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Oil Shale: Introduction and Perspective

There appears to be no question that the potential value of Colorado's untapped oil shale reserves represents a "bonanza" far in excess of the wildest dreams of the old gold rush prospectors, dwarfing the uranium boom of the 1950's.¹ Whether efforts to develop these vast deposits will succeed in opening a treasure chest or a Pandora's box depends substantially upon the manner in which the Federal Government evolves policy for the orderly development of oil shale reserves. The American citizen is the major stockholder; his Government owns an estimated 72 per cent of the oil shale lands of the Green River formation² — which contains almost ten times the known oil shale reserves in all the rest of the world.³ These lands are the richest, too, carrying perhaps 900 billion gallons of oil in deposits rated upward from 15 gallons per ton.⁴ Little wonder, then, about the rekindled interest in finding ways and means of converting this vast treasure into productive wealth.

Despite the current swelling of interest in oil shale, oil from shale deposits has been produced commercially for more than a century, principally in oil-short Europe.⁵ After a brief period of production in the period immediately preceding the Civil War, the infant United States oil shale industry folded upon discovery of the major petroleum deposits in Pennsylvania.⁶ The ease with which new deposits of petroleum were found and put into production caused interest in the relatively high-cost oil shale to diminish.⁷ Only in recent years have the oil industry and the Federal Government stepped up research efforts to a significant degree.⁸

¹ A national petroleum trade publication computes the value of recoverable oil in the shale deposits of the Green River Formation at \$2,577,000,000,000 (OIL AND GAS JOURNAL, March 9, 1964, p. 65) [hereinafter cited as OIL AND GAS JOURNAL].

² Childs, *The Status of the Oil Shale Problem*, QUARTERLY OF THE COLORADO SCHOOL OF MINES, July 1965, p. 2.

³ U.S. BUREAU OF MINES, BULL. NO. 611, OIL SHALE MINING, RIFLE, COLO., 1944-56. Table 2, p. 4 (1964).

⁴ Childs, *supra* note 2 at 1.

⁵ U.S. BUREAU OF MINES, BULL. NO. 611, *supra* note 3 at 4.

⁶ *Ibid.*

⁷ OIL AND GAS JOURNAL, p. 33.

⁸ *Ibid.*

I. TECHNOLOGY

A major impediment to production of oil in commercial quantities from shale has been the cost of extracting oil from the tough matrix-like rock in which it is contained.⁹ Because of its peculiar chemical properties the solid hydrocarbon — kerogen — must be separated from the marlstone, of which it is a part, by application of heat. At 800 to 900 degrees the kerogen decomposes into a liquid oil similar to petroleum crude, leaving about 25 per cent in a solid state similar to coke.¹⁰

The liquid itself is a highly viscous oil which is a slushy solid at room temperature, and has a pour point of between 90 and 100 degrees F. Thus it must be partially refined before it can be transported by pipeline.¹¹

The ore may be mined by conventional means, crushed and retorted on the surface. A plant having a capacity of 40,000 barrels of oil per day is considered the minimum for economic success;¹² such a plant would represent, including mining development costs and a share of research expenditures, a capital outlay of approximately \$100,000,000 — this before realizing a cent from production.¹³ And in the absence of a Federal policy directed toward oil shale, only the conventional mining depletion rate of 15 per cent is available, compared with a 27½ per cent depletion rate for crude oil.¹⁴ Further, the status of shale oil with respect to a refiner's import quota has not been determined, and if no credit is given the shale oil must absorb a price penalty proportionate to the reduction of the refiner's import quota.¹⁵

Despite these factors, industry spokesmen think shale oil can now be produced as cheaply as the average barrel of crude, and one trade publication has indicated a 1970 date as most realistic for "on stream" commercial production.¹⁶

II. LAND STATUS

The status of oil shale lands adds to the complexity of the picture. The Green River formation comprises some 896,000 acres in Colorado, 2,700,000 acres in Utah, and 460,000 acres in Wyo-

⁹ *Id.* at 79.

¹⁰ Lekas & Carpenter, *Fracturing Oil Shale With Nuclear Explosives for In-Situ Retorting*, QUARTERLY OF THE COLORADO SCHOOL OF MINES, July 1965, p. 21.

¹¹ OIL AND GAS JOURNAL, p. 71.

¹² *Id.* at 69.

¹³ *Id.* at 80.

¹⁴ *Id.* at 76.

¹⁵ *Id.* at 80.

