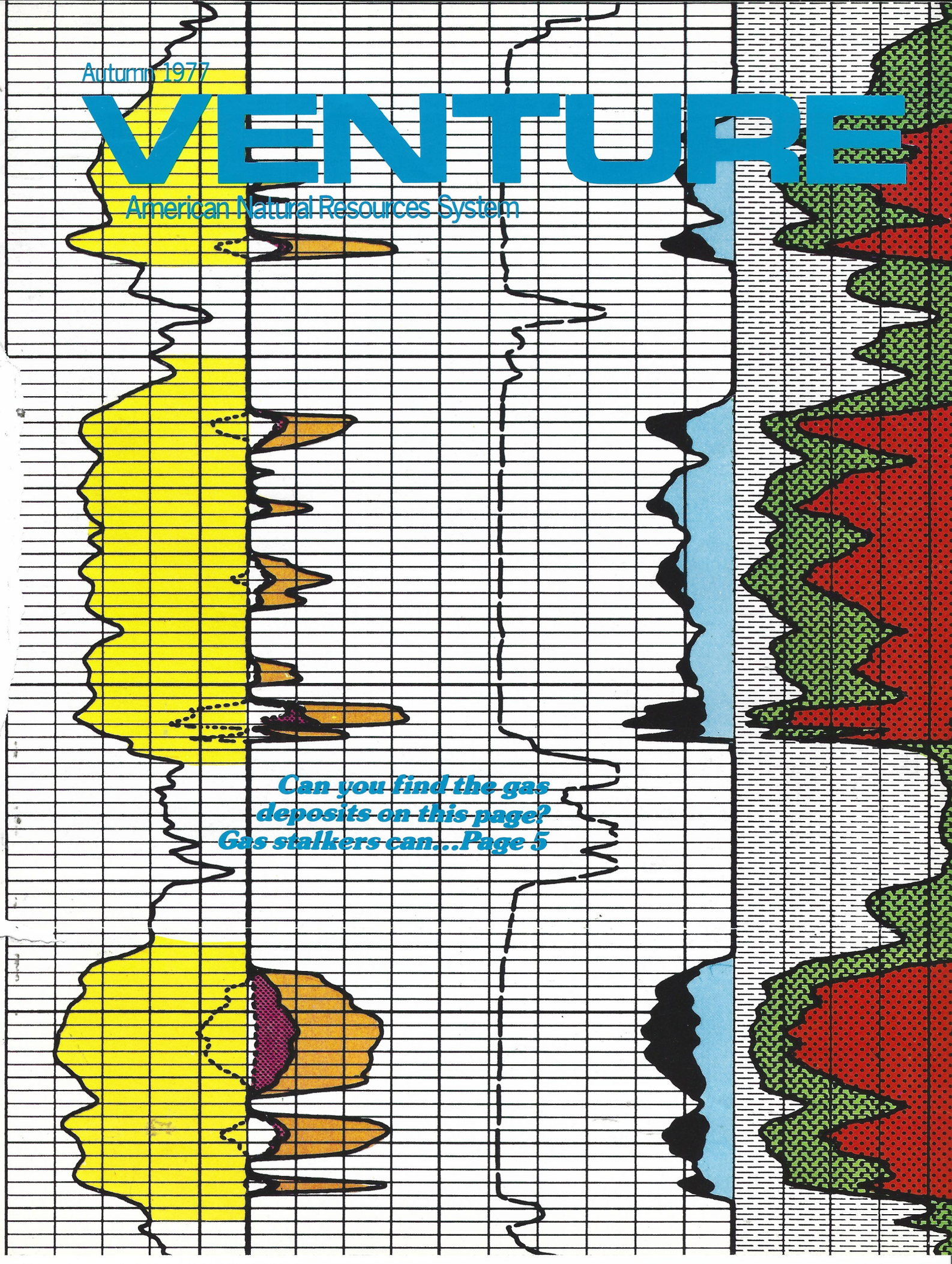
Autumn 1977

VENTURE

American Natural Resources System



Can you find the gas deposits on this page? Gas stalkers can...Page 5

Loreed:

MOTHER NATURE'S DOUBLE DIP

BY GARY WITZENBURG

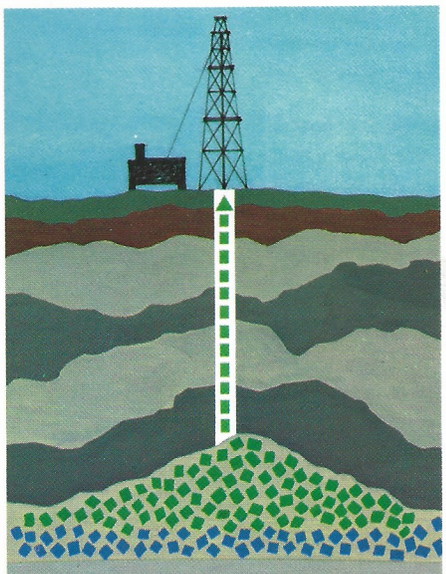
TAKE A SALAD BOWL, fill it with sponge rubber, turn it upside down and force it to the bottom of a pan of water. If careful not to let the air trapped in the sponge escape, you'll notice it's trying to force the bowl to the surface.

Now rest the edge of the bowl on something to keep it off the bottom and place a rock on top to hold down the bowl. Left undisturbed, the bowl will continue to trap the air. And imprisoned by the water, the air cannot leak around the bowl's edge.

If you could insert a straw through the bottom of the bowl and let the air escape, water would rise into the sponge. Blow into the straw, on the other hand, and the water would retreat.

What you have created with the bowl, the straw and the sponge is a simplified model of American Natural's Loreed natural gas storage field near Reed City, Michigan. The bowl represents a formation of solid rock, the sponge porous rock and the trapped air deposits of oil and natural gas. *(See illustration.)* At Loreed, these deposits are some 3,600 feet underground and the surrounding water is brine (water saturated with salt).

This is where the analogy ends. The air in our model may remain trapped indefinitely, but the oil and natural gas at Loreed are providing a steady source of energy for ANR customers. Through a process called "repressuring," oil is being produced daily. And through storing natural gas at Loreed from producing areas in the Southwest and the Gulf of Mexico, ANR has an energy stockpile to meet the demands of winter.

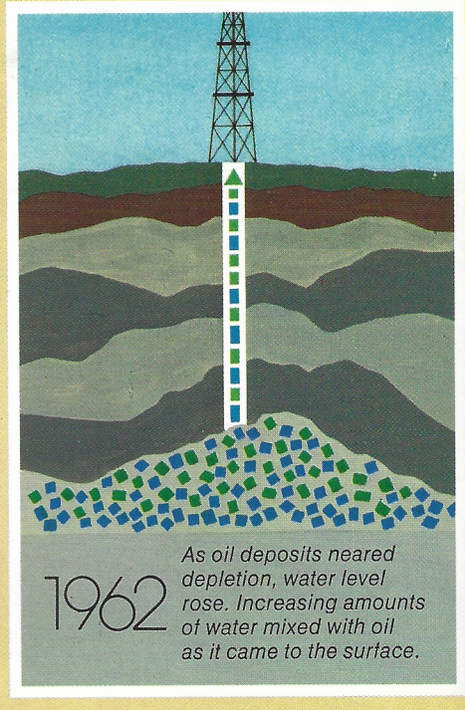


1941 *Originally, Loreed yielded oil (green) from porous formation under dome of solid rock sealed at bottom by water (blue).*

