UTAH GEOLOGICAL & MINERAL SURVEY

QUARTERLY REVIEW

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LAND USE STUDY RELEASED

The U. S. Bureau of Mines (USBM) has published a study on the mining industry's use and restoration of land in the United States for the period 1930-1971: *Land Utilization and Reclamation in the Mining Industry, 1930-1971*, Bureau of Mines Information Circular 8642.

The principal source of USBM data was the 17,000 responses to the 23,000 queries sent to individual operations in the domestic mineral industry. USBM sought information about surface excavations, disposal sites, subsided areas, and physical facilities from many different mining operations: mines, quarries, pits, mills, and coal preparation plants. From the 74 percent response, USBM made estimates for the nonrespondents to cover 100 percent of the U. S. mineral production. The petroleum and natural gas industries were not included in the survey.

Out of the total land mass of the United States of 2.27 billion acres, the mining industry utilized 3.65 million acres (or 0.16 percent of the country's land mass) from 1930 through 1971. By comparison, airports or railroads in the U. S. had utilized nearly the same area by 1971; highways occupied over six times the mining area. Of this 3.65 million acres used for mining, 59 percent was for excavation, 20 percent for overburden disposal from surface mining, 13 percent for disposal of mill or processing wastes, 5 percent for disposal of underground mine waste, and 3 percent for subsidence connected with underground mines. The fossil fuel and nonmetal operations occupied 86 percent of the land during this period, while metal mining used 14 percent.

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OIL PROJECTS PROPOSED FOR UTAH

by Howard R. Ritzma
Assistant Director, UGMS

Worldwide dislocation of energy supplies and strong emphasis on development of new domestic sources of oil has already set in motion five projects in Uintah County. In Wayne County, in the Tar Sand Triangle area, an experimental fireflood project has been proposed and approved by several governmental agencies.

In the first Uintah County venture, Sohio Petroleum, Sun Oil, and Phillips Petroleum have proposed an oil shale operation on two 5,120 acre tracts leased in 1974 by competitive bidding through the U. S. Department of the Interior prototype leasing program. In March, Phillips and Sun bid $75.6 million for the first tract; in April, White River Shale Oil Corporation, the combine of Phillips, Sun, and Sohio, bid $45 million for the second tract. Together with other acreage under various lease arrangements, the combine appears to control mining rights on more than 27,000 acres within and around the two original federal lease tracts. Soon after the federal leases were granted, environmental monitoring, hydrologic studies, surveys of socio-economic impact on the area, and coring to better define the extent, thickness, and grade of the oil shale began on the project.

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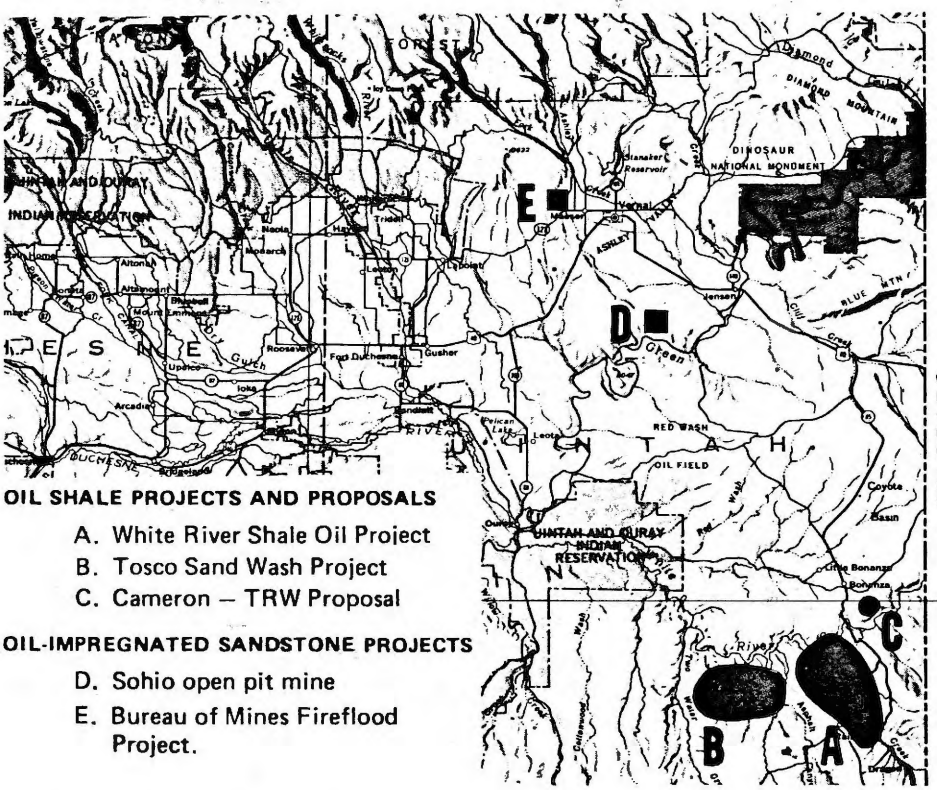

