unearned and received by absentee investors. As the problem is distributive so is the probable solution. Wide distribution of the benefits of oil and gas development will make it much more acceptable. Leasing policy can contribute to this solution, although it is by no means the whole story.

Another external cost imposed on society by extractive industries is frequently instability, and many people fear the boom and bust characteristics of oil and gas and other mining industries. This consideration argues for leases that yield steady revenues and encourage steady activity and it also may argue for a steady flow of lease sales. Neither of these is an absolute, obviously, and must be balanced against the question of getting top dollar by turning production and sales on and off.

6. Coordination with leasing on federal and native lands

Federal and native lands will share common transportation lines and support bases with State lands. They may be on the same structures. State and federal lands especially have extraordinarily long common boundaries in oil-prone areas. The State evinces strong desires not to be led by federal policy and to have some input into federal policy. At the same time, there is no drainage treaty or compact between the different landowners even though England and Norway have managed to work this out on an international basis. Until this is done, clearly a strike near the boundary will force a drainage sale on the other side. If the Feds and the natives get and keep ahead of the State, the State

might do very well by specializing in drainage sales, a policy favored by many. But there is an uncomfortable feeling that this loss of initiative might also impose high costs by letting others determine the location of activity as well as the timing. There is also some fear that division among the three kinds of landlords might divide them for easier conquest by the industry. The State's objective therefore is clearly to achieve a higher degree of cooperation.

C. Elements of Leasing

There are several elements in a lease, most of which are optional and variable along a wide spectrum. Kinds of leases are frequently distinguished by identifying the bid variable; but the constant elements may be more important than the bid variable where they are set at very high rates. Thus we discuss the pros and cons of each element in leasing first, and only at the end discuss the choice of a bid variable.

1. Prior claim: the noncompetitive system

A substantial acreage in Alaska remains under noncompetitive lease. Figures forwarded by Mr. Denton of the DNR for noncompetitive acreage of "oil companies" totaled to 625,000 acres. In addition there is acreage held by individuals. Ranking the companies in order of their net acreage held, we find that the top 10 percent hold 58.9 percent of the noncompetitive net acreage. This compares with 64 percent when we do the same thing for competitive net acreage. Major holders of noncompetitive acreage are Texaco, Union, Cities' Service, Amoco, and Atlantic Richfield. (Major holders of competitive acreage are the same firms plus Sohio, Phillips, BP Alaska, Exxon, Standard of California, and Mobil.) (See Appendix C.)

Noncompetitive systems are widespread outside the United States. Major faults appear to be that they give away State property without payment, and so encourage premature claims and, where there is a work requirement, premature use. The claim-staker rather than the State gets in on the ground floor of the elevator and holds the resource while it appreciates from a zero value up to whatever value its natural richness

warrants. Any rate of return beginning from a base equal to 0 is mathematically infinitely high and therefore not to be lightly given away.

We append an analysis by Professor Michael Crommelin, Faculty of Law, University of Melbourne, Australia (Appendix D).

2. The bonus

There are several advantages to using a high bonus in allocating leases and it has many staunch advocates, including Walter Mead and Milton Lipton. Advantages of a high bonus include:

a. Large commitment by the lessee -- he will not walk away.

b. There is no marginal disincentive imposed on the lessee.

c. The State receives its money up front.

d. Major corporations have access to market funds at rock bottom interest rates, about 7.5 percent on bonds today, and therefore presumably will discount future expectations at correspondingly low rates. Some of them have access to internal funds whose opportunity cost or alternative use may be even lower in the event the management is embarrassed with more assets than it can manage effectively. Some utilities, in seeking to support their rate bases, have advanced money to invest in leases. This last kind of investment is being cross-subsidized by the profit-making parts of the firm and may yield extremely low marginal rates to the company. Historical evidence presented by Mead from the Gulf of Mexico indicates rates of return of about 7.5 percent.

e. If the State should be exploited inadvertently it can use the tax mechanism later on to compensate.

f. The transfer is complete and there is no need for policing prices later on, auditing costs and so on.

On the con side, major problems with high bonus payments are the following:

a. High capital barrier to entry, reducing the number of bidders. This is undesirable both because of the concentration of wealth and power which it implies but also because reduced competition might prevent the State's receiving fair value. Data supplied by Mr. Denton when ranked by net acreage indicate that the top 10 percent of the holders of competitive net acreage have 64 percent of the acreage. These top 10 percent consist of Arco, Phillips, Union, SoCal, Exxon, Sohio, Mobil, and Cities' Service. While this degree of concentrated control is not unusual in other places and other industries it is still higher than many would consider socially desirable.

b. As low as the industry's internal cost of capital may be, the State's effective rate is probably lower. This is a considerable change from the past and calls for a change in policy. The State is no longer desperate for front money but on the contrary is looking for outlets for its permanent fund. The industry, on the other hand, may be entering an era of higher internal interest rates. It is freely alleged that figures like 20 percent are used in determining bonus bids although this is difficult to nail down. It is certain, however, that monumental capital requirements are projected for oil and gas related investment requirements in the next decade, presaging increasing tightness of capital and therefore lower bonus bids relative to resource values.

c. The bonus aggravates the cash crunch since it is synchronized with the need to find capital for drilling and equipping. This may result in underallocation of money to the latter, especially for small firms.

d. The time preference and therefore the production scheduling of different firms is ruled by their internal interest rates which vary from one firm to another. The allocation of credit among companies is based not on marginal productivity but on collateral security. The result is too much time pressure on some lessees and too little on others. The one may depend on extremely rapid use while the other may depend on speculation and delay above and beyond the social interests.

e. The payment is determined and made before enough is known about actual reserves. There is a large lottery element in the outcome and the outcome is not closely correlated with the price paid. The State might sell $10 billion worth of oil for $6 million as it apparently did at the 1965 auction at Prudhoe Bay. At the same time it sells some barren land for a high price. The rule of caveat emptor is applied, frequently intentionally by the seller. This constitutes a fraud with malice aforethought, which would not be tolerated in private business dealings and it is questionable if the State should observe a lower level of elementary morality than is expected of private sellers.

f. The distribution of petroleum reserves in nature is extremely unequal as among different deposits and tracts. The result is extreme inequality in the distribution of gains to wealth when all the payments are made up front and the results of successful and unsuccessful gambles fall entirely on the lessee.

g. If, as is generally believed, most investors are risk-averse, then the lottery element in having a high bonus acts as an additional filter screening out possible entrants. This leads to higher concentration and less active competition in the bidding for State property. Also, to the extent that accumulated wealth and a positive attitude towards gambling are factors determining the high bidder, productivity and cost control are less determinant.

h. Use of bonus bidding lends itself to preemptive, preclusive buying by wealthier firms concerned with controlling the market and discouraging competitors.

i. Once a bonus is paid and then a discovery made it is hard and costly to deny production if the environmental damage turns out to be high relative to the value of production. We have just lucked out of one such trap; we might do worse another time.

j. Transfer or sale of lease for a high bonus is a de facto sale of land but without much property tax liability imposed on capital or land (notably excepting the special Alaskan reserves tax). The capital invested in drilling and equipping is partly exempt and the intangible capital developed from exploratory drilling is not taxed. The leasehold interest itself is not always taxed. While such tax relief should result in higher bonus bids, this exacerbates the problem of the front-end filter.

k. The front-end filter becomes even tighter when lease sales are large and there is no slide bidding and the usual 20 percent advance bonus is required.

1. If oil and gas prices are regulated, and of course they are vulnerable to this risk, a bonus paid in the past is not treated as a current cost and not rolled in, resulting in lower prices received, whereas certain kinds of subsequent participation demands by the State might be treated in the regulatory mechanism as costs. In distinguishing between old oil and new oil, regulation may also distinguish between old costs and new costs.

Our worst suspicions of bonus bidding are confirmed by the brilliant, succinct and damning analysis of Alaska's past experience researched and written by my associate, Professor Richard Norgaard of the School of Resource Economics, University of California, Berkeley (Appendix E). Bonuses captured only from 9 percent to 16 percent of the surplus DCF value above costs and royalties in Cook Inlet. There were too few bidders to assure effective competition. Outcomes were wildly unrelated to bonuses bid and paid. Bidders have successfully used advanced gaming strategies and statistical analyses to take advantage of a State without expert staff in these fields. The State has not set adequate reservation prices or screened out fishing bids and overnominations: only 2 percent of the offshore Cook Inlet tracts leased through 1968 have produced. Dr. Norgaard recommends drastic changes.

3. The delay rental

Delay rentals are the smallest of the three major payments in the usual bid, the other two being bonus and royalty. They have been by no means negligible, however, and in Alberta, for example, have run at 50 percent as much as royalties and bonuses at various times. In addition,

as compared with royalties they come earlier, and when we figure compound interest are blown up into an even larger figure.

Delay rentals are usually an annual yearly payment that ceases when production and royalties begin but there is room for many variations. They might continue until production ends, for one. For another, they need not be at a fixed level but might increase in proportion to some index such as cost of living or they might be made proportional to the assessed value of reserves, giving them the character of a property tax on reserves. Another possibility is to pay the bonus on the installment plan over several years. Yet another possibility is the production bonus, a contingent payment which is due only when and if commercial pay-rock is struck. This has some of the character of a bonus and some of the character of a rental and will be treated here.

The advantages of delay rentals and other rentals are the following:

a. Payment is deferred. This has the same effect as extending credit to payers of bonuses and letting them pay on the installment plan. This is of greater advantage to the leaner interloping firms and tends to increase competition.

b. The payment is fixed with respect to production and places no drag on it therefore. Thus it achieves two goals at once that the State is seeking. It shifts payments into the future and it does so without disincentive effect. If anything, it applies positive leverage to accelerate production.

c. At present when the firms need more time they simply request that leases be extended and the request is frequently granted. This involves arbitrary exercise of judgment by officials. It would be better for lessees to pay so much a year and make their own decisions. The pressure would be on them, of course, to accelerate production once the lease was signed. Firms would be less anxious to nominate acreage and insist on lease sales many years in advance of the availability of transportation.

d. Alaska has millions of acres out under lease. It could all be returning more money each year or else be relinquished for future sale at a more propitious time. Alaska is getting $1.00 per acre year for these lands. OCS lands are yielding $3.00 per acre year in practice and go higher on drainage and development tracts. Norwegian rentals go up to $21 per acre year.

e. Most capital is subject to property taxation and must therefore yield a return high enough to cover both interest and property taxes. The investment in withholding oil reserves from production, however, need only yield a competitive interest rate. A delay rental serves to compensate for the lack of property taxation so that the same discount rate is applied in both cases.

f. A rental is terminable in practice when a lease is dropped due to lack of interest. This reduces the risk imposed on the lessee considerably and should result in higher bids on the bid variable, whatever that might be.

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g. A delay rental is smoothly convertible to an ad valorem base at such time as enough is known about the reservoir and its contents to allow reasonably accurate assessment. Thus, instead of being a fixed amount per year it would be a fixed percentage of the assessed value of the reserves, still retaining its key qualities of shifting payments into the future and not varying as a function of production.