THE REBIRTH OF LOREED

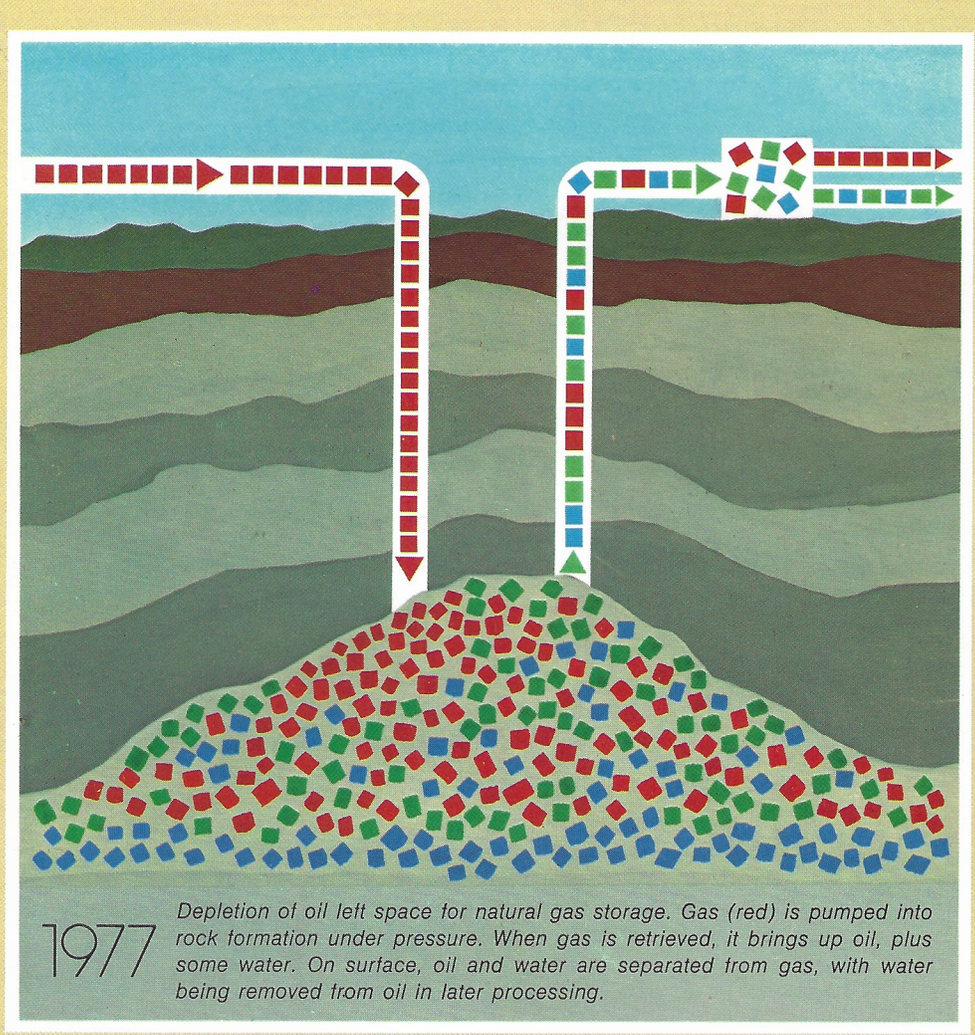
To understand how ANR is gaining this "double dip" calls for a look into the past. Just before World War II, oil development wells were drilled at Loreed. As oil was pumped out, however, brine began to seep into the field. And as less oil and more brine appeared, Loreed's economic value began to diminish — until in the early 1960s oil production appeared at an end.

At that point, Michigan Consolidated acquired Loreed and brought new life to the field by applying a technique it had been using since the early 1940s, the storage of natural gas in depleted fields.



1962 *As oil deposits neared depletion, water level rose. Increasing amounts of water mixed with oil as it came to the surface.*

Loreed was a natural selection for storage. Some two miles wide by five miles long, it had the size necessary to store large quantities of natural gas. And close to the major population centers of southeastern Michigan, where large quantities of storage gas supplement winter pipeline supplies, it had the type of rock formation which would allow quick and easy gas withdrawal during high-demand days.



