologic Work at an Operating Mine

"What privilege it is for a geologist to live and wrestle for months and years with a tough problem, watching it forced by the steady penetration of underground workings, to yield and at last surrender, so that its inner secrets may be known."

L. C. Graton

Metal Deposits

"...the earth does not conceal metals in her depths because she does not wish that men should dig them out, but because provident and sagacious Nature has appointed for each thing its place."

Agricola De Re Metallica, 1556
YOUR STATE GEOLOGIST REPORTS

It is interesting to me to see how people have lost track of where their affluence has come from. So far as I have been able to determine, there are only a few basic industries that provide the wealth of this nation. They are the mining, agricultural, logging, fishing, and hydroelectric industries. The rest of us are simply redistributing the wealth by providing services.

The realization that the grubby old miner on the end of a shovel or pick and my grandfather out slopping the hogs are making a greater contribution to the wealth of the nation than I am, came as quite a jolt to my ego. The more I thought about it, however, the better I felt because I recognized a similarity between the miner, the logger, the commercial fisherman, and the farmer. They all seem to have a basic humility about them. They all seem to be men of somewhat simple tastes, who were just as happy during hard times as they are during good times. They generally do not tend to get involved in or taken up by crusades for purposes of so-called conscience. They seem to be uncomplicated individuals who recognize what life is all about.

In thinking about this I remember back to the days when I worked on my grandfather’s farm. Those were carefree days when my only worry or thought was to get the hay on the wagon so it wouldn’t tip over, and how many days it would take to shoot 40 acres of wheat, which was the largest grain field my grandfather had.

Somehow over the years, my concerns seem to have shifted to what I supposed were more lofty concepts, such as struggling with personnel problems, preparing budgets, and all those things a manager must cope with. It’s kind of startling to realize that my contribution to supplying new wealth to the nation is probably less now than it was when I was a teenager.

I suppose the thing I am getting at is that instead of establishing laws and rules to regulate and restrict the activities of the miner, logger, farmer, fisherman, and hydroelectrician, we should be praising them for putting their hands to the plow, so to speak, and supplying us with the basic products that fill our material needs, and that instead of continually putting stumbling blocks in front of them we should be doing our level best to encourage them to keep up the good work.

Ted Livingston

Geologists

"And some run up hill and down dale, knocking the chunky stones to pieces with hammers like so many road makers run daft. They say it is to see how the world was made."

Sir Walter Scott, 1824

DIVISION OF MINES AND GEOLOGY
HAS AN ADVISORY COUNCIL

A year ago, Land Commissioner Bert L. Cole invited eight people to serve on a Geology and Mineral Industry Advisory Committee to help the Division of Mines and Geology recognize and meet the geologic needs that exist in our society. The committee meets with the department at least three times a year and has made some really worthwhile contributions in helping formulate goals for the future.

At the present time, the committee is made up of the following people:

Professor Donald L. Anderson
Mining Engineering, Roberts Hall
University of Washington
Seattle, Washington 98195
Phone: 206-543-2611

Russell Chadwick
President, Northwest Mining Association
West 522 First Avenue
Spokane, Washington 99204
Phone: 509-624-4822
Eighty-nine mines and prospects in Okanogan, along with their locations, mineral workings, and former production, are included in a new report done cooperatively by the U.S. Geological Survey and the Washington State Division of Mines and Geology. It was written by C. Dean Rinehart and Kenneth F. Fox, Jr., of the U.S. Geological Survey, and published as our Bulletin 64, "Geology and Mineral Deposits of the Loomis Quadrangle, Okanogan County, Washington." It is available from the Division of Mines and Geology in Olympia at a prepaid price of $4.00.

Kenneth F. Fox, Jr., and C. Dean Rinehart are also the authors of our Bulletin 65, "Distribution of Copper and Other Metals in Gully Sediments of Part of Okanogan County, Washington." It is available from us at a prepaid price of $2.00. This report resulted from a geochemical exploration program, sponsored jointly by the U.S. Geological Survey and the Washington State Division of Mines and Geology, which was conducted to determine the regional patterns of metal distribution and to pinpoint the areas likely to contain undiscovered ore deposits.

SUPERSLUDGE

"Supersludge", the concrete-like pollutant product that researchers hope can be used eventually for highway construction, continues to live up to early expectations.

"Supersludge" is made from a mixture of fly ash, waste sulphate sludge, and hydrated lime. The pulverized fly ash is obtained from the burning of pulverized coal; waste sulphate sludge is a precipitate resulting from the neutralization of acidic industrial waste effluents, such as spent pickle liquor from steel plants or acid mine drainage from coal mines. When hydrated lime is added to fly ash and sludge and the resultant mixture is permitted to stand for a few days, it assumes the hardness of concrete, at a fraction of its cost.

To test its durability, the Federal Highways Administration constructed a 100-acre parking lot last spring near Washington, D.C., at the site of TRANSPO 72. "Supersludge" satisfactorily passed all engineering tests during and since the travel exposition.

Federal Highway Administration engineers are also studying the feasibility of using "supersludge" as an aggregate material in asphalt and concrete mixtures.
Coal mining states have been following, with understandable interest, the development of "supersludge". If the product proves to be successful—as presently indicated—it will provide an excellent market for substances heretofore considered industrial wastes.

West Virginia is currently considering a project which calls for the experimental use of "supersludge" on a section of new highway. In this instance, the product would replace the aggregate normally used as a base for an asphalt highway.

Excerpt from Conservation News, October 1972

MINES AND GEOLOGY LIBRARY

An extensive reference library of geologic and mining literature is maintained by the Division for the use of the staff and as a convenience to the public. Books are not loaned but may be consulted by anyone during office hours. Most of the material is acquired without cost on an exchange basis from the U.S. Geological Survey, U.S. Bureau of Mines, and other federal agencies, and also from the geologic surveys and mining bureaus of the other states. Similarly, publications are acquired from Canadian and various foreign sources. The library includes many technical books, texts, and maps dealing with special phases of geology and the mineral industry. The available reference material, therefore, is fairly complete and is continually used in the progress of research.

U.S. GEOLOGICAL SURVEY 71/2-MINUTE TOPOGRAPHIC QUADRANGLES
(New maps received in Division of Mines and Geology Library since January 1, 1973)

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Topographic quadrangle maps of Washington State are available for inspection at the Division of Mines and Geology Library. They may be purchased from the Distribution Section, U.S. Geological Survey, Federal Center, Denver, CO, 80225, for 75 cents each.