



Bait House on the Texas Gulf Coast

Al Richardson

The **LUFKIN** Line

WINTER, 1982



MACHINERY DIVISION

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CONVENTIONAL

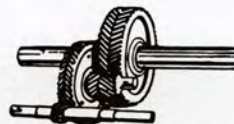


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MARK II

OIL FIELD PUMPING UNITS



GEARS FOR INDUSTRY
AND SHIP PROPULSION

ROCKY MOUNTAIN DIVISION

The Mystery of Mesa Verde	4
None Deeper	10
Herringbone & Double Helical Gearing vs. Single Helical Gearing	12
LUFKIN Installations	14
LUFKIN Snapshots	15

COVERS

Front:

Bait House on the Texas Gulf Coast
Painting by Al Richardson,
Bellaire, Texas

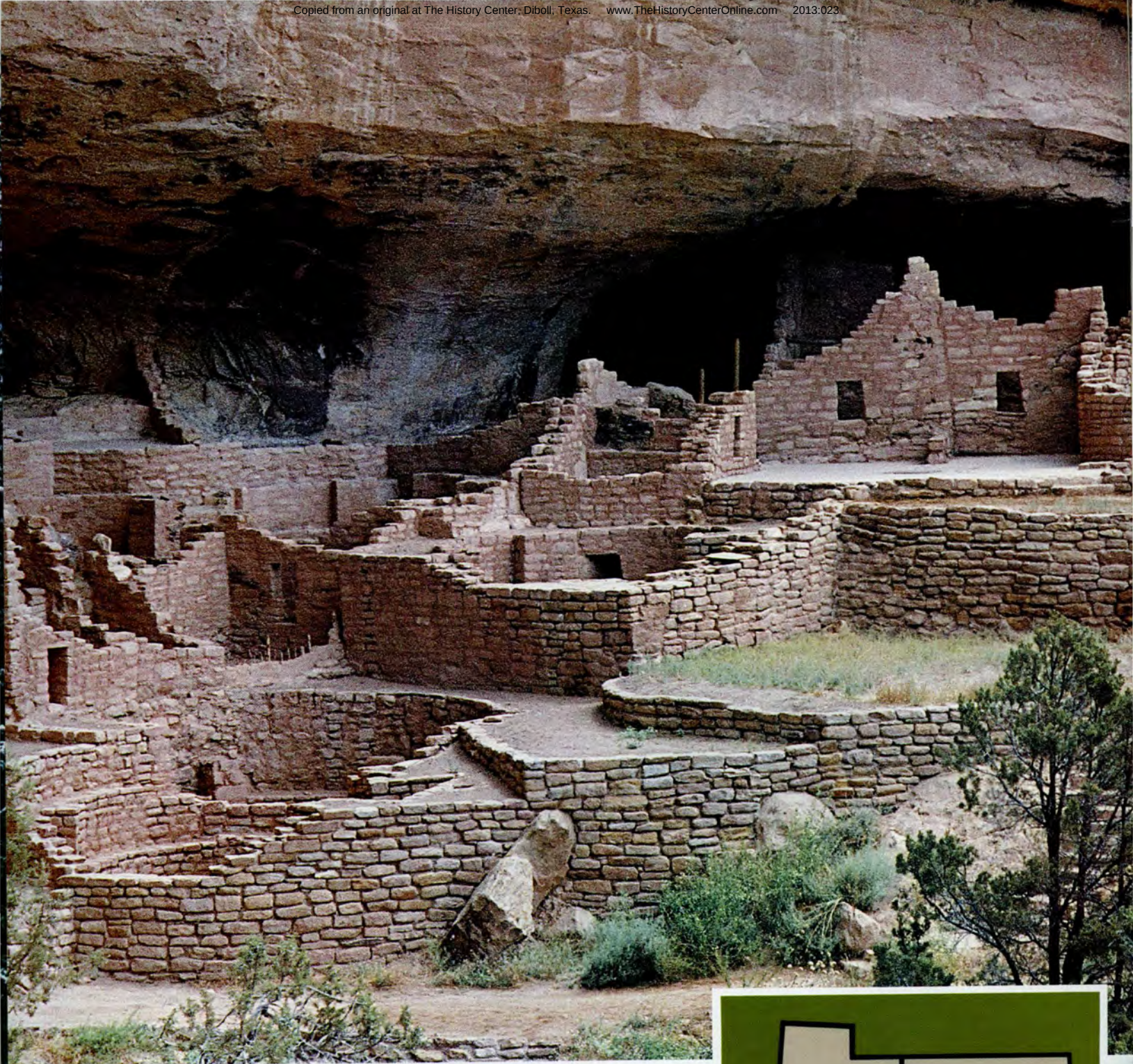
Inside Front:

Hoosier Pass near Breckenridge, Colorado
Photo by Tom Johnston,
LUFKIN photographer

Framing reproductions of the painting, Bait House on the Texas Gulf Coast, are available in a limited number. Requests should be made to the Director, Public Relations, P.O. Box 849, Lufkin, Texas 75901.



