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"The future economic development of Alaska will provide a critical testing ground for U. S. regional development theory and practice. It is here that the demands of the future for fuel and economic expansion will confront all of the traditional issues in regional development. But in addition, more recent conflicts in contemporary U. S. values are emerging in Alaska on a very large scale."¹

I - Special Opportunities for Alaska

In the face of sharply increasing national and international demand for its vast untapped oil reserves, and with approval granted for construction of the Trans-Alaska Pipeline (TAP), the State of Alaska now enjoys unique opportunities to use oil revenues to design its future development. With large anticipated revenues (to some degree already realized, in the billion dollars in lease bonuses for North Slope oil), and large unsettled open spaces, the State of Alaska is in a powerful position to observe historical experience in regional development elsewhere and by avoiding the mistakes that have been made, to develop in ways responsive to the demands of the future. The low density of population and lack of heavy industry have thus far made it possible for Alaska to avoid committing some typical errors of the "lower 48" states in the pursuit of regional development. In particular, serious large scale damage to the environment has been avoided. The State has unprecedented opportunities to observe the experience of other regions and to break new ground in designing development

¹ John H. Cumberland, Regional Development Experiences and Prospects in the United States of America, Paris, Mouton Press, 1971, Chapter 11, "The Special Case of Alaska."

policies to improve the standard of living or the quality of life (where this is defined in broader terms, for example including environmental amenities, than the traditional per capita (money) income measures) for the people of the region and which might in turn serve as a new pattern for reorienting development in other areas. Thus, Alaskans, learning from the experience of other regions in the past, may provide lessons for development of still other regions in the future. Both the opportunities and the problems in Alaska are formidable.

II - Special Development Problems of Alaska

Major problems for development in Alaska are the harsh climate and great distances involved, making transportation and communication particularly difficult and expensive. The distances and the low density of human population prevent economies of scale and keep the costs of transporting people, goods, and services very high. This in turn suggests, at least to some residents, the desirability of public sector investment to provide transport facilities for resource development. Because of the climate and distance problems, and the need for economies of scale and transport facilities, Alaskans tend to perceive their development problem as one of subduing a hostile environment. One of the great dangers in this perception is the fact that the Alaskan environment, with its perma-frost and tundra, is actually rather fragile, easily damaged in ways which require extremely long periods of recuperation, or are even irreversible.²

²For a discussion of the special problems for planning posed by environmental losses of extremely long duration, with particular reference to the Alaskan environment, see John Krutilla and Anthony Fisher, The Economics of National Environments: Studies in the Valuation of Commodity and Amenity Resources, Baltimore, Johns Hopkins University Press, 1975, Chapter 3, "Irreversibility and the Optimal Use of Natural Environments," and Chapter 10, "The Trans-Alaska Pipeline: Environmental Consequences and Alternatives."

Another danger in Alaskan development, suggested by the experiences of Appalachia in particular, is the confusion of resource exploitation with regional development, which we understand as improvement in the overall quality of life in the region. In Appalachia, large scale investment in resource exploitation, mainly coal and timber, has produced benefits primarily accruing to investors and consumers outside the region. Much of the cost - the massive and well documented environmental damage, for example - has however fallen on the less affluent local residents.³

There is at least some danger that this could be repeated in Alaska, where the development of oil and gas resources by major corporations could primarily benefit absentee stockholders and residents of the continental U.S., with only minimal benefits to the native population. Considering the possibilities of extensive and irreversible disruption of the environment associated with the raising and transporting of oil under such difficult circumstances, the native communities could even wind up as net losers from the development. One very important aspect of coal resource development in Appalachia has been the freedom of the coal companies from liability for damages to surface property occasioned by mining activity. Typically, a lease carries the right to remove the mineral by "whatever means necessary," with no mention of compensation for surface losses. We shall want to consider this question of assignment of liability for damages and its affect on resource allocation in the next section's discussion of planning policies.

