

subsequent combustion phase is a question mark. There is a general misunderstanding of the \$0.29 per barrel cost for the nuclear approach estimated by Dr. M. A. Lekas of the AEC.² Lekas took some highly optimistic assumptions and applied them to hypothetical situations to get some idea of the comparative economics of shale oil production by the nuclear method under various conditions. The lowest conceivable figure was \$0.29 and even if achievable could be applied only to a limited part of the shale reserve in Colorado and not at all in Utah or Wyoming. Furthermore the costs would likely be considerably higher because ideal conditions are almost never encountered. This figure (\$0.29/bbl) was used in congressional testimony to support the idea that oil shale royalties should be as high as possible,³ a classic example of the misuse of information by those with inadequate background in the subject.

Before dismissing *in situ* retorting entirely let me make clear that an efficient economic *in situ* shale oil production method is a desirable objective and worthy of research effort. I have confidence that such a method can be developed but I am not optimistic that one will be available by the time we need shale oil. Therefore, it is my belief that shale oil will be produced first by mining and retorting using techniques already in an advanced stage of development and that these methods will be improved still further through commercial application. *In situ* methods of production may be in use within 20 years but they will not likely be more economical than the mining/retorting systems of that day.

THE NEED AND THE MARKET

Do we need shale oil now? Obviously with imports of 2,500,000 barrels a day, we have an adequate supply of oil for the present. The fact is that we cannot have shale oil in any significant quantity for at least 10 years. The more pertinent question is whether or not we will need shale oil by 1975 or 1980.

Take almost anyone's appraisal and you will find a prediction that domestic oil supply will fall short of demand by a wide margin by 1980 or thereabouts. Since we are now supplementing domestic supply with imports amounting to 20% of demand we obviously are going to have to find much greater quantities of oil, to increase imports or develop synthetic oil. Most likely we will do all three.

In this light, let me focus your attention on a regional situation. The Rocky Mountain area now produces about 1,000,000 barrels of oil per day from a proven reserve of less than 3 billion barrels. Both production and reserves have been static or declining in most of the producing states. Exploration also has declined significantly. Colorado is a striking example of production declining, with a decrease in 10 years from 160,000 to 90,000 barrels per day.

It seems to me that shale oil first will become a regional supply of oil making up the decline in production of conventional oil in the Rocky Mountains and this combined with increased demand for petroleum products in the area may take all the shale oil that can be produced for the next 10 to 15 years.

TIMING AND COST

Contrary to some expressed thought, oil shale will not emerge in a flood to drown the domestic oil industry. Many factors will see to this, not the least of which is the time required to build an industry and its cost. By the time the technology is proven to the degree needed to justify the large expenditures that are inevitable we may be into the 1970's. It has been stated that a 58,000 B/D oil shale plant using the TOSCO II system will cost \$130 million.⁴ If we round this off to \$2000 per daily barrel, simple arithmetic tells us that 1,000,000 barrels per day will cost \$2 billion. If we add the power plants, pipelines and other similar industrial installations, and the expansion of highways, schools, hospitals, and municipal facilities, this cost could double. To build a 1,000,000 B/D industry by the end of the 1970's will be a monumental task requiring that no time be lost at any step. To build the industry faster probably is out of the question owing to the physical size of the effort and the political, technical and financial barriers to be surmounted. It seems likely that there will be a need for the oil about as fast as it can be developed.

² Lekas, M. A., "Economics of Producing Shale Oil by the Nuclear *In Situ* Retorting Method", Third Annual Oil Shale Symposium, April, 1966.

³ Paul H. Douglas, testimony before the Subcommittee on Antitrust and Monopoly of the Senate Judiciary Committee, April 19, 1967.

⁴ Morton M. Winston, Executive Vice President, The Oil Shale Corporation, testimony before the Subcommittee on Antitrust and Monopoly of the Senate Judiciary Committee, April 1967.