Oil shale and oil-impregnated sandstone activity, Uinta Basin.

AT HOME WITH GEOLOGY

PROMISE OF A SURE FOOTING

by B. N. Kaliser
UGMS Engineering Geologist

Even though a house exerts relatively little pressure upon its foundation, this pressure can cause serious problems if the foundation is situated on a poor substrate. Let's examine some conditions of a prospective homesite and the adverse situations that can damage or destroy a house built without regard to potential hazards. Among these are excessive and non-uniform moisture conditions, uneven compaction, expanding clays, unstable materials, solution effects, and poor fill—these poor substrates sometimes acting singly, sometimes in combination.

Surface observation can point out many of these adverse conditions. Any indication of the surfacing of underground waters should arouse suspicion. Subtle clues are frequently provided by lush vegetative cover, particularly in subarid Utah. Seeps, marshes, and bogs present serious foundation problems.

The nature of the most shallow geologic materials on the site should be investigated. If the superficial materials are fine in texture (silt and clay) and soft, it is likely that the bearing strength of the material will be inadequate to support a house. The degree to which the material varies over short distances can be an even more serious matter. If the material under one portion of a house is more resistant to compaction than under another portion, it is likely that the settlement of the structure will not be uniform, and the result will be structural cracking or more severe distress. A combination of water, fine material, or materials subject to uneven compaction is especially a cause for concern.

Some fine geologic material with a content of certain types of clay minerals may not compress when wet but, conversely, may expand. In these circumstances upward heave pressures are exerted upon structures. With an increase in moisture content a corresponding change occurs in the volume of the foundation material, and severe damage may result to pavement, curb, and gutter, and possibly even to lightly loaded house foundations. Some rock types as well as soil materials have this potential for swell, and shales that have this capacity may, with addition of moisture, also deteriorate rapidly on exposure when uncovered in an excavation. When constructing on terrain where these materials exist near or at the surface, particular caution is necessary.

Some dry fine soils appear to stand well in vertical excavations and, therefore, may mislead one into believing that they are quite stable. The materials may, in fact, collapse due to rearrangement of their structure when water is applied. Water may not become a factor until sometime in the future when lawns are irrigated, utility lines begin to leak, or surface drainage is realigned adversely. Clues to the presence of unstable materials of this type are circumferential ground cracks or depressions in the ground surface, or both. It is best to avoid this type of material whenever possible.

In the subarid to arid climate of Utah there exists at and near the surface geologic material with a relatively high content of minerals that may actually dissolve with application of water. The dissolution process, of course, leaves voids into which the surrounding material will eventually settle. Resulting loss of strength of the material may be sufficient to destroy a house completely. Even quite hard rocks are susceptible to dissolution. There exist in Utah formations of limestone and dolomite which are cavity-ridden through past geologic episodes of grossly wetter climate. Tragic incidents resulting from "sinkhole" collapse have occurred frequently but fortunately not in Utah. However, as home sites in the state cover a wider range of geographic and geologic situations, this problem will undoubtedly be encountered.

