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The Rise and Fall of Natural Resource Systems

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There is a pronounced tendency to view each legal system which deals with a particular natural resource as a unique entity. In this article Professor Kratchman advances the thesis that there is a systematic pattern of development common to all natural resource legal systems. The author proposes that the recognition and study of these similarities may serve many useful functions.

THE RISE AND FALL OF NATURAL RESOURCE SYSTEMS

*Jack Kratchman**

In 1956, A. E. Coleman discovered, claimed, and began to exploit a deposit of quartzite stone located on public domain[1] in southern California. Twelve years later the U.S. Supreme Court ruled that he could be ejected from his claim.[2] This order affirmed the determinations of the Secretary of the Interior that a discovery of valuable mineral[3] had not taken place, which would have entitled Coleman to a patent for the land he claimed and, furthermore, quartzite stone

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1. Public domain refers to land which has come into federal ownership by purchase, cession, or treaty; which has not been reserved by the Federal Government for special purposes or remains unappropriated; and is subject to the public land laws of the United States.
2. 390 U.S. 599 (1968).
3. The Mineral Location Act of 1872 states the basic national minerals policy that all valuable mineral deposits are to be free and open to exploration. Act of May 10, 1872, ch. 152, § 1, 17 Stat. 91 (codified at 30 U.S.C. § 22, (1970)). In order to prevent wrongful claims, Congress required a discovery of valuable mineral deposit before a claim could be validated or title, known as patent, issued to private ownership. *Id.* § 2 (codified at 30 U.S.C. § 23 (1970)).

was a "common variety"[4] of mineral which cannot serve as a basis for claims for land patents.

In 1958, the U.S. Supreme Court upheld[5] contracts between the Secretary of the Interior and several irrigation districts in California which withheld project water[6] from lands in excess of 160 acres in single ownership held by certain landowners in the Central Valley of California. In so doing, the U.S. Supreme Court overruled the determination by the California Supreme Court that the limitation on delivery of project water was inapplicable and improper under State law and that the contract was, therefore, invalid under Section 8 of the Reclamation Act.[7] According to the U.S. Supreme Court, the United States was only required to comply with State law when "in the construction and operation of a reclamation project it becomes necessary for it to acquire water rights or vested interests therein. . . . We read nothing in § 8 that compels the United States to deliver water on conditions imposed by the State."[8]

At first glance, there would seem to be little resemblance between ejectment from a building stone claim and refusal to deliver water to excess lands in an irrigation project. But, on closer examination, some basic similarities become apparent. Both cases are concerned with the development and use of natural resources in a systems context, there is an interaction between private parties and governmental institutions, and public policy strongly influenced the outcome of each

4. To prevent mining claims based on discovery of minerals of widespread occurrence, the mining laws were amended in 1955, so that:
> "A deposit of common varieties of sand, stone, gravel, pumice, pumicite, or cinders shall not be deemed a valuable mineral deposit within the meaning of the mining laws of the United States so as to give effective validity to any mining claim hereafter located under such mining laws."

Act of July 23, 1955, ch. 375, § 3, 69 Stat. 368 (codified at 30 U.S.C. § 611 1970)).

5. Ivanhoe Irrigation District v. McCracken, 357 U.S. 275 (1958).

6. Section 5 of the Reclamation Act of 1902, generally provides that no right to the use of water from water supply facilities constructed by the Federal Government, i.e., project water, shall be sold for lands in excess of 160 acres in single ownership. Act of June 17, 1902, ch. 1093, § 5, 32 Stat. 389 (codified at 43 U.S.C. § 431 (1970)).

7. Section 8 of the Reclamation Act of 1902 provides that the Act is not to be construed as interfering with state laws "relating to the control, appropriation, use, or distribution of water used in irrigation. . . ." Also, it requires that the Secretary of the Interior shall administer the Act "in conformity with such laws. . . ." *Id.* § 8, at 390 (codified at 43 U.S.C. § 383 (1970)).

8. Ivanhoe Irrigation District v. McCracken, *supra* note 5, at 291-92.

case. In addition, economic, social, and technologic factors had a marked influence in the way in which rights to the natural resource were allocated or denied. These and other similarities are common to other natural resources whether they be familiar like land, water, minerals, and oil and gas, or less familiar resources like geostationary orbits[9] or oyster beds.

Based on a comparison of these similarities, as they change over time, a thesis is propounded in this article that each of these natural resources has a systematic pattern of legal development, the basic elements of which are quite analogous from one natural resource legal system to another. The pattern generally followed by natural resource systems is to pass through successive stages of maturation and decline, moving from unfettered exploitation to legitimation, and then to correction of abuses in exploitation, and on to regulation, and eventually to disintegration. The various stages through which natural resource systems evolve are described in this article as well as some of the forces and means which cause or effect system change. With this perspective, the thesis is assessed in terms of its research and policy implications.

THE DEVELOPMENT OF NATURAL RESOURCE SYSTEMS

Embryonic Stage—Unfettered Exploitation

In the first or embryonic stage, there is little or no legal framework within which participants operate. Where applicable law exists, it is often ineffective, tardy, subverted, or defied. The technical and economic environment is usually primitive, relatively few individuals are involved, and the system is comparatively unintegrated with few or no substantive interactions between parties. Simple, uncomplicated principles, *e.g.*, "first in time, is first in right," govern allo-

9. The geostationary orbit is a band of space about 22,300 miles above the Equator in which communications satellites orbit about the earth. The satellites appear to be stationary above a fixed point on the earth's surface because the speed of the satellite equals the speed of the earth's rotation. The geostationary orbit has only a limited capacity for satellites, and its communications potential represents a modern-day resource with problems of allocation and use similar to traditional natural resources.

cation of resources, and serve to resolve conflicts and establish priorities.

Reflecting the rapid rate of development and exploitation of natural resources within the United States, all significant resource legal systems have matured beyond the embryonic stage. At present, examples of natural resource systems in the embryonic stage must be sought in the internation commons[10] such as outer space and the high seas.

Despite the fact that man has sailed the seas for several millennia, the oceans as a resource are still in an embryonic stage of development. Except for technical portents of the future such as offshore oil and gas rigs and whaling ship factories, the technical level of exploitation is not high, the rate of usage generally is modest as compared to the available resource, the operating units are generally unintegrated with few significant interactions between each other, and the applicable law often does not adequately order the relationships among national entities and the individuals involved.

For some centuries prior to World War II, there was comparatively little change in the legal status of the oceans and the sea floor. Coastal states generally claimed jurisdiction of territorial waters within three miles of the high water mark. The balance was available to all in seeming abundance. This situation changed in 1945 when the United States claimed the natural resources of the American Continental Shelf.[11] This was followed in 1952 by Ecuador, Peru, and Chile, claiming the ocean and sea floor for 200 miles, and in 1953, the United States passed the Outer Continental Shelf

10. Hardin, *The Tragedy of the Commons*, 162 SCIENCE 1243 (1968). Each incremental use of a shared resource returns a full unit of value to the individual, but the negative effects are shared by all. This tends to lead to the destruction of the resource held in common.

11. Proclamation 2667, September 28, 1945 stated:

> "[T]he exercise of jurisdiction over the natural resources of the subsoil and sea bed of the Continental Shelf by the contiguous nation is reasonable and just . . . .
>
> . . . .
>
> [T]he Government of the United States regards the natural resources of the subsoil and sea bed of the Continental Shelf beneath the high seas but contiguous to the coasts of the United States as appertaining to the United States [and] subject to its jurisdiction and control."

10 Fed. Reg. 12303 (1945).

Lands Act[12] which extended its claims seaward without specifying any limit. In an effort to cope with these unilateral attempts to acquire a natural resouce increasingly perceived as having enormous value, a Conference on the Law of the Sea was held in Geneva in 1958. Some international agreements were forthcoming from this Conference, but these agreements established no seaward boundaries for the sea floor contiguous to coastal states. The 1958 conference may be considered as an initial step toward modifying the embryonic nature of much of the system of ocean resources, but in the absence of governing treaties or law, other Latin American, Asian, and African countries began to claim exclusive fishing rights for 100 miles out to sea. At the same time, incidents of fishing vessel seizure were on the increase.

More recently, President Nixon proposed on May 23, 1970,[13] that claims to seabed resources beyond the depth of 200 meters be renounced by all and that an international trusteeship be established for exploitation of the mineral wealth of this "common heritage" of all mankind. Apparently, the requisite degree of maturation has not yet appeared on the international scene because the U.S. proposal has been resisted, American fishing vessels continue to be seized off Ecuador, threats are made by Spain to control passage of vessels through the Straits of Gibraltar, and the Latin American claims to exclusive and extremely broad control of the seas adjacent to their coasts are receiving increased support from less developed Asian and African countries. The latest in the series of events is the unilateral extension by Iceland of its exclusive fishery zone around Iceland from twelve miles to fifty miles. This was done in defiance of an injunction imposed by the International Court of Justice.