³The situation is described in moving detail by Harry Caudill, Night Comes to the Cumberlands, Boston, Little, Brown and Co., 1963.

The major policy issue for Alaskan regional development is then how to channel the forces of development generally, and demand for Alaskan resources, into pursuits which will improve the quality of life for Alaskans, as well as yielding money returns to outsiders.

III - Gearing Economic Development to Improvements in Quality of Life

In meeting the challenge of channeling the returns which overflow from development of Alaskan oil and gas into true regional development, among the most important considerations are advance planning and protection of the local environment. Major problems of development in the continental United States and elsewhere have resulted from lack of planning and from planning which came too late.⁴ That mistake need not be repeated in Alaska. Given the vast revenues which will flow from its oil, the investment of only a small percentage of the total could provide Alaska with regional planning facilities second to those of no other state, and could unquestionably yield benefits far in excess of costs involved in planning. A good start has been made in the establishment of the Joint Federal-State Land Use Planning Commission, discussed further in section IV below. Though this Commission has advisory powers only, its charge is extensive, and if supported by good research could play a crucial role.

⁴The Wall Street Journal of June 10, 1974 carries a story which indicates that Ataturk, the founder of modern Turkey, was advised back in 1923 not to locate his capital in Ankara, then a city of 30,000, because the enclosed (by mountains) site would give rise to serious air pollution if the city grew much. The advice was ignored and Ankara is one of the world's most polluted cities, even without the benefit of substantial auto traffic or heavy industry.

Advance planning for regional development in Alaska is particularly critical in the environmental area. It is in this area where Alaskans can learn most from the errors of other regions. The application of a number of basic principles can go far to prevent the Alaskan counterpart of the damage from Appalachia strip mining, and the air and water pollution that characterize many areas of the U.S. In particular, the principles which can prevent this type of damage include full liability of the polluter, life cycle planning, region-wide planning, a multi-disciplinary approach, and democratic participation in the planning process.

A fundamental principle is full liability of the polluter-developer for any environmental damage. This may be justified on ethical or political grounds, but is also suggested by economic theory. Advance knowledge by the polluter that he must pay the full costs of his damage provides strong economic incentives to use the best possible technology, to use his ingenuity and ability to best advantage to reduce pollution. At the same time, the pollution charges and abatement expenditures which they induce raise the prices of products whose production requires intensive use of the environment, in turn choking off demand for these products. In general, the introduction of prices for the scarce assimilative resources of the environment can be expected to move the economy toward greater efficiency in allocation.⁵

Another principle closely related to polluter liability is life cycle planning. It should be obvious that any type of development project goes through

⁵The efficiency properties of pollution charges, or effluent fees, are now well-known to economists. Although many have contributed to the literature here, the work of Allen Kneese might be singled out. See, for example, Allen V. Kneese and Blair T. Bower, Managing Water Quality: Economics, Technology, Institutions, Baltimore, Johns Hopkins University Press, 1968

a number of phases including planning, exploration, development, operation, and then finally, termination and restoration. All of these phases are important and must be recognized, particularly in the huge scale developments which are anticipated for Alaska, such as the Trans-Alaska Pipeline and the potentially huge water resource development plans. All of these activities involve potential pollution and other environmental damage during the exploration stage as well as the construction, development, and operation stages. In the frigid Alaskan environment wastes are not easily assimilated and the scarring of the land surface cannot easily be healed. For these reasons developers could be required to plan adequately for the recycling or removal of wastes and restoration of the environment where possible. An effective way of achieving this is to require that bonds be posted to assure compliance.⁶ Where restoration is not possible, a additional charge might be levied on the developer to compensate for the loss of options in perpetuity, as discussed further in section V below.

We know from the emerging science of environmental economics that all phases of production and consumption involve waste. The concept of materials and energy balance can be utilized to assist in showing for regional development projects what inputs go into every phase of the project, and what residuals, outputs, and environmental damage result from each phase.⁷ We also know from the materials balance concept that pollution treatment processes themselves generate

⁶This approach is put forward and discussed in John H. Cumberland, Regional Development Experiences and Prospects in the United States of America, Paris, Mouton Press, 1971.