Solid-waste disposal on local and regional scales has become a topic of intense interest in recent years. On a local scale it has always been an expense and bother to rid a site of excavated material and construction debris. Frequently a neighboring lot or land parcel ends up as the depository for such material. With time the material may blend in appearance into the surrounding terrain and become further disguised by establishment of vegetation. Sometimes the material is placed most unjudiciously so that it poses a significant hazard such as when it blocks a drainage. Such material is best called "unengineered fill." It should be avoided for construction of a house or larger structure or removed, if necessary, so that the site will safely support a building. Properly engineered fill is, of course, another matter; it is a selected material placed according to rigid specifications so that it is capable of supporting an intended structure.

Promise of a sound foundation, "a sure footing," is very seldom included with the title to a lot. Keeping this in mind and keeping one's eyes open to potential risks can help to avoid a great deal of physical distress in the future house and mental distress in the household.

LAND USE STUDY

(continued from page 1)

Forty percent or 1.46 million acres of the 3.65 million was restored to a useful condition either by the regulator compliance with public laws or in the private opinion of mine management. Of the excavation area 68 percent was reclaimed. Twenty-seven percent of the overburden disposal and other mine wastes was restored. Mill waste areas, underground mine waste, and areas of subsidence made up the remaining 5 percent. Of the total area reclaimed, the fossil fuel industry restored 69 percent, the nonmetal industry 28 percent, and the metal industry 3 percent. According to the study the metal industry had a low reclamation rate because its open-pit methods were difficult to restore by fill or were still potential mineral sources although temporarily inactive. In the last year of the survey the reclamation rate for the whole industry rose sharply to 80 percent, spurred on by the growing public interest in the ecological and commercial value of land.

Utah was below the national average for reclaimed mining lands. During the 42 year period, Utah's reclamation rate was 10 percent of the utilized land. For the year 1971 the rate climbed to 36 percent. Utah's low reclamation rate was caused by the high proportion of its land used for metal mines—open-pit copper mines that occupied 60 percent of Utah's total mining land.

OIL IN UTAH

(continued from page 1)

The White River Shale Oil Corporation's plans call for a one-billion dollar oil-from-shale facility along the White River. By the early 1980's the complex will produce about 100,000 barrels of high quality synthetic crude oil daily, an amount close to the combined daily production of all Utah oil fields in 1974. The oil shale will be mined from underground. The refinery will use the Paraho process which is self-sufficient in fuel and consumes little water.

A second project, which will consist of underground mines that are to supply a plant with enough material to produce 75,000 barrels-per-day, is the 14,700 acre Sand Wash operation of The Oil Shale Corporation (TOSCO) of Los Angeles. The plant is to use the TOSCO II process, the outgrowth of many years of experimental work in western Colorado. The land leased from the state will include a 19,890 acre-foot reservoir in the valley of Sand Wash to store water pumped from the White River. Cost of this project is estimated at $600 million.

Another enterprise is an *in situ* experiment proposed by a number of companies headed by Cameron Engineers-TRW Systems and Energy and by the U. S. Bureau of Mines (USBM). The land, a 10-acre parcel three miles south of Bonanza, has been donated by the Atlantic-Richfield Company. The experiment involves mining out three vertical chimneys and then, by using conventional explosives, filling them with fragmented oil shale. The different fragment sizes produced in each chimney will allow for experimentation with variable retorting conditions. Waste rock is to be disposed into mined-out gilsonite veins. The mining will be done by the American Gilsonite Company. The $10 million cost is to be shared equally by government and industry.

For the fourth project, Sohio Petroleum has permission to open a surface mine in oil-impregnated sandstone (tar sand or oil sand) in the southern Asphalt Ridge deposit seven miles south of Vernal. Sohio will operate the mine, but Arizona Fuels Corporation (Major Oil) and Fairbrim Corporation will extract the oil from the sand in two semi-works plants of modest size. The Arizona Fuels