The rush to gain control of a newly perceived resource is still on, and priorities still depend more on aggressive action and force than statute. As the disadvantages of individual action manifest themselves still further with the passage of time, the trend begun with the Geneva Conference

12. Act of Aug. 7, 1953, ch. 345, 67 Stat. 462 (codified at 43 U.S.C. §§ 1331-43 (1970)).
13. *Statement about U.S. Oceans Policy*, PUBLIC PAPERS OF THE PRESIDENTS OF THE UNITED STATES, RICHARD NIXON, 454-56, May 23, 1970.

of 1958 and the Nixon proposal can be expected to advance to the point where a framework can be created within which the multiplicity of national interests and current technical and economic limitations of ocean exploitation can be resolved.

Unlike fisheries or oil and gas, the absorptive capacity of the high seas was not widely thought of as a resource until recently. As a result, the ocean has been used as a free resource for dumping of wastes of all kinds, and chemical degradation of the seemingly limitless ocean vastness has taken place. Recognition of this dangerous trend has come slowly, but it is now emerging. The United States proposed to the United Nations Conference on the Human Environment in June 1972, a draft ocean-dumping convention. This convention would require the establishment of national systems to regulate ocean dumping based upon internationally agreed upon principles for the protection of ocean water quality and the marine environment. As another example of attempts to beneficially use this resource, on November 13, 1972, representatives of ninety-one countries, including all of the world's major maritime nations, agreed on a global convention to end the dumping of poisonous waste matter at sea. When fifteen of the legislatures of the signatory countries sign the "Convention on the Dumping of Wastes at Sea," it will take effect.

While no significant embryonic systems remain in the United States, it is possible to observe the development of more mature systems such as those for the land, water, and locatable minerals,[14] and to note their characteristics when they were in their embryonic stages.

During the period 1781-1867, the U.S. Government acquired by state cession, treaty, and purchase, 1.8 billion acres of land and water for less than a nickel an acre. Into this vast, almost empty, and untouched territory there poured a host of people bent on development.

14. Metallic and other minerals subject to claim location under the general mining law are known as locatable minerals. See *supra* note 3. These are distinguished from deposits of oil, gas, coal, phosphate, sodium, and certain other non-metallic substances which can only be acquired by federal lease if situated on the public domain.

At first, the young Federal Government tried to sell or lease the public lands to meet its revenue needs.[15] When this failed, settlement and development replaced revenue as a national policy. From the mid-1800's until the passage in 1916 of the Stock Raising Homestead Act,[16] the last of the general land acts for development, various homestead and desert land laws were passed to dispose of vacant public land according to the use for which it was best suited.[17]

In the meantime, settlers were quick to take and hold land either before or in defiance of federal land laws.[18] For example, under the homestead laws, cattlemen were unable to secure title to grazing land in the amount needed for a viable operation. As a result, they took what they needed in whatever way they could. Although the public domain was open to everyone on an equal basis, the key to control was water. Ranchers proceeded to take control of springs, claimed both banks of streams, and then leased the range back to the divide, or diverted streams upstream from new settlers' ranches. In order to limit access of others to land and to increase their own holdings, cattlemen purchased alternate sections, in checkerboard fashion, from the railroads on easy terms and fenced the outside of their purchase, thereby illegally enclosing an equal amount of alternate sections owned by the Federal Government. While there was no statutory basis for doing so, they claimed lands through publication in newspapers or by prior possession. In an effort to keep others out, they formed exclusive associations which denied latecomers use of local roundups, common corrals, and group protection against Indians and rustlers. Fraud was often

15. For a discussion of the credit sales experiment and the cash sales phase of public land disposal by the Federal Government see GATES, HISTORY OF PUBLIC LAND LAW DEVELOPMENT chs. 7-9 (1968).

16. Act of Dec. 29, 1916, ch. 9, 39 Stat. 862 (codified at 43 U.S.C. §§ 291-302 (1970)).

17. For example, the Homestead Act of 1862 offered 160 acres of free land to settlers after meeting the requirements of settlement, residence, and cultivation. Act of May 20, 1862, ch. 75, § 1, 12 Stat. 392 (codified at 43 U.S.C. § 161 (1970)). The Desert Land Act of 1877 permitted acquisition of up to 640 acres (reduced to 320 acres by Act of Aug. 30, 1890, ch. 837, § 1, 26 Stat. 391) of arid land subject to the payment of a nominal fee and irrigation of the land applied for. Act of March 3, 1877, ch. 107, § 1, 19 Stat. 377, *as amended*, 43 U.S.C. § 321 (1970).

18. Scott, *The Range Cattle Industry: Its Effect on Western Land Law*, 28 MONTANA LAW REVIEW 155 (1967).

resorted to and it was commonplace to use dummy entrymen and then buy the land from them at bargain rates.

When gold was discovered in California in 1848, mineral exploitation, as in the case of land, did not pause until Congress spelled out its statutory guidelines. When the gold rush started, no positive mineral policy existed in theUnited States. Mineral lands were excluded from disposition under the various developmental land acts and other laws of local applicability. But there was no statutory policy which provided for disposition of lands in the public domain which contained minerals.

Despite the absence of legal opinions on title, the abrogation of Mexican mining laws, and the vacuum created by the absence of state or federal laws, mineral exploitation began. At the outset, the miners did not interfere with one another—there was always a new, better claim downstream. But as the gold rush gained momentum, diverse associations and mining districts were created to settle disputes among the miners and to cope with squatters, claim jumpers, and other latecomers. These mining districts developed distinctive rules and regulations called "customs of the diggings," which were described as: "[A] special kind of law—a sort of Common Law of the miners . . . [which] presented in the value of a "Mining Right," a novel and peculiar questions of jurisdiction. . . ."[19]

Out of this ad hoc lawmaking there emerged a simple principle for resource allocation—first in time became first in right.[20] This principle was well suited for the conditions existing at the time. The mining camps were small compared to the potential resources so there was enough for all and those who established the principle were not constrained. The mining operations were independent of one another and the principle preserved that status while providing an easy basis for resolving disputes if and when they arose. In the rough and isolated terrain of the mining camps, where even the primitive equipment of a miner involved a comparatively

19. Sparrow v. Strong, 70 U.S. (3 Wall.) 97, 100 (1865).
20. Jennison v. Kirk, 98 U.S. 453, 461 (1878).

large individual investment, the principle also provided needed economic protection.

A similar approach was followed by those concerned with the use of water in the arid western states. In these states, the appropriation doctrine was established which recognized that priority of right to water was governed by precedence in taking water and using it beneficially. In the words of the Colorado Supreme Court: "The right to water in this country, by priority of appropriation thereof . . . and the obligation to protect it, existed prior to legislation on the subject of irrigation."[21]

Early Youthful Stage—Legitimation

The transformation from an embryonic to a youthful stage of development may begin when increased numbers of participants threaten "established rights," *e g.*, claim jumpers, or when the sphere of operations of existing participants becomes visibly preemptive of limited resources or expands to the point where conflicting interactions are more frequent. As might be expected in an individualistic milieu, where the reach of the law is minimal, self-help actions such as the "customs of the diggings" cited before may be tried first. Although such self-help may be temporarily effective, resort to legislation tends to take place next in order to protect or maintain existing rights. The resulting legislative framework institutionalizes the operative principles informally relied on before to assure minimum disturbance to freedom of individual action and maximum access to natural resources.

The legal system controlling oyster fishing in the waters of Maryland's Chesapeake Bay provides a current example of protection of special interests and existing rights by exclusion of others. This is accomplished primarily through a variety of limitations on access to the oyster beds and restrictions on the allowable take of oysters as enforced by the State of Maryland.[22]

21. Coffin v. Left Hand Ditch Company, 6 Colo. 443 (1882).
22. Power, *More About Oysters Than you Wanted to Know*, 30 MARYLAND LAW REVIEW 199 (1970).

Access limitations are effected through license requirements; prohibitions against non-Maryland residents, except for Virginia[23]; establishment of "county waters"[24] (from which non-county residents, even other Marylanders, were at one time excluded[25]); and prevention of corporations from oyster fishing.[26]

In addition to protecting the individual oysterman from competition from other individuals, as well as the threat of corporate capital and technological expertise, the legislature of Maryland established protective restrictions by limiting allowable oyster production. In general, these productive restrictions consisted of limiting what can be taken, by what means, where, and when. At the present time, only oysters exceeding three inches in length may be taken and old oyster shells must be returned to the bottom.[27] The manner of taking was first restricted as a consequence of the arrival in the early 1800's of fishermen from New England in the Chesapeake Bay.[28] This new competition used dredges to scoop up the oysters by dragging instead of the forceps-like tongs which had been used historically by Chesapeake Bay fishermen. Banned at first, dredges were later permitted in deeper water (where tongs were ineffective), and the shallow waters were reserved for the use of tongs.[29] Even more important than geographic limitations on equipment usage is the prohibition against the use of motor power in oyster dredging operations,[30] in which the rate of taking is several orders of magnitude greater than that of using tongs. The timing of the take is still another method of restricting production. Oysters may not be taken during months without the letter "R" in their names, and the season is longer for tongers than it is for dredgers.