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The Mystery Of **MESA VERDE**

Ancient dwellings preserved in sandstone cliffs
tell the story of a forgotten people.





One can only wonder what went through the mind of the first person who laid eyes on the fabulous cliff dwellings of Mesa Verde. The reaction to viewing the abandoned homes of prehistoric Indians must have been one of utter disbelief.

It does seem impossible. Ancient cities clinging to sandstone cliffs, withstanding the forces of nature and time. A forgotten people living and prospering, then vanishing.

Their story had gone untold for centuries. Just who were these cliff dwellers and why had they chosen the rough canyons and pinyon-

juniper forests of the Mesa Verde as home?

The mystery of the San Juan Anasazi Culture has been unraveled after nearly a century of archaeological investigations. Their great stone cities in the cliffs of southwestern Colorado have become a national park, and the largest archaeological preserve in the United States.

Visitors to Mesa Verde National Park are moved back in time 1,300 years ago when ancestors to the American Pueblo Indian tribes built mesa-top villages and later awesome towns in the caves of cliffs. For a thousand years, the Anasazi lived on the mesa and in its canyons, developing a sophisticated society. Then, around the year A.D. 1300, almost two centuries before Columbus discovered America, they left their magnificent homes and disappeared.

When they departed, they left their villages and cities and many of their personal possessions behind. It was not until more than a decade after the end of the American Civil War that their ancient homes were rediscovered. Today, they stand as a tribute to America's early Indian settlers.

Mesa Verde National Park was established in 1906 to protect and preserve the ruins and archaeological values. Nearly 3,900 Indian sites have been found within the 52,000-acre park. Some 600 of these are cliff dwellings. In 1978, it was named America's first World Heritage Cultural Park.

The national park is located on a majestic plateau that rises abruptly from semi-arid land bordering the Colorado high mountain country, near the Ute and Navajo Indian reservations. The region is known as Four Corners country, and on a clear day, one can see four states from the highest elevation in the park, Park Point.

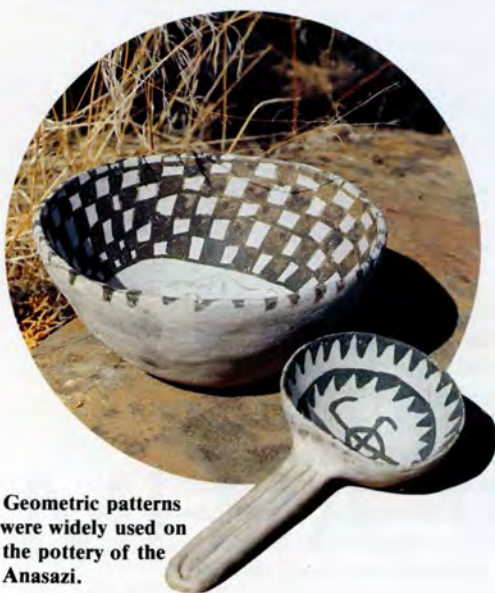
The name Mesa Verde, which means "green table," dates from the time of early Spaniard explorations in the mid-18th century. Although the Spanish passed through the area, they did not see the ruins. In the 1860s, the discovery of gold and silver in the Rocky Mountains brought many people into the eastern part of Colorado where the Ute Indians still roamed. The tribe was assigned to a reservation west of the mountains, and this included much of the Mesa Verde.

Because the Utes were not particularly friendly at the time, most travelers avoided the area. The Utes themselves did not go into the mesas and canyons as they feared the spirits of the departed ancient ones.

The second largest ruin in the park is Long House with its 150 rooms and 21 kivas.



(Far, right) From a distance the canyons appear empty, but a closer look reveals dwellings tucked into crevices and caves below the mesa tops. (Above) The Rocky Mountain mule deer is the most common and abundant animal at Mesa Verde National Park.



Geometric patterns were widely used on the pottery of the Anasazi.

It was not until 1874 that the first cliff dwelling was officially discovered. A photographer, William Henry Jackson, and his party, hearing tales from miners about canyons with cliff dwellings in them at the Mesa Verde, decided to investigate. Their first night out they sighted a ruin. The next day, they photographed the dwelling, dubbing it "Two-Story Cliff House."

