

PARAHO—OUTLOOK FOR COMMERCIAL DEVELOPMENT

Harry Pforzheimer

What is the outlook for oil shale commercialization? Particularly, what is the outlook for commercialization of the Paraho Process?

As Sohio's vice president for oil shale and tar sands, my main interest is to get a technology we can use, rather than a technology we could sell. Sohio got started on oil shale back in 1964 with Cleveland-Cliffs, and TOSCO. We organized the original Colony Operation to build and operate the Parachute Creek plant, using the TOSCO process. We also acquired a significant spread of oil shale properties. Cliffs and Sohio backed out of the Colony operation in 1966, but retained our land interests.

Sohio and Cliffs made a world-wide survey of available technology applicable to oil shale. We looked at about 35 different possibilities. They weren't all different processes; in some cases, just a piece of equipment that could be used in a process. We picked as the most promising, John Jones' new series of inventions, collectively called: "The Paraho Technology". That was in 1966

We really didn't get started on the development of the Paraho technology at that time. Actually, we began negotiating with Arco, and four companies, Arco, Cliffs, Tosco and Sohio, went into the Colony II program. Arco got the Parachute Creek plant started again in 1971. However, Sohio and Cliffs, having completed their financial responsibility to the program and still not satisfied with the progress being made, backed out later that year.

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The plans that John Jones described in his talk were initiated to test the Paraho Process. First, a lease of the Anvil Points facilities had to be obtained because the tail end of the Colony II program was still going on at Parachute Creek. We are very fortunate to be at Anvil Points. I'm quite proud of what Paraho has accomplished there. John Jones and Kumar Kunchal have told you, much better than I could, what our results have been. To summarize some of the points they made:

- (1) The Paraho retort has very few moving parts and low construction and operating costs.
- (2) It uses counter-current flow and gravity transport. This means that it doesn't require a separate circuit for solid heat-carrying bodies; it doesn't require anything to move the rock up through the retort.
- (3) The retort consumes no water. In fact, it produces water.
- (4) It uses lumps of retorted shale and does not produce any serious dust problems.
- (5) In one very important area, retorted shale management experiments have demonstrated that this material can be compacted to where it is impermeable to water. Very little water is required in the direct fired type of retorted shale management. Retorted shale from indirectly fired retorting may be a different story.
- (6) The primary use of water consumed in retorted shale management is in vegetating the surface of the retorted shale. I've been told vegetate, not "revegetate", because nothing ever grew on this material before. (depends on how you define "this material").
- (7) Emissions of sulfur, nitrogen oxides and particulates, at our Anvil Points operation, have been found acceptable by the strict Colorado standards. We have a permanent permit, under Colorado law, to operate our oil shale retorts.
- (8) The Paraho retorts have very high thermal efficiencies. These were reported to you. Rather than discard the residual carbon on the retorted shale, the Paraho direct heated process consumes much of it to fuel and power the process. On the other hand, the Paraho indirect mode produces a high Btu gas and a better quality oil. Now, these are actual results in large scale equipment.

A combination of the direct and the indirect mode may be the ultimate solution. This was successfully tried during the Paraho Oil Shale Demonstration program. Results indicate that it should be possible to fuel the combination mode by direct burning of the carbon on the retorted shale produced from the indirect mode. This would liberate both the oil and high Btu gas produced. The retorted shale would have the desirable characteristics of retorted shale from the direct fired mode. Obviously, the combination mode is something we need to do more work on.

Anticipating the June 30th Paraho project completion date, the Anvil Points mine was closed in December 1975, leaving enough rock on hand to carry out the remainder of the privately-funded retorting program. The retorts were shut down in April. All reports were issued by May 31. Except for the Commercial Evaluation Study. This study was distributed to participants in the 9th Oil Shale Symposium (June 1976).

After analyzing the actual results of Paraho's retorting program, we will select a mode or modes of operations for the Commercial Evaluation Study. Kunchal (1976) reported some of the work done toward this end. Hopefully, the advantages of the Paraho Process will be reflected in the economic results obtained in the Commercial Evaluation Study. The study will almost certainly involve both the direct and indirect modes, but not the combination mode because we haven't done enough work on it. We are also confident that, when the Commercial Evaluation Study is completed, we will find that the upgraded shale oil or syncrude will have a price of \$15.00 to \$20.00 per barrel for a 15 percent return on investment. This may seem to be a pretty broad estimate but it is within narrower limits than before. Up to now, we had been estimating from \$10.00 to \$20.00 per barrel.

Exact price does not seem to be very important at this time. Until we review the module type program, briefly reported by Jones (1976), in some detail, the real cost of producing shale oil won't be known. With the present controlled average price of \$7.66 a barrel for domestic crude oil, obviously, shale oil at \$15 to \$20 per barrel cannot compete. If we look at the controlled price of new domestic oil, still \$11.28 a barrel, the same is still true.

No one really knows what oil prices would be if we were not in a controlled situation with respect to domestic crude oil. We think it is very important that we approach the ultimate commercialization of shale oil in an economy where we have a free market in oil and the ability to compete with foreign sources of oil. Possibly, by the time we get through what is yet to be done, including the module step, we will have a free market on oil. Maybe shale oil will then have a chance. However, if the industry team is to be held together not just our Paraho team, but all those people who have been working on oil shale during the last few years in various research projects, in the prototype oil shale leasing program, and in various educational institutions about the country—if this team is to be held together, we must have a suspension of the terms of the prototype oil shale leases while we await developments. We all need additional time to put our capabilities into the module program. Although Paraho is not a lessee under the federal oil shale leasing program, I am involved because Sohio holds the Utah-b

lease. We are participants with Sun and Phillips in the White River Shale Project.