On the negative side are the following considerations:

a. Early shutdown. This traditional argument against fixed charges would apply only to one of the several alternative forms of rental, the nonterminable level payment. It can be prevented by adopting one of the declining forms. Professor Rooney's studies (Appendix F) indicate that the problem of early shutdown is not a serious one in general unless there is a substantial bias against investments in pressure maintenance. A constant rental contains no such bias. An ad valorem rental based on the value of as yet unproduced minerals would exempt the value of capital in place and therefore leave the lessee with a substantial investment even at such time as the rental charge approached zero.

b. Rentals are traditionally lowest of the three kinds of lease payments. This suggests that the industry doesn't like them and would not accept them readily. While this point is often made, this consultant discounts it because of other evidence, presented later (Section 7c).

c. Some federal tax provisions favor delayed production, advantages which might be lost by any lease provision which promotes early production.

d. A lessee might promise to pay a high rental and then walk away from the lease in a short number of years if it proves to be unproductive. Some would consider this to be a disadvantage of the system although it is included among the positive aspects as well.

e. The rental is normally fixed ex ante. It therefore has the same lottery qualities as a bonus.

The pros and cons discussed above indicate there are alternative forms of rental, which are listed here:

a. One might pay the bonus on the installment plan over a specified number of years at a specified rate of interest.

b. The traditional "delay rental" terminates when production begins and royalties are paid. It is usually at some fixed level per acre independent of value, although BLM policy permits figures of $3.00, $5.00 and $10.00 per acre, depending on the class of acreage.

c. A rental might increase yearly at a fixed or an accelerating rate during the preproduction period in order to emphasize the landlord's intent to force action.

d. A rent might be level for the term of lease. This is the pattern that must be faulted for forcing early shutdown.

e. A rental might be a specified percentage of the bonus bid, for a fixed number of years. If the percentage were rather high, say 20 or 30 percent, the effect would be nearly the same as option (a.), that is paying the bonus on the installment plan, but with a substantial down payment. If the rate were 100 percent you would have exactly the same effect as an installment plan payment.

f. The rental might be a specified percentage of the appraised value of the unproduced minerals in the ground. This is an ad valorem charge (AVC). It closely resembles the ad valorem property tax in its impact and administration. Administrative aspects of this form of levy, mainly the technique of assessing minerals in the ground, have been ably discussed before this body by Robert Paschall. Basic principles of the application of such a charge are laid out in Appendix H with a numerical example showing how one would use the data in the Van Poollen report on the Sadlerochit Formation to levy the charge, and how it would diminish over time.

The ad valorem charge differs sharply from those discussed previously in that it is based on progressive disclosures of the value of minerals actually present while the others are based, like bonus bids, on ex ante surmising about what might be there. The ad valorem charge (AVC) is ex post discovery, while the other forms of rental are ex ante.

Thus AVC has some of the good and some of the bad qualities of a royalty. Like a royalty, it is based on what is actually in the ground rather than an uninformed guess as to what might be there, and is a function of actual outcomes. It therefore prevents many of the distributive inequities which flaw the system of high bonuses.

On the negative side, again like a royalty, it has some disincentive effect on discovery since discovery and proving of reserves result in higher assessments. The effect is much weaker here than with a royalty, however, because the ad valorem charge is based only on the value of the resource in situ whereas the royalty is also, in effect, a

charge on all the costs of extracting the deposit as well. In the extreme, on a marginal deposit the ad valorem charge will be zero whereas a royalty, could it be collected, would be substantial. Similarly, at the end of life the ad valorem charge falls to zero while royalties continue with a fixed rate.

The two more substantial weaknesses of the ad valorem charge appear to be, first, there is some question about whether assessments can be tolerably accurate in practice, and second, there is some disincentive effect on exploratory drilling. These weaknesses may be substantially overcome by a combined system which would work as follows: There would be two stages in the life of a lease, before and after the discovery of commercial petroleum. Before discovery, the rental would be a specified percentage of the bonus bid (as in paragraph (e.) above). Following discovery, the same percentage would be applied to the assessed value of the discovered reserves. It would progressively rise as more reserves were proven and decline as they were exhausted (see Appendix H).

The presence of several lessees on any one structure would probably prevent substantial concealment of reserves. However, if experience suggested such concealment to be a problem, it might be offset by programs of compulsory disclosure, State participation in drilling, penalties for concealment, and so on. Professor Norgaard (Appendix E) and Professor Rooney (Appendix F) both suggest schemes for State exploration.

g. Lease terms might be quite short, say five years, with rents "renegotiable" at that time. Such "renegotiation" would be rather

unilateral with the State holding the upper hand and would seem to impose unreasonable risks on lessees. Unilateral renegotiation of terms is actually practiced in many countries around the world in the wake of multiplying petroleum prices which made the original lease terms seem egregiously favorable to the lessees. Even American law occasionally permits change of contracts in the face of gross unforeseeable, external change of conditions. In general, however, this seems an unsystematic and arbitrary approach and less desirable than AVC which, although it might be criticized for some arbitrariness in the assessment process, is subject to objective administration and evaluation of performance.

4. The royalty

Production-based royalties are traditionally a large element in mineral leases. The most frequently heard proposal for reducing high front-end bonuses today is to increase royalty rates either directly or through making them the bid variable. The advantages of high royalties would be the following:

a. Payment is deferred. This eases entry for leaner firms and conserves front money for actual drilling and equipping leases. It increases competition and aids small business.

b. Major payments are contingent on the lessee's finding commercial petroleum and are in proportion to the volume, although not the value of what he finds. This reduces the risk element in lease bidding. It also reduces the premium now placed on prior knowledge of what is there and reduces the advantage of firms that can afford extensive early investment in preleasing surveys.

c. It removes the possibility of the lessee's paying a high price for something that is not present and removes the probability of windfalls when more is present than the market expected.

d. The State now has a lower discount rate than many potential bidders and can better afford to participate in future income at the expense of immediate cash. This must be tempered with the thought that the median voter is poorer than the median corporate shareholder and has a higher time preference. On the other hand, the State is free from federal income tax so that a given percentage return on investment is more attractive to the State than it is to a taxable private body. If it were just a matter of avoiding State taxes this advantage would be spurious, but if the State can successfully avoid federal taxes where private lessees cannot there appears to be a net advantage from the State's own viewpoint. Countering this is the observation that some large energy corporations have succeeded in lowering their effective federal income tax rates to a low percentage of profit, but the answer to that is that it is not an objective of the State to encourage a small number of large firms but to maximize the number of potential entrants into the field, including those too small to take full advantage of tax loopholes.

e. A royalty is the exact opposite of the depletion allowance. Oil and gas firms, in their eagerness to secure depletion allowances, will be willing to pay higher royalties than otherwise, a relationship which might be exploited to benefit the State. However, this again runs counter to the desire to benefit smaller firms inasmuch as the depletion

allowance is now limited to smaller wells and is programmed to shrink progressively over the next few years.

f. A properly attuned royalty might substitute for unitization of a common pool. It may also substitute for direct controls on well-spacing and rates of flow.

In spite of its attractive features, the royalty has a long list of problems.

a. There is no commitment by the lessee. He may tie up land at little cost by merely promising to pay high future royalties and wait for a free ride on his neighbor. A successful bidder who overbids may abandon the lease, but there is no symmetry. The bidder who successfully underbids cashes in at the expense of the lessor, who cannot back out.

b. Marginal deposits are made submarginal and marginal effort on rich deposits is made submarginal. This applies to entire tracts, to the high-cost fringes of low-cost deposits, to the extra wells and capacity needed to give better control of timing, to equipping the lease, to work-overs, to the date of beginning production, to the stretch-out of the entire period of production, to the date of terminating production, to pressure maintenance and secondary recovery, to exploration for smaller and marginal deposits, and to production during high-cost seasons. Vastly more is involved here than the problem of early shutdown usually emphasized.

Royalties are not automatically passed on to consumers. Prices are determined by supply and demand in world markets. The burdens of the royalty system are borne primarily by the landowner in the form of lower net income.

c. A good deal of leakage of surplus cash flow is suffered by the landlord on the low-cost flush deposits, especially during their flush years when the surpluses are yielded. To be sure the prospect of winning these surpluses tends to raise bids all round but as noted, high royalties on low-value deposits are uncollectible whereas low royalties on low-cost deposits are irretrievable.

d. The lessee's incentive to defer production is exaggerated. There is a strong future shift. The mathematics of this are developed in Appendix J. The basic idea may be simply expressed: It costs more to produce faster, and royalties discourage incurring costs (because the resulting output is shared with the landlord but the costs are borne entirely by the lessee). In addition, there is an exaggerated motive to wait for higher prices. A royalty makes a marginal field or unit of production submarginal, but by waiting for higher prices the lessee can wait until it becomes somewhat better than marginal even after paying the royalty.

By the same token, if fluctuating prices are expected or experienced the lessee's motivation to turn production on and off at his convenience is exaggerated. The lessor's royalties are therefore afflicted by instability beyond what would be an optimal adjustment to changing markets. Instability also has negative external effects on impacted communities, of course.

It may be shown mathematically (see Appendix J) that the disincentive of a royalty operates with greatest force on investments that are incurred immediately before their effects are felt in increased

production. That is, it strikes hardest at workovers, at pressure maintenance, secondary recovery, and so on. Its effects are relatively less in relation to investments that occur well in advance of production such as exploration. The overall result of this pattern is a stretch-out of the commitment of unrecovered capital between first outlay and ultimate recovery. This pattern increases overall capital requirements which in turn works to the advantage of wealthier firms and helps to screen out the leaner firms. Thus the royalty system works to the disadvantage of the very firms that it is designed to help.

e. The deferral of revenues hurts the State, of course. The additional deferral caused by the future shift of production hurts even more. Deferral of State revenues is acceptable if it serves the function of encouraging more competitive firms; but deferral of revenues after discovery serves little or no such function. The lessee who discovers commercial pay-rock may cash out immediately in several ways. Companies regularly borrow or issue stock on the basis of discoveries. Not only does this take cash out of them, it does so without incurring any federal tax liability and is thus substantially subsidized by the workings of income tax law. Economists regard the nontaxation of unrealized capital gains to be a major source of bias in tax law. Unrealized gains are an unpreempted potential tax source. It is a good principle of State policy to go after unpreempted revenue sources, as noted earlier, and a royalty fails to do this. On the contrary, it widens the loophole.

f. The lessee may shortchange the lessor by understating the price of produced oil and gas. This has to be policed carefully at some expense.

g. Environmental damage from oil and gas production is more a function of the fact that some production is taking place than it is a variable function of the flow of volume in any year. The royalty-induced stretch-out therefore increases the total environmental damage.

h. There are many more little finds to be discovered than big ones, more poor ones than rich ones. The effect of royalties is to screen out the little ones. This greatly reduces the success ratio where success is defined as simply finding a commercial find that is producible. It screens out the little ones without succeeding in capturing all the rent on the big ones. It tends, therefore, to reduce sharply the number of viable firms since the expected success ratio is an important consideration, especially for the leaner firms which cannot afford a large number of failures. Once again it fails in one of its primary objectives, which is creating an economic environment more favorable to the leaner firms.

The discussion of pros and cons of royalties has centered on the simple concept of a high royalty rate. Some of the disadvantages may be overcome by the use of step royalties, sliding scale royalties, and using royalty as the bid variable which results in different rates on different deposits. Professor Rooney has outlined a workable step-royalty system (Appendix F). In our recommendations we include this among the workable alternatives.

There are many drawbacks, however. The problem with sliding scales is that they slide only with volume, and volume is only one of several factors that need to be considered. In addition, a scale which

is progressive with respect to volume worsens the tendency of royalties to shift production into the future, since the high rate brackets may be avoided by reducing production now and stretching it out. If the rate is progressive per well it may be avoided by drilling more wells.

If it is progressive per tract it also depends arbitrarily on the size of the tract. It causes future shift. And it has a built-in bias against the marginal fringes of superior tracts which may exist where the tract is fractured and complicated.

It takes no account of cost differences which are independent of the volume factor. Thus, a high-volume well in a difficult, remote location gets a high rate while a low-volume well in a convenient location without much depth gets a low rate. It is a blunt instrument.

It makes no distinction between high volume which is the result of natural pressure achieved at no cost, and high volume which is the result of costly pressure maintenance such as that now experienced in several Cook Inlet fields whose volume has been maintained over the years at some cost.

It might be possible to adjust for all these and other variable factors by an extensive and complex system of variable rates based on extended observation of particular circumstances. All this would accomplish is the same thing that might be accomplished generally and accurately by letting costs be deducted. Deducting costs, however, has its own problems, and this lets us avoid them.

One problem with royalties may be solved by the use of a State marketing board. That is the problem of price determination if it

appears that the lessees are fiddling the transfer prices which are used to determine the State's share. This is the approach taken by British Columbia in marketing its natural gas through a provincial marketing board. The royalty is taken as an excess profit of the marketing board. Unfortunately, this only solves one of the several problems of the royalty system. The British Columbia experience has been one of having progressively to raise the field price and reduce its profits in order to stimulate more exploration and production. The basic fault is that it fails to distinguish between the low-cost and the high-cost deposits.

A very useful adjustment in a royalty system is to let the rate increase as a function of an index of petroleum prices. This offsets part of the future shift problem since it removes the incentive to hold back waiting for higher prices. It fails to account for cost changes, however.

Another device similar to a royalty would be taxation levied on a major pipeline. There is a case against any taxation of pipelines, especially underutilized ones, because of their economies of scale.[1] The "six-tenths rule" implies that optimal rates would cover only 60 percent of costs. This implies the need for a subsidy, rather than a tax. I.C.C. regulation is not geared to accommodate this kind of thinking, so we can forget about the subsidy idea. There is also a special case for taxing, TAPS, to recoup the windfalls at Prudhoe. In general, however, taxing

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[1] There is an engineering rule of thumb, the "six-tenths rule," that the cost of incremental capacity is 60 percent as high as the unit cost of the capacity before the increment. The rule is inaccurate and not universal but gives a rough notion of what is normal.

pipelines has the same faults as a royalty. (Inflating pipeline rates for reasons other than taxation, as I.C.C. regulation seems to do, has all the bad effects of a royalty without the benefit of raising revenue.)

Another feature of a royalty which may be an advantage or disadvantage is that it may be taken in kind and marketed by the State. This has aroused great enthusiasm in Alaska recently but the kind of enthusiasm suggests the kind of problems that would be encountered, namely domestic use at low productivity in preference to export at higher prices. This is a subsidy. The recipient has to take his subsidy in the one form of underpriced petroleum products and will use them wastefully. Industries which use lots of cheap energy do not constitute an unusually seminal economic base. Energy-intensive industries tend to be capital-intensive, and frequently polluting. Located in remote areas, they generate a minimum of associated activity. As an example there is Kitimat, British Columbia, with its hot house aluminum industry dependent on underpriced power. What would be the effects of reallocating this power to a more diversified community in a more attractive area where it would attract more labor-intensive industry?

5. Specific terms

Here we treat specific terms that are not generally specified in money; but we do not treat field regulations, which are in Section 8. The use of specific terms generally runs counter to the goals of administrative simplicity and objectivity, since terms tend to be arbitrary or discretionary and are usually discrete with sharp black and white boundaries as opposed to incremental pressures which run along a spectrum.

The present treatment is abbreviated in order to reserve more time and space for matters of higher current priority.

a. The term in years

i. The term before beginning production. Five years is usually allowed subject to discretionary extension. It might be better to substitute a delay rental increasing at an increasing rate. Lessees naturally will argue in favor of longer terms. That is their interest. Ours is to sit on the landlord's side of the table. From this position there is much to be said for holding feet to the fire.

ii. The term after beginning production. The practice, of course, is to let the term continue as long as production continues. An alternative is to terminate the lease after the lessee has recovered a volume of reserves previously agreed upon. This is discussed in a later section.

b. Size limits

i. Size per parcel. Professor Stephen Cheung, an authority on leasing systems, has emphasized the landlord's advantage in keeping parcels small. This helps to assure that each lessee, in making a viable operation, will apply a certain minimum of labor and capital to the landlord's land. Lessees argue in favor of larger parcels. Again that is clearly their interest, but it is adverse to the landlord's.

ii. Cumulative total acreage by state and by substate region. There is an argument for limiting the holdings of one firm in any area, in order to increase the operating base of as many potential competitors

as possible. This also assures closer attention to each individual parcel. There are nine firms who currently hold more than 200,000 acres each of competitive leases in Alaska. It is not clear that one firm can effectively explore and operate that many acres at once. However, acreage maxima are difficult to enforce, so that in general we prefer the use of general economic incentives rather than acreage limitations.

iii. A "market-structure impact statement." The State might reasonably mount a substantial antitrust operation, presumably in the Attorney-General's department. Winning bids might be rejected if the Attorney-General's office determined that accepting the bid might tend to reduce competition.

c. Joint bidding

There is a good case for prohibiting joint bidding, which reduces the number of competitors. Professor Norgaard's statement (Appendix E) speaks to this point. Like Professor Mead in an earlier study, Professor Norgaard found that the number of independent bidders is a most important variable determining the size of bids. The counter-argument that joint bidding permits bids to occur which would not otherwise be made, owing to high capital requirements, is unpersuasive where the bidders are large multinational firms, which are simultaneously bidding elsewhere in Alaska and the world.

d. Liability for environmental damage

It would make sense for environmental damages anywhere in Alaska to be made a first lien on the lease from which the offending oil

originated. We might further introduce a progressive element in this by making the liability a first lien on all leases held by the offending company.

For damages beyond the amount thus recoverable, it probably is desirable to make participation in environmental damage insurance a mandatory feature of all State leases.

None of these terms should be imposed in a punitive or negative spirit. The objective is never to damage the industry, but to help the State. The objective is never to penalize larger firms for being large, but to open the door to help smaller firms. We should carefully avoid referring to "the industry" as a block, and praising or blaming it as a whole. Lease terms which favor small business over big business are not hostile to "the industry." They are, rather, designed to help most firms in the industry by offsetting unfair advantages enjoyed by the large and wealthy firms. Whenever the State can help itself by helping the industry it should do so. Whenever the State can help itself by weakening oligopolistic elements in the industry in order to strengthen competitive elements in the industry, it should do so. None of this is "hostile to industry" in general.

In addition, the State's interest as landlord is generally adverse to that of the industry as tenant. In asserting its legitimate property interests, the State is adverse to industry without being hostile to industry. These are all important distinctions which should be held firmly in mind to avoid confusion. The American Petroleum Institute, in one of its publications, argues in favor of larger parcels,

bigger sales at one time, longer terms, and the absence of any reservation price. In opposing the Institute's position, the State is not being "hostile." Rather, it is asserting its own legitimate interests and at the same time being friendly to smaller firms whose interests seem neglected in the API positions.

6. Profit sharing

To overcome the weaknesses of the royalty system the lessor may allow the lessee to deduct from royalty payments an allowance for costs. In return he raises the basic rate charged per barrel. Thus the royalty, which resembles a sales tax, is converted into a profit share resembling an income tax.

The concept is simple enough in regard to regular expenses of operation and routine maintenance which are deducted from production payments in the year in which the are incurred. The allocation of deductions becomes more complicated with respect to capital outlays, and since these are normally quite high relative to ongoing expenses the matter cannot be overlooked.

Capital outlays must be deductible over a considerable period of years, presumably the useful life of the capital. This immediately engages us in a number of complexities and tricky questions which we will discuss under the negative aspects of the proposal.

Since we are dealing with a lease and not a tax on the total income of the multinational corporation, only those costs can be deductible which are expended on site, or in such close conjunction with it that we have no difficulty identifying them. This means that overhead

expenses are not deductible. Neither are federal taxes. The proposal thus resembles what is called a "net proceeds" tax rather than a pure income tax. The distinction is important and fundamental. The income tax is in personam; that is, it is levied on a person or corporation as such. The net proceeds tax, on the other hand, is in rem: it is levied on the income and expenses attributable to a particular "thing," in this case the leasehold.

This also means that interest payments are not deductible. The deduction is based on the value of the capital applied to the site regardless of whether it is debt financed or equity financed. It might seem preferable to allow some deduction for the cost of capital whether it be equity capital or debt capital, but this proposal is considered in the following section, #7.

The lessee might recover his capital on a per year basis or, alternatively, on a per barrel basis. If the latter, it must be subject to some yearly maximum to avoid his recovering his capital all in one or two years as would happen with a flush producer. Such accelerated recovery would mean in effect that the lessee's capital would not be tied up for any appreciable number of years and that there was no base remaining on which he could legitimately be said to be contributing to the profit. This in turn would convert the arrangement from profit sharing to simple rent collecting, which is discussed in Section 7. The present proposal is that the State share in the lessee's profits, which presupposes that the lessee still have some unrecovered capital outstanding which contributes to the joint profit.

The per barrel recovery basis resembles the depletion allowance of the income tax and may be thought of in similar terms with this difference: the present proposal limits the depletion allowance to recovery of costs actually incurred. On the surface the per barrel basis might seem much superior to the per year basis of cost recovery, because the per barrel cost credit comes in the form of a depletion allowance and would offset the disincentive effects of the royalty element. Actually this is a minimal advantage for two reasons. One is that there must be an upper limit per year in any event to keep this a profit share system, and the other is that the deduction of current expenses eliminates the disincentive effects of the royalty in the short run in any event. In fact, adding to this a per barrel depletion allowance would have a slight tendency to accelerate production.

Therefore, we do not sharply distinguish between the per barrel basis and the per year basis in discussing the pros and cons.

The advantages of the net proceeds or profit sharing approach are the following:

a. Allowing costs to be deducted overcomes the problems that plague the royalty system without incurring the problems that plague the bonus system. It succeeds in binding the lessor and the lessee in much more of a common interest -- they share the profits and they also share the costs.

This means that we succeed in preserving incentives at the margins, both intensive and extensive, and reduce (without eliminating) the "deadweight loss" that is caused by the disincentive effects of a

royalty. Second, we can and indeed we must charge a basically higher rate which rifles in on the flush producers who have little cost to deduct per barrel and succeeds in extracting a large amount of rent which leaks away when we depend on royalties.

b. Because costs themselves are deducted, this approach obviates the complex schemes of sliding scales and so on which one might use to modify the royalty system to make it approximate a cost sharing system.

c. This approach sustains over a long period of time the union of interests between lessor and lessee.

d. The nonacknowledgement of overhead costs creates minimal bias since this merely results in lower bids for the bid variable. Overhead costs will be roughly proportionate to on-site costs for many firms. For some others, overhead costs will be large relative to on-site costs and they will be discriminated against, but it may be desirable to discourage such firms since their overhead costs will be incurred outside the State and since they tend to be the larger firms. The intent is not to discourage larger firms but to encourage smaller ones relatively.

e. The income received by the State from different leases will be now made progressive with respect to profitability. That is, the State's share per barrel on marginal oil will be zero while its share per barrel on profitable oil will be quite high.

On the negative side, we now create some new problems and are left with some old ones:

a. The basic problem of the royalty system is only partially solved because a large share of the economic costs remains undeductible,

that is, the interest on the lessee's investment. This is normally a high figure compared with current operating costs because in this industry capital costs are very high relative to operating costs. As a result, there will still be some deadweight loss because some marginal opportunities will be made subeconomic and there will also be some leakage of rents because the basic rate cannot be set high enough to extract all the rent from the best deposits.

b. The problem of future shift, which is so exaggerated in the royalty system, is compensated for by cost deduction but not 100 percent compensated for. This point requires mathematical exposition and is treated in Appendix J.

c. There are new and formidable administrative problems in allowing cost deductions, several of which have been suggested above. Substantial staff will be required to frame the system properly in all its details initially and then to administer it. Administrative problems will resemble and approximate those involved in the corporate income tax. They might be considerably ameliorated by legislation requiring disclosure of corporate income tax returns to DNR personnel. This is not altogether on the negative side. Information about the costs of the industry would be of great aid to DNR personnel and administrators in performing their functions effectively. On the negative side, the industry would avoid such exposure and this might reduce bids.

d. The slow recovery of capital allowed, which is an inherent feature of this system, will be harder on the leaner firms which we want to encourage. Of course, the fact that some capital is recoverable is

attractive to all. The fact that it is recoverable only slowly is more acceptable to the richer firms than it is to the leaner ones.

e. The ability to deduct exploratory costs is not worth much where the probability of success is low. Thus, if the success ratio is one in ten, only 10 percent of the preproduction exploratory costs will ever be eligible for deduction. On the other hand, the costs of working over a producing field would all be deductible. This constitutes a large bias in the treatment of different kinds of costs and different parcels, which would need to be compensated for although there may be no simple and administrable way of doing so. It constitutes a serious drawback to a parcel-by-parcel system.

f. There will be some padding of costs and some gold plating which will leak through our best efforts to prevent them. These problems will be greatest on drainage tracts where production is a sure thing. Professor Rooney indicates that padding of costs is a very serious problem in the profit share leases in Long Beach, California.

g. If there is no inflationary adjustment made, the actual capital recovery allowance will be less in constant dollars than the amount of capital invested.

h. The allowance of fixed capital recovery has a negative leverage effect on incentives. It is the opposite from a regular fixed charge which has a positive leverage effect. After the lessee has recovered his allowable capital quota for the year, his incentives will be less. And after he has recovered it for the life of the deposit, his incentives will be permanently less. This pattern is bound to create some distortions.

Another and very different approach to profit sharing is through the State's taking an equity participation in one or more private corporations, as Canada has done with Panarctic Oils and Great Canadian Oil Sands, Limited. This does not directly solve the problem of land disposal, however, unless the State secures its equity by trading land for shares in the corporation. This, however, then makes the State a partner in all the affairs and ventures of the corporation around the world and gets far beyond the basic question of leasing policy which this study addresses.

A distantly related proposal is that offered by Phillips Petroleum that the bonus bid should be recoverable by the lessee as a deduction from royalties. This would either constitute a net cost to the State or else result in higher initial bonus bids in anticipation of later recovery. The latter has no particular advantages and would raise the bonus higher than otherwise and worsen the problem of the front-end filter.

7. Rent-sharing

We have seen how the landlord may share the lessee's costs in effect by letting him write them off against royalties. We've discussed profit sharing where the lessee may write off his operating costs and also his capital costs. The next and last logical step is to let him write off interest on his capital costs as well. What remains, then, for the landlord is the net contribution of the land; that is, the contribution to output which may be attributable to the resources which the landlord contributed. In theory this divides the product exactly as it

should be. The lessee gets a return in proportion to his investment and the landlord gets a return based on the value of his contribution. The question is whether this theoretical ideal can be approached in practice.

There are three basic approaches which are sufficiently different that we will discuss them separately:

a. Guaranteed rate of interest

In this scheme the lessee may deduct from his royalty base the operating costs, the capital costs, plus interest on unrecovered capital. The interest rate would be set at some market-derived figure like 8 or 9 percent. The capital could not be written off immediately. It would have to be depreciated over several years. There are many alternative rates of depreciation and many alternative ways of selecting the life over which capital may be depreciated. Were we to opt for this alternative, we would have to give detailed consideration to the complex choice of depreciation paths and life. An extended discussion of this is premature at this point, however. We would also have to decide whether to allow carry-forward of unused depreciation in years of no production.

b. Front-end recovery of capital

We can let the lessee have the first cut at production, letting him keep the entire proceeds until such time as he shall have recovered all of his deductible capital expenses. In a flush producer this will occur so rapidly that the question of interest rate is not critical. His capital is tied up for such a short period that interest on it is not a large amount. Following this, the State takes the lion's

share of the operating profit, leaving 15 or 20 percent to the operator as an incentive. There will be a bid variable, probably a bonus, to soak up any residual net advantage which operators anticipate.

(An unnecessary variation on this scheme would be to let the bonus also be deductible. As discussed in Section 6, this merely adds to the capital which the lessee has to put in and take out without achieving any particular purpose. Another elegant variation would be to let operators write off their capital outlays against the bonus. This, too, would result in inflating bonus bids and simply constitute lost motion with little net effect. We do not, therefore, discuss these bonus recovery options any further.)

c. Ad valorem charge based on reserves in place

This method has been alluded to earlier in Section 3, dealing with rentals. Like a rental it is based on time rather than production, but unlike the traditional concept of a delay rental it is not determined simply ex ante or per acre, but is based on a continuing assessment of the capacity of a reservoir to produce. It is determined ex post the disclosure of reservoir contents rather than ex ante. Therefore we continue and complete the discussion of it in this section.

There are pros and cons of rent sharing by whichever of the three methods, and then they have their individual pros and cons. First we consider all three collectively. On the positive side, they all have the following benefits:

1. There is a theoretically attainable degree of perfection where there is no deadweight loss. This theoretical perfection is not

attainable in practice but is worthy of note because other systems would impose deadweight losses on the State, even if they could be perfectly administered at zero cost, because of fundamental conceptual defects. In the rent-share schemes every cost of developing any resource is deductible. On marginal resources where the costs just equal the gains the rent share equals zero, so there is no charge levied to have a disincentive effect on the producer.

2. The counterpart of zero deadweight loss is zero leakage of State income into private hands. This again presupposes perfect administration and administrability. Rent is exactly the income properly attributable to the State's share in the joint effort, that is, the share contributed by land which the State owns.

3. The rent share is progressive with respect to profitability, like the profit share, only more so. Oil produced from strictly marginal deposits where costs equal gains yields the State no share whatsoever. But oil produced after the lessee has recovered his capital from rich tracts goes nearly 100 percent to the State. The State gets a higher share from the more "profitable" -- only now we should say "rentable" -- deposits because the basic rate can be so much higher. By virtue of allowing the deductibility of all costs, including interest on investment, we can now increase the basic rate nearly to 100 percent (subject to administrative feasibility).

Ideally, the State's share will be progressive only with respect to that profitability that derives from the land input. Extra profits that come from more efficient management, cutting costs and so on

should accrue to the operator. Whether this can be accomplished depends on how effectively we can audit the deduction of costs. Under alternatives (1.) and (2.) especially, this poses serious problems which we discuss later.

4. Rent sharing is based on ex post disclosures of the outcomes of exploration rather than ex ante guessing.

On the negative side, there are these problems:

1. Rates must be much higher than under other systems. This accentuates incentives to evade, and it makes all valuation questions more critical.

2. By virtue of its efficacy in collecting rents, the system reduces incentives for preleasing exploration. This forces us either to provide substitutes or to come to a decision that the present level is economically excessive and costly. Even if we do so conclude, this will leave a number of firms with a substantial investment in preleasing information subject to some capital loss, which they will resist.

a. Capital recovery with fixed interest

The proposal is to let the lessee write off capital investments against royalties at so much per year. He may write off capital together with interest on unrecovered capital at a fixed rate of interest like 8 or 9 percent. The advantages of this arrangement are the following:

1. The State starts recovering money right away. The lessee's capital continues to work for the State and the lessee remains entangled for a considerable period of time.

2. There is an upper limit on what the lessee can get. He is guaranteed a reasonable rate of return on his investment and little more. He is not relieved of all risks because the guarantee depends on production.

3. In case the State's share is left too low, there is a safety valve in the fact that there is still a bid variable, like the bonus, to soak up any excess of expectations.

4. The guarantee of interest reduces risk, and so reduces any risk premium needed or alleged to attract capital.

5. Full cost recovery with interest eliminates the tendency to slow down production which the royalty imposes (Appendix J).

6. There is no intertemporal bias against early costs incurred long before there is income from the lease. Exploratory drilling is recoverable. Compound interest accrues and may finally be recovered. (This does pose severe auditing problems, however.)

7. There is no temptation to pad capital costs in the declining years, because they can only be taken at so much per year.

Disadvantages are the following:

1. Padding expenses and gold plating. With a high basic royalty rate and generous deductions allowed with interest, the temptation towards boondoggling is at a maximum. The landlord may expect severe problems of monitoring, surveillance and evaluation. This system makes a lessee think and act like a regulated utility. This probably gives some practical notion of its impact. We have learned to survive with regulated utilities even though utilities pad their rate bases. We might similarly learn to survive with this system, in spite of its problems.

There are special aggravated problems in remote areas where "base maintenance," rather than drilling per se, is the largest cost. "Base maintenance" comprises a wide range of the necessities, amenities, follies and recreations of life, a bottomless sink of unauditable expenses.

Just as with profit sharing schemes, there is underrecovery of capital on long-shot, wildcat acreage. The British and Canadians have tried to compensate for this by extending somewhat beyond the individual parcel the area in which accounts may be consolidated, so that the costs of losers may be written off against the gains of winners over some considerable area. They call the boundary of this area the "ring fence." They are vague about how this fence line is drawn. Their system delegates more arbitrary power to civil "servants" than ours does, and may not be tolerable here (or there).

To be sure, federal income taxation contains a bias in favor of risky ventures; leasing upon industry demand, as Alaska has done, has a similar bias. It is difficult to evaluate countervailing biases and this has not been undertaken. If this idea is one that the Legislature wishes to pursue such an investigation would be desirable.

3. The guaranteed interest rate is the same for all firms regardless of their own cost of capital. This is a relative advantage to the wealthier firms whose cost of capital is lower. It is not as great an advantage, however, as that in the bonus element, because the discounted present value of the bonus is derived by discounting all future revenues, not simply those imputable to the lessee's capital.

The lower cost of capital to larger, wealthier firms may be inferred from data in Appendix K. Larger firms make less use of their credit ratings than smaller firms do, even though the credit ratings are better. This is to say that the larger firms could, if they wished, borrow a good deal more at 7.5 or 8 percent but are choosing not to. This displays the presence of internal funds such that the internal cost of capital is no greater than 7.5 percent.

b. Front-end recovery

The proposal is to let the lessee recover his capital at the front end before the State gets anything. The lessee recovers his capital with maximum feasible speed. His stake is in and out s rapidly that it need earn little interest.

The advantages are the following:

1. The incentive is towards haste. The lessee will not dawdle just to have interest pile up. He avoids interest costs by minimizing the period of capital commitment rather than writing off interest at a given rate.

2. There is reduced temptation to pad the early, preproduction outlays, because no interest is allowed. Exploratory drilling is already largely expensible for federal tax, and further temptation by the State might be redundant.

3. There is minimum feasible risk imposed on the lessee except as before where there is wildcat acreage.

4. This system favors the leaner firms. It shifts payments into the future more than any other system. The lessee owes the State

nothing until he has recovered almost everything -- everything that is his.

5. Lessees' capital is kept working in the industry, going in and out in a rapid reciprocating movement. A maximum of work is performed with a minimum of capital tied up. Small firms, particularly, depend on high capital turnover.

6. There is no need to determine depreciable lives and depreciation paths.

7. There is no inflationary leakage because so little time passes between investment and recovery.

The negative points are the following:

1. The premium on early inception may be excessive and in some cases cause wasteful haste. Presumably this could be controlled.

2. There is no explicit provision for the lessee's receiving interest on his capital. He would, however, adjust for this by reducing his bid (for the bid variable, whatever that might be). The best arrangement probably is for the State not to try to capture 100 percent of the cash flow after capital is recovered but to set the rate at 80 percent or so, leaving the bid variable to soak up the remainder.

3. The nominal royalty rate will be extremely high. This will lend itself to exaggeration and misinterpretation by critics who might succeed in having the system changed after the lessees had already recovered their capital, resulting in severe losses to the State. There is no protection against this other than widespread understanding.

4. The problem remains of a bias against wildcat acreage and other long-shot acreage. If the system is attractive enough on other grounds, some means could probably be devised to compensate for this. It would have to be something other than simply letting large firms pool their entire accounts within the State, because this contains a built-in bias in favor of the larger firms just as the corporate income tax does.

5. The temptation to expense dubious capital outlays against any flush producer is overwhelming, posing a severe auditing problem. To be sure, the auditor must be shown that the capital is to be productive on the same parcel, with its diminishing returns from a limited resource. So the possibilities of fraud are finite. In addition, this encourages intensive infilling and development as opposed to overdecentralization, probably a needed antidote to other biases. But this remains a drawback.

c. The ad valorem charge (AVC)

We touched on this method earlier in Section 3, the discussion of rentals, because it has some of the character of a rental, being an annual charge independent of production. We continue the discussion here because it also is a device for sharing rent. The ad valorem charge or AVC resembles a property tax. It consists of a base which is the current appraised value of the resource; and a percentage rate. The charge is the product of the base times the rate. The rate is high and common to all. The base varies from zero up to very high values for superior deposits.

The advantages of this leasing element are the following:

1. It cures the major fault of a high bonus by shifting payments into the future.

2. It cures the major fault of delay rentals by depending on ex post disclosures of what the ground contains rather than ex ante estimates made in the dark.

3. It cures the faults of a high royalty by not varying with production and by allowing for cost differences automatically in the evaluation procedure. That is, high-cost production carries a low AVC base. (In the extreme a marginal deposit has no value at all and hence there is no ad valorem charge.) As a counterpart, AVC minimizes the leakage of rents from low-cost resources out of the State treasury. They carry a high AVC base; and the common rate is high.

4. It cures the fault of profit sharing by allowing interest on the lessee's capital, again automatically in the valuation process. The "automaticity" depends on the appraiser's having proper legislation to work with and upon the legislation's having competent appraisers to implement it, so it is only automatic on the assumption of careful preparation and continued vigilance. The present point is that an appraisal of the resource in situ is always made net of the full costs of developing it and one of these costs is interest on the capital required for the purpose.

5. This lease element cures the fault of other rent-sharing techniques by having no place for padding costs or gold plating. A lessee cannot reduce the assessed value of his property by overdeveloping it. The major risk indeed is the reverse. He might inadvertently get it

increased that way, although this would constitute an error in administration rather than the intent of the system.

The intent is that the appraiser would calculate that schedule of production which maximizes discounted cash flow (DCF). He would value the deposit based on the assumption that that schedule was followed and that only those costs were incurred which were necessary to follow that schedule. Incurring additional costs would not lower the valuation, nor increase it either.

There should be no difficulty about recognizing this concept and procedure because it is what any buyer in the market place goes through when determining what to pay for bare land; and it is what any appraiser goes through when estimating what a market price would be, based on highest and best use.

6. AVC cures the fault of noncompetitive leasing, which is to overstimulate investment in exploration (which occurs whenever landlords fail to collect rent). A concern is that it might overcure the problem, leaving us with inadequate exploration. This is considered further on the negative side, and also in Section II on how to motivate exploration.

Overinvestment in exploration is just as much padding and gold plating as any other kind of overinvestment. It is insidious and seductive because it is invisible and hard to evaluate, and because there is in the "cultural subconscious" a proexploratory bias. There is also a federal tax bias for exploration to which the State need not add.

Nevertheless, one could go too far, and we must be careful to preserve enough motive to explore. There are several possible ways of

doing this. One would be to let the lessee recover his postleasing costs of exploratory drilling before the ad valorem charge is imposed. Other options are discussed in Section II.

7. Like options a. and b., this method of rent collection is progressive with respect to rentability -- the State gets a high share per barrel from rich deposits and little or nothing from marginal deposits. This option scores better on this count than the first two because of the absence of padding and gold plating (which would dissipate rent from richer deposits).

8. Because of advantage #7, this method permits the State to schedule the timing of lease sales in an optimal way, and to get more money from bid-variable-bonuses. Compare it with a high royalty rate. A high royalty rate means that at the time a deposit has risen to marginal status (owing to increased prices or any other cause) it is still worth less than nothing to a lessee after paying the royalty: yet it has a large positive value to the State, or would have if the State could induce a lessee to produce it. This gives the State an interest in selling leases at a time when lessees have little interest in buying them.

This in turn puts the State at a bargaining disadvantage at the time a lease is sold. When, on the other hand, the State's share is based merely on the net value of the resource, the State has an accurate criterion to follow in timing leases. Maximizing the DCF of the State is now socially optimal. This point is discussed in more detail in Section D below.

9. Where the AVC element is large, and appraisals are kept current (as they must be), the State assumes almost all the "passive" risks. Those are the risks imposed by price changes, cost changes, and changes of market interest rates. When prices rise, valuations rise and vice versa. This is appropriate since price basically affects the value of land which is the State's contribution. This also removes a good deal of risk from the lessee. It accomplishes for the lessee just what a perfect hedging market would accomplish.

As to interest rates, when market interest rates rise the capitalization or "cap rate" used in valuation should rise, too. This lowers the valuation and reduces the tax. Mathematically, it reduces the valuation exactly by that amount required to let the lessee continue to earn a market rate of interest at the new market rate. The mathematics is shown in Appendix H.

This is quite an important feature whose importance might not be as immediately obvious as the price hedging feature. It makes the investment less risky than investment in a government bond with a fixed coupon. When market interest rates rise, the value of fixed coupon bonds falls below par. Under the AVC system a rise in market interest rates does not reduce the valuation of mineral deposits by nearly the same amount -- the State's claim falls, protecting the holder from the same degree of price risk that he would experience with a government bond.

Both these features would be attractive to risk-averse investors. This probably would increase the number of bidders for State lands.

10. The valuations of reserves required to operate this system would constitute an inventory of proven reserves, an inventory much more accurate than what is available today and much more objective. This inventory information would be useful in planning community facilities, transportation, and allied infrastructure. The sum total of information known might be little greater than now, but it would all be of public record and centralized in one location and accessible to all State planning agencies as well as to private individuals, local governments, native corporations, and firms interested in exploration on comparable or adjacent lands. The benefits of better planning extend outside the State into consuming states and federal regulatory agencies which are concerned about supply adequacy when pipelines are authorized. This national interest in improved inventory would justify Alaska's requesting financial support for its program.

11. AVC is free from the fault of a royalty, that there is no early commitment. There is an immediate and growing commitment from the lessee to the lessor. This is accomplished without imposing such a heavy front-end load as the bonus does, but without deferring state revenues as much as front-end capital recovery would do. In this respect it is comparable to the Alaska tax on mineral reserves.

This time pattern may approach optimality in terms of the credit needs of all the parties involved, beginning from the assumption that it is desirable to encourage smaller firms as well as to prevent speculation and to protect State revenues. When we look at borrowing rates and credit ratings we note that small firms can borrow for short

periods of time at a small disadvantage compared with large firms. The greater disadvantage of small firms in capital markets is long-term borrowing. The present proposal calls for some short-term advance of capital by the lessee, but not very much in comparison with a high bonus payment.

A pure bonus bid would be derived by discounting future expectations over the next 30 or 40 years, including future gas production which may be way down the line. This means that the same 30 or 40 years will in general be required to recoup the investment. The unrecovered investment must be financed over that whole period. Access to long-term money is what gives larger multinational conglomerated firms their special edge in financial matters. The present proposal cuts deeply into the prospects of future gain from leases and thereby minimizes the need for long-term financing to purchase leases initially.

12. A minor and uncertain potential advantage is that under price regulation by FEA and FPC, with their "cost plus" philosophy, an AVC might be construed as a current operating cost and rolled into the price, in contrast to historical bonuses which might be ignored.

13. AVC moves into one of the largest loopholes in federal tax law, the exemption of unrealized capital gains. After discovery, and before production, there is a large increase in the wealth of the lessee. The increase is bankable and bondable and therefore realizable in cash, but not taxable. AVC, like the Alaska reserves tax, taps this unpreempted source of revenue.

By taking early cash from lessees this might seem to hurt the leaner firms, but not so: they are not asked for cash until they have a bankable asset to raise cash on. At this point they are on the way from lean to fat.

On the negative side are the following drawbacks:

1. AVC is not in common use. We would start near the bottom of a learning curve when introducing a new system. In addition, there must be a lingering suspicion that there could be some reason why it is not in common use.

Tempering this, however, the components of the system are in common use and are acceptable business practices. In 1973 five of eight majors operating in Alberta voluntarily chose an AVC in preference to increased royalties. (Alberta did not follow through.) The concept of a variable payment based on an index determined by fallible human beings is not uncommon. The variable rate mortgage has been successfully introduced. Another acceptable practice is setting farm rents in midwestern counties by "county average yields." This allows for the effect of weather fluctuations. Property taxation everywhere, of course, depends on assessed variations. Almost every investment everywhere in real estate is made subject to this hazard. While valuations vary in quality and complaining is constant, the system has lasted for 2,000 or 3,000 years and undoubtedly will continue. Mr. Paschall has explained how the system works in California and has emphasized that successful appraisal does not presuppose a 100 percent accurate estimate of ultimate reserves. Professor Adelman says "The development of known oil pools can

be calculated with tolerable accuracy even on the basis of incomplete data" (Adelman, 1969:26), and in his research has demonstrated how one can draw inferences from limited data.

Oil companies buy and sell their reserves, and also each other, based on appraisal. A frequent practice is to hire two recognized appraisers and agree in advance to accept the average of their two appraisals. In a recent case this resulted in a price increment of $6 million.[2] Loans and credit ratings are based on appraisals of property value and many outstanding contracts involve payments which are indexed or tied to the consumer price index or other price index.

The question is whether firms would have confidence that an objective assessment would be made by a State employee, and not whether such an objective assessment is possible or acceptable. It is up to the State, therefore, to set up procedures assuring objectivity. Judicial review is one of these and it might be desirable to create a court specializing in this kind of case, to be sure the judge understood the issues. This is the practice in Australian property taxation and is reported to work better than the use of general courts.

2. AVC is a tax on successful exploration to the extent that exploration identifies the reserve whose value is the tax base. Large private landholders in the lower 48 have sometimes deferred exploration in order to avoid property taxation, at least by their own account. This fault is not peculiar to AVC: any system of tapping revenues from proven

[2] The purchase of McAlester Fuel Co. by Alaska Interstate Co. for $45.8 million instead of $39.4 million originally announced (Wall Street Journal, January 6, 1977).

reserves is also a tax on exploration. The problem is worse with AVC, however, by virtue of its greater efficiency in identifying and capturing the rent of proven reserves. Other systems, by their very inefficiency and inaccuracy, allow a considerable leakage of mineral rent out of the State treasury, which in turn serves as an incentive for more exploration.

Preleasing exploration is not the problem, so long as there is a lease sale with a bid variable. The lease sale would provide the same opportunity as it does now for firms to limit the size of their bids in light of the need to earn a rate of return high enough to recoup investment in preleasing exploration. The problem centers about post leasing exploratory drilling.

To keep this problem in perspective, this problem concerns one-tenth of all costs. The Joint Association Survey reported the following breakdown of expenditures from its respondents in 1974. These respondents were estimated to comprise about 76 percent of the revenues of the industry in the United States (Joint Association Survey, 1976).

	Billion $	%
Exploratory wells	1.6	11
Acquiring undeveloped acreage	5.7	38
Geological and geophysical	.6	4
Development wells	2.7	18
Lease equipment	.8	5
Production expenditures and overhead	3.5	23
Total	14.9	99[3]

[3]Differences due to rounding

Ad valorem taxes, that is property taxes resembling in their impact our AVC, were included among production expenses and overhead and were equal to $.4 billion or almost two-thirds as much as was spent on preleasing exploration. Spending on exploratory wells is a substantial but not an overwhelming part of the total, being substantially less than the costs of development and production. While there is a problem to be solved yet, it is not as great a problem as it would be if exploratory drilling were a larger share of total costs.

A partial solution to the problem of motivating exploration adequately is simply to adopt a lower percentage rate for the charge.

Another mitigating factor is that deposits which are expensive to produce, and which therefore carry a low ad valorem base for the AVC, are on the whole the same ones that are expensive to find by virtue of being small, deep, remote and so on. AVC therefore does not take a large bite out of the value of deposits that are expensive to discover but mainly out of those that are cheap to discover. In this respect it is less discouraging to exploration than would be a royalty which raised the same total revenue.

This problem is further explored in Section 11. In general there is a choice to be made between leaving some rent as bait for explorers or paying for exploration by direct contract before leases are signed.

3. As with other rent-collecting devices, the AVC rate is going to be high; so all judgments and decisions are more critical. In order to work properly the system must be more fine-tuned than a royalty

for example. It is something like licensing surgeons to operate instead of giving aspirin. More careful training and control are called for, and personnel capable of more discriminating judgments. I would not overstate this point, because the judgments called for are primarily of one kind -- valuation -- and are subject to review according to preannounced objective criteria. Nor are they regulatory kinds of judgments which involve ordering lessees to do or not to do specific acts. They are nonetheless judgments and the consequences of error may be severe, and this must be reckoned as a fault of this lease element.

Another disadvantage of high rates is the ease with which they may be misinterpreted. A high rate on a small base raises no more money than a low rate on a large base, but more easily evokes images of confiscation. This problem may be ameliorated by using a capitalization rate rather lower than the 18 percent currently in use in the Alaska reserves tax. Eight percent, a market rate of interest, seems more reasonable today. Inflated capitalization rates are the same as underassessment of the base. As indicated, the State is assuming a large share of the risk under this system so that a low, riskless capitalization rate is appropriate.

4. The first few annual payments are preproduction. As compared with some other systems, therefore, this one has a larger front-end load. This issue is discussed under advantage #13.

8. Regulating field operations

In issuing a lease, the State reserves the right to regulate field operations in the interest of preventing waste. This primarily involves control over rate of flow, unitization and spacing.

a. Rate of flow

Where many independently owned tracts overlie a common communicating pool, everyone recognizes that some regulation of flow is needed. This is true even where production is not rate-sensitive, in order to obviate the excess costs of hyperaccelerated withdrawals. Even where physical waste is caused by rapid recovery, it may be the lesser economic waste: capital sunk in excess capacity may be the greater one. The most frequently heard rationale, however, is to prevent physical waste, because of the traditional overemphasis on physical waste. Whichever we emphasize, all hands can agree that some control is needed over rate of flow. This may be accomplished through total unitization, or through prorating allowable flows to individual wells and parcels based on an overall reservoir plan.

It would be most desirable to stipulate that the objective of such a plan, by whatever means administered, be to maximize discounted cash flow (DCF) rather than ultimate recovery. The latter is no criterion at all for reservoirs which are not "rate sensitive," and it is the wrong criterion for those that are.

In Appendix I we present discounted cash flow values derived from different production schedules for the reservoir at Prudhoe Bay as presented in the Van Poollen report. It is clear that the fastest option

which they presented is the one that maximizes the gross DCF without deducting costs. Information on costs is not given in the report. In Appendix I, however, we show what to do with such cost information when it is available. Shifting from the 1.2 MBD schedule to the 1.8 MBD schedule increases gross DCF by $5.6 billion when a 10 percent discount rate is used. All we need to do now is match this gain against the cost of additional wells required to achieve it. The number of wells and the cost per well are figures that knowledgeable people could supply readily. It is quite likely that they would be less than the gain in DCF, and therefore be justified (in the absence of major considerations not listed here). Even as we complete this Report, the operators are announcing their intent to increase capacity in daily flow towards the upper figure.

Appendix I indicates that optimal flow is not very sensitive to the rate of interest. The gain in gross DCF from speeding up flow is calculated over a wide range of interest rates and is not much affected. To the extent it is affected, the effect is the opposite from what one normally expects in other kinds of investments: at a higher rate of interest more investment in drilling wells is justified rather than less. Most long-term investments, of course, look worse at higher rates of interest. Investment in recovering minerals looks better, because we shift cash flow towards the present.

It might be thought that anticipated rising prices of petroleum products would reduce the optimal rate of flow. So they do but not by very much. The effect of well-head prices rising at 5 percent per year is the same as the effect of lowering the discount rate from 15

percent to 10 percent and Appendix I shows that this effect is not very great.

We must distinguish sharply, however, between anticipated rising prices and absolute high prices at a fixed level. While anticipated future increases tend slightly to reduce optimal flow, high prices today and continuing into the future (but not rising) increase the payoff from investment in additional wells and argue strongly in favor of speedier production. The existence of today's elevated price level, therefore, calls most urgently for review of traditional flow regulation based on MER or maximizing ultimate recovery. In the DCF analysis a slight loss of ultimate recovery is a minimal consideration. Even a substantial loss of ultimate recovery may be small relative to the interest costs of holding unproduced reserves longer than necessary. Tradition has elevated the minimal factor to a maximal and almost the sole criterion of rate determination.

Interest on assets which one owns is an "invisible" cost and all too easily relegated to the limbo of irrelevant, abstruse, philosophical speculation by those who don't actually have to pay it. Proper economy of valuable natural resources would be achieved if we regarded the managers as being saddled with a mortgage equal to the value of the resource, on which interest is due regularly, thus converting the invisible cost into a tangible, painful cash outflow.

A lessee, left to his own devices, will in his own interest act so as to maximize DCF. If the State prohibits this in advance of lease sale, it makes the lease that much less attractive. The cost of

this kind of regulation is thus borne by the State in lower bids. If the State imposes an uneconomical concept of regulating flow it has little gain to show for its cost. By the same reasoning, future leases can be sold at considerably advanced values if they are free from flow regulation based on the concept of MER.

Should the State decide to abandon MER, this also opens the possibility of renegotiating old leases. The State can calculate the present value to the lessee of being allowed to produce faster and offer to sell him that right for that price.

b. Unitization

Unitization may be partial or complete and it may be under the control of the operators exclusively or it may involve extensive State participation and surveillance.

There are advantages in keeping unitization partial. It is always tempting to view the potential gains from total rationalization of a large works project, consisting of many parts, but there is also the danger of losing individual initiative, enterprise and familiarity with the local scene; and there is the danger of doing too much at once. Not all producers are ready to move simultaneously, as we see today at Prudhoe Bay.

A two-tier approach is recommended, analogous to that used in irrigation areas for administration of aquifers overlain by many competing landowners, each with his own water pump. Landowners join in forming a water conservation district which is given the task of aquifer management, and certain powers over withdrawals by individuals. Water

conservation districts generally have inadequate powers, but an analogous petroleum conservation district in Alaska, beginning de novo, need not suffer such limitations. The State might initiate such a district for each communicating pool and make membership compulsory among its lessees.

The argument for this two-tier approach is weaker with petroleum management than it is with aquifer management inasmuch as we cannot visualize a water agency taking over the minutiae of operating every farm, where the water input is relatively much less important than petroleum to an oil firm. Even so, the Joint Association Survey data cited earlier indicate that development and production costs in field management outweigh exploratory well drilling costs by a substantial amount, and it might be letting the tail wag the dog to let unitization become total. Partial unitization could involve trade-offs and adjustments among separate lessees. Where wells need to be divided unevenly among tracts, cash payments could be made to compensate the losers from the gains of the winners. The same can be done when one producer is ready to go and another wants to wait. Whether this is a feasible and superior arrangement in the circumstances would call for extended study, so in this Report we advance the suggestion without endorsing it.

It is desirable as a general principle to minimize the intervention of State officials in decisions which might be left to operators in the field who have a proprietary economic interest in the outcome. The arguments for this are numerous and traditional and need not be repeated here. A great advantage of abandoning the MER criterion and substituting the DCF criterion is that it eliminates the conflict of

goals between the State and the lessees concerning flow regulation, thus making it possible to delegate fuller authority to the lessee operators themselves and minimize State intervention. The presumption today is that the State needs to prevent the operators doing something which is advantageous to them but somehow disadvantageous to the State. Things go better when we can presume that the operators are serving the public interest by attending to their private interests.

The State cannot impose unitization unilaterally where oil-bearing structures straddle the border with federal lands, to say nothing of subjecting federal structures to regulation by State officials. On the other hand, if communicating pools were subject to regulation by an organization of the operators, using a two-tier system like that suggested, it should make it easier to achieve successful unified management in the field. The delegation of operating control and planning to local organizations should obviate the question of which central agency is in charge.

Much of the above presupposes that the State accept DCF in preference to MER as the criterion for regulating flow. Let us therefore recap how we justify spending more money to speed up flow even when that will result in physical waste. Can we accept real physical waste merely for the purpose of saving something as vulgar as money, in a form as profane as interest, and as imaginary as interest foregone on investments which we might have made?

Say it costs $100 to discover $50 worth of oil in the ground. The world is telling us something by the way it prices petroleum, as well

as the resources required to develop it. It is telling us that the resources which we sacrifice to gain the petroleum are worth more than the petroleum. This is clear enough when the resource cost is materialistic in the form of steel and when it is personal in the form of labor. It is harder for some people to accept when the cost is entirely financial in the form of interest payments on a mortgage, but interest too is a real social cost.

Interest is the cost of getting your hands on wealth today which you do not own, in order to build something today which will yield you a much greater return in the future. Thus, if you put $100,000 into a building to be rented, you will get your $100,000 back in less than ten years, normally, in voluntary payments made by renters. After that everything is a surplus above the cost of production. Over a life of 50 years the unit will probably yield five or six times its initial cost in net cash flow to the owner. Thus, having wealth at your disposal today instead of years down the line is very productive, which is why interest is paid. The rate of interest is the rate of exchange between wealth this year and wealth next year. It is determined in the same kinds of markets that determine conversion factors between apples and oranges.

Economists and businessmen are saying we are in greater danger of running out of capital to develop resources, than we are out of resources in the ground themselves. There is nothing vulgar or profane, therefore, about economizing on capital in a resource-short world. Nor is there anything sacred about economizing on physical resources when the cost is wasting capital.

Let us consider the feeling sometimes expressed that there would be something prodigal about producing rapidly from proven reserves at Prudhoe Bay. A purpose of faster production at Prudhoe Bay would be to fill the pipeline and thus delay the need for new lease sales. The pressure will be on, obviously, to increase production from some source until the pipeline is full. By producing slower at Prudhoe, we would not reduce the withdrawal of petroleum from Alaska; we would rather cause some to be withdrawn from other areas instead. Speeding the flow from Prudhoe means getting the same flow from fewer acres and from a lesser investment in exploration, drilling and equipping wells, and equipping leases.

This is not to argue against advance planning to keep the pipeline full. It is, rather, a matter of planning to do so at the least cost. Doing anything at the least cost involves a small risk of not accomplishing the goal, but that is acceptable. Keeping the pipeline full is not an absolute. It is a desirable thing, if at a reasonable cost. What is required is a careful cost-benefit analysis of the whole picture. It would be a mistake to let leasing policy be dominated by any absolute commitment to keep the pipeline full regardless of cost. When we look at the chaos at the marketing end of the pipeline it would be ludicrous to demand absolute certainty at the production end at the expense of the people of Alaska.

c. Well spacing

This is largely the same issue as rate of flow. Higher flow rates require more wells, more closely spaced. It is not very fitting that the State of Alaska should impose wide spacing requirements on its lessees. This may be a throwback to another situation in another state where surface subdivision caused excessive well density, which had to be countered by public regulation. In Alaska the State is the landlord collecting royalties. The interest of such a landlord is to maximize the capital invested by the lessee. The royalty reduces the operator's incentive to apply capital, and this needs to be countervailed.

Closer spacing in addition to increasing rates of flow may also have some effect in increasing ultimate recovery. In fractured reservoirs with noncommunicating pools, this is obviously true. In other reservoirs it may be true. Little is published on this. It may be desirable for the State to commission a study on this subject: what is the optimal well spacing, well diameter, and rate of flow to be adopted, assuming that the goal is to maximize discounted cash flow net of costs? Most past analysis is not on target because it is premised on the goals of minimizing physical waste, and prorating excess capacity to market demand. Alaska, 1977, is no time and place to be invoking "standards" and going by the book when the standards and the books were developed for other conditions in other places and times.

It sometimes happens that regulators, operating under what appear on the surface to be counterproductive criteria, modify them in practice and make regulation work out better. We have not reviewed

actual procedures, and limit these comments to the criteria which appear to be followed as guidelines, whether by legislative mandate or professional tradition. No criticism is intended or implied of any individual or group.

9. Acreage reservation (checkerboarding)

The Alberta system of crown reservations has attracted considerable attention. Professor Andrew R. Thompson of the University of British Columbia Faculty of Law has been an exponent, although his enthusiasm is reported to be waning. Alberta, too, is modifying and backing away from the system. The concept as explained by Professor Thompson is for ". . . free entry on unproven lands under an exploratory reservation or permit which carries the right to lease, but requires that at least half the acreage, or some other fraction, be relinquished to the State on a checkerboard or corridor pattern after the lapse of a sufficient period of time for completing exploratory work and evaluation. Thus, it is the oil company that . . . must decide when and what to lease . . ." (Thompson 1969:86-87). An attractive feature of this system is, as Thompson points out, that it relieves State officers of a "tremendous burden of decision."

On the negative side, this may also relieve the State of a large quantity of oil since the State (or the Alberta crown) gets the leftovers after the lessee has picked the eyes out of the land.

It does seem advantageous for the Commissioner of Natural Resources, in his discretion, to lease out some areas for exploratory drilling while holding back adjacent and interstitial tracts for later

drainage sales to benefit from the spillover of exploration on the leased tracts. This is discussed further in Section D on the timing of lease sales.

It does not seem advantageous to let the lessee have the choice of lands to select. This is another "blunt instrument" whose results may be capricious and arbitrary. Since finer instruments are available, we do not pursue this further at this time. Authorities who have studied this subject in some depth are Professor Michael Crommelin, Faculty of Law, University of Melbourne, Australia; Professor Andrew R. Thompson; Dr. Campbell Watkins, Petroleum Consultant in Calgary; and Professor Anthony Scott, Faculty of Economics, University of British Columbia. For a fuller description of the Alberta system we are submitting along with this Report a copy of Crommelin, Scott, and Peter Pearse, "Management of Oil and Gas Resources in Alberta: An Economic Evaluation of Public Policy."

10. Sale of undivided interests

It has been proposed that communicating pools or even larger units should be sold as such, rather than as volumes of the earth's crust underneath tracts of land measured on the flat. There are certain advantages:

a. The "transactions costs" of negotiating among the several surface owners would be obviated. Unitization is inherent and automatic.

b. Small firms could take a small interest. The scheme allows for ownership to be divided into many units, let's say 100. Each bidder would indicate a price and also the number of units he wished to acquire

at that price. These would then be ranked in order of price until they added up to 100 percent. The winning bidders would then automatically become an operating consortium.

c. There is a dramatic reduction in risk, since offsetting risks are pooled. There is much less need for preleasing survey, therefore. The structure itself can be confirmed before there is great concern about just where upon it to take a position.

On the negative side, here are some considerations:

a. Entire structures or geologic features would have to be marketed at one stroke. The possibility of the State's withholding acreage for later drainage sale at high price is precluded.

b. The degree of centralized administration may be unnecessary, and the loss of autonomous action by the smaller individual firms undesirable. The controlling operator presumably would be the largest owner of shares and production would be presumably regulated more for his benefit than that of others. Smaller firms would tend to lose some freedom of action. There are alternative unitization methods available which do not impinge on freedom of action to the same degree (see Section 8 above).

c. Professor Rooney's analysis of the Long Beach case sheds some light on problems inherent in undivided interests. The dominant interest there evidently gains considerably by integrating the Long Beach production into its vertically integrated operation. If the smaller interests represented other firms their interests would tend to be neglected.

On the whole this represents an interesting possibility for solving one of the many problems of petroleum leasing, but it is neither broad enough nor promising enough to warrant further discussion in this Report of limited scope.

11. Handling information: generation, control and disclosure

Preleasing investment in geological and geophysical investigation accounted for 4 percent of the expenditures recorded by the firms in the Joint Association Survey (JAS Survey, 1976). For a fairer picture of the importance of these expenses we should multiply by three or so, to account for the time difference. These expenditures take place many years before the others do and before their results show up on the positive side of the income statement. Remember that money doubles every seven years at 10 percent. Then we should multiply by another factor because preleasing work is bigger in Alaska than the lower 48.

The industry pays these costs on the first round but the State inevitably bears them in the form of lower bids. Alternative methods of financing preleasing exploration have therefore been suggested. We will consider the existing system and a couple of alternatives.

a. The present system: open access to State unleased lands; timing of leasing dependent on industry initiative through the nomination system

Some advantages are the following:

1. It is hard for the State to play the sleeping landlord. Enterprising private businessmen are free to call the attention of State officials to economic opportunities.

2. Judgmental decisions are in the hands of highly motivated private firms. Several of them are in competition so that many concepts are applied to the same land by people who are rewarded by being creative.

3. The State does not have to bear the cost of conducting its own survey.

4. The system is time-honored and familiar and acceptable to the industry.

On the minus side:

1. Preleasing investment is another front-end filter like a high bonus. It is a tighter screen as well for the leaner firms, at least per dollar involved, because of the long waiting period between investment and recovery and the uncertainty of recovery. A firm possessing no real estate but only intangible wealth in the form of information is not very creditworthy, especially for long-term loans, so that this activity is nearly unfinanceable and requires equity capital. The advantage then is to firms with accumulated wealth.

2. Preleasing exploration adds no value to any real asset owned by the firm and therefore has to find its reward in the firms' acquiring State lands at a low value. An extreme case, of course, is the 1965 sale of 90 percent of the oil in the Prudhoe Bay field for $6 million. Application by the State of a low "discovery royalty" rate to early finds aggravates this situation. The State gets a lot of wildcat acreage surveyed in this manner, but there is no guarantee that the cost to the State is less than the benefit. It is more likely to be the other

way around. And the State does not get the information. (Nomination does not convey much information, because overnomination is the standard operating procedure.)

3. A counterpart to point #2 is that the firm with a large investment in preleasing exploration may neglect intensive infilling and development of acquired leases, and instead buy more leases. This is implied by the common allegation that many firms do not look at investments that yield less than 20 percent, even though they can borrow at 7.5 or 8 percent. The excess of 20 percent over 8 percent presumably reflects, among other things, some allowance to cover the overhead of preleasing exploration. But if a firm spurns investment opportunities on leases which yield less than 20 percent, it will not apply adequate capital to develop them. This would lead to a pattern of decentralization of development in the State.

4. Duplication and prematurity. Since access is open, the competitive edge in exploration comes only in part from doing the job better. In large part it comes from doing it sooner. The result is "soonerism," somewhat akin to behavior in the Oklahoma land rush when the race went to the swift. In addition, there is a certain amount of costly duplication, some of which may be justified and some of which has been prevented by cooperative line-shooting, but not all of which has been or could be eliminated.

Even where the lines are shot jointly, costly interpretations are duplicated many times without there being any occasion to ask if the first exploratory well might not be a cheaper alternative. By the

time many firms are interested in duplicating the same interpretation it is most likely that the existence of a structure is well known and the purpose of incurring this expense is primarily acquisitive and redistributive rather than productive: that is, it is a matter of jockeying for competitive advantage over other firms wishing to acquire the same resource rather than a matter of increasing the resource.

5. Each firm's information is held tightly secret. Secrecy is almost always counterproductive and expensive to maintain. Secrecy prevents any positive spillover value from information in advance of disclosure. State planning agencies cannot use it and environmentalists cannot use it. Peg Tileston, spokesperson for Alaska Center for the Environment, advises me that industry secrecy about future plans for activities with large environmental impacts ranks at the top of environmentalists' concerns and that full disclosure would go far towards abating many of these concerns. Tina Stonorov, Executive Secretary, Alaska Conservation Society, writes "Thorough public discussion of lease proposals . . . should precede every such decision. . . . If an area is so poorly known that . . . guidelines can't be written, lease sales are obviously premature" (Stonorov, 1976). These concerns are much aggravated by the fact that overnomination is routine on the part of many firms seeking to hide their real intentions.

6. The system is vertically integrated. The firms that explore and nominate a tract early have every advantage in bidding for it at the time, more or less of their choosing, when they nominate it and push for it to be auctioned. There are, to be sure, some firms which

specialize in preleasing exploration and acquisition and then try to sell their acquisitions to production and marketing firms. Such sales are, however, subject to taxation at that time, which the vertically integrated firm is spared.

7. Larger deposits are generally easier to find than smaller ones. This system draws most exploratory effort into the search for big ones where it is least needed and away from the smaller ones. An elephant in the bush looks much better than several birds in the hand. This reinforces the propensity towards decentralization.

8. Preleasing exploration does not necessarily or even generally increase the value of State lands. It may reduce the value if the absence of petroleum is confirmed. This information is of value to potential buyers but not to the State and the State need not feel obligated to pay for it.

9. State officials, to recoup losses, may turn around and knowingly sell bad acreage for h'gh prices as in 1969. It should, I believe, be considered beneath the dignity of a sovereign state, equipped with the powers and immunities of sovereignty, to withhold information that would prevent a businessman from damaging himself by bidding high for defective real estate. The sovereign should be above this game, not part of it.

10. Independent exploratory firms which acquire leases for sale to majors may be exploited by the latter's superior bargaining power.

Because of these several criticisms, alternatives have been suggested which we now consider:

b. Exploration by contract

The State may employ firms specializing in exploration to perform geological and geophysical investigations on the understanding that the results would be made public. Contracts might be drawn in a variety of ways with or without substantial bonus incentives, based on results of investigations. Professor Rooney suggests one method (Appendix G). The State would also do its best to secure greater cooperation from the U.S. Geological Survey, NOAA, and the Department of Interior in order to use information derived from federal lands to learn more about adjacent State lands. Cooperation with native corporations would also be desirable. The advantages would be the following:

1. Preleasing investigations would be unitized, obviating the cost of duplication. The State would recoup its investment in the form of higher bids and it shold recoup more than its investment because the bidding firms need not cover the overhead of their duplicative preleasing investments. Entry would be open to many more bidders, resulting in keener competition as well.

Once information has been gathered it costs little to disseminate it. It is a "public good" (a good which, once created, may be provided to any number of people at little extra cost). It probably costs less to publish data than to keep it secret. Some analogous cases where government publicizes valuable information are: weather reporting, earthquake fault-mapping and prediction; navigation aids; road maps; public land survey; the Torrens system of land title registration used in Canada and Australia; farm market reports; farm extension services; public health information; and public education.

2. The State may control timing of lease sales better, reducing industry initiatives with demands for premature nomination. In order to time lease sales in an economic way, State officials need have some basis for predicting expected sale proceeds and this procedure supplies them some of that information. The State at the time of sale can set its own reservation price as well.

3. Contracting explorers would come from the same geo-data industry that presently exists in firms now doing contract work for the industry.

4. The State's exploratory function would not be preclusive. Any firm that can do the job better still has the option of doing so. Thus, while it may be true that the Postal Service is unenterprising, this criticism should be directed against the Post Office and not against the present proposal, which does not contain any prohibition on competition.

5. There is no built-in propensity towards underpricing or overpricing leases, as with the present system. All parties on the buying and selling sides have available all the information that there is.

6. A substantial barrier to entry would be eliminated. Many more firms could bid on any given lease. The State itself would also become an effective "bidder" in the sense that it could set an affective reservation price. Leaner firms have a greater need for foreknowledge and a lesser ability to finance it.

7. The State would assume the riskiest element in the petroleum business, a risk it is able to bear because of its diversification, and a risk which it should bear because the risk is inherent in the land which the State owns.

8. Contracting exploratory firms will be motivated by a desire to enhance their reputations and get future contracts. In addition, various bonus and incentive systems may be adopted which reward them with percentages of what they find.

9. The problem of secrecy is dispelled. Planners and environmentalists can know as much as anyone about what is planned and what is going on.

On the minus side, here are some weak points:

1. Firms in the geo-data industry are not used to allowing disclosure.

2. Incentives are less acute than when the firm is gambling its own money. In the extreme, we might visualize a group of long-haired geology professors out practicing art for art's sake, mindless of any payoff.

We might alleviate this problem by spelling out objectives clearly, keeping contracts short, and shifting away from poor performers. We could give performance bonuses based on findings, even though we know this is a function of what there is to find as well as the skill of the finder. At least we would not be giving it all away in order to get it found.

We could allow two or more contracting firms to explore the same ground, provided we had some rational reason based on evidence to think that might be worth the extra cost (as opposed to the present system of letting all comers in regardless of any evidence of productivity) and the door is always open to others if the government is botching the work. Experience would soon show if officials were capable of being productive. Competition and exposure would stir them up, too -- pride of performance is an important element in competition, regardless of remuneration. Most workers in competitive industry also work on fixed salaries.

A variation of the contract system is the Alberta practice. The province contracts with private firms to put up 30 percent of their costs in return for which it gets their information after a lapse of one year. The Province can, but normally does not, publish the information before a sale of the land in question. Canadians are great compromisers and this system appears to compromise between two or three different principles. The results, we may surmise, will be equally mixed.

Another variation is the incentive-bonus contract. Instead of paying the exploring firm a fixed fee or a cost-plus fee, we may reward it with a percentage (or other function) of the value of its findings. This is similar to the contract system except with greater performance bonuses built into the contract, and lesser cost-plus payments.

Either method has the advantage that the State breaks into a joint in the vertically integrated industry and creates a market at that joint. In this case it is a market for the "products" of exploration

firms. It gets the job done cheaper and without giving away its right to dispose of the resource once its outlines have been discovered.

Incentive-bonus has the advantage of keying motivation more to results. It has the disadvantage that the value added by exploration depends on luck. No matter how skillfully you search and how hard you work you cannot find what isn't there; while a fool may stumble on an elephant in the dark. A good job of exploring barren land will reduce its value by confirming its barrenness. It is hard to find a system for rewarding the effort of exploration on small tracts on an incentive basis.

There is a federal tax problem, too. Cash rewards paid out become ordinary taxable income in contrast to capital gains, only 50 percent of which would be taxable, and in even greater contrast to unrealized capital gains enjoyed by vertically integrated corporations which are not taxable at all. The weight of bias in the federal tax system would work against this proposal. Simple contract exploration doesn't share this fault in the same degree, since the capital gains would be realized by the State which is not taxable. While we should in general be chary of exploiting the State's nontaxability, in this case it seems justified in order to offset the special tax privilege accorded to private firms which are vertically integrated.

Another approach which becomes feasible in the event that we announce our intention to recapture the lion's share of any findings (by any of the various methods described in earlier sections) is to abandon the distinction between preleasing and postleasing exploration. We could

divide State lands into large tracts and lease them as wildcat acreage. In order to be sure that lessees were highly motivated we would subject them to a delay rental which rose annually at an increasing rate or a constant percentage rate of about 10 percent per year. This would assure that no one took out any such lease without exploring diligently.

Instead of the delay rental we might use the shrinking concession as Iran does. Iran progressively takes back a percentage of concession acreage after five, ten, and finally, twelve years, charging $3.00 per acre year in the meantime.

Another variation on this plan would be modeled on the proposal frequently made and sometimes implemented to base property tax assessments on self-assessment by the landowner. In this case the leaseholder would set his own delay rental, which would be considered an Ad Valorem Charge at a specified percentage of a base value. To prevent his setting a low base value, the lease would contain a reservation stipulating that the State might repossess it for the base value declared by the lessee. Another reservation would open the area to exploration by others who might acquire the lease from the sitting leaseholder by paying him his declared value plus 15 percent. The idea is to allow a reasonable security to the leaseholder but to keep everyone on his toes and avoid exploiting the State by underpayment.

There is little doubt that such a system could be made to work, even though it is novel and would require much explanation and discussion. Among its prominent advocates are Professor Arnold Harberger, University of Chicago, and Professor Daniel Holland, editor of

the National Tax Journal. At this point we merely pose this as a beguiling alternative without lengthy discussion.

d. Postleasing incentives

All systems that take a bite of mineral rents based on ex post disclosures have some tendency to discourage postleasing exploration, primarily exploratory drilling. This is no problem with the bonus system or with delay rentals. A high royalty rate still leaves an incentive to explore for large, rich deposits which still will yield a surplus but biases exploration away from possums in favor of elephants. Profit-sharing and rent-sharing schemes allow the deduction of exploratory outlays, solving the problem but creating another problem of padding.

The Ad Valorem Charge, in most ways ideal, may leave inadequate incentive for exploratory drilling. We can now see several solutions to this problem. One is to allow a deduction for drilling costs, guarding as best we can against padding of costs. Second is the use of high and rising delay rentals. The level of such rentals might be the bid variable. This has the advantage over the first method of raising money instead of giving it away. Third is a time limit on leases. Fourth might be a reservation by the State, in its capacity as assessor, of the right to enter the leasehold to investigate sections not being actively produced. It could also reserve a right to repossess them for the purpose of resale to others.

12. Sale of fixed volume

The State might contract with lessees to sell them a specified volume of oil, subject to the lessee's finding it at the lessee's expense. After the lessee had withdrawn the specified quantity, the lease would terminate and possession revert to the State for future resale, along with capital invested by the lessee. All information generated by the lessee would belong to the State.

The purpose is to get the State's land explored at a reasonable cost without having to give away or sell below value those few extraordinarily valuable deposits.

The effect of the proposal would be similar to paying explorers a fixed finder's fee for any commercial deposit, regardless of its size. It has the advantage that there need be no dispute over whether a deposit is "commercial" or not. The lessee would search until he found one that he himself considered commercial.

The proposal seems potentially workable. It is, however, novel and untried and, insofar as we are aware, undiscussed. It contains several possible pitfalls to guard against, all of which would require further analysis. We omit further discussion here, leaving this for future study if there is interest.

13. State intervention

The State cannot achieve its goal of business-like management without knowing a great deal about the nuts and bolts of the industry with which it is dealing.

On the price side, almost all leasing schemes presuppose accurate knowledge about price. Internal transfer prices of vertically integrated corporations can rarely be taken at face value. In addition to the obvious kinds of fiddling which are possible and frequently discussed, there is the question of volume discounts. There may be a spot market for petroleum at a considerably higher level than the price for firm wholesale supplies. There may be independent refineries that would pay a higher price than the major firms' internal transfer price. What, then, shall we consider the prevailing price?

In a perfectly competitive industry we would find a central market somewhere in which we could have some confidence. In an industry dominated by vertically integrated firms, where oil is frequently swapped for oil rather than for money, where certain markets are dominated by a small number of refineries and marketing networks, these questions assume great importance. The question of marketing is beyond our scope, but it seems obvious that the State would benefit by moving aggressively and definitively in this area to preclude its being exploited by under-pricing. A very productive use of royalty oil might be to supply a state marketing agency to "test the waters" and find out what price might be fetched by independent oil offered outside of regular marketing channels.

The possibility should not be overlooked, particularly with natural gas, of dealing directly with governments of the consuming states. These governments, after all, regulate the distribution of gas within their boundaries. California has taken some halting steps in the direction of looking into securing its own supplies of gas reserves.