But it was another 14 years before the many canyons of the mesa began to be explored. In 1888, a family of ranchers living near the Mesa Verde, the Wetherhills, discovered three more of the ruins, Cliff Palace, Spruce Tree House and Square Tower House. During succeeding years, the Wetherhills collected thousands of artifacts from the ruins, and served as guides for hundreds of visitors.

Two years after the Wetherhills discovery, a Swedish gentleman, Gustaf Nordenskiöld, sought the assistance of the family in exploring the Mesa Verde. During the preceding two years, most of the cliff dwellings had been named. In his book, "The Cliff Dwellers of the Mesa Verde," he described his investigations, using the names in his writings. Those names remain the same today.

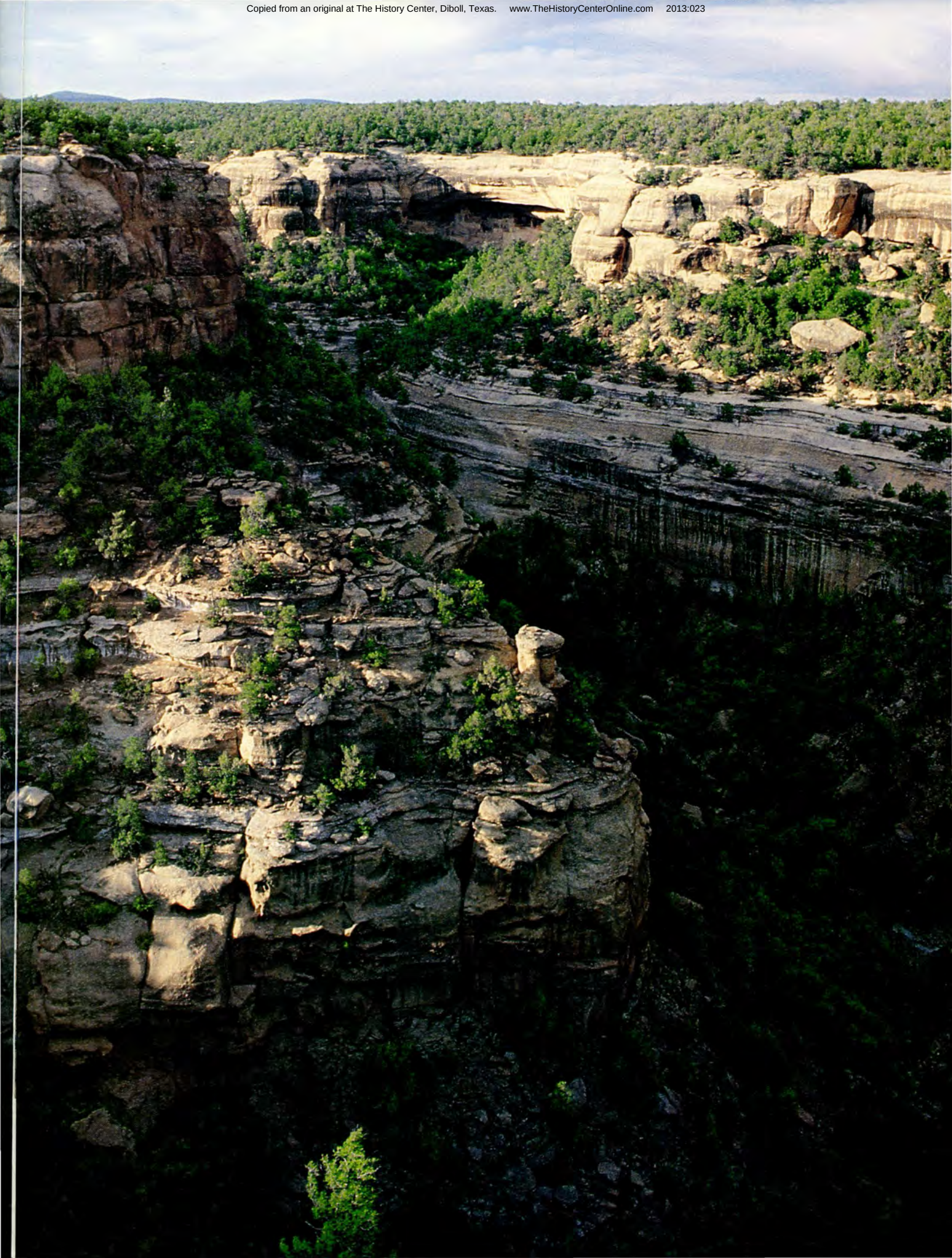
Nordenskiöld tested and excavated a sizeable number of ruins. His collection was shipped to Sweden, creating a public uproar. It was the removal of these specimens from the country that incited the first efforts to protect the archaeological resources at Mesa Verde.