23. In return for Virginia allowing toll-free access to the Chesapeake Bay, Maryland agreed to permit Virginia oystermen free access to the Potomac and Maryland portions of the Bay. Potomac River Compact of 1958, art. III, § 4 (codified at MD. ANN. CODE art. 66C, § 261A (1970)).
24. MD. ANN. CODE art. 66C, §§ 700, 703 (1970).
25. Ch. 87, Sec. 6 [1829] Md. Laws.
26. MD. ANN. CODE art. 66C, §§ 700 (a), 702(b), 708(e) (1970).
27. MD. ANN. CODE art. 66C, § 699(a) (1970).
28. BREWINGTON, CHESAPEAKE BAY 171 (1956).
29. MD. ANN. CODE art. 66C, §§ 700(i), 702(b), (c), 703(h) (1970).
30. MD. ANN. CODE art. 66C, § 702(k) (1970).

Private oystermen in Chesapeake Bay also prevented intrusion on their established methods of exploitation by attacking efforts to lease barren bottoms for private oyster culture. Like the cattlemen of the West who sought to preserve the open range through special preference state legislation,[31] oyster fishermen opposed any actions which would change the status quo by threatening open public fishing by expanding private oyster farms. Applications to lease barren bottoms were contested successfully in the courts and a variety of laws passed[32] which had the effect of hampering the issuance of leases, keeping their size and quality down, and restricting the use of equipment.

The main thrust of the Chesapeake oyster industry has been exclusionary and conservative. Thanks to the unusual practice of the Maryland Legislature, by which local bills or local exemptions from general bills may be requested by county delegations, time has been made to stand still for the oyster industry which now is often called picturesque or quaint. The pursuit of traditional ways has not only succeeded in excluding other entrepreneurs, but capital and technology as well, *e.g.*, Japanese oyster production through use of raft culture with oysters growing suspended beneath the water surface.

Other natural resource systems which have not become "frozen" in their development as did the oyster industry, encouraged the influx of capital and technology while legitimating existing rights and protecting the interests of participants. The assurance provided by statutory legitimation, judicial formalization, and public policy stimulated a developmental ambience which led to increased investment, economics of size, and the application of increasingly advanced technology.

Thus, we see in the Mining Act of 1866[33] an explicit recognition of the unrestricted right to go upon the public domain and to claim, if the first to make discovery, any valuable mineral found there. This claim, good against any to come

31. Scott, *supra* note 18, at 166-68.
32. Power, *supra* note 22, at 213-16.
33. Act of July 26, 1866, ch. 262, 14 Stat. 251.

later, required only minimal public notice, did not even have to be reported to the Federal Government and could be, for all practical purposes, maintained indefinitely at nominal expense.

In 1870, these principles were extended to placer[34] claims. Two years later, these two enactments were consolidated into the Mineral Location Law of 1872[35] which now governs acquisition of minerals on the public domain. Between 1873 and 1901, statutes followed which disposed of lands valuable for coal,[36] building stones,[37] petroleum,[38] and other deposits in somewhat similar terms. It was not until 1920 that the Federal Mineral Leasing Act[39] inaugurated a new phase of resource system evolution, to be discussed later, at least for petroleum and certain other minerals.[40]

At the same time that Congress legitimated priority in time as a principle for mineral disposition, it also confirmed the appropriative principle[41] and protected the existing water rights necessary for exploitation. Also, all land patents granted, or preemption acreage, or homesteads allowed were made subject to any vested and accrued water rights. The Desert Land Act of 1877[42], which allowed entry and reclamation of desert lands in certain western states, further extended the vesting of rights in water. The act provided that the right to use water depends on bona fide prior appropriation, not to exceed the amount of water taken and used for irrigation. Significantly, the Act also provided:

34. Act of July 9, 1870, ch. 235, § [illegible], 16 Stat. 217.
35. Act of May 10, 1872, ch. 152, 17 Stat. 91, *as amended*, 30 U.S.C. §§ 21-54 (1970).
36. Act of March 3, 1873, ch. 279, § 1, 17 Stat. 607 (codified at 30 U.S.C. § 71 (1970)).
37. Act of Aug. 4, 1892, ch. 375, §§ 1, 3, 27 Stat. 34 (codified at 30 U.S.C. § 161 (1970)).
38. Act of Feb. 11, 1897, ch. 216, 29 Stat. 526.
39. Act of Feb. 25, 1920, ch. 85, 41 Stat. 437, *as amended*, 30 U.S.C. §§ 181-287 (1970).
40. Sodium, 30 U.S.C. § 261 (1970); Sulfur, 30 U.S.C. § 271 (1970); Potash, 30 U.S.C. § 281 (1970).
41. Section 9 of the Mining Act of 1866 states:
> [W]henever, by priority of possession, rights to the use of water for mining, agricultural, manufacturing, or other purposes, have vested and accrued, and the same are recognized and acknowledged by the local customs, laws, and the decisions of the courts, the possessors and owners of such vested rights shall be maintained and protected in the same. . . .

Act of July 26, 1866, ch. 262, 14 Stat. 251.
42. Act of March 3, 1877, ch. 107, 19 Stat. 377, *as amended*, 43 U.S.C. §§ 321-39 (1970).

> [A]ll surplus water over and above such actual appropriation and use, together with the water of all lakes, rivers, and other sources of water supply upon the public lands and not navigable, shall remain and be held free for the appropriation and use of the public for irrigation, mining and manufacturing purposes subject to existing rights.[43]

In the words of the Supreme Court, the Desert Land Act, "[S]imply recognizes and gives sanction, in so far as the United States and its future grantees are concerned, to the state and local doctrine of appropriation, and seeks to remove what otherwise might be an impediment to its full and successful operation."[44]

In the case of ranchers, they were able to persuade state legislatures to support ranchers' rights by such devices as making it a crime to drive stock from accustomed ranges; animals running at large were, by law, deemed to commit no trespass if they wandered on unenclosed private lands; and giving rights by state law to graze on public domain, which did not belong to the state, but which helped nonetheless against outside interference except from the Federal Government who, of course, had title. Although Congress forbade enclosures on public domain, this effort was only partially successful in changing range practices.[45]

Late Youthful Stage—Correction

Development and exploitation surged forward even more rapidly under the institutionalized encouragement of the new statutes. Almost inevitably, however, there followed abuses and fraud,[46] as well as dangers of rapid resource depletion.[47] Inevitably, there also occurred an increase in the number of parties competing for the resource involved, intensified conflicts of interest in how to achieve an integration of the physical and technological aspects of the natural

43. 43 U.S.C. § 321 (1970).
44. California Oregon Power Co. v. Beaver Portland Cement Co., 295 U.S. 142, 164 (1935).
45. Scott, *supra* note 18, at 168-71.
46. *See* CLAWSON & HELD, THE FEDERAL LANDS 26-27 (1957); GATES, *supra* note 15, ch. 17. The plunder of timberlands is described in the Report of the Public Lands Commission, H.R. EXEC. DOC. No. 46, 46th Cong., 2d Sess. (1880).
47. See quote *infra* p. 444.

resource system, and the beginnings of change from single, simple developmental objectives to multipurpose, complex objectives in resource policy.

Out of this new environment a later stage of youthful development begins to emerge. In this new stage, an effort is made to correct the deficiencies of previous policy and to allow for expanded participation, but still within the framework of those same policies.

There is great variety to the corrections or constraints which can be applied. In the case of minerals made available under the General Mining Law of 1872, the key to acquisition of mineral land is the discovery of a valuable mineral deposit. At first, a liberal interpretation of this requirement prevailed. To determine whether a mineral deposit was valuable, a "prudent man" test was established in 1894.[48] In the early youthful stage of mineral development, this test was construed in such a way that virtually any showing of profitability, even on minerals of widespread occurrence, was sufficient[49] to constitute the basis for a mineral claim.