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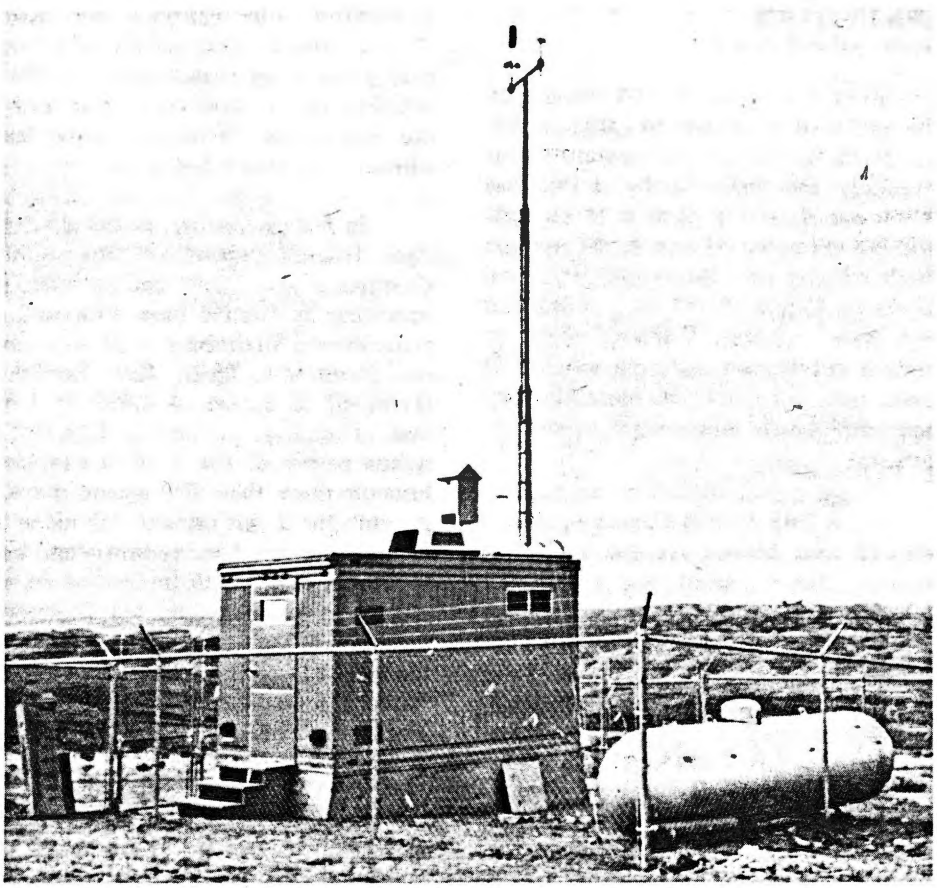
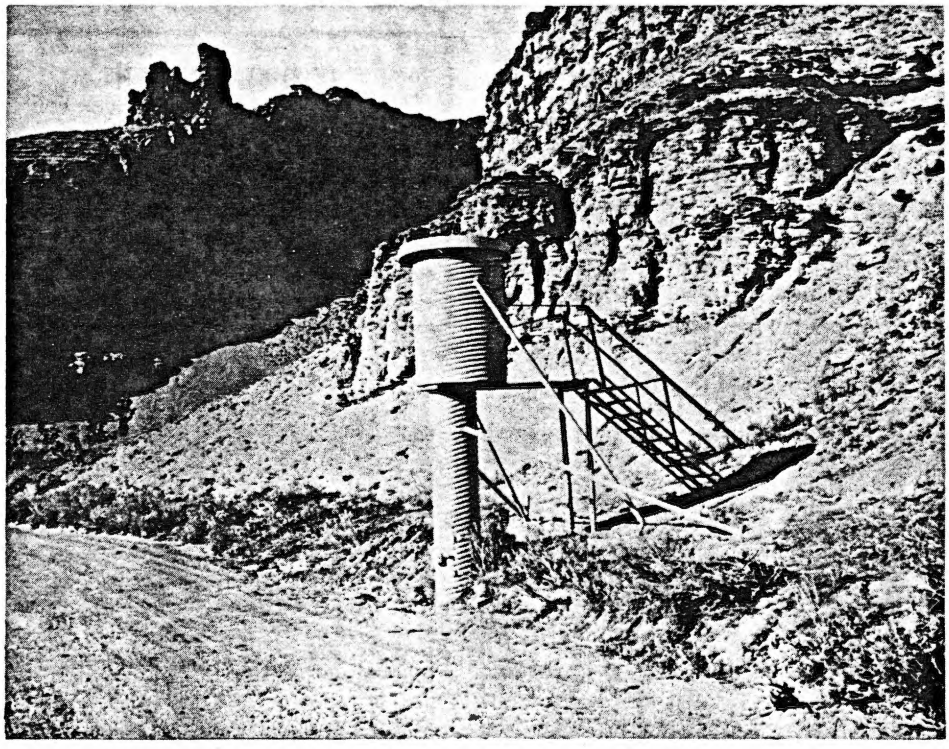