Leading the movement for permanent protection of the cliff dwellings was Virginia McClurg, a newspaper correspondent who once explored the ruins. She toured the country, giving speeches and decrying the destruction of ancient walls by treasure seekers. Her efforts were successful. On June 26, 1906, President Theodore Roosevelt signed the bill creating Mesa Verde National Park.

Since that time, archaeologists have studied the relics of Mesa Verde, learning much about the life of the Anasazi, or "Old Ones." From technical excavations and studies, they have reconstructed the life of the ancient Indians who lived there for more than seven centuries.

The earliest people to live in the area have been labeled as Basket Makers, in recognition of their impressive skill in the craft. At first, these people lived in pithouses, dwellings dug into the ground so the walls of the pit were the walls of the house. They clustered their pit houses to form small villages, usually on the mesa top, but occasionally in the caves of the cliffs. Crops of







beans, corn and squash were grown in the rich, red, windblown soil of the mesa tops. Dogs and turkeys were their only domestic animals. The turkeys provided feathers which were woven into blankets for the cold winter months.

For many years, the Basket Makers thrived on the mesa. By the middle of the eighth century, their descendants began building above-ground homes of mud and poles. These were often constructed side by side, in curving lines, much like a row of houses seen in our cities today. Before the year 1000, stone masonry evolved.

Baskets were replaced with handsome pottery, painted black on a white background. The mesa-top became heavily populated, and sturdy, compact apartment-like buildings were built. By the 12th century, some stood as high as three stories and contained more than 50 rooms. Often the rooms were built around courtyards that contained several kivas—underground religious chambers. Stone-and-adobe construction was perfected with blocks shaped to corners and curved walls.

Then, near the end of the century, for some unknown reason, the people moved down into the caves in the cliffs. What caused them to make such a drastic change in their lifestyle has not been determined. Was it an invasion by enemy tribes? Or an inner strife, possibly a civil war?

Why the Anasazi moved from the mesa into the cliffs may never be known, and a century later, they abandoned the region completely. It must have been a hard life living in the cliffs. Rock climbers today, with modern equipment, find entrance to some of the ancient dwellings difficult. And despite advancements in their architecture and general technology, the Indians clung to their old gods and old crafts.

Droughts were common to the Mesa Verde during this period, and the Pueblo people had learned to cope with them. But when it stopped raining in the late 1200s, the marginal farmlands could no longer provide food for the growing populations. Fewer animals were on the mesa to be hunted. More and more people were dying. After 700 years in the Mesa Verde, the Indians were forced to desert their Colorado cliff homes.

A trip today to their ancient homes is a lesson in the past, and a solution to a mystery that had pervaded the stunted forests and rough canyons of Mesa Verde for centuries. The wonderfully preserved dwellings in the great overhangs of sandstone yield the secrets of a forgotten people. Finally, their story has been told. □



(Far, left) In the spring, the mountain brush community of Mesa Verde comes alive with the bright colors of flowering plants. (Above, top) Balcony House was built on a high, easily defended ledge. (Bottom) Kivas were centers for religious rituals and planning.

None Deeper

The industry's deepest rod-pumped well
features a LUFKIN unit.



At one time 10,000 feet was considered by many the maximum well depth for a rod pumping system. But recent improvements in sucker rod and pump design have extended such depth limitations. Rod pumping is now a viable alternative in deep well production.

In September, Shell Oil Company installed a LUFKIN M-912D-365-168 pumping unit on a well and set the rod pump at 14,500 feet. The well in the middle of a waterflood project in the foothills of Wyoming became the deepest rod-pumped well in the industry.

The pumping unit replaced a hydraulic lift system that had been used on the well since it was completed in May, 1957. Since 1975, the Rocky Mountain Division of Shell Oil Company has removed 135 hydraulic lift installations because of their high operating costs.

"We were servicing the pump at the rate of 14 times annually. Those repairs alone cost us \$25,000 last year, and that figure does not include lost production and supervisory time," explains C.I. (Charlie) Gott, supervisor well analysis production, Rocky Mountain Division, Shell Oil Company. "The pumping unit was more energy efficient, saving us some \$1,100 on electrical costs a month."

The installation is unique, featuring many advanced concepts in beam pumping, such as an improved polished rod, an Electra rod string, a specially-designed downhole pump powered by a Mark II unit with an ultra high-slip

electric prime mover.

Because the polished rod in a pumping situation at this depth must be more durable, Shell chose a special steel rod with an undercut pin and shoulder configuration that mates with the rod string permitting pre-stressing the joint to a greater load than it will be exposed to during operation. "Without the improved polished rod, we could have been confronted with polished rod failure."