⁷The materials balance approach, which stresses the pervasiveness of residuals in the economy, was developed in a seminal article by Robert U. Ayres and Allen V. Kneese, "Production, Consumption, and Externalities," American Economic Review, June 1969.

pollutants, and pollutants from waste treatment processes are becoming part of the problem. Developers might therefore be required to show how they plan to recycle, reuse, or otherwise dispose of wastes from each phase of a project, including waste treatment processes. The use of complete materials balance planning plus life cycle planning and posting of bonds to cover any unforeseen consequences can be used to assure the developers will be responsible not only for all of the costs of their projects, but also for restoring, at the end of the useful life of the project, any land, air and water which is damaged. In the case of the Trans-Alaska Pipeline, this would require the formation and disclosure of plans for the eventual dismantling of the Pipeline and the restoration of the surface and the disposal of any materials involved.

A major shortcoming of regional planning in the Continental United States has been domination of the planning process by segments of politically and economically powerful groups in both the private and public sector, usually to the exclusion from the planning process of those who are damaged by it. The task of converting regional economic development into socially beneficial regional development oriented towards the public interest, as well as the private interests, of the various social and economic groups in Alaska will be particularly difficult because of the need to include not only local citizens, but also the native populations of Indians and Eskimos. Under both ARA legislation and EDA legislation in the U.S., token efforts were made to assure democratic planning of regional development projects, but these efforts all too often failed because of the power of established groups.

Another reason for the failure of planning for regional development has been the non-availability of regional planning models and concepts adequate to indicate to local planners the full range of options and the probable impacts and distributional consequences of these alternative development strategies. Using local planning powers of zoning, land use, and similar instruments, regional governments can exercise some discretion over the types of economic activities and development strategies to be emphasized in the region, such as heavy vs. light industry, public vs. private sector investments, or capital- vs. labor-intensive processes. Each of these choices implies alternative sets of impacts and trade-offs for job creation, revenue generation, public expenditure, and environmental management. Regional development models are now available which can help to estimate the impacts of these alternative development programs and aid in the design of development strategies which are optimal, given the particular objectives and priorities of the region.⁸

The task of achieving a meaningful democratic planning process will be made particularly difficult by the varied cultural background of the growth oriented white settlers and the traditional cultures of the Indians and Eskimos who had evolved a viable ecological relationship with the fragile environment of Alaska. This fragile environment is now threatened by extraordinary pressures that the rest of the world is bringing to bear upon Alaska in order to extract its oil, gas, and other natural resources. Clearly the task of achieving

⁸See John H. Cumberland and Robert J. Korbach, "A Regional Inter-Industry Environmental Model," Regional Science Association Papers, 1973, Volume XXX.

regional development in the true sense with improved quality of life for all Alaskans including Indians and Eskimos, cannot be achieved through economic initiatives alone. Development of Alaska under current pressures will require new mixtures of insights not only from economists, but also from anthropologists, ecologists, and many others. Perhaps for the first time in Alaska regional development will be perceived as a problem in total social development. Certainly efforts are being made, for example through the Land Use Planning Commission with its native Alaskan representation, to avoid the worst excess of expropriation (of Indians) and exploitation (of blacks) that characterized some phases of continental U. S. development.

IV - The Joint Federal-State Land Use Planning Commission

We have mentioned the Land Use Planning Commission a couple of times in passing. It seems potentially an important enough departure in regional planning to warrant separate discussion here. To begin with, it is very much a partnership between state and federal governments, having been created by the Alaska Native Claims Settlement Act (1971) of the U. S. Congress, and an act (1972) of the Alaska legislature. Co-chairmen are the Governor of Alaska and an individual appointed by the President of the United States. Four additional members are appointed by the Governor, and four by the Secretary of the Interior. At least one member of the Commission must be an Alaska native, and there is, in addition, an advisory committee representing a broad cross-section of Alaskan interests - commercial users, recreationists, environmentalists, natives, and others.