We come now to the module program: The success of the Paraho Project suggested to us some time ago that the next logical step would be to construct and operate a full-sized retort or module. This module needs defining. By a module, we mean one full commercial sized retort; the mine required to supply rock to feed that retort; crushing equipment to crush and size it; equipment and facilities to dispose of retorted shale; a place to put the crude shale oil produced; and all the supporting equipment. Generally, we do not anticipate that a module includes any upgraded facilities.

Paraho made a proposal, back in May 1975, to construct a full-sized module at Anvil Points. This proposal was pretty well distributed. It was discussed in the press. At that time we, estimated a cost of \$76 million for both construction and operation. It could be done at Anvil Points at that price because of the lower cost of the Paraho retort and because of the support facilities available. Anvil Points is not a remote area. However, since last May, inflation has increased our estimate to \$85 million in the first quarter of 1976. This includes \$58 million for construction and \$27 million for 30 months of operation. But, this is still a phenomenally low-cost module.

When we came out with our original announcement about the Paraho full-size module, both industry and government showed considerable interest and support. The chairmen of the Armed Service Committees of the U.S. House of Representatives and the U.S. Senate granted us the right to mine the additional shale required from the Naval Reserve. Then, the Navy authorized us to proceed with the module whenever we were ready. The Navy is involved because Anvil Points is located on the Naval Oil Shale Reserves. The Bureau of Mines completed a favorable environmental assessment of the module proposal. The Solicitor's Office, Department of Interior, issued Guidelines for the Federal Prototype Oil Shale Leasing Program. These guidelines provided, among other things, that expenditures by lessees for patented or demonstrated technology, such as Paraho's, could be credited against the fourth and fifth bonus payments under the Prototype Leasing Program. Paraho, in proposing its module program, expressed a willingness to accept contributions as prepayments for the use of the Paraho technology. In effect, Paraho was willing to take its future income to build the module.

In July 1975, the \$6 billion Synthetic Fuels Amendment was added to the Energy Research and Development Administration (ERDA) appropriation act and approved by the U.S. Senate. With this federal assistance in the offing, it appeared that we could have everything we needed to move

ahead with joint government-industry financing for a full-size Paraho module.

President Ford visited Paraho in August of 1975 with Frank Zarb, Congressman Tim Wirth and Senator Gary Hart. They toured the mine and plant, witnessed Paraho's ability to produce oil from oil shale and were impressed. President Ford reported favorably to the media about the size, productivity, and environmental acceptability of Paraho's operation and stated that oil shale must have a bigger part in this country's energy program. This was the high point of the current cycle for oil shale.

Since then things have gone down hill — through no fault of President Ford. First, there was a threat of a suit by one of the environmentalist groups if ERDA permitted us to build a module without first obtaining another Environmental Impact Statement. We already had one approved Environmental Impact Statement. We designed our module proposal to comply with the existing Environmental Impact Statement, but the threat of a suit was a little too much. In October 1975, ERDA decided that a new Environmental Impact Statement would have to be prepared before Paraho could build its full-size module at Anvil Points. This will take a year or more to complete. We began working on it immediately.

Two additional adverse federal actions occurred in December of 1975: One was the defeat of the \$6 billion Synthetic Fuels Amendment in the House of Representatives. The other was the passage of the compromise 1975 Energy Policy and Conservation Act which rolled-back the price of domestic crude oil. Unfortunately, these actions came at a time when incentives, rather than restraints, were and still are needed to encourage energy production and conservation.

So far, it seems that this country has not yet recognized in that we have an energy shortage, and that all acceptable forms of domestic energy development will fall short of meeting our needs, particularly for transportation fuels. New legislation must be passed to correct the adverse federal actions of December 1975. With the economics of shale oil being what they are, and the fact that modules are not profitable investments, we are going to need federal grants or non-recourse, guaranteed loans to move ahead. Only in this way can we eliminate the uncertainties relating to the production and economic acceptability of oil shale. Most of all, we will obtain some really good cost figures. The estimated cost of a 100,000 barrel per day shale oil plant has increased from around \$150 million ten years ago to \$1.5 billion dollars now.

After the module phase is completed, one or more retort technologies should come to the front. Paraho does not seek a unique position in the module program. There are other retort processes available. But, no matter what the process, ten to twenty full-size retorts will be required for

a commercial plant. To justify moving into commercial development, we must have a free market. Hopefully, the price then will be high enough to justify making the decision to go forward. But, even if it isn't high enough, it's important that we go forward anyway. This might have to be done through some sort of government-industry partnership.

Our national alternative to supplementing our domestic crude oil supply with shale oil production is to purchase more and more imported crude oil. As this supply declines, such purchases would inevitably be at higher and higher prices, exporting more and more dollars and U.S. jobs. Under this alternative, we will become more and more vulnerable to another oil embargo and less and less capable of maintaining a prosperous economy or of mustering an effective national defense.

Conceding that our government needs to consider carefully how to achieve energy independence and help developing technologies toward commercialization, it is still in this nation's best interest to encourage private industry to move through the profit system into new technologies as they reach feasibility. Future conditions required to encourage commercialization by private competitive enterprise cannot be determined at this time. When such conditions do occur, if federal funding assistance is required, it should be available to encourage construction of the first group of commercial plants or pioneer plants by industry and for the socio-economic projects required by the communities to be impacted by such commercial plants.

It is unfortunate that the forecast for the outlook for oil shale commercialization is no better. We are still optimistic that oil shale must and will become commercial and that Paraho will have an important part in this development. If not, I wouldn't be staying in this business. We feel it can be done and we think it will have to be done. But, it will take the cooperative efforts of all of us to do it.