Meteorology and air quality measurement instrument trailer station constructed as part of the White River Shale Project baseline environmental study. Eight such structures have been placed within and surrounding the oil shale lease area. The unit is run by a 1,000 gallon propane tank which operates a generator for the electricity necessary to make instrument readings. *(photo and caption courtesy of Vernal Express)*



Hells Hole Canyon surface water monitoring station is placed in the mouth of the canyon to measure runoff into White River which is located in the background in the photo. Each station contains a battery pack unit with instruments for measurement readings. *(photo and caption courtesy of Vernal Express)*

OIL IN UTAH

(continued from page 3)

operation is to begin at 500 barrels-per-day and then to increase to 1,000 per day sometime in 1975. If the operation runs smoothly and economically, a full-scale 5,000 barrel-per-day plant is to be built and the extracted oil sent to the Arizona Fuels refinery near Roosevelt. Extraction of the oil from sand will use a solvent and hot water process. Fairbrim, using an undisclosed solvent and cold water, will begin with a modest 100 barrels-per-day and with output increasing as operations progress.

The fifth Uintah County project is located near Maeser. In the northwest Asphalt Ridge deposit, the USBM will conduct a reverse combustion fireflood on 10 acres of privately owned land leased to Sohio Petroleum. Preliminary work, site preparation, and the drilling of a dozen closely spaced holes will be finished in early 1975. The fireflood operation will continue for several months. About 1,000 barrels of oil taken over a few acres from depths of 400 to 500 feet are expected to be produced by the experiment. Extensive state lands surround the USBM-Sohio site.

In Wayne County, in the giant Tar Sand Triangle deposit, Oil Development Company of Utah and several co-operating companies have proposed an experimental fireflood project to recover oil from the White Rim Sandstone (Permian) at depths of 1,400 to 1,600 feet. The area, containing 12½ to 16 billion barrels of heavy oil in a reservoir beneath more than 200 square miles, is possibly the largest oil-sand deposit in the United States. The project has been approved by the Utah Division of Oil and Gas Conservation and by federal agencies but awaits final approval at the highest levels in Washington. The project area lies within the borders of the Glen Canyon National Recreation Area administered by the U. S. Park Service.

Survey Releases Latest Studies

by Carlton H. Stowe
UGMS Information Specialist

The Utah Geological and Mineral Survey has released its latest publications through the UGMS Publications Office, 103 UGS Building, University of Utah, Salt Lake City, Utah, 84112. When ordering by mail, add 10% for handling and mailing charges.

Utah Geology, *Vol. 1, No. 1, Fall, 1974:* This is the first issue of our new journal, published biannually. Subscriptions are $6.00 per year. Each issue is $3.50. Reprints of any article are $1.50 each. This issue includes papers on the "Relicted Lands Case" by Don McMillan; "Mt. Olympus Cove Environmental Geology Study" by Bruce Kaliser; "Bonneville Salt Flats: A Possible Geothermal Area?" by J. A. Whelan and Carol Petersen; and many others of significant interest.

Bulletin 104, *"Stratigraphic and Depositional Analysis of the Moenkopi Formation, Southeastern Utah,"* by R. C. Blakey ($4.00). This geologic study of the Triassic Moenkopi Formation is the first to provide a basis for regional correlation and division of the formation into four distinct members: the Black Dragon (new), Sinbad Limestone, Torrey (new), and Moody Canyon (new). Bulletin 104 includes four tables, 38 illustrations, and an index map showing cross-sections of the formation.