Until very recently nearly all the land in Alaska, some 375 million acres, was in Federal ownership. Under the terms of the Alaska Native Claims Settlement Act, 40 million acres will pass to Native Regional Corporations, and another 103 million to the State of Alaska and private owners. Moreover, the Secretary of the Interior is directed to withdraw up to 80 million acres to be studied for possible inclusion in the various federal management systems - parks, forests, wildlife refuges, wild and scenic rivers, and so on. The task of the Commission is to assist in this process of transition and study.

In the first instance, it is to undertake a planning study as a basis for recommendations concerning areas to be retained as part of the federal management system. At the same time, recommendations are to be made concerning the disposition of lands to the state and the native regional corporations, and ways to avoid conflict in the selection process.

Secondly, the Commission is to advise and assist in the formulation of land use plans for the state and the native corporations. With respect to both federal and state agency lands, recommendations are to be made concerning programs, budgets, and changes in law and policy. And interestingly, in view of our earlier discussion, all of these recommendations are to be for the purpose of insuring that development improves the economic and social well-being of the native peoples and other citizens of Alaska, and is compatible with national and local environmental policies.

It is clear that in pursuing these objectives, a major focus of the Commission's efforts will be extractive resources - oil, timber, and potentially

also the metallic minerals. In what areas, and at what times, are these commercial resources of Alaska to be developed in order to yield maximum net returns, taking into account environmental costs? Since the most important resource in value terms, oil, is extracted via leasing arrangements, and the metallic minerals may soon be too, this question can be formulated in terms of leasing policy. As a matter of fact, the Commission recently (December 1973) held a conference on minerals leasing, designed to explore whether and how the oil leasing system could be used to obtain better value from the land bearing other minerals. Among the questions considered were, what should be the objective of a minerals leasing policy, and how can it best be realized? As suggested above, a plausible objective is maximization of net social returns from the mineral in question, taking into account environmental costs of extraction and transportation. How, then, is it to be realized? What areas should be leased, at what royalty rate, and so on? We conclude with some suggestions on these matters from the economist's point of view, drawing also on some of the principles of regional development discussed earlier.

V - Minerals Leasing Policy and Alaskan Regional Development

The first question we should address is, why have any policy charging miners for use of federal, state, or native lands? We said earlier that the related policy of charging for pollution would promote efficiency, but according to a well-known theorem, the same allocation of resources would result if the polluter had the rights to use of the environment, and was paid by others not to pollute.⁹

⁹Ronald Coase, "The Problem of Social Cost," Journal of Law and Economics, October, 1960

Changing liability, or property rights, would affect only the distribution of income. Similarly, it might be expected that charging miners a royalty or rent would not affect use of the land. It would still be employed in the use which maximized value, and only a certain amount of redistribution of income, perhaps better accomplished via an explicit policy for this purpose, would result.

Although the Coase theorem is well known, less well known is that it is applicable only under certain rather restrictive conditions, namely that transaction costs and income effects are negligible. In effect assigning property rights to miners (as under the 1872 Mining Law) can lead to inefficient use of the public lands in the increasingly common case in which mining is not the highest valued use, but the costs of gathering together all of the thousands of affected parties to buy out a mining claim are very high - or more than they can afford to pay!¹⁰ The situation is the same with respect to pollution (with the exception discussed also by Coase of producer-to-producer spillovers, for which transaction costs and consumer income effects are not relevant). There seems to be a case, then, for a policy of charging for environmental modification and extraction of mineral resources, along with careful benefit-cost analyses of alternative uses of the land. Also, though this is not subject to proof, it seems desirable that the rents to scarce mineral resources on their lands should go to the native population or Alaskans generally. As noted above, present leasing arrangements for oil and gas do

¹⁰This assumes that the non-mining values are not easily capitalized.

work this way, and access to the metallic minerals, though still typically free under the 1872 Mining Law, seems to be moving in this direction.

