vert the kerogen to natural crude oil.

Now man is trying to finish the job for nature.

It's a tough job—and an expensive one. But it's a job that must be done, and done on a huge scale—especially if this nation is ever to reduce our heavy dependence on insecure foreign oil sources. And the more companies working on the job, the better.

The Resources Are Vast

The kerogen locked in U.S. oil shale amounts to more than the total crude oil reserves of Saudi Arabia —the largest oil-producing country in the free world. And it's nearly 20 times greater than this nation's proved reserves of crude oil.

The largest deposits in this country, by far, lie in the Green River area of Colorado, Utah and Wyoming. Much of the oil shale will probably never be recovered from that area. The U. S. Department of the Interior estimates that the Green River formation contains 80 billion barrels of shale oil recoverable under present conditions, and that there are at least 2 trillion barrels of known shale oil resources in the Green River formation.

The U.S. now consumes about six billion barrels of oil a year. So, oil from oil shale could by itself provide the oil needs of American consumers for about 100 years, at present rates of consumption. Once produced, oil from oil shale would move much like crude oil through the existing petroleum distribution system. It would be processed into gasoline, heating oil, jet fuels and the other petroleum products, at refineries that now process crude oil.

That's the possibility.

What about the probability?

That's something else again.

Several large-size problems must be overcome before shale oil moves from the "possible" to the "probable."

Technical Problems

It's relatively easy to produce a small amount of oil from a chunk of oil shale. Just heat the chunk of oil shale to about 900° Fahrenheit. This results in the kerogen being separated from the rock — first as a vapor mist, then when cooled, into a liquid much like crude oil. After the liquid has been treated to remove the impurities, the shale oil can then be refined into gasoline and other products.

It works in the laboratory, and even in a small experimental pilot plant. Unfortunately, converting oil shale to shale oil on a large scale is not yet a reality.

There are two general processes for removing the oil from the oil shale. One involves physically mining the oil shale and heating it above the ground. The other involves heating the oil shale *in situ,* i.e. underground. The *in situ* process eliminates the usual mining method and consists of fracturing and fragmenting the shale underground, introducing heat into the underground deposit to release the shale oil, and then pumping out the oil.

Oil companies are emphasizing research and development in their current oil shale development activities. A variety of processes are being tested, both above ground and underground.

One oil company, for example, is developing a modified *in situ* process. Under this approach, a small portion of the oil shale is removed by mining—in order to create a void space or chamber deep underground. Then, the oil shale still in the ground is reduced to rubble by use of explosives. The rubble is ignited in the chamber—which serves as a retort—and the heat frees the oil from the shale rock. The oil is then pumped out of the ground.

Environmental Problems

The environmental difficulties fall into three major areas:

1. *What to do with the spent oil shale rock?* When oil shale is heated, it expands and fragments. For every cubic yard of oil shale that's mined, 1.2 cubic yards of rock must be disposed of after the oil is recovered. Engineers and other scientists are grappling with the problem of how to dispose of the spent shale in an environmentally acceptable way.

2. *Where will the water come from?* In many oil shale processes, it takes a lot of water to process shale oil, and additional water to establish new vegetation on top of the spent shale. But fresh water is relatively scarce in the Green River Basin area. There's the added problem of making sure that any salt brought up with the oil shale doesn't end up combining with underground or surface waters.

3. *How will the air of the region be affected?* Obviously, a certain amount of dust will be created in mining and moving the shale. And other emissions will occur during the processing stage. These problems