¹⁶ *Id.* at 65.

ming.¹⁷ In 1914 the lands were open to homesteading with mineral rights reserved,¹⁸ and six years later the lands were made subject to the Mineral Leasing Act of 1920.¹⁹ President Hoover in 1930 withdrew the classified oil shale lands from entry on a "temporary" basis for the purpose of "investigation, examination, and classification."²⁰ It is of interest to note that during the 10-year period between the effective date of the Mineral Leasing Act and the executive order withdrawing lands from location no leases were issued.²¹ Meanwhile, in 1916 and 1924 three large tracts of land in Utah and Colorado were withdrawn from entry as a future source of oil for the Navy;²² the Colorado tracts comprise 38,700 acres with an estimated content of 5 billion barrels of oil in deposits rating 25 gallons per ton.²³ Further, under terms of the Multiple Mineral Development Act of 1954,²⁴ certain of the lands in the oil shale area have been opened to location for conventional petroleum exploration.

Thus the picture of land status is mottled. Basically, homestead entries made prior to July 17, 1914, carry with them mineral rights; subsequent to that date mineral rights for homestead lands are retained by the Federal Government. Patents issued prior to November 11, 1920, are generally considered unassailable.²⁵ Placer mining claims made prior to that date are open to question; some have been patented in subsequent years.²⁶

Following the decline of the early oil shale boom in 1926, many of the estimated 30,000 claims were abandoned.²⁷ A series of contest actions initiated by the Federal Government resulted in declarations that claims were void for failure to perform requisite annual development work.²⁸ But in 1935 the Supreme Court resolved the question by holding that the requirement for annual work did not apply to oil shale claims.²⁹ Then, in a significant holding in

¹⁷ U.S. BUREAU OF MINES, BULL. NO. 611, *supra* note 3 at 14.

¹⁸ 38 Stat. 509 (1915), 30 U.S.C. § 122 (1942).

¹⁹ 41 Stat. 437 (1921), 30 U.S.C. § 22 (1942).

²⁰ Exec. Order No. 5327, April 15, 1930.

²¹ U.S. BUREAU OF MINES, BULL. NO. 611, *supra* note 3 at 15.

²² *Ibid.*

²³ PRIEN, *Oil Shale* in MINERAL RESOURCES OF COLORADO, 452 (1960).

²⁴ 68 Stat. 711 (1954), 30 U.S.C. § 527 (1942).

²⁵ *United States v. Chandler-Dunbar Water Power Co.*, 209 U.S. 447 (1907).

²⁶ Records of the Colorado Land Office, U.S. Bureau of Land Management, indicate 269 oil shale patents covering 1,750 claims have been issued in the last 45 years. See Meek, *Records, Documents, and Service of the Colorado Land Office, Bureau of Land Management*, this edition, *infra*, p. 85.

²⁷ Meek, *supra* note 26 at 85.

²⁸ See Lohr, *Conclusiveness of United States Oil Shale Placer Mining Claim Patents*, this edition, *infra*, pp. 35-37.

²⁹ *Ickes v. Virginia-Colorado Dev. Corp.*, 295 U.S. 639 (1935).

1964, the Solicitor of the Department of the Interior held that the 1935 Supreme Court decision did not apply retroactively to claims voided prior to that date by departmental action.³⁰ Even though the Department might have been in error, he said, cancellations which were neither appealed from nor attacked over a period of 25 years could not now be reopened to inquiry, being barred by "the principles of *res judicata*, finality of administrative action, and laches."³¹ With millions of dollars potentially at stake, it is undoubted that final determination of the question must await completion of the lengthy process of appeal through the Federal courts. Further, the unsettled circumstances have raised questions as to the conclusiveness of all patents issued since 1920. And of an estimated 30,000 claims recorded in the Colorado office of the Bureau of Land Management, nearly one-fourth are still considered representative of "administrative problems" to the Land Office.³²

III. ECONOMIC FACTORS

The status of the land itself is but one of the problems encountered in analyzing prospects for oil shale development. The effects of a burgeoning oil shale industry upon the economy of the state, nation, and world must also be considered.

If ore carrying 10 gallons per ton is considered, the Green River formation contains at least 2 trillion barrels of oil, or 25 times the amount of oil produced to date from all sources by the United States.³³ An "open door" policy toward oil shale would cause enormous dislocation of the oil industry as now constituted. The regulation of oil imports by the United States maintains a fine balance predicated upon consideration of domestic production, exploration, and development; maintenance of adequate domestic reserves for national defense purposes; conservation of resources; dollar balances involving oil-producing nations; competition with the Communist bloc for economic and political considerations abroad; policy toward research and development of other fuel sources, *i.e.*, tar sands and atomic energy.

Domestic economic implications are equally complicated. There is enough oil in Green River shales to constitute 189 East Texas oil fields, enough potential wealth to pay off the national debt with \$11,000 left over for every man, woman, and child in the United

³⁰ Union Oil Co., 71 Interior Dec. 169 (1964).

³¹ *Id.* at 185.

³² Meek, *supra* note 26 at 85.

³³ Childs, *supra* note 2 at 1.

States.³⁴ A continued increase in the cost of finding crude could shift substantial attention to shale oil; revision of depletion allowances to favor shale oil could have a similar effect. Yet a major crude oil find discovered subsequent to multi-million dollar commitments by the oil industry to shale operations could burst the bubble overnight.³⁵

IV. WATER PROBLEMS

A thriving oil shale industry will require vast quantities of water, not only for the anticipated metropolitan area of 340,000 persons envisioned by one researcher for western Colorado,³⁶ but also for the refining process essential prior to pipeline transportation of the oil. Thus provision must be made for the acquisition of water in quantities estimated at up to 455,000 acre feet per year.³⁷ It is not at all certain that oil shale industry representatives are fully aware of the legal complexities surrounding acquisition, diversion, and retention of water rights. It is disconcerting, for example, to hear an industry expert dismiss the question of water rights as being a simple market place transaction whereby "some of the poorer farms which are now using water will be purchased, and water from them will be stored and used for oil shale processing and the related communities."³⁸ While water may become available to the extent that it is needed, as need increases so does price. Reliance upon purchase of existing irrigation rights to supply projected oil shale requirements could well price the industry out of existence.

In view of the interest of the Federal Government in the orderly exploitation of oil shale reserves, the problem of water allocation could be solved by the Secretary of the Interior, who serves both as master of the Colorado River Basin by Supreme Court edict,³⁹ and as custodian of the public lands held in trust for the American people. Coordination of these two aspects of the Department of the Interior's responsibilities through initiation of planning for capture and retention of now-surplus flood waters has been advocated as one means of insuring adequate water for oil shale at a reasonable price.⁴⁰

³⁴ OIL AND GAS JOURNAL, p. 65.

³⁵ *Ibid.*

³⁶ PRIEN, *op. cit. supra* note 23 at 458.

³⁷ Colorado Conference Committee, *Water Requirements of an Oil Shale Industry*, Sept. 24, 1953.

³⁸ Ertl, *Mining Colorado Oil Shale*, QUARTERLY OF THE COLORADO SCHOOL OF MINES, July 1965, p. 83, 90.

³⁹ *Arizona v. Colorado*, 373 U.S. 546 (1963).

⁴⁰ Delaney, *Water for Oil Shale Development*, this edition, *infra*, at p. 75.

V. CONSERVATION

Conservation problems go a lot deeper than just tidying up the landscape after the mining operation. Certain of the deposits may be amenable to strip mining, but others are topped with hundreds of feet of overburden and range up to 1,500 feet in depth. A unique property of the mineral and the retorting process results in an expansion of the shale so that spent shale occupies about two-thirds more volume than does the marlstone ore. A 40,000 barrel per day plant thus would be required to dispose of 62,000 cubic yards of spent shale from the 37,000 yards of raw shale it uses each day.⁴¹ Where to put the mountainous debris and then what to do with it is something more than an inconsequential problem.

Oil shale need not be mined; experiments have been conducted to determine feasibility of extracting the liquid product from the ground by application of heat through steam, by controlled burning (fire flooding), and by use of nuclear explosions to make a vast retort of the ore body itself. Researchers are divided on the effectiveness of the "in situ" process, but the nature of the method indicates built-in problems. It seems agreed that the process is less efficient, thus an ore body decomposed by in situ retorting is likely to produce less oil than an identical body conventionally mined and retorted above ground.⁴² Ramifications of a process which will recover only a portion of the kerogen in place raise serious questions related to conservation of resources.

Although theoretical studies have been made under auspices of the Atomic Energy Commission and the U.S. Bureau of Mines aimed at developing a commercially feasible means of using nuclear explosions for oil shale retorting, field experimentation must await results of the current research and experimentation before being given serious consideration, although the subject has some conservation-minded groups worried.

Conservationists, too, are concerned about effects of an oil shale industry takeover of irrigation rights to farmlands, and see as the consequences of such a takeover a return of fertile fields to arid semi-desert land with a concurrent diminution of wildlife. The prospect of a return flow of 165,000 acre feet of water per year from a prospering oil shale industry⁴³ raises further worries about contamination of downstream domestic water and of fishing waters and waterfowl rookeries.

⁴¹ OIL AND GAS JOURNAL, p. 69.

⁴² *Ibid.*: yield from one mechanical retorting process is reported as approaching 100 per cent.

⁴³ Delaney, *supra* note 40 at 74.

VI. A FEDERAL POLICY

Formulation of federal policy toward oil shale is replete with pitfalls. Since the rekindling of interest in oil shale following World War II, the Department of the Interior has moved sporadically toward evolving a policy through intradepartmental studies and committees,⁴⁴ the efforts of the President's Materials Policy Commission⁴⁵ and, most recently, the Oil Shale Advisory Board.⁴⁶ And in the absence of affirmative action by the Department, rustlings have been heard from Congress about legislating an answer.⁴⁷ It is not without justification that oil shale industry leaders accuse the Department of moving with leaden feet; the Department's Solicitor, speaking at an oil shale symposium April 23, 1965, in Denver, reminded his listeners: "There is enough oil in 10-gallon shale for 368 years. . . . It would be presumptuous for us to attempt to solve the problems people may have 368 years from now. We owe it to future generations to pass along some of the good things on this planet. We owe it to ourselves to pass along some of its problems."⁴⁸

There is much to be said for a "go-slow" attitude on the part of the Federal Government, however. Until the force of an oil shale industry's impact upon the economy can be predicted with some reasonable basis of assurance, a green light for development of shale lands might prove disastrous. There seems to be good basis for expecting a federal policy to evolve on a cautious basis designed to keep oil shale in the position of supplementing conventional petroleum resources, rather than competing directly with them.

In seeking a method of leasing oil shale lands, federal officials are caught on the horns of a dilemma. To permit only a few companies to obtain leases could well bring down charges of favoritism, while opening the doors wide could result in a wild scramble and consequent disorganized development. The great capital cost of developing a mine and retorting facility supports the argument that leases should be restricted to companies which are financially able to proceed immediately into production. Further, an open policy

⁴⁴ Mock, *The Oil Shale Advisory Board*, this edition, *infra* at 48.

⁴⁵ *Ibid.*

⁴⁶ *Ibid.*

⁴⁷ Most recently, Senator Douglas of Illinois introduced a measure (S. 2708, 89th Cong., 1st Sess. (1965)) providing that upon opening of federal lands to leasing the Federal Government would retain a one-eighth royalty, proceeds of which would be allocated to reducing the national debt. The proposal has been attacked by Sen. Wallace F. Bennett of Utah as "unrealistic and another example of Easterners telling us how to handle our natural resources in the West." (Rocky Mountain News, Nov. 3, 1965, p. 24, col. 3.)

⁴⁸ Barry, *A National Policy for Oil Shale*, QUARTERLY OF THE COLORADO SCHOOL OF MINES, July 1965, p. 97, 105.

of competitive bidding would encourage speculation in what may very well be the nation's most valuable untapped natural resource.

Advocates of an open-door policy on oil shale lands include not only the holders of extensive tracts of oil shale lands, but also state officialdom, particularly in states with extensive deposits, industrial development agencies, such as chambers of commerce, and a cadre of congressional members including some who look to federal oil shale holdings as the key to paying off the national debt.

How many of the problems are resolved today and how many are passed on to future generations will depend to a great extent upon how effectively the Department of the Interior, the Congress, and the oil shale industry itself cooperate in seeking to devise a means of meeting and overcoming the technological, economic, legal, political, esthetic, and international complexities which now stand between the immense wealth in the ground and its unrealized fruition.

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In this Oil Shale Symposium edition of the Denver Law Journal the editors do not propose to provide a comprehensive analysis of the legal problems confronting the oil shale industry. To attempt to do so would be far beyond the resources and capacities of the Journal in view of the immense complexities of the current picture. The purpose is, rather, to provide a broad general view, touching in greater detail upon issues related to validity of claims and patents, acquisition and retention of water rights, factors involved in formulation of a federal policy, and upon some of the tools available to the practitioner who might have occasion to inquire into title questions.

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