Although there are many varieties of leasing arrangements employed, in the U. S. at least the essence of the system is bidding by mining firms for a lease to a tract of land which confers exclusive rights to the mineral, say oil, there, subject to the payment of a royalty on production. The royalty is a fraction, often around $1/8$ to $1/6$, of the gross revenues from sale of the mineral, and the amount bid is called the lease bonus. In principle, the objective of the public agency or native regional corporation is, or should be, maximization of the combined sum of bonus and royalty payments (net of environmental costs, which we ignore for the moment). The policy instrument for this purpose can be the setting of the royalty rate. But since the royalty payments are received over a long period of time and are uncertain, it may not be obvious how the rate should be set to maximize rent. In what follows, we offer some guidelines.¹¹

Suppose the public agency is less concerned than the typical private mining firm with a quick return from exploitation of the site. This seems a realistic proposition since the government (or native regional corporation) is in the position of a steward of resources for future generations, as the private firm is not. Then a given future return from the mine would be worth more to the government. Put another way, the return is discounted at a lower rate (of interest). The government discount rate might be low relative to the pri-

¹¹ This discussion is based in part on an unpublished NSF grant proposal by Hayne Leland, and on conversations with Professor Leland.

vate firm's for another reason as well. The private firm would likely be more risk-averse, requiring a higher premium for risk-bearing in the form of a higher discount rate. Now, to the extent that future returns are less heavily discounted by the government for the reasons given above, a higher royalty rate would be desirable. This gives the government a larger stake in the long-lived investment, without unduly reducing the lease bonus it receives, since the firm's bonus bid will be relatively unaffected by loss on an increment of future income. In the limit, the government might set the royalty rate at 100 per cent, in effect assuming the role of entrepreneur, hiring factors of production to exploit the mineral deposit on its property. Against the gains from this policy would have to be balanced the possibly undesirable aspects of government as opposed to private enterprise (bureaucratic inefficiency, and so on).

Apart from its differential effect on discount rates, uncertainty about returns from the mining operation should influence the choice of royalty rate for another reason. If the government is more optimistic than mining firms about the probability of discovery at a site, the size or richness of the strike, or the price it will bring, a relatively high royalty rate is indicated. Again, this gives an expected future return greater than the cost in foregone bonus. Where private firms seem more bullish, on the other hand - or for that matter more inclined to gamble - the rent-maximizing royalty rate is correspondingly reduced.

How much land, or how many tracts, should be leased at a given time?

¹²For a review of the discount rate literature, including a discussion of the reasons why government would be less risk-averse than private firms, see Krutilla and Fisher, *op. cit.*, Chapter 4.

One consideration here is the owner's monopoly power, if any. Where the state of Alaska, for example, represents a substantial share in the supply of a resource to a market, it may realize greater returns by not opening up to development too much of the resource at any one time, i. e., by not "spoiling the market". Monopoly restriction of output, which this is an example of, is generally considered socially inefficient, but may not be in this case. Spreading out extraction over time is, after all, practicing resource conservation. To the extent this is considered desirable, some element of monopoly return to the state may not be contrary to national policy.

Another influence on the rate and pattern of leasing is the effect of experience with earlier leases on expectations, and hence bids, for new leases. Exploration by the leaseholder develops information about prospects for other tracts. A favorable outcome in one is likely to result in higher bids for others close by or in similar geological configuration. Certainly this has occurred in the leasing of North Slope oil tracts in Alaska. One counter consideration here is that exploration may be less vigorous if a firm expects that much of the benefit will accrue to others. Large lease blocks may be desirable for this reason.¹³

How do environmental effects fit in the rent-maximizing framework? Recall the earlier discussion of the desirability of polluter liability. It is applicable here, and should lead to more stringent control of pipeline breaks, oil spills, acid mine drainage, and so on, as well as compensation to the victims of these effects. In cases where potential environmental damages are very great,

¹³The "information spillover" in petroleum exploration and its implications for policy are discussed by Frederick M. Peterson, "Two Externalities in Petroleum Production", study for the Ford Foundation Energy Policy Project.

or returns from the mining operation marginal, firms may not find it profitable to bid for development rights to a site, and it would remain unmodified.