1977 *Depletion of oil left space for natural gas storage. Gas (red) is pumped into rock formation under pressure. When gas is retrieved, it brings up oil, plus some water. On surface, oil and water are separated from gas, with water being removed from oil in later processing.*

Loreed had another asset: "orphan" oil that conventional methods couldn't remove. The revival of depleting oil fields has been a problem for decades. Sometimes, particularly in the American Southwest, it is economic to rejuvenate a well by water injection — flooding of water into wells around the perimeter of a field to drive the oil toward a central well to be lifted out. But the process is too costly for widespread use.

But as Michigan Consolidated began pumping gas into Loreed at some 2,000 pounds per square inch, the same effect as water injection was achieved. The wells of Loreed, then non-commercial, began to produce oil again. Only now the pressuring agent was natural gas. In 1966, Michigan Consolidated leased these Loreed operations to its affiliate, Michigan Wisconsin Pipe Line Company.

HOW MICHIGAN WISCONSIN ACHIEVES THE "DOUBLE DIP"

Basically, Michigan Wisconsin achieves both oil production and gas storage at Loreed by pumping gas down "input wells" in the center of the field. As the gas moves down these wells in a process called "repressuring," it takes the place of underground water. When gas is pumped out of other wells, oil flows with it.

At this point the gas and oil move to "separators," where the oil is removed from the gas. Some brine comes up with the oil and gas, of course. But it too serves a purpose. Following separation, the brine is pumped back underground around the edges of the field to contain the oil and gas.

ONE LINK IN A CHAIN

Through this double dip from Mother Nature, Loreed now yields some 240 barrels of oil each day, as well as providing storage for more than 32 billion cubic feet of natural gas. But Loreed, although it is the only Michigan storage field producing oil, is not American Natural's sole natural gas reservoir in the state. ANR has 17 such fields in Michigan with a combined working capacity (gas which can readily be

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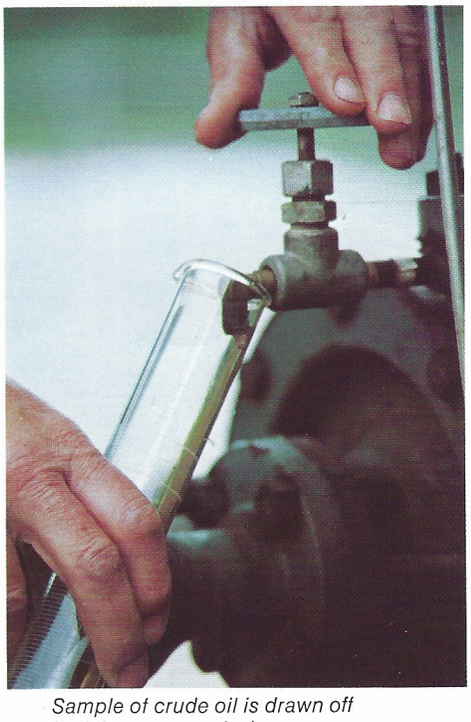
Oil from Loreed is loaded into tanker truck for delivery to refinery. Repressuring technique produces about 240 barrels of crude oil daily.



Sample of crude oil is drawn off for laboratory analysis.

withdrawn during the winter) of some 300 billion cubic feet — equal to about one-third of the System's total annual sendout.

These storage fields played a key role in helping ANR through the bitter winter of 1976-77. (See *How ANR Knocked Out the Winter That Was,* Venture, Summer 1977.)

"The storage concept allows us to operate our pipelines at maximum capacity year-round," explains Walter Nelson, Loreed Superintendent. "We're moving all the gas we can from producing areas 365 days a year. During periods when the demand is there, we sell the gas. If not, we store it."

Every day, according to Nelson, some 50 million cubic feet of gas is piped into Loreed. And as the gas injected into Loreed for storage continues to sweep the field of oil, more capacity becomes available. "Every barrel of oil we produce," says Nelson, "gives us room for another 1,000 cubic feet of gas."

And so Loreed's double dip might be considered a triple dip. For in addition to oil production and gas storage, Loreed's capacity increases by some 240,000 cubic feet a day, making it an increasingly valuable link in ANR's chain of Michigan storage fields. What more can you ask from a field once thought to be worthless? □