

# Workshop in Political Theory & Policy Analysis

W87-18

8/21/87

## MICRO-CONSTITUTIONAL CHANGE IN A MULTI-CONSTITUTIONAL POLITICAL SYSTEM

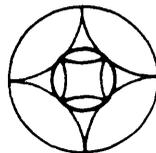
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Paper to be presented at the Conference on "Advances in Comparative Institutional Analysis" to be held at the Inter-University Center of Postgraduate Studies, Dubrovnik, Yugoslavia, October 19-23, 1987, and the Conference on "Constitutional Design, Constitutional Reform, and Liberty in Canada" to be held at The Prince of Wales, Niagara-on-the-Lake, Ontario, November 6-7, 1987.

The ideas in this paper have been developed as part of the CPR project at the Workshop in Political Theory & Policy Analysis (supported by USAID Grant Number DHR-1066-GSS-6042 and NSF Grant Number SES-8619498). I am appreciative of the many contributions made to my own thinking by William Blomquist, Roy Gardner, Edella Schlager, S. Y. Tang, and James Walker both in extensive discussions and in their critical review of the first draft of this paper. I am also appreciative of the extensive comments made by Roger B. Parks and Vincent Ostrom.

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**1. A Different View of Constitutional Choice**

The American and Canadian systems of governance are characterized by many constitutions rather than one constitution. A necessary condition of a federal system is the existence of more than one constitution. In the United States, it is difficult to estimate how many governmental constitutions actually exist. One national and fifty state constitutions head the list. Within most states, numerous constitutions are embedded in organic legislation authorizing the establishment of counties, cities, and special districts and specifying the set of decision rules to be used in establishing, operating, and terminating these units of government. In home rule states, many localities devise their own constitutions (charters) in addition to those that have used pre-designed constitutions available through organic legislation. Special districts have been established with their own charters defining the limited rights and duties of citizens and officials included within those jurisdictions. The number of independent, actively used, public-sector constitutions in the United States today is in the thousands.

The meaning of property ownership in the United States -- a right considered to be constitutionally protected -- does not depend upon one national constitution nor even upon one state constitution. The rights and

duties of a property owner depend on several layers of rules that together define which actions a property owner can take in relationship to a resource (and, thus, which actions other persons are obliged to allow an individual to take), and which actions may or may not be taken. In many localities of Northern California, for example, anyone who owns land, may sink a well on their own property to obtain water for their own use. In parts of Los Angeles County, on the other hand, land ownership no longer includes the right to drill a well. In neighboring Orange County, a land owner may drill a well, but will be required to pay a substantial "pump tax" on each acre-foot of water produced. The differences in the property rights of the California residents are not due to provisions of national or the state constitutions nor even to those of a county or a city. The differences are the result of basic constitutional rules embedded in negotiated settlements formulated as court decrees and the charters of several special districts.

In a federal system that allows for considerable self-organization by citizens confronting particular problems, constitutional creation and reform occurs frequently and involves groups varying in size from very small to very large. Some of the most effective constitutional contracts are negotiated, in fact, by small groups of individuals who are jointly dependent on resources that have particular spatial, temporal and environmental characteristics that differ substantially from one locale to another. Efforts to design a single constitution to define the property rights for an area composed of diverse physical environments, demographic characteristics, and cultural traditions may produce an ineffective set of rules for all but a few conditions found within that area.

Formulating and revising constitutions at less than a national level has largely been ignored in the political economy literature. Constitutional processes themselves have not received much analytical attention with the notable exceptions of James Buchanan, Friedrich A. von Hayek, Albert Breton and Vincent Ostrom. The emphasis in much of the recent work on constitutional choice has related almost entirely to national constitutions and not to the constitutional processes in multi-constitutional political systems.<sup>1</sup> In this paper, I wish to reverse this focus and examine micro-constitutional situations that are embedded in multi-constitutional systems.

I will examine a particular type of micro-constitutional choice -- the situation facing a set of individuals or firms who jointly use a common-pool resource where there is rivalry in appropriation leading to suboptimal outcomes. The individuals involved in such situations (or an external authority) are faced with the need to renegotiate (or impose) a revised set of basic rights and duties. Otherwise, individuals following their short-term strategies will continue to produce, in the operational level of this situation, a suboptimal equilibrium from the perspective of the user community. The users may destroy a resource that they would have preferred to have saved. They may dissipate potential rent they could have earned; or they may invest at a suboptimal level in the maintenance of the resource itself.