High strength Electra rods were selected to handle the severe loads expected. Electra rods are heat treated by passing them through a computer-controlled induction coil. The resulting binary construction features a stronger outer shell capable of withstanding unusually heavy loads.

A rod pump modified by Shell engineers was used instead of a standard downhole pump. "A standard rod pump would have burst at that depth. At 15,000 feet, if you were to assume a .37 gradient, the hydrostatic weight of the fluid column on the bottom of the pump would be 5,555 pounds per square inch. So it was necessary for us to modify a pump that could withstand that amount of pressure," says Gott.

The prime mover for the installation is an ultra high-slip motor which decreases mid-string shock loading. The motor slows down under extreme loads at the downhole bottom reversal, minimizing sudden stresses on the rod string.

At such extreme depths the forces of friction are greater,

and several measures were taken to lower the friction. "Rod couplings with a spray metal surface were used that reduced loading about five percent. And as a final measure, we loaded the entire tubing string with oil. This provided lubrication to the rod string during initial start-up."

How much deeper can producers like Shell go using similar equipment? "Right now, we feel we could go another thousand feet without any problems and without changing anything," comments Gott.

The success of the installation was also a tribute to Shell Oil Company's commitment to furthering technology. "We have been the benefactor of a great deal of knowledge because of our investments. Consequently, we have some of the best design capabilities in the industry."

The well analysis supervisor believes that others will soon follow Shell's lead of rod-pumping wells. "There are many companies that have wells that are declining to flow at depths equal to or slightly greater than our installation, and they are seeking a method to produce these wells. When they begin to choose an artificial lift method, they will certainly consider beam pumping. It is a reliable system."

And the Shell installation is more proof of that reliability. Since the changeover to the rod pumping system, there have been no problems reported at the well site. The industry's deepest rod-pumping well is simply and dependably producing oil. □

Herringbone & Double Single Helical Gearing.

by Fred D. Griffin, vice president and director of product design engineering, Lufkin Industries, Inc.

Lufkin Industries manufactures single helical, double helical and herringbone gearing in its industrial gear reducer and increaser lines. We have little or no trouble with any of these types of gearing when properly applied. Through the years, however, we have found that herringbone or double helical gearing is the definite choice for pumping unit gear reducers.

Herringbone and double helical gearing does not generate end thrust on any of the shafts of a reducer, such as occurs with single helical gears and, therefore, straight roller bearings, which allow the shafts to float, can be utilized on two of the three shafts on a double

reduction reducer. The third shaft, of course, has to have a minimum thrust bearing which only has to "position" that shaft (and gear) to keep it from floating to one side of the box or the other. With this shaft "held," the other two shafts can float since each gear set is kept aligned by its apex which is unique with double helical and herringbone gearing.

Most operators are not aware of the significance of load reversals experienced by pumping unit gearing operated at normal and abnormal pumping conditions.

To illustrate this point, we have examined the last 100 field dynamometer cards in our files,

and the number of load reversals per stroke has been tabulated and is shown below:

1 unit	- had no load reversal
22 units	- had 2 load reversals
61 units	- had 4 load reversals
14 units	- had 6 load reversals
2 units	- had 8 load reversals

TOTAL: 100 units

From the above, the "average" unit had 3.88 load reversals with many units having six or eight load reversals per stroke.

With double helical or herringbone gearing a load reversal can only result in minor gear backlash noise, as the load is transferred from one side of

About the author

Fred D. Griffin was appointed vice president, director of product engineering for Lufkin Industries, Inc. in 1974. He joined the company as a design engineer in 1947, and was named chief engineer in 1968.

He is a graduate of Corsicana High School in Corsicana, Texas, and holds a bachelor of science degree in mechanical engineering from the University of Texas at Austin. He is a past president and member of the Texas Society of Professional Engineers.

e Helical Gearing vs.

the gear teeth to the other. There is no end thrust on any of the reducer shafts.

But with single helical gearing, in addition to the load being transferred from the front to the backside of the gear teeth when the load on the gearbox reverses, there is a definite change of direction of the end thrust on each of the three shafts. This abrupt change in direction of the load can pound out bearings in short order unless near perfect bearing adjustment can be maintained. This is particularly true if bearing adjustments are too loose. On the other hand, if a bearing is pre-loaded to any degree to prevent this end shift, bearing life can be adversely affected.

While desired bearing adjustment can be made by the manufacturer in the plant if particular pains are taken by an experienced assembler, this can seldom if ever be accomplished in the field if bearing replacements become necessary. In addition, if slow-speed bearings of the tapered-roller type have to be replaced, the cranks have to be removed. If the cranks are pressed on the slow-speed shaft, this can be a problem. If the cranks are attached to the slow

speed shaft with clamp bolts, this can present definite problems, too, if not performed by an experienced field mechanic. Just handling the cranks in the field or in the repair shop with a crane can be a major problem no matter how the cranks are attached.