Subsequently, to correct the most flagrant abuses from people making claims based on widespread minerals of occurrence, and as part of a general shift in national policy toward multiple use of public lands, some limitations were placed on disposal of mineral lands under the General Mining Law of 1872. In 1955, Congress drew a distinction between common and other varieties of minerals and removed deposits of sand, stone, gravel, and additional common varieties of minerals from operation of the mining laws.[50] In addition to the Congressional action, the Department of the Interior began to apply the prudent man rule more rigorously and require demonstration not only of physical evidence of min-

48. Castle v. Womble, 19 L.D. 455, 457 (1894). In language later approved by the Supreme Court in Chrisman v. Miller, 197 U.S. 313, 322 (1905), a valuable mineral deposit was defined as one in which "the evidence is of such a character that a person of ordinary prudence would be justified in the further expenditure of his labor and means, with a reasonable prospect of success in developing a valuable mine. . . ."

49. Layman v. Ellis, 52 I.D. 714 (1929).

50. Act of July 23, 1955, ch. 375, § 3, 69 Stat. 368 (codified at 30 U.S.C. § 611 (1970)).

eralization but also of economic value as indicated by current marketability of the deposit.[51]

The General Mining Law of 1872, after 100 years, continues to serve as the basic legal framework for locatable minerals subject to the comparatively minor constraints indicated above Despite continuing abuses of various kinds, uncertainty as to what constitutes discovery, problems related to dormant claims, the environmental impact of mining operations, the lack of notice to the Federal Government that a claim has been made, and conflicts arising from the inability to find claims on the ground because they are not required to conform to public land subdivisions, the legal system for these mineral resources does not impose the regulatory features common to the mature stage of resource system development which is discussed below.

The possibility of such a transition existed as a result of assessment of this and other resource systems undertaken recently by the Public Land Law Review Commission.[52] Although changes were recommended, in the words of a minority view to the Commission's report: "The recommended modifications preserve the location-patent approach devised more than 100 years ago. It served an earlier period but cannot, even as modified, provide an adequate legal framework for the future."[53]

As in the case of locatable minerals, the unimpeded rush to exploitation of water resources led to the imposition of some corrective action. The prior appropriation concept of first in time, first in right continued to prevail, but state governments began to be concerned that defective and badly located diversion works wasted water; that no right became definite until adjudicated; and that such adjudications were often long delayed and not based on accurate measurements of ditches or the land irrigated. To correct these defects in the previous system, states began to impose administrative controls of various kinds and degrees of intensity.

51. *See* Coleman v. United States, 390 U.S. 599 (1968).
52. Established by Congress in 1964 to conduct a review of existing land laws and regulations and recommend revisions necessary therein. 43 U.S.C. §§ 1391-1400 (1970).
53. PUBLIC LAND LAW REVIEW COMMISSION, ONE THIRD OF THE NATION'S LAND: A REPORT TO THE PRESIDENT AND TO THE CONGRESS 130 (1970).

Wyoming established a system which was the forerunner and, in some instances, a model for water administration systems established in most of the western United States to replace nonsupervision by state control of new appropriations of water. Its procedure requires that anyone initiating new appropriative rights must apply to state officials for permits.[54] In addition, Wyoming established a coordinated system of public water rights control in order to provide for acquisition, adjudication, and distribution of water to appropriators based on their relative rights. These administrative systems corrected previous abuses, and represent a preliminary step toward the integrated, highly controlled water systems characteristic of many western states today. Not all of the western states have chosen to correct abuses in this way. Colorado, for example, has rejected a permit system and relies instead on special proceedings for determination of water rights,[55] tabulations of all decreed water rights,[56] and state control over distribution over "adjudicated" water.[57]

Another form of correction is to be found in the practice of leasing land or selling materials[58] which were formerly free for the taking. Perhaps the most important example of this is to be found in the passage of the Mineral Leasing Act of 1920[59] which converted acquisition of oil rights on public domain to a leasing system.

At first, oil operators in the West secured petroleum rights on the public domain under the placer mining laws.[60] So quickly did they move that the Director of the Geological Survey reported, in 1909, to the Secretary of the Department of the Interior:

> "[T]he Government will be obliged to repurchase the very oil that it has practically given away. . . ." "In view of the increasing use of fuel by the American Navy there would appear to be an immediate necessity for assuring the conservation of a proper

54. WYO. STAT. § 41-201 (1957).
55. COLO. REV. STAT. ANN., §§ 148-21-18 to 148-21-23 (Supp. 1969).
56. *Id.* §§ 148-21-27, 148-21-28.
57. *Id.* § 148-21-34.
58. 30 U.S.C. § 601-04 (1970).
59. Act of Feb. 25, 1920, ch. 85, 41 Stat. 437, *as amended*, 30 U.S.C. §§ 181-287 (1970).
60. Act of Feb. 11, 1897, ch. 216, 29 Stat. 526.

> supply of petroleum for the Government's own use. . . ." and "pending the enactment of adequate legislation on this subject, the filing of claims to oil lands in the State of California should be suspended."[61]

The forces for national security were joined by conservation forces at this point, and private entry onto oil lands was prevented by major withdrawals by the President of the public domain. Following this, President Taft requested confirmation of his action by Congress, and this was done by the passage of the so-called Pickett Act.[62] Under this act, the President received discretionary power to "temporarily" withdraw public lands from entry and to reserve such lands for various "public purposes" to be specified in the withdrawal order.

With this power, the executive branch was able to withdraw almost all of the unappropriated public domain from location for petroleum and related resources under the mining laws. During the decade 1910-1920, the disposition of the lands which had been reserved produced much controversy. The compromise solution, the Mineral Leasing Act, made the resource available, but on new and significantly more restrictive terms.

As can be seen from the examples above, system correction can take many forms. Statutes are narrowed in scope. They are construed strictly where formerly they were interpreted liberally. Lands are leased and materials sold which formerly were free for the taking. Administrative procedures are imposed where formerly they were absent. Regardless of the device employed, the end result is the same—a more complicated, constrained system correcting or adjusting the previous system, and reflecting new and multiple objectives. We also see a fuller integration of the elements of the resource system and the beginnings of fuller participation by other elements in society. The latter change is the prelude to the mature stage of natural resource system development which is primarily characterized by regulation.

61. United States v. Midwest Oil Co., 236 U.S. 459, 466-67 (1915).
62. Act of June 25, 1910, ch. 421, 36 Stat. 847 (codified at 43 U.S.C. §§ 141-43 (1970)).

Mature Stage—Regulation

In the mature stage of development, the policy emphasis begins to shift to regulated exploitation under highly integrated system conditions. Of course, resource systems are exploited in earlier stages, but the operator proceeds with scant concern about others, slight influence over, or even awareness of the larger system of which he is a part, and with limited or no social controls.

Some natural resource systems, however, under the influence of their physical characteristics, and technological, economic, and social forces, may evolve into a more complex stage with significantly higher levels of resource system integration. System integration inevitably brings with it a greater degree of regulation, not merely to correct malfunctions but to achieve a variety of system objectives and to control its operation. This regulation may be through private institutions or by state or federal government. It may take a variety of forms, perhaps the most complete of which is the regulation by the Federal Power Commission of sales and prices of independent producers of natural gas sold to interstate pipelines. The authority of the Federal Power Commission to regulate interstate sales of natural gas is based entirely on the Natural Gas Act of 1938.[63]

The Act's provisions do not specifically extend to producers or to wellhead sales of natural gas, and the Federal Power Commission declined to regulate sales until 1954. It began to regulate sales only after the Supreme Court held[64] that independent producers are "natural gas companies" within the meaning of Section 2(b) of the Natural Gas Act.[65] This Act was an attempt to protect consumers during a time of economic depression and rising gas prices along the eastern seaboard. Pipelines from the Appalachian region were in the hands of a few holding companies. This created a highly concentrated control of the market. While holding companies dominated both production and distribution, they segregated those activities into separate subsidiaries, the

63. 15 U.S.C. §§ 717-717w (1970).
64. Phillips Petroleum Co. v. State of Wisconsin, 347 U.S. 672 (1954).
65. 15 U.S.C. § 717 a(6) (1970).

effect of which, if not the purpose, was to isolate some end of their business from the reach of any one state regulatory commission. The price of natural gas moved steadily upward until the public demand for regulation culminated in the Natural Gas Act.

The Federal Power Commission labored with obvious difficulty under the terms of an ill-suited statute to use a utility model of rate regulation for a diverse and growing industry. Any gas producer who wanted to sell his gas in interstate commerce was required to make an application for a certificate of public convenience and necessity and to secure approval of his rates based on his cost of service. Although this method has been widely employed in various utility rate-making situations, it ultimately proved inappropriate for the regulation of independent gas producers which, as resource companies, were unlike utilities in many significant respects.

As a consequence, the Federal Power Commission turned to fixing producer prices by means of proceedings applicable to all producers in particular areas delineated by the Commission.[66] Although the area method was approved by the Supreme Court, it also directed the Commission:

> [T]o assess the requirements of the broad public interests entrusted to its protection by Congress. Accordingly, the "end result" of the Commission's orders must be measured as much by the success with which they protect those interests as by the effectiveness with which they "maintain . . . credit and attract capital."[67]

In so doing, the Commission may "employ price functionally in order to achieve relevant regulatory purposes; it may, in particular, take fully into account the probable consequences of a given price level for future programs of exploration and production."[68] This the Commission has done, and a complex system of multiple price levels and other regulatory incentives and constraints are currently evolving which will con-

66. Upheld by the Supreme Court in Permian Basin Area Rate Cases, 390 U.S. 747 (1968).
67. *Id.* at 791.
68. *Id.* at 797.

trol the total natural gas system in order to achieve changing public interests.[69]

Oil and gas are often, though not necessarily, found together in nature. They are also natural resources which involve a highly integrated system of production and distribution, an enormous investment of capital, and extremely sophisticated technology. Despite these similarities and some equivalent end uses to which they both may be put, their development took somewhat different courses, and the regulatory scheme for oil tended to emphasize state regulation with federal assistance rather than the preemption of resource regulation by the Federal Government which took place in the interstate natural gas industry.

In the early days of oil production, the landowner could and did drill and produce oil and gas from under his own land, even though the oil or gas had migrated from adjoining land owned by others. He could waste the product if he wished, even if it injured his neighbor or depleted a valuable national resource. This rule of capture took no account of the fact that an oil field is an integrated physical system, and led adjoining landowners into wasteful economic drilling practices. To prevent the loss of oil to competitors, operators rushed to drill unnecessary wells which decreased reservoir pressure, reduced the maximum ultimate production of the field, and forced producers to produce the maximum amount of oil even though field or market conditions dictated a different course of action.

In time, the waste and conflict became so intolerable that the courts imposed minor limitations on private operations, and some legislation was passed requiring plugging of abandoned wells, dispatch of oil to proper storage and transportation facilities, and prohibiting wasteful use and the escape of gas. As could be expected, restraints on the taking of oil and gas by a landowner or lessee were attacked bitterly as an unconstitutional taking of private property without due process. At first, the rationalization for limiting private freedom in oil field production was that it was a valid exer-

69. *See, e.g.*, Southern Louisiana Area Rate Cases, 428 F.2d 407 (5th Cir. 1970), *cert. denied*, 400 U.S. 950 (1970).

cise of the police power of the State which was necessary to maintain correlative rights of landowners in a supply of oil and gas which they shared. From this it was a short and not inconsistent step to regulating reservoir pressure[70] and restricting the number of wells that could be drilled in a given area.

These early decisions and legislation did more than correct wasteful exploitation of the oil and gas resources of the nation and related abuses. They marked the initiation of a legal framework for regulation of an integrated natural resource system. Once this was done, the system continued to mature further with common purchaser statutes,[71] followed by other types of statutes designed to prevent waste by encouraging or requiring unit operation[72] and secondary recovery practices.[73]

Most of these types of regulatory devices are directed at narrowly defined subsystems, as small as the property of individuals or as large as an entire oil pool or field. This degree of integration, however useful it was in preventing physical waste in a specific area, was inadequate to cope with sharp fluctuations in price brought on by unrestricted oil production of old fields and the low-cost supplies which

70. In order to maintain the reservoir pressure needed for petroleum production, state regulatory authorities do not permit wells to produce at full force, as under flush production conditions; rather, their rate of production is reduced to a point which will preserve reservoir pressure and facilitate the maximum recovery of petroleum from the reservoir. This is described as the MER of the reservoir—the maximum efficient rate at which production can be secured without impairing the efficiency of reservoir drive. Second, ratios are prescribed to assure that neither gas nor water pressure is unduly dissipated; oil can be produced only in prescribed ratios to gas and water. Where the ratios are exceeded, oil production must be curtailed or pressure maintained by injecting the excess water or gas back into the reservoir.

71. Enactments of this type may be applied to require a pipeline purchaser to take ratably from all wells with which it is connected; or the pipeline may be required to go further and establish connections with additional wells, from which ratable taking is also required.

72. Unit operations involve the combination of separately owned or leased tracts of land overlying a common source of supply for operational purposes. Wells are placed at locations and produced at rates which are efficient for the pool as a unit. Production is apportioned among each participating owner or lessee on an equitable basis regardless of the location of the well through which production is secured. Voluntary unitizations do not require state approval. Compulsory unitization statutes are in force in most producing states. See 5 SUMMERS: THE LAW OF OIL AND GAS 193-225 (1969), for citations of pertinent state statutes.

73. Secondary recovery involves injecting gas and fluids into a producing stratum in order to maintain pressure and thereby increase the amount of hydrocarbons ultimately recoverable.

periodically flooded the market when new fields were discovered. Because of the doctrines of capture, it was not practical for individual owners to make voluntary curtailments of production. Using a conservation justification, an extensive system of interlocking state and federal regulations was designed to limit oil production. Through these regulations, which take a variety of forms, production is limited to consumptive demand in states producing about three-quarters of the petroleum in the United States. The means by which this is accomplished is primarily through the establishment of proration systems by which oil production is limited and production quotas are assigned to individual producers. Although there are many variations on the theme, proration systems generally operate in the following sequence:

> Based on anticipated demand, state regulatory agencies establish the statewide total of production for several months ahead.
>
> Deductions from the statewide total are made for certain categories of wells such as small operator and low production wells which are not economic unless they operate at full capacity. These exemptions, incidentally, can be substantial.
>
> The balance of allowable statewide production is then prorated to the remaining wells according to a depth-acreage formula.

In establishing the statewide total of production, the regulating agency in each state has to estimate supply and demand. The U.S. Bureau of Mines provides projections of future oil consumption and the large oil companies submit "nominations" or estimates of the amount of oil they intend to purchase in the state during the proration period under consideration. Prices are not fixed by the regulating agency, nor does any federal authority coordinate the production ceilings fixed by the individual states.[74] Federal law, how-

74. However, on August 27, 1935, Congress approved the Interstate Oil Compact to Conserve Oil and Gas "by the prevention of physical waste thereof from any cause." H.R.J. Res. No. 407, art. II, 49 Stat. 940. Over 25 member states now belong to the Interstate Oil Compact Commission which carries out the administrative functions of the Compact to provide a forum for the discussion of industry problems and for exchange of information.

ever, provides a powerful instrument to make state regulation effective in that the Connally Hot Oil Act[75] prohibits interstate shipment of oil produced in excess of the amount permitted by state conservation regulations. This system of mutual restraint by the states supplemented by federal administrative and statutory support effectively limits production and stabilizes prices. As a result of recent shortages of oil and a strong demand, limitations on production have been lifted, but could be reimposed if required.

During the 1950's when the entire domestic system of state production regulation was imperiled by low-cost imports, the Federal Government stepped in to protect the bulk of the market for domestic producers by establishing the Mandatory Oil Import Program.[76] This program regulates imports through a variety of separate quota levels and allocates permitted imports among domestic refiners and historical importers. The overall level of import restriction is set in percentage terms and has not varied significantly since the inception of the program. For the states west of the Rocky Mountains and Alaska and Hawaii (District V), the crude-products quota is set at the difference between estimated demand and estimated U.S. and Canadian supply produced in or shipped into the District. Thus, District V producers receive 100 percent protection from imports. Imports are allowed to displace a limited portion of domestic capacity in Districts I to IV, consisting of all states east of the Rockies. In those Districts, a crude-product import quota level has been set at 12.2 percent of estimated production.

The use of quotas to regulate the operation of natural resource systems is not limited to oil. In today's highly integrated, worldwide commerce, low-cost resources from overseas often are or seem to be a threat to the continued existence of many domestic resource systems. For example, in the past decade potash imports have climbed from about ten percent to forty percent of domestic consumption. As a result, there

75. 15 U.S.C. §§ 715-715m (1970).
76. The Mandatory Oil Import Program was established by President Eisenhower's Proclamation No. 3279, issued March, 10, 1959, 24 Fed. Reg. 1781, under authority of Section 2 of the Trade Agreements Act of July 1, 1954, Pub.L.No. 85-686, § 2, 72 Stat. 673.

is substantial excess production capability as compared to consumption, prices drop, and unemployment rises. Protective devices of various kinds are proposed. In the case of potash, proposals have been made to limit imports to less than twenty-five percent of domestic production. A different, more sophisticated device has been proposed for lead and zinc. For these minerals, recommendations have been made to establish quotas to come into effect whenever stocks owned by primary producers exceed a specified percentage of the average shipments of either metal during a 3-month period. Under this arrangement, there is no requirement that the inventory buildup be due to increased imports. Increased productive capacity could lead to excess supplies and control of imports could therefore be determined by the industry.

Fluctuations in relative supply and demand may bring remissions in the condition of various systems and the demand for quotas may vary accordingly. For example, in 1958, import quotas restricted the imports of lead and zinc ores to eighty percent of the average commercial imports during 1953-57. Later, when conditions of trade in lead and zinc materially changed so that consumption substantially exceeded production, prices increased sharply and the quotas were terminated in 1965. Still later, when conditions reverted to supply exceeding demand, the demand for quotas rose again. Oil import quotas, considered sacrosanct since being established in 1959, are beginning to be reevaluated,[77] and although President Nixon has not chosen to act on the recommendations of his task force, he has relaxed import quotas[78] in light of rapidly increasing domestic demands which are exceeding supply capabilities.

In general, control of oil and gas involves governmental regulation over a highly integrated, private network, but private enterprise is responsible, as a rule, for production of the resource which is to be marketed. In the case of water, federal

77. CABINET TASK FORCE ON OIL IMPORT CONTROL, THE OIL IMPORT QUESTION, A REPORT ON THE RELATIONSHIP OF OIL IMPORTS AND THE NATIONAL SECURITY (1970).

78. Proclamation 4156, Sept. 18, 1972, 37 Fed. Reg. 19115. This Proclamation modifies Proclamation 3279, *supra* note 75, to permit additional imports of No. 2 fuel oil, and allows holders of certain allocations under Proclamation 3279, to import petroleum and its derivatives in advance of allocations to be made for 1973.

or state governments may go even one step further by themselves undertaking enterprises, often of vast size, for the purposes of water production, i.e., capture, storage, and distribution. These governmental units also fix water prices at a "desirable" level by manipulation or subsidies of various kinds.

The Federal Reclamation Program provides a good example of this type of extended regulation of a natural resource system. Like the motivation for natural gas regulation, Congress wished to counteract monopoly or oligopoly, the evils of which were acutely felt during a period of economic depression. It was not long before the dream of free land in the West for a family-based agriculture established securely on homesteads[79] came face to face with the reality of aridity in western states, and the impossibility of using 160 acres for agriculture without irrigation. But the creation of irrigation works demanded the expenditure of capital far beyond the capacity of the homesteaders. In the late nineteenth century when times turned bad and a number of private irrigation companies went bankrupt, and then some dams failed, it was inevitable that the farmers turned to the only institution capable of constructing the necessary irrigation works—the Federal Government.

After an unsuccessful attempt to encourage state and private irrigation initiatives,[80] a federal reclamation program was started in 1902.[81] Under this program, water is provided from irrigation works built by the Federal Government for use on no more than 160 acres in individual private ownership. Originally, the program was to have been self-supporting, but over the years a substantial subsidy has been made available to irrigators. They enjoy interest-free, long-term loans; irrigation costs are covered by reclamation project revenues from electric power and from sale of municipal and industrial water; and costs of multiple-purpose projects are often charged heavily to the non-irrigation parts of the

79. See *supra* note 17.
80. Act of Aug. 18, 1894, ch. 301, § 4, 28 Stat. 422 (codified at 43 U.S.C. § 641 (1970)).
81. Act of June 17, 1902, ch. 1093, 32 Stat. 388 (codified in scattered sections of 43 U.S.C.).

project, thereby reducing the ultimate costs payable by irrigators. The Secretary of the Department of the Interior, who is responsible for the reclamation program, contracts with water user associations which assume the repayment obligation, backed by a power to tax lands within the project.

The pricing controls of government reclamation projects extend not only to water but to land as well. To safeguard against monopoly, the original reclamation act specified: "No right to the use of water for land in private ownership shall be sold for a tract exceeding one hundred and sixty acres to any one landowner, ..."[82] In its present statutory form,[83] the Secretary of the Interior now has the authority to specify the appraisal methods whereby the non-irrigated value of land is to be determined, and to withhold project water unless the owners of the land agree to execute a valid recordable contract at a price not to exceed the appraisal price.

It is beyond the scope of this discussion to present details of the law[84] that has developed in connection with the development of the Colorado River system which is the only significant source of water in an area of 242,000 square miles in the western states, comprising one-twelfth of the continental United States. Because of its obvious importance, it is also the most highly controlled river in the United States in which the Secretary of the Interior, as the person who operates the storage works on the river, exercises authority across a wide range of policy decision-making. For example, he sets the operating criteria for coordinated long-range operation of federal reservoirs on the Colorado River so as to facilitate

82. *Id.* § 5, at 389 (codified at 43 U.S.C. § 431 (1970)).

83. 43 U.S.C. § 423e (1970).

84. The main elements of the "Law of the River" consist of the Colorado River Compact, WITMER, DOCUMENTS ON THE USE AND CONTROL OF THE WATERS OF INTERSTATE AND INTERNATIONAL STREAMS 39 (1956); the Upper Colorado River Basin Compact, *Id.* at 218, 63 Stat. 31 (1949); Treaty with Mexico on Water Utilization, Feb. 3, 1944, 59 Stat. 1219 (1945), T.S. No. 994; the Boulder Canyon Project Act, 45 Stat. 1057 (1928) (codified at 43 U.S.C. §§ 617-617t (1970)); the Boulder Canyon Project Adjustment Act, 54 Stat. 774 (1940) (codified at 43 U.S.C. §§ 618-618o (1970)); the Colorado River Storage Project Act, 70 Stat. 105 (1956) (codified at 43 U.S.C. §§ 620-620o (1970)); the Colorado River Basin Project Act, 82 Stat. 885 (1968) (codified in scattered sections of 43 U.S.C.); and the various Supreme Court decisions culminating in Arizona v. California, 376 U.S. 340 (1963).

water regulation.[85] In so doing, he assures the availability of water to supply the consumptive uses apportioned by the 1922 Colorado River compact, subject to certain priorities, and balances water supply levels in the Lake Mead and Lake Powell reservoirs so that they shall both rise and fall in general, but not necessarily in exact correlation with each other. He may also, in connection with the Central Arizona Project, the largest reclamation project in the river system, enter into arrangements with non-federal utilities to acquire by prepayment of costs the right to capacity in large thermal-electric power plants which will be used for pumping requirements in distribution of river water to users in central Arizona.

The sweeping powers exercised by the Secretary of the Interior in connection with the Colorado River do not constitute the totality of control applied to waters in the western United States. Those described here serve only to illusrate another form of regulation of a capital-intensive, fully integrated natural resource system.

We have seen examples of mature systems in which regulation, as in oil and gas, was intended to stabilize markets mainly through price and supply control. For water, regulation extends still further back into what may be called the "production subsystem," but there are many irrigators who do not participate. One must turn to special resources like helium and enriched uranium to find examples (though likely to be comparatively short lived and, in the case of helium, involving less than comprehensive control in recent years) of total regulation extending over the full range of production, distribution, marketing, and participation.

On earth, helium is generally found only in natural gas. Unless the helium is extracted from the natural gas before delivery to the consumer, the helium will be dissipated into the atmosphere when the gas is burned. The cost of extracting helium from natural gas is proportional to its concentration, and a 0.3 percent concentration is customarily considered to be the economic cutoff point. The natural gas fields of

85. 35 Fed. Reg. 8951 (1970).

Kansas-Oklahoma-Texas (mainly the Hugoton and Panhandle Fields) are unique in that they contain far more natural gas with helium at concentrations of one percent than any other known source. To conserve this valuable resource, a new conservation program was begun in 1960.[86] Prior to this time, the U.S. Bureau of Mines had produced and distributed all helium and set the prices for Government and non-Government users alike. Under the new program, private plants were built on the basis of long-term supply contracts and the extracted helium was stored underground near Amarillo, Texas. To make the program self-sustaining, the price of helium was almost doubled. This led private producers to start supplying non-federal helium consumers, from major sources of helium in the Hugoton area not covered by Government storage contracts, at prices substantially below the Bureau of Mines price. Since the Government lacked a monopoly and the price was set at a level profitable to industry, the attempt to regulate the resource is malfunctioning and the Administration is attempting to abandon the program. This action is justified in part on the grounds that the need for conservation is ended since Government needs can be met from stored helium, and new technology will permit extraction from newly discovered, lower grade sources.

The fissionable uranium isotope, uranium-235, is like helium—rare and found in low concentrations. It is this latter quality, together with its fissionable properties which has created the circumstances for governmental production, price fixing, and control of foreign imports of this resource. Because the process of separating uranium-235 from the other isotopes with which it occurs is extremely difficult, expensive, and uses a classified technology, the enrichment plants in which the process is carried out all belong to the Federal Government. These enrichment plants produce enriched uranium which is made available at a Government specified price for private nuclear reactor power plants. They also process foreign uranium source materials into enriched uranium subject to the condition that the enriched

86. The Helium Act Amendments of 1960, Pub. L. No. 86-777, 74 Stat. 918 (codified at 50 U.S.C. §§ 167-167n (1970)).

uranium from foreign sources must be reexported and cannot be used in domestic nuclear facilities.

Old Age—Disintegration

When a natural resource system reaches the final stage of its development, the cycle which began with primitive and unfettered exploitation and passed through successive stages of legitimation, correction, and regulation, ends with disintegration. The increasing degree of system integration which is characteristic of a growing system now is reversed. There are fewer participants, they interact with one another less frequently, and the need or expectation of coordination diminishes. The flow of capital is out of, not into, the resource system, and the capital stock is reduced through depletion or through neglect. Maintenance is abandoned, and access to the resource becomes progressively more difficult. Regulation is progressively diminished.

Very few resource systems have reached the point of old age in the United States. Gold mining represents the best example. Historically, the United States led the world in the production of gold from 1849, the year after gold was discovered in California, until 1905 when the Union of South Africa became the world's leading gold producer. In 1934, when President Roosevelt set a price of $35 an ounce and controlled the industry rigidly, gold was selling at $20 an ounce. Since then, the cost of almost all commodities, including mining machinery and labor, has increased many times over—with no corresponding change in the price of gold. In addition, early in World War II, American gold producers were denied access to supplies, equipment, and manpower needed for mining operations.[87] Although the limitation was rescinded July 1, 1945, many gold mines never recovered from its effects and remain closed to this day. As a consequence of these events, production has declined steadily so that now the United States consumes some four times more than it produces. In an effort to prevent continued disintegration, a variety of legislative proposals have been made

87. War Production Board Limitation Order L-208, October 8, 1942, 7 Fed. Reg. 7992.

over the past twenty years.[88] One of the more recent proposals recommended that American gold producers receive payments from the Government based on the differences in the costs of gold production in 1939 and costs of production today on an individual gold mine basis. None of these proposals has been implemented, and although recent rises in the price of gold on the world market have stimulated some domestic exploration and development, the downward movement in the viability of the gold mining industry continues.

It should be noted that price has a profound influence on resource system development, particularly in its later stages. Resources are not depleted abruptly. Typically, richest concentrations of ore are mined first, or oil fields under high pressure are exploited most easily. Later, lower ore content may be compensated for by economies of scale or improved technology and, in oil fields, pumping or injection of gas or water may replace natural energies as the driving force for lifting the oil to the surface. At some point, incremental costs exceed returns and exploitation ceases—not because there is no more resource, but because it costs more to get it than it is worth. If the market changes and prices go upward, then additional costs can be incurred and exploitation can be resumed. Ultimately, for all practical purposes a resource is totally depleted regardless of economics and in a metaphorical sense "death" occurs. Certain types of endangered animal species, considered a resource by some or perhaps certain types of tree stands would fall in this category.

CONCLUSION

The idea that natural resource systems pass through successive stages of growth and decline, each of which is characterized by typical features due to specific causes, is an abstraction, the value of which must be assessed. To do so, it is useful to consider its utility as a tool for organizing facts; as a basis for research which can develop greater insight into natural resource systems; as a guideline for evaluating policy for existing natural resource systems, or for new resource

88. For a comprehensive tabulation, see *Appendix* in AMERICAN GOLD MINING REVITALIZATION, S. REP. No. 67, 90th Cong., 1st Sess. (1967).

systems which develop when social and economic developments change free goods into allocative resources.

The ingenuity of man is so great, the exploitative values and physical characteristics of natural resources are so varied, and the social, technological, and economic influences on resource development are so diverse that it is no surprise that the law of natural resources seems so fragmented with each subsystem isolated from the other. And yet, is a quota for lead and zinc any different from an oil quota in its policy and ultimate legal implications? Is there any essential distinction between the oyster farmer who limits access to his beds in the Chesapeake Bay and the rancher who sets up a leasing system under the Taylor Grazing Act,[89] which is administered by local ranchers in each area, and which perpetuates the right of ranchers to use the public domain on a preferential basis and even sell the right to such preference if and when the private property adjoining the public domain is sold?

It is the thesis of this article that the similarities are equal to, if not more important than, the differences. From the similarities, a pattern of development can be perceived which brings order out of a welter of facts. At the same time, and more importantly, it provides a framework for research. For example, more and better criteria may be formulated to characterize each stage of development. These criteria may be quantified and undergirded with econometric analyses.[90] Some systems may not conform to the model. Exploration of the reasons for this variation may provide critical insights into the system under study by focusing attention on the underlying reasons for its lack of correspondence. Out of this may come modifications to the system or refinement of the model which will make it a more workable tool for understanding natural resource systems.

The essential test, however, of the proposed model is in its policy implications. Can the model be used to assess our

89. 43 U.S.C. §§ 315-315r (1970) (original enacted as the Act of June 29, 1934, ch. 865, 48 Stat. 1269).

90. Smith, *Economics of Production from Natural Resources*, 63 AMERICAN ECONOMIC REVIEW, 409-31 (1968).

existing practices, does it tell us where trouble may be coming, and can it provide guidelines in coping with the development of new resource systems?

The United States, as a nation and society, has become a complex, systems-integrated, capital-intensive, technologically advanced mass democracy. As such, there can no longer be any place in it for a comparatively few non-interacting individuals to operate in a primitive environment with little or no legal framework, and in fact the United States has no significant natural resource in which this is the case. It is to the credit of the United States that it recognizes the implicaions of the concept of "spaceship earth," and has, through its efforts, attempted to bring the great resources of space[91] and the oceans, which are still in many respects in the embryonic stage, into some legal framework.

The policy question remains—are there any systems which are now at a stage of development unsuited to the optimum exploitation of the resource or to the needs of the nation? Since most of major systems have reached a "mature" stage, reflecting the general evolution of the country, attention focuses on those systems which have not reach that stage. One might expect that the farther a natural resource system is from a "mature" stage, the greater will be the disparity between reality and optimum. This expectation is fulfilled in the examples of oyster fisheries and mining of locatable minerals chosen previously in this discussion to illustrate youthful resource systems.

Oyster production in the Chesapeake Bay is clearly not at an optimum. In the past century, its production has declined by more than seventy percent. This reduction may be explained, in part, by the degradation of the Chesapeake Bay

91. American space technology has been applied to the practical benefit of mankind through the establishment of a global commercial communications satellite system. The Communications Satellite Corporation (COMSAT) is an instrument created by Congress to participate in the International Telecommunications Satellite Consortium (INTELSAT), and is also the manager of and has the largest ownership interest in the earth stations with which the U.S. utilizes INTELSAT satellites for international service. For details on COMSAT and other efforts by the United States to open space to cooperative, international development, see SENATE COMM. ON AERONAUTICAL AND SPACE SCIENCES, INTERNATIONAL COOPERATION IN OUTER SPACE: A SYMPOSIUM, S. Doc. No. 92-57, 92d Cong., 1st Sess. (1971).

ecosystem due to pollution, silt, and competing plant growth. More important, however, have been the economic and legal constraints which have maintained access to the resource at traditional modes. The State of Maryland has mounted a restoration program for the oyster beds, but has not succeeded in its objective of establishing a fishery which is self-sustaining and unsubsidized.

The problems of mining locatable minerals are in many respects the results of carrying over, into a more advanced stage, practices which are now obsolete. Today's legal doctrine, with some minor exceptions,[92] require physical evidence of discovery which is a necessary prerequisite to staking a valid claim. This requirement of physical evidence was appropriate in a day when exploration was tied to the ground, relied on what the eye could see, and chemical assay verify. But today's sophisticated exploration methods can detect deposits which are not visible to the eye, may be buried far below the surface, and are often discovered from aircraft. In such circumstances, the concept of physical discovery is not only outmoded but is also a hindrance to resource development because it is not broad enough to encompass the changed meaning of what constitutes discovery.

A strong pattern of unrestrained, individual action is also carried over in the manner in which land is claimed for locatable minerals and the terms and conditions under which the minerals are removed. When a discovery is made and a claim staked, the law requires that a record of the claim be made at the county seat where the discovery is made. Even though it is federal land which is claimed, the Federal Government is not notified, nor is it necessary for the party making the claim to tie its location to the public land survey grid of

92. Because it is sometimes necessary to undertake physical exploration before achieving discovery, the doctrine of pedis possession has been developed to protect the person occupying the claim before the requisite discovery. In the words of the Supreme Court: "[A] miner may hold the place in which he may be working . . . and while he remains in possession, diligently working towards discovery, is entitled—at least for a reasonable time—to be protected. . . ." Union Oil Co. v. Smith, 249 U.S. 337, 346-47 (1919). See Olson, *New Frontiers in Pedis Possessio: MacGuire v. Sturgis*, 7 LAND AND WATER LAW REVIEW 367 (1972). Some weakening of the requirement for physical evidence of discovery is to be found in Dallas v. Fitzsimmons, 137 Colo. 196, 323 P.2d 274 (1958); Rummell v. Bailey, 7 Utah 2d 137, 320 P.2d 653 (1958).

township, ranges, and sections. Since the Federal Government is awarding oil and gas leases on these same lands, the opportunity for occurrence of conflict and confusion is great,[93] and both systems are hindered in their operation.