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<sup>1</sup> Since much of this work has been written by economists, this reflects the almost exclusive focus in economics on the government. As Sugden recently commented, "Most economic theory describes a world presided over by a government (not, significantly, by governments), and sees the world through this government's eye (Sugden, 1986: 3).

Several reasons exist for this focus on micro-constitutional choice related to common-pool resources. Some reasons are related primarily to methodological problems of concern to scholars. Others are related to substantive concerns about how best to organize a self-governing society. Given the novelty of this approach to constitutional choice, I will discuss both the methodological and substantive reasons for taking this approach.

### 1.1 Methodological Reason for Studying Micro-Constitutional Situations

Constitutional processes are difficult to understand in any setting. Constitutional rules are meta-meta-rules. That is, constitutional rules govern collective choice processes which, in turn, govern operational choice processes. Constitutional rules are rules about rule-making. Constitutional rules have direct and indirect effects on the structure of rights and duties faced by individuals engaged in operational choice. Rights defined directly and protected by a constitutional contract imply that collective choice mechanisms may not change these rights. Thus, in the United States, the "right to free speech" is "protected" in the First Amendment stating that "Congress shall make no law . . . abridging the freedom of speech. . . ."

The structure of operational choice situations is further affected by constitutional rules that state who has the authority to make collective decisions and how those decisions are to be implemented by the procedures and decision rules to be used for those purposes. To study the effects of constitutional rules, one must ultimately work through at least two levels of analysis: (1) how constitutional rules affect collective choice processes and (2) how constitutional rules and collective choice rules together affect collective and operational choice processes. The larger

and more complex the setting, the more difficult it is to understand either how constitutional rules operate or how individuals who are engaged in constitutional choice actually make such complex multi-leveled decisions. When studying complex processes that are poorly understood, a useful scientific strategy is to identify for intense study the simplest possible system where the process occurs in a clarified form. Considerable scientific progress in the biological sciences has occurred as a result of the selection of an appropriate organism for studying a particular type of process.

Micro-constitutional processes related to the use of common-pool resources (CPRs) by a collection of individuals or firms involve all the elements of constitutional choice situations in simple and clarified form. To understand complex processes of interdependence, one wants to study constitutional choice processes in groups that are larger than families or face-to-face groups but considerably smaller than the populations contained in nation-states. Many CPR problems involve groups which vary from 50 to 5000 participants. Usually these groups are involved in negotiating the rights to the use of one resource (or, a very limited number of resources) rather than all resources. Participants design mechanisms that are limited in scope, even though these may involve various aspects of taxation, adjustments in property rights, punishment, and other difficult problems related to the governance of human affairs. CPR problems, where the resource and the group using the resource are limited in size and scope, are particularly well suited for intensive study of micro-constitutional processes.

Another advantage of studying micro-constitutional processes is that they help the analyst shift perspectives about constitutional processes

from an image that "once long ago a constitution was created" to an image of a reoccurring process of constitutional change. While constitutional rules do not change as rapidly as other rules, constitutional choices are not "once and for all time" choices. As Buchanan (1975) has pointed out, constitutional rules are a form of public capital. As such, they are "long run" rather than "short run" decisions. Constitutional rules, particularly those related to the definition of property, evolve or are consciously changed from time to time as the circumstances to which they relate change. Given the greater complexity of macro-political settings, it is hard to trace the effects of constitutional rule changes over time. In a micro-political setting, the antecedents and consequences of constitutional change are easier to identify.

Related to the view that constitutions were established in dimly remembered history, is the presumption that one cannot undertake empirical analyses of the processes of constitutional choice. Constitutional scholars since Hobbes have recreated fictional constitutional processes to try to understand what would need to be taken into account in such an "initial" contract. We learn much about the logic of constitutional situations from imaginary accounts. For the development of an empirical theory of constitutional change, however, one needs to be able to study many similar constitutional processes so that one can begin to eliminate theoretical hypotheses that do not help explain observed processes. To do this, one needs to find the types of situations that are repeated often enough to allow empirical observations to be made and tested against theoretical inferences. Sufficient numbers of small-scale CPR problems exist to engage in comparative empirical analyses of such situations.