Herringbone or double helical gear reducers virtually never have to have slow-speed bearings replaced as long as adequate lubrication is maintained. When considering the time required to assemble gear reducers, the use of bearings that require no adjustment is even more important.

Lubrication is another factor affected by the type gearing involved. When oil wipers are utilized (usually on the slow speed gear), single helical gearing, due to the helix angle, directs most of the oil to one side of the gear housing while directing a much smaller amount to the opposite side of the box. This can be a critical item when oil is thin in the summertime.

The above reasons are the basic ones that have dictated to LUFKIN that herringbone or double helical gearing be maintained in our pumping unit gear reducers. □

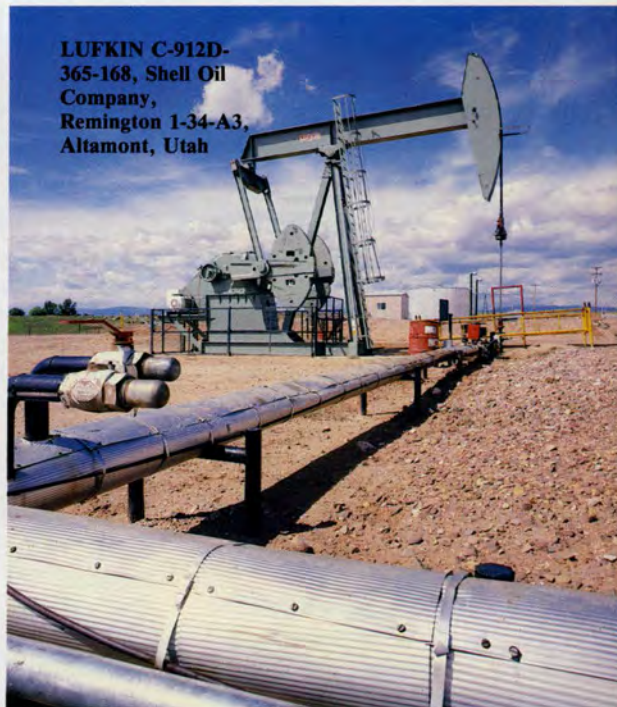


LUFKIN
Installations

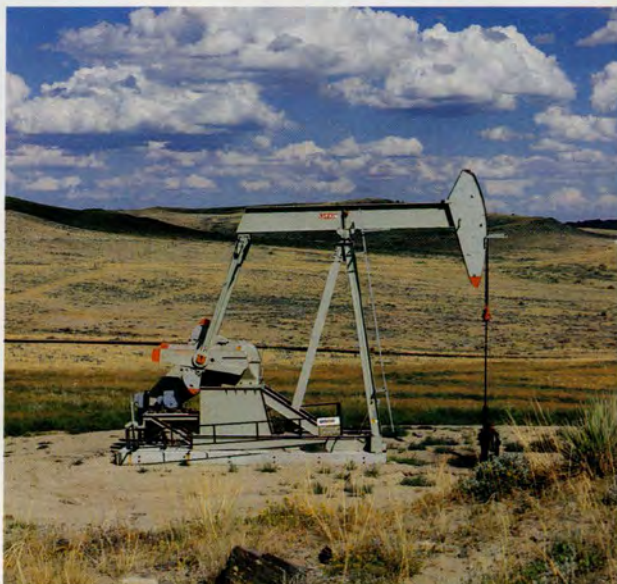
ROCKY MOUNTAIN DIVISION



LUFKIN A-2560D-470-240, Conoco Inc., Dickinson Unit Well No. 1, Stark County, North Dakota



LUFKIN C-912D-365-168, Shell Oil Company, Remington 1-34-A3, Altamont, Utah



LUFKIN C-320D-213-120, Union Oil Company, South Casper Ck. Field, U.S. Government Well #3-9-2, Natrona County, Wyoming