In the latter half of the nineteenth century, the prevailing outlook assumed that full, unimpeded exploitation of natural resources would produce the greatest return to the nation as a whole. Consequently, no royalty was required from mining operations on the public domain. This practice remains unchanged for locatable minerals even though substantial revenues now accrue to the Federal Government as a result of rents, royalties, and bonuses now paid for the opportunity to exploit deposits of oil, gas, sulfur, and a variety of other substances covered by the Mineral Leasing Law of 1920,[94] as amended. Dissatisfaction with the continuance of this privilege, as well as the previously mentioned problems concerning recordation and the requirement of discovery, has prompted remedial recommendations from the Public Land Law Review Commission.[95]

One should not assume that a system which displays indicia of maturity is in some preferred state of equilibrium. Regulation, which characterizes this stage, spans a broad range of intervention. Such intervention may be well adapted at one time and because of externalities of many kinds may become ill-suited for a particular resource system. In general, interventions begin as preventive steps for conservation purposes or a remedy for supply-demand imbalance or to achieve some other national objective. In time, this intervention tends to become protectionist, invoking import restrictions, subsidy, and market stabilization. Where this takes place, unnecessary misallocation of economic resources may take place.

93. In 1924, the Department of the Interior ruled that in the case of Joseph E. McClory, 50 L.D. 623 (1924), during the life of a prospecting permit, any entry under the general mining laws was precluded. No significant conflicts between the mining and leasing acts arose until difficulty was encountered in the exploitation of uranium ores on the Colorado Plateau which were also situated on lands covered by federal oil and gas leases. Stop gap relief was provided in 30 U.S.C. §§ 501-05 (1970), and a more definitive resolution of the problem was achieved in the Multiple Mineral Development Act, Act of Aug. 13, 1954, ch. 730, 68 Stat. 708 (codified at 30 U.S.C. §§ 521-31 (1970)).

94. 30 U.S.C. §§ 181-287 (1970) (originally enacted as Act of Feb. 25, 1920, ch. 85, 41 Stat. 437).

95. *Supra* note 52, at 128.

The review of oil import quotas[96] represents a top-level assessment of an important method of system regulation and evaluation of alternative ways of achieving national objectives. Although the recommendations of the task force were not implemented, at a later date lesser modifications of the quota systems did take place. After several years of study, the National Water Commission is proposing that the full costs of irrigation water be paid by farmer beneficiaries. Both of these instances represent situations where regulation or intervention had gone further than current circumstances warrant and a reversion to a less regulated, less protected or subsidized basis would result in optimizing the economic factors of the natural resource system.

In the United States, only gold mining has reached old aged in its development. The fact remains that we do not know how to deal with natural resource systems that reach such a point. We can expect that other systems as they are depleted, or become lower in grade and increasingly uneconomic, will also experience disintegration. Should such systems be allowed to terminate? Should incentives be created to stretch out the decline, avoid low priority uses, and encourage consolidations, capital in-flow, or research and development? As a nation, we are unfamiliar with problems of disintegration and we tend to ignore the problems of entropy in the various forms it takes. Perhaps an early examination of questions related to aging natural resource systems is overdue.

Does the perspective of resource cycles help in determining what to do with "new" natural resource systems? As we become more numerous or require previously unused resources for technological purposes, or create resources through cultural or social reorientation, we are faced with the challenge of incorporating a new or unused resource into a far more complex society than existed earlier in our history. The overall maturation of the United States has reached the point that neither an embryonic nor early youthful phase of development is appropriate any more. Since a "new" system is in the process of integration rather than the reverse, approaches suitable for old systems are inappropriate as

96. *Supra* note 76.

well. By a process of elimination, the number of alternatives are limited, subject, of course, to numerous specialized variations required by the intrinsic features of the resource itself.

Policy for "new" natural resource systems may, broadly speaking, be unregulated but with some safeguards to prevent windfalls, wastage, or similar undesirable conditions. Alternatively, regulation may be established at the outset, involving public intervention in the system at high or low levels of intensity. The development of oil shale provides a good example of this process at work.

The oil shales in the western United States constitute the greatest reserve of oil on earth. The oil content of the shales varies, but shales assaying twenty-five gallons or more of oil per ton contain an estimated 600 billion barrels of oil. The Federal Government owns almost three-fourths of the oil shale acreage and about eighty percent of the oil shales in place. Before 1920, fee simple ownership of Federal oil shale could be acquired under the Oil Placer Act of 1897.[97] The resource then passed into the regulatory phase with the passage of the Mineral Leasing Act[98] which provided for leasing of federal oil shale lands by the Secretary of the Interior. The situation, however, was frozen ten years later when the oil shale lands were temporarily withdrawn from disposal.[99] The Secretary of the Interior was later given the authority to lift the order,[100] but this has not yet been done.

A resource of such great value cannot be kept intact indefinitely, and only the righ rate of discovery and production of liquid petroleum and the political implications of disposing of such an enormously profitable resource allowed the difficult job of policy-making for oil shales to be postponed since 1930.

During the past decade, interest in the oil shales renewed and momentum for exploitation has accelerated sharply. In 1964, an Oil Shale Advisory Board was appointed, but they

97. Act of Feb. 11, 1897, ch. 216, 29 Stat. 526.
98. Act of Feb. 25, 1920, ch. 85, 41 Stat. 437, *as amended*, 30 U.S.C. §§ 181-287 (1970).
99. Exec. Order Nos. 5327, April 15, 1930; 6016, February 6, 1933; and 7038, May 13, 1935.
100. Exec. Order No. 10355, May 26, 1952, 17 Fed. Reg. 4831.

were unable to reach agreement on the key issue of ways and means of opening federal oil shale lands for private leasing. This was then followed in 1967 by the issuance of proposed regulations by then Secretary of the Interior, Steward L. Udall.[101] These regulations, among other things, provided for two-step development leases. In the first step, the contractor would expend research and development funds on relatively small acreages. If the Secretary of the Interior finds the work successful, acreages large enough for commercial production would be made available. Work would be done under tight controls with royalties ranging up to fifty percent of the net income from the property. The right to use inventions made during the research term of the lease was to be made available to the public without charge.

This attempt to lease federal oil shale lands under terms and conditions which represented a significant governmental intervention in operations, resource economics, and externalities was unsuccessful. It was followed by another program proposal issued by the current Secretary of the Interior, Rogers C. B. Morton.[102] The current proposed regulations provide an initial permit period of core drilling to assess environmental and resource characteristics of selected lease sites. Resource data will remain confidential for five years or until the permit lands are leased for oil shale. Leases would be granted on the basis of sealed, competitive bonus bids with rentals as required by the Mineral Leasing Act and royalties at the rate of twelve cents for each ton of oil shale containing thirty gallons of shale oil per ton of material. These and other technical provisions of the regulations provide for substantially less governmental intervention and potentially greater financial return to private industry than did the Udall proposals, and in many ways resemble a stage of development just prior to or at the outset of regulation. The purpose of this article is not to compare or to evaluate these different proposed regulations, but rather to indicate that they represent fundamentally different approaches in their placement of oil shale in the scale of evolutionary develop-

101. 32 Fed. Reg. 7086 (1967).
102. Dep't of Interior, Program Statement for the Proposed Prototype Oil Shale Leasing Program (June 1971).

ment of resource systems. One factor in assessing the suitability of a given policy can be whether the placement proposed is consonant with the actual degree of integration, level of technological skill and capital investment, and other developmental characteristics of the resource under consideration.

Having described a model of natural resource systems and indicated some possible uses of the model, it is only right to close with some cautions about its limitations. Much of the social change about us is not evolutionary; it is discontinuous, discrete, and nondirectional. Since the impact of social developments on natural resource systems has been referred to previously in this article, is not the evolutionary analogy developed here possibly a mere metaphor? Is it proper to group non-renewable resources like minerals with renewable resources like cattle or water? Isn't the fact that oil, gas, and water are found in the fluid state critical in their degree of system integration as compared to the solid resources such as gold and immovable resources like land? Should scarce substances like uranium and helium be treated separately from resources which are more plentiful and not tinged with the national security? These are, of course, among the differences which one might anticipate would influence the tactics of development. Whether these differences are so basic that the course of development for individual resources is unique for *each* resource is the question addressed here in the negative. Each reader can apply his experience and knowledge of his own specialty to judge whether the thesis is valid and useful.