It is not only the incidental effects of commercial resource development that should be taken account of. Suppose a mineral deposit, a stand of timber, or a site for hydroelectric power production, is also valuable in its natural state, i. e., if not modified for any of these purposes. Minerals and timber often occur in scenic mountain areas, and a hydroelectric site may be a free flowing stream suitable for inclusion in the national Wild and Scenic Rivers System. Loss of the recreation and other values associated with unspoiled natural environments is, or should be, just as much a consideration as potential pollution damages in the decision whether to develop a site. In principle, efficient use of the environment would require that development take place only if the expected gains (net of pollution damages) are at least as great as the opportunity losses - the values that are sacrificed by conversion of the environment to developmental purposes. We should acknowledge that both the theory and the practice of measuring these values are currently rather primitive. Hopefully this is due only to neglect, nearly total to date, and will be remedied by future research.¹⁴

We stated just above that an area should be opened up to development via minerals leasing only if the expected returns, the rents to the mineral, are at least as great as the environmental costs. Although this has to be true, given that the land manager's objective is to maximize net social returns, it

¹⁴The only organized research effort we are aware of which addresses the issue of valuing the amenity resources of natural environments, and integrating these values into a theoretical resource allocation framework, is the Natural Environments Program at Resources for the Future. For a statement of results in theory and method obtained in this program, along with some examples of empirical studies, see Krutilla and Fisher, op. cit.

conceals a point that is not obvious and should be made explicit. Earlier we spoke of long lasting or irreversible environmental damage. Where the magnitude of the damage, along with the returns from commercial development of a site, is uncertain, development may entail a cost - the loss of "option value" - in addition to the measured losses from the damage (and, of course, the direct resource costs). Option value, as the name suggests, is the value to an individual of an option to consume a good or service sometime in the future. One interpretation is that it is the amount he would pay to avoid the risk of not being able to consume, to assure the availability of the good should he demand it.¹⁵

Another interpretation, which does not depend on risk aversion, and instead makes use of a Bayesian approach, is the following. Suppose a public agency has under review an (otherwise profitable) activity which will result in the irreversible loss of a natural environment. Suppose, further, that the passage of time results in new information about the benefits of alternative uses - development or preservation - of the environment. Since this information can be taken into account only if the irreversible decision has been deferred, there is a value to refraining from development. Conversely, development entails a cost - the loss of this option value.¹⁶ One important implication for leasing

¹⁵Option value was first discussed by Burton Weisbrod, "Collective Consumption Services of Individual Consumption Goods", Quarterly Journal of Economics, August, 1964. It is further discussed and the relation to conventional consumer surplus clarified by Charles Cicchetti and A. Myrick Freeman, "Option Demand and Consumer Surplus: Further Comments", Quarterly Journal of Economics, August, 1971.

¹⁶See Kenneth Arrow and Anthony Fisher, "Environmental Preservation, Uncertainty, and Irreversibility", Quarterly Journal of Economics, May, 1974.

policy is that development of different sources of energy (or for that matter other materials) should be sequenced in a way that permits planners to take account of new information about the full social costs of each.

VI - Conclusion

The main point of this paper is that Alaska presents an unusual challenge to the U. S. and to the world to use its non-renewable fossil fuels and other natural resources in ways, and at rates of use, which reflect maturity and responsibility with respect to the rights not only of current generations, but of future generations, not only of those who will use the resource, and gain from its exploitation, but also of those on whose land it has been found. Perhaps then Alaska offers the first and last great opportunity, at least for us in the U. S., to perceive regional development not only as a process of exploiting the earth, but of achieving a new balance between the claims of economic development and social and environmental responsibility.