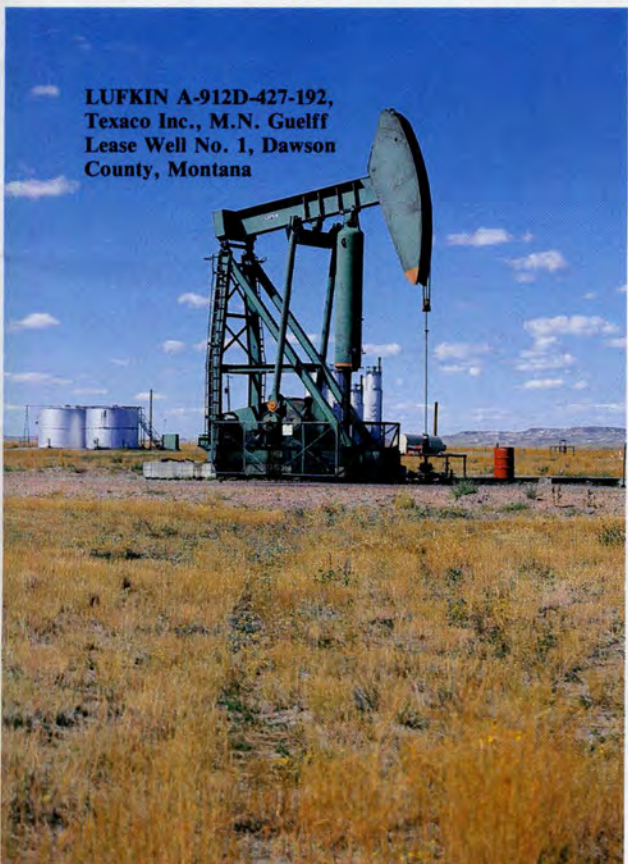
**LUFKIN M-456D-305-120, Aminoil
USA Inc., Stien Beisser No. 3, Rich-
land County, Montana**



**LUFKIN M-640D-305-
144, William H. Hunt,
Gregory No. 1, Billings
County, North Dakota**



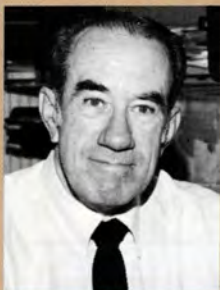
**LUFKIN A-912D-427-192,
Texaco Inc., M.N. Guelff
Lease Well No. 1, Dawson
County, Montana**



**LUFKIN M-640D-305-144, Cenex, Burlington Northern 9-1, Billings
County, North Dakota**

LUFKIN

Snapshots



EARL MELVIN
Mobil Oil Corp.
Denver, Colorado



BILL CALLAWAY
Sundance Oil Co.
Denver, Colorado



ROY SCAFE
Ladd Petroleum Corp.
Denver, Colorado



RICH FERRIS
Luff Exploration Co.
Denver, Colorado



AVIS BROWN
Mobil Oil Corp.
Denver, Colorado



JACK TUNSTALL
HPC., Inc.
Denver, Colorado



HAROLD DIENER
Ladd Petroleum Corp.
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Consolidated Oil & Gas Inc.
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JOEL GAMBOA
Mobil Oil Corp.
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HPC., Inc.
Denver, Colorado



DANIEL REINHOLTZ
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J.D. STEWART
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Denver, Colorado



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R.D. BREW
Central Operating Inc.
Denver, Colorado



KIRK SMITH
Diamond Shamrock Corp.
Denver, Colorado



ADAM BLUM
Puma Petroleum Co.
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O.L. TAULMAN
Mobil Oil Corp.
Denver, Colorado



RON DERINGTON
Petro Lewis Corp.
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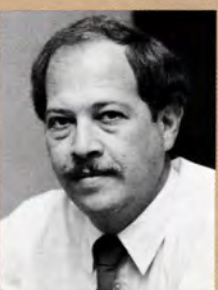
CLARENCE BROWN
Kimbark Oil & Gas Supply
Denver, Colorado



REBECCA WISSBAUM
PanCanadian Petroleum Co.
Denver, Colorado



L.A. DOTY
Mobil Oil Corp.
Denver, Colorado



GARY SMITH
Petro Lewis Corp.
Denver, Colorado



JOE ADAMS
Luff Exploration Co.
Denver, Colorado



ROBERT CRUTCHFIELD
PanCanadian Petroleum Co.
Denver, Colorado



HOWARD HUDLER
Champlin Petroleum Co.
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JOHN RAGER
The Louisiana Land and
Exploration Co.
Denver, Colorado



GEORGE FARMAR
QED Exploration, Inc.
Denver, Colorado



GREG MERRION
Superior Oil
Cortez, Colorado



GARY BRUNE
Samedan Oil Corp.
Denver, Colorado



RAYMOND KERSEY
Apache Corp.
Denver, Colorado



TONY KOENIG
Lear Petroleum
Exploration, Inc.
Englewood, Colorado



DWAINE BLANSCEY
Superior Oil
Cortez, Colorado



CLIFF BIXLER
American Quasar
Petroleum Co.
Denver, Colorado



DWAYNE SCHULTZ
Apache Corp.
Denver, Colorado



DAVID BANKO
Lear Petroleum
Corporation, Inc.
Englewood, Colorado



ROY HORD
Bow Valley Petroleum, Inc.
Roosevelt, Utah



JERRY SCHNELL
Amoco Production Co.
Denver, Colorado



RED MACKIE
Apache Corporation
Denver, Colorado



RICHARD LANZ, JR.
Kissinger Enterprises
Englewood, Colorado



BEN CLARK
Bow Valley Petroleum Inc.
Roosevelt, Utah



TIMOTHY LIEN
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Denver, Colorado



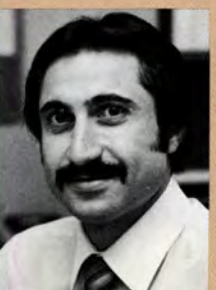
BRUCE PATTERSON
Juniper Petroleum Corp.
Denver, Colorado



GENE KISSINGER, JR.
Kissinger Enterprises
Englewood, Colorado



DOUGLAS HOWARD
Bow Valley Petroleum Inc.
Roosevelt, Utah



DAVID DANGOOR
Superior Oil
Denver, Colorado



DAVE ARMSTRONG
First Energy Corp.
Denver, Colorado



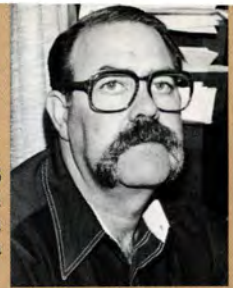
CHARLES HILL
Superior Oil
Cortez, Colorado



JIM HOOKS
Bow Valley Petroleum Inc.
Roosevelt, Utah



BOB PATRICK
Energy Reserves Group, Inc.
Casper, Wyoming



BRUCE EDWARDS
Cenex Exploration
& Production
Sidney, Montana



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RALPH TRONSTAD
Marathon Oil Company
Casper, Wyoming



LEE McLEAN
Energy Reserves Group, Inc.
Casper, Wyoming



ED GETZ
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Sidney, Montana



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Union Oil Company
of California
Casper, Wyoming



FRED KASTNER
Marathon Oil Company
Casper, Wyoming



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Energy Reserves Group, Inc.
Casper, Wyoming



RONALD PETERSON
Aminoil USA, Inc.
Sidney, Montana



DAVE ELLINGSON
Union Oil Company
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Casper, Wyoming



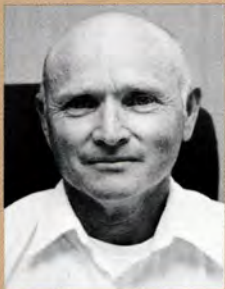
DALE CADDY
Marathon Oil Company
Casper, Wyoming



H.D. CARPENTER
Gulf Oil Exploration and
Production Co.
Dickinson, North Dakota



JIM WEAVER
Aminoil USA, Inc.
Sidney, Montana



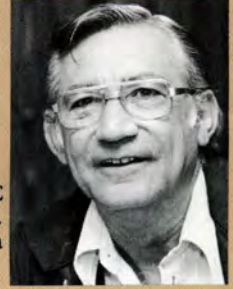
HOUSTON COOR
Union Oil Company
of California
Gillette, Wyoming



LES HOLLADAY
Energy Reserves Group, Inc.
Casper, Wyoming



MATT DUTTENHEFER
Gulf Oil Exploration and
Production Co.
Dickinson, North Dakota



F.J. ISTRE
Aminoil USA, Inc.
Sidney, Montana



J.N. PARKER
Union Oil Co. of California
Worland, Wyoming



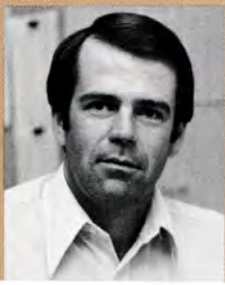
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Casper, Wyoming



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Ladd Petroleum Corp.
Dickinson, North Dakota



FRED BACH
Shell Oil Co.
Sidney, Montana



BILL SHADE
Marathon Oil Company
Casper, Wyoming



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We've improved them every year for the past 57 years.

Since we began building pumping units in 1923, we've developed every significant breakthrough in the pumping unit industry. Patented improvements that are still standards in pumping unit design today.

We patented the first adjustable crank balanced pumping unit in 1925

In July, 1925 LUFKIN introduced the Trout Adjustable Counterbalanced Crank, the first major breakthrough in the industry. In 1931, we introduced the twin crank unit, still the standard of pumping unit design today.

We pioneered the use of nodular iron gears for pumping unit reducers

LUFKIN was the first to propose nodular iron as an improved material for pumping unit reducer gears in the early 1950s. As a result of our testing, nodular iron gears became an accepted API practice. Then in 1959, we marketed the patented Mark II Unitorque pumping unit the most advanced pumping unit design to date. Today we offer the largest selection of sizes and unit designs of any pumping unit manufacturer in the world.

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