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UTAH CLAIMS NEW MOUNTAIN

The United States Board on Geographic Names has officially named an 11,340-foot mountain after the late Ray Marsell. Mount Marsell is located in the Mirror Lake area of Summit County (sec. 15, T. 1 S., R. 9 E.), west of Mount Agassiz and Mount LaMotte.

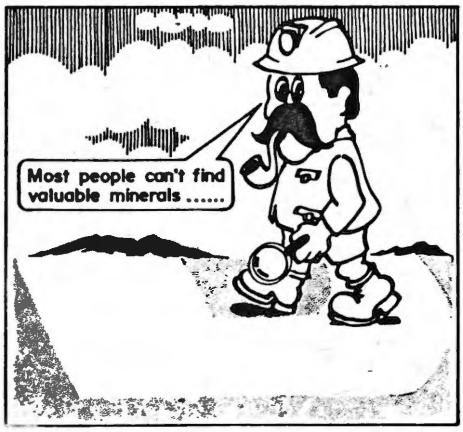
Ray E. Marsell (1893-1971) was a respected environmental geologist and professor of Geology at the University of Utah. He made significant ground-water basin studies for the Salt Lake City metropolitan districts. His lectures, fascinating because of his thorough understanding of and enthusiasm for geological subjects ranging from "Powell's Exploration of the Colorado River" to "Cloudburst Floods in Utah," influenced not only classroom students but also audiences attending his public lectures and geological field trips.

TOO MANY ZEROS

In the article on "Anaconda's New Mine" in our November issue we stated that Anaconda would produce 560,000 tons of copper yearly. Well, for those who didn't catch that mistake, the tonnage figure should have been 56,000.

ROCKY RIDGES

by Greg McLaughlin



SANDY'S WOOLLY MAMMOTH

EVEN FOSSILS NEED PROTECTION

by James H. Madsen, Jr.[1] and Roger C. Stewart[2]

Last Halloween a very large bone was uncovered during the digging of a ditch at a new apartment complex. The bone was identified by the University of Utah's department of Geology and Geophysics and the Utah State Historical Society as being part of the pelvis of a mastodon or mammoth. The discovery excited scientists because it would be locally significant to the prehistory of the Salt Lake valley. Yet the experience of this excavation proved once again that even the extinct creatures of this world need the equal right of protection.

Mammoth bones are not uncommon in Utah. Mammoths and mastodons roamed widely through the area over 10,000 years ago in their epochal eastward migration from Asia. But knowing that there are bones "out there" and then finding them is uncommon.

The fossil that makes its way into man's understanding of natural history is most often an outcome of propitious circumstances controlled by a sympathetic budget director who will keep the priority of scientific research alive and a conscientious land owner, the fossil discoverer in most cases, who will permit the project a beginning. Sometimes funds are not available. Sometimes the bones are in the midst of private construction where they are ignored and crushed into oblivion by a builder's deadline. When the funds and land are available, other variables such as weather, accessibility of the site, and numerous minor factors may combine to cause delays and to bring back into question a limited use of funds and land.

Conditions surrounding the Sandy Mammoth were favorable at the start. The owner of the land permitted the paleontologists to begin excavating immediately, even though he would have to delay his own on-going construction. For the university, the dig would be a "backyard" operation and would not drain research funds in expensive field trips. Because the site was local and public interest was high, the paleontologists could also rely on volunteer help in removal of the bones to the laboratory. The only variable worth worrying about was weather. The winter storms common in this time of year had not arrived. Bad weather would suspend a project indefinitely, and, in a case where construction was being delayed, could end the excavation permanently in order for the builder to finish his project. Fortunately, while unusually mild weather held, the paleontological crew was able to extricate the fossil remains with the least amount of trouble and delay.

What remained of the fossil was enough to make it a significant find. The dental structure revealed it to be a mammoth rather than a mastodon. In addition to the original discovery of the pelvis, the left femur, sacrum, vertebrae of the back, ribs, both scapulae, bones of the right wrist, and skull fragments were taken to be cleaned, measured, and studied under the supervision of the director of the Utah Museum of Natural History of the University of Utah. The results of carbon-14 dating will determine whether the mammoth lived before, during, or after the time when Lake Bonneville covered the area. University of Utah scientists are now pursuing the relationship of this mammoth with similar Utah valley finds, one near Payson and the other near Provo, specimens of which are included in the University of Utah's vertebrate paleontology collection. Furthermore, this spring scientists will be exploring more of the Sandy site at the generous invitation of the property owner.

Yet for all the good fortune that shone on those few days, the excavation was far from a complete success. The suspicion that much of the original skeleton had been bulldozed away during construction and subsequent landscaping of the apartment complex was confirmed when only 25 percent of the fossil was recovered. Knowing that recovery of the full skeleton was possible under more thoughtful circumstances, the scientists were disappointed in the limited scope of this find.

A constant flow of onlookers watched the progress. Here, crew prepares plaster-cast jacket to keep the mammoth pelvis intact during removal. *(photo courtesy of University of Utah)*

Why were the bones not reported earlier? Were they not seen? It seemed highly improbable that even a sleepy D-8 Cat operator could not notice bones belonging to something the size of an elephant. The most likely explanation, second only to a general indifference in matters paleontological, appeared to be that the contractor feared his project

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Donald Hague, director of the Utah Museum of Natural History, contrasts mammoth's molar with molars of a mastodon (located in jaw bone). *(UGMS photo by Jim W. Hamblin)*

[1] Research Assistant Professor, Department of Geology and Geophysics, University of Utah.
[2] Editor, UGMS.

WOOLLY MAMMOTH

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would be closed down, or at least held up, while the scientists did their thing. If it had not been for an alert apartment manager who sought a specialist's opinion about his discovery, the secret of the bones would have been lost—and no one the wiser.

Vertebrate paleontologists are very much aware that a builder's time is valuable. For this reason they have developed efficient techniques whereby they can examine the bones and excavate them, when necessary, at a minimum inconvenience to equipment operators and contractors. The scientists want builders and contractors to give them a chance. The problem for the paleontologist, of course, is to cultivate the public's awareness of its fossil heritage before great roads and massive dwellings mar earth's recorded history.

Fortunately for paleontologists, the Sandy Mammoth may make its greatest contribution to the earth's natural history in the field of public relations. The mammoth attracted national news coverage. More than 10,000 people, including thousands of enthusiastic school children, visited the site. The diggers were drawn from the ranks of the Mid-Shore Apartments, the Utah State Historical Society, the University of Utah's department of Geology and Geophysics, the Utah Museum of Natural History, the Utah National Guard, and other interested individuals including school children, an insurance executive, and an unemployed psychologist. The public response was fantastically sympathetic. Nevertheless, the serious study of our fossil history needs more to protect its subject matter from ultimate extinction than the whimsical interest of an impressionable public. While the Sandy Mammoth is still in the public's mind, state laws similar to those that have protected our anthropological and archaeological prehistory should be enacted to protect the paleontological evidence of Utah's earliest inhabitants.

LATEST STUDIES

(continued from page 4)

Bulletin 106, *"Utah Mineral Industry Statistics through 1973,"* by Carlton H. Stowe. After many years in preparation, this publication presents Utah's mineral industry statistics from first recorded production. Applicable United States' mineral industry statistics are included. To be published in March.

NEW CONTOUR MAPS

The U. S. Geological Survey is issuing new 7½-minute orthophoto maps covering the Great Salt Lake. The maps carry one-foot contours between the 4,193-foot elevation and the 4,200-foot shoreline. These contours were plotted from infrared photography supplied by UGMS.

OFFSHORE OIL LEASES

Since the first U. S. Department of the Interior sale of offshore leases in October 1954, oil companies have bid more than $14.85 billion for the right to explore 10.778 million acres lying offshore in the Gulf of Mexico and along the coast of California, Oregon, and Washington. More than $5 billion was spent for 1.763 million acres in 1974 alone.

The March 28, 1974, lease sale was the most expensive for oil companies and the most profitable for the U. S. Treasury. Bids amounted to $2.092 billion.

The most expensive single tract ever leased was on the Destin anticline off Florida, a $212 million investment by Exxon-Mobil-Champlin that so far has yielded two multi-million dollar dry holes.

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