## 1.2 Substantive Reasons for Studying Micro-Constitutional Situations

Another reason for studying constitutional change in micro-political settings related to common-pool resources is that they are frequently modeled as "commons dilemmas" or "iterated, N-Person, Prisoners' Dilemmas" and are presumed to be unsolvable by the participants who find themselves in such social situations. Because the users of a common-pool resource system are viewed as trapped in a dilemma, scholars repeatedly urge that an external "solution" must be imposed. The imposed solution may vary from: (1) assigning responsibility for managing the resource with a centralized bureau to (2) partitioning the commons into a set of private property rights. Regardless of the structure of the reform, the contemporary view is that a solution must be imposed upon the participants from the outside.

Presuming that participants in all commons dilemmas are incapable of changing the structure of the situation in which they find themselves is a conceptual error. In order to analyse any situation, a scholar must hold some variables constant while examining the effect of other variables. The variables that are held constant are the parameters of the analytical situation. Sometimes these parameters are realistic constraints on the problem solving capabilities of individuals in real settings, but not always. In order to analyze the effect of a given set of rules, an analyst must hold those rules constant. The persons involved, however, may be capable of changing the level of their decision-making process and thus converting a parameter at one level into a variable at another level.

The difficulties and costs involved in changing these parameters vary from situation to situation. In some situations, the parameters may become virtually immutable, while in others, participants may be able to switch levels relatively easily. As analysts, we must acquire new modes of

analysis that enable us to examine multi-leveled situations in which participants may be switching back and forth among constitutional, collective choice, and operational choice levels.

Operational, collective choice, and constitutional choice situations can be stacked one on top of the other in a self-governing society in a fashion similar to the stacking of computer languages in computer systems. What we see as output is the result of the operation of several levels of languages working together. If we are dissatisfied with the way one language operates, we may fix the problem by moving down to a different language in the stack to change some element of the configuration there. Moving back and forth across levels of computer languages is not without cost. Some computer users have more capabilities to shift levels than others. Further, computer systems differ in the ease with which users may switch levels. In a large, multi-user system, access to some levels is privileged and a user of the system may not switch to some levels. As analysts, we need to recognize that the ease or difficulty of moving back and forth across the levels separating operational, collective choice, and constitutional choice situations varies from one empirical setting to another. In a centralized political system, citizens may face insurmountable costs in attempting to shift levels while in a more polycentric, open political system, the costs of shifting levels may be far less. Even in a polycentric system, the costs of engaging in collective choice may vary substantially from one policy arena to another.

In some common situations, therefore, participants communicate with one another about the underlying structure of the problem they jointly face and engage in a constitutional discourse about ways of reconstituting the set of rules they use so as to produce a different pattern of incentives

and behaviors related to their common-pool resource. While some commons dilemmas result in tragedies, evidence exists that individuals in other commons dilemmas have been able to negotiate ingenious local constitutions that enabled them successfully to utilize a common-pool resource over a period of several centuries.

The important question to ask about commons dilemmas is: What factors affect the likelihood that participants in such situations will shift levels of decision making and agree to change the structure of their operational situation toward one that produces better outcomes for the participants. So long as analysts presume that rules are unchangeable by participants, this question is not addressed. Analysts who recommend the imposition of solutions by external authorities, rather than exploring the conditions that may impede effective constitutional choice processes by participants, reinforce the arguments made by central officials that they must be given authority to solve diverse local problems in a society because the individuals involved cannot solve these problems for themselves.

Having now indicated why I wish to focus on the analysis of micro-constitutional choice processes in the comparative study of political orders, let me briefly indicate how I intend to proceed in the balance of this paper. In Section 2, I shall enumerate the attributes of CPR dilemmas included within the frame of this analysis. In Section 3, I shall briefly discuss how situations having these attributes have been analyzed in the literature. Section 4 will examine the assumptions that need to be changed in a revised theory of CPR dilemmas. Section 5 will build on Section 4 to begin to analyse CPR dilemmas from this revised foundation. Section 6 will

apply the analysis to contrast the processes of constitutional choice in four groundwater basins underlying Los Angeles and Orange County in Southern California with the experiences of inshore fisheries where national and state governments have strongly discouraged constitutional decision-making by local participants. Section 7 will examine some of the policy questions raised by this analysis.

## 2. The Attributes of a CPR Dilemma Situations Included in This Analysis

A CPR situation occurs when a set of individuals repeatedly use the same natural (or artifactual) resource to obtain a flow of resource units or goods. Five conditions exist in all situations included in this analysis:

### Condition 1: Rivalry

The presence of a resource or facility that makes available a flow of resource units over time which are subject to rivalry in appropriation. Examples of such resources and their resource units include:

- A groundwater basin and acre-feet of water per year
- A fishing ground and tons of fish harvest per year
- A grazing area and tons of fodder consumed per year
- A bridge and number of bridge crossings per year
- A stream and the quantity of biological waste absorbed per year

### Condition 2: Multiple Appropriators

More than one team of individuals withdraw resource units from the resource. Following Plott and Meyer (1975) let us call the process of withdrawing units "appropriation" and those who withdraw units appropriators.

### Condition 3: Suboptimal Outcomes

The strategies of the appropriators, given existing technology, rules, and market conditions, leads to (or has led to) suboptimal outcomes from the perspective of appropriators. While the CPR problem is frequently treated in the literature as one problem, it turns out upon close examination of the theoretical models of CPR situations and cases describing real CPR problems to be a family of problems all

characterized by suboptimal equilibria from the perspective of appropriators.

At least five types of suboptimality may be involved: (1) destruction, (2) rent dissipation, (3) suboptimal assignment, (4) crowding, and (5) underinvestment. In a destruction problem, continued or accelerated withdrawals from the resource will lead to its destruction. In a rent dissipation problem, the private investment made in appropriation activities is greater than economically optimal. In an assignment problem, the appropriators expend more resources on aggressive or defensive behavior and suffer higher damages than alternative assignment rules would produce. In a crowding problem, the costs of appropriation, given current uses, are higher than alternative use patterns would produce. In an investment problem, the investment strategies adopted by appropriators involves less resource maintenance than is economically optimal.

#### Condition 4: Feasible Alternatives

At least one set of coordinated appropriation and/or investment strategies exists that is mutually advantageous to the appropriators over the long run. Mutually advantageous means that total discounted benefits of this coordinated strategy exceed total discounted costs including production, investment, governance, and transaction costs and that the benefits and costs are allocated in such a way as to be individually beneficial as well.

#### Condition 5: Constitutional Autonomy

The resource is located within a multi-constitutional political system which allows participants some capabilities to negotiate new constitutional rules. This condition excludes two types of common-pool resource problems from the current focus: (1) CPRs which extend beyond the boundary of a single nation (e.g., international seas or airspace) and (2) CPRs located in nations where individuals have no freedom to engage in the negotiation of constitutional contracts.

Conditions 1 and 2 create a CPR situation. Conditions 3 and 4 distinguish a CPR dilemma situation from a simple CPR situation. Condition 5 distinguishes mutable from immutable CPR dilemmas.

### 3. Existing Analyses of CPR Dilemma Situations

The predominant theoretical finding stemming from a wide diversity of analyses of CPR dilemmas is that each individual will be led to harvest an

excessive quantity of resource units resulting in a suboptimal equilibrium. The most famous analysis of a CPR dilemma situation is Garrett Hardin's "The Tragedy of the Commons" (1968). Hardin asks the reader to envision a pasture "open to all." Each herder is presumed to be a rational utility maximizer who receives substantial positive utility from selling his own animals and a lesser quantity of negative utility from overgrazing. When the aggregated actions of all herders begin to exceed the yield of the pasture, each herder is still motivated to add more animals since the herder receives all of the proceeds from the sale of his or her own animals and only a partial share of the costs from overgrazing. Hardin concludes:

Therein is the tragedy. Each man is locked into a system that compels him to increase his herd without limit -- in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons (Hardin, 1968: 1,244).

The standard analyses in modern resource economics also conclude that in relationship to any common-pool resource to which a number of appropriators have unlimited access, total resource units withdrawn from the resource will be greater than the optimal economic level of withdrawal (Clark, 1976; Clark, 1980; Gordon, 1954; Dasgupta and Heal, 1979). Most analyses conclude that "the" government must impose some external solution on the appropriators of a CPR since their private incentives lead them to produce a socially inefficient result. Alternative institutional arrangements proposed include: (1) unified management or sole ownership, (2) entry licenses and use taxes, (3) allocation of marketable withdrawal rights, and (4) entry and production quotas. While the favored policy prescription varies substantially from analyst to analyst, the method of change is uniformly seen as exogenous to appropriators using a resource. An external government is seen as needed to design new institutions, impose them on appropriators, and enforce the new definition of rights and duties.

The standard theory of CPR dilemmas provides an explanation for many empirical events including the ruin of the Pacific sardine fishery (McHugh, 1972) and the Antarctic blue whale (Clark, 1977). In spite of its capability to explain many cases where the participants overuse or destroy a common-pool resource, the standard theory cannot explain the anomalous cases where overuse has been reduced by the appropriators themselves. A surprising number of CPRs exist -- given the unambiguous theoretical predictions -- where appropriators have not continued to overuse a resource and have instead negotiated their own micro-constitutions defining property rules and restricting access and use.<sup>2</sup> Major responsibility for enforcing the rights contained in these micro-constitutions has been undertaken by the appropriators themselves. Some of these property systems have worked for centuries in relation to highly fragile CPRs that would have been destroyed long ago if rules regulating use had not been established by the appropriators.

The standard theory of CPR dilemmas helps us understand how individuals may find themselves in a perverse situation and pursue short-term strategies, which leave themselves and others worse off than strategies that are potentially available to them. The standard theory does not begin to address the conditions that might enhance the probability that appropriators themselves would negotiate a new micro-constitution related to their resource situation. Consequently, the standard theory does not help explain why or how some appropriators avoid the tragedy of the commons.

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<sup>2</sup> See Berkes (1985; 1987), Blomquist and E. Ostrom (1985), Cordell and McKean (1987), Davis (1984), Runge (1981), Wilson (1977), Acheson (1975), McCay (1980), McKean (1987), Netting (1976), Siy (1982), Coward (1980),  
(Footnote continued)

#### 4. Assumptions for a Revised Theory of CPR Dilemmas

Predictions that too many appropriators will withdraw excessive quantities of a common-pool resource are based on a series of assumptions about the nature of individual decision makers and the nature of the situation in which they find themselves. A revised theory of CPR dilemmas must lead to predictions about the conditions that are likely to enhance self-organizing through micro-constitutional processes as well as conditions which are likely to diminish these prospects. To do so, it appears that five of the assumptions frequently made in the development of the standard theory need modification. These are:

- (1) Individuals are omniscient and omnicompetent (they know everything about the immediate situation relevant to making a maximizing decision and they can process all this information flawlessly.
- (2) Individuals have symmetrical attributes (same utility functions, similar skills and stakes, etc.)
- (3) No normative constraints, other than formal law, limit individual choice of strategy.
- (4) No formal laws exist to limit the entry of appropriators or amount appropriated.
- (5) The strategies available to appropriators are limited to one level of action and these strategies taken independently of the current or past actions of other appropriators.

##### 4.1 From Omniscience to Fallible Learners

Instead of assuming omniscience and omnicompetence, I will assume that individuals attempt to be rational and make decisions on the basis of expected benefits, expected costs, and their own discount rate, but the amount and accuracy of information they have varies from situation to

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<sup>2</sup>(continued)

Dahlman (1980), Gilles and Jamtgaard (1981), Gray (1963), Jodha (1987), and Kisangani (1987).

situation and may exceed the competence of an individual to compute a solution based on fuller analysis. Individuals may make errors in perception, in their comprehension of how a complex structure works, or simply in computations. Individuals can also learn from experience, especially in situations which are often repeated, such as those faced by appropriators of a CPR. Repeated interaction with the same resource situation will enable appropriators to gain an ever more accurate (even if incomplete) image of the structure of the resource and the physical and biological transformations that occur in the resource system.

Interactions with the same set of individuals enable a person to gain more accurate estimates of the strategies that others are adopting. Of course, the larger the set of individuals using the same resource and the more diverse their strategies, the more difficult it is for anyone to gain an accurate perception of other's strategic behavior. Further, individuals tend to adopt those strategies that have returned the highest payoffs over time. If the situation in which they are acting is stable, and they interact within this situation for a long time, individuals will tend to discover those strategies that an omniscient individual would have selected. But convergence through learning to a "perfectly rational strategy" may not occur when the situation is large and complex, changes frequently and/or the individuals do not participate in that situation with regularity.

In some cases, appropriators may even need to discover the interdependence of their situation and the structure of that situation. This is particularly the case in respect to CPRs whose structure is hidden from the typical appropriator and can be discovered only with substantial investment in information gathering, such as in a groundwater basin. When

appropriators first use an underground source of water, they may perceive themselves to be taking actions in relationship to "nature" alone. Each draws down his own well and perceives that the height of the water in his own well is a function of his own independent action and the supply of underground water but not of the action of others. When many appropriators pump water from the same basin, however, the level of water in any one well is, in fact, a function of the quantity produced by an individual producer and all other producers using the same source. Without arenas in which to discuss problems related to a CPR, and without ways of financing and disseminating studies about the structure and supply conditions in a groundwater basin, individuals may make decisions about their use patterns with grossly incorrect images about the supply and use patterns of a resource.

Assuming fallibility leads the researcher to ask important questions about who has what information. The adequacy and type of information that an individual may have about a CPR situation depends on:

- (1) The size of the resource;
- (2) The number of appropriators and the way they are organized;
- (3) The length of time that the resource has been used;
- (4) The quantity and type of information regularly recorded and available to appropriators about supply and appropriation patterns;
- (5) The availability of technical studies of this resource; and
- (6) The presence of arenas where the appropriators discuss supply and appropriation patterns.

The level and accuracy of information about a CPR affects whether the appropriators themselves can easily negotiate a new micro-constitution to

change the incentives they face in a continuing operational situation. To the extent that a resource is large and amorphous, the number of appropriators is great and appropriators are poorly organized, the duration since the resource has been open to appropriation is short, regularly recorded information is not available to appropriators, and few opportunities exist for extensive communication about the conditions of the resource, one would expect the predictions from the standard theory to hold. Individuals in such CPR dilemmas are much less likely to be able to overcome their lack of common and accurate information, the absence of organization and arenas for discussion about how to "get out of" the commons trap. Ocean fisheries are a classic example of this type of CPR and are indeed where many notable tragedies of the commons have occurred.

On the contrary, when a relatively small group of appropriators have used a well defined and relatively small resource system for some time, and they have available regularly collected information for discussion, one would expect a higher proportion of successful micro-constitutional settlements to occur. High-mountain alpine meadows used over the centuries by local villagers are a classic example of this type of CPR. Many of these CPRs have been regulated by appropriators for centuries using a diversity of locally designed charters for local corporations and cooperative associations (Picht, 1987). The above speculations need to be more fully developed and empirically tested, but they illustrate why the fallibility assumption plays a key role in a revised theory.

Assuming fallibility as the general working assumption of a theory does not preclude modeling well-defined subparts of a CPR dilemma as

generating sufficient information that an assumption of complete information can be used for a model of that subpart. Such models enable one to ask both what a perfectly well-informed maximizer should do in this limited situation as well as what such an individual would do. While these models of well-defined subparts of CPR dilemmas allow one to pursue these questions, one ought not presume that these specific models sufficiently represents more complex realities to form the basis of broad policy prescriptions.

#### 4.2 From Symmetrical to Potentially Asymmetrical Appropriators

The assumption of symmetrical (or identical) appropriators is useful for the purposes of generating an equilibrium result in a particular model of an operational situation. Assuming that appropriators have different assets, preferences, information exposures, skills, production technologies, or historical patterns of use greatly increases the difficulty of specifying a model with clear results. The presence of asymmetries among appropriators helps to account for different strategies adopted by appropriators and thus for differences in outcomes.

In his analysis of collective-action problems, Olson (1965) stressed how one type of asymmetry, which might be called asset asymmetry, enables some groups to obtain collective goods where others fail. The presence of some appropriators who have a higher stake in the CPR (they withdraw proportionately more units than others, for example) may enable some groups to get out of a dilemma situation where others can not. The appropriators with more assets will obtain higher benefits from a successful effort to renegotiate property rights. Thus they may be willing to bear a higher proportion of the costs involved in negotiating new rules. If the

asymmetry is very great, the group may even be a "privileged group" wherein those who will benefit the most from a change in appropriation patterns adopt new patterns even if others do not.

Alternatively, if some users are located in a protected location in respect to the CPR, such as the head-enders on a irrigation canal, they may oppose changes in constitutional rules which give tail-enders a fair chance to obtain more water. The presence of a powerful group of appropriators, who are either physically or legally protected from harm, may prevent or delay the process of renegotiating property rules.<sup>3</sup>

Asymmetry of information may also explain resistance to the negotiation of settlements by those who expect to be favored by future events. Libecap and Wiggins (1985) have contrasted the relatively successful oil unitization policies pursued on federal lands which encourage agreement prior to actual development with the unsuccessful policies adopted in Oklahoma and Texas where state law allows unitization only after development (see also Wiggins and Libecap, 1985). Their analysis suggests that information asymmetries after development increase the transaction costs involved in negotiating a unitization agreement (which is a micro-constitution for oil producers relying on a single pool).

Asymmetries may help explain why some appropriators support one type of constitutional reform and oppose others. Johnson and Libecap (1982)

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<sup>3</sup> If some appropriators are in a protected location and use a resource for one purpose that is harmful to the uses to which it is put by others, it is more appropriate to conceptualize this as a strict externality problem rather than a CPR problem. The problem of acid rain falls into this class. One group is using the atmosphere to take away pollutants and "downstream" appropriators are using it for clean air. Given the vastness of the resource and the number of persons involved, such problems are far less likely to be "solved" through a micro-constitutional process.

have pointed out that the rules that could be used to regulate a CPR have differential impact on players who vary in regard to skill. Assigning a fixed quantity of resource units to be harvested, such as the number of tons of fish per season, will be supported by fishers who are less skilled and opposed by the more skilled fishers. The more skilled fishers are apt to support a fixed season which allows them to catch more fish during the open season than their less skilled compatriots.

In the revised theory of CPR dilemmas, the degree of symmetry or asymmetry of appropriators in regard to such key factors as assets, information, and physical location will be seen as important variables to be taken into account in an attempt to understand how these factors affect the likelihood of self-organization.

#### 4.3 From the Absence of Normative Restraints to the Possibility of Shared Norms

Some rational choice theorists have prided themselves on exorcising the concept of norms from rational analysis. Using one sweeping assumption -- the law and order assumption -- theorists presume that individuals tell the truth, keep promises, and fulfill contracts only because of a fear of external sanctions. The behavioral maxim "cheat whenever it is to your advantage and the expected probabilities of detection and punishment are low" is as much a "norm of behavior" as "fulfill contractual obligations when engaged in long-term business associations." This similarity has escaped much notice (but see Taylor, 1988, and V. Ostrom, 1986). James Coleman has recently made a cogent argument for how a particular way of viewing norms "fits within the rational choice framework" (1987: 134).

Coleman defines norms as the "expectations about action -- one's own action, that of others, or both -- which expresses what action is right and what action is wrong" (Ibid.: 135). Coleman stresses that norms are like all constraints on decision making in that they may affect the utility that individuals derive from various actions but do not determine actions.

Norms which have been internalized through socialization directly modify the utilities of certain actions, while norms that depend on external sanctions modify the utilities only to the degree that the actor believes that external sanctions will be applied. In either case, however, the modifications they bring about serves only to change the balance of costs and benefits associated with particular actions (Coleman, 1987: 135).

Coleman argues that new norms are more likely to arise in situations where actions affect the utility functions of persons in addition to those directly involved in a transaction or, in other words, where substantial positive or negative externalities exist. Given the externalities, each person might be willing to forego some degree of his or her liberty to take action in exchange for an element of control over similar actions of others. At times, it may be possible for individuals to develop an overt market for rights to control particular actions. Such a mechanism may be the result of a micro-constitutional process that succeeded in defining some separable rights which could then be bought and sold freely. Markets cannot, however, always be created or set up with sufficiently low transaction costs that they are efficient mechanisms to deal with externalities. In such situations, individuals may self-consciously develop different types of property rules, drawing on existing shared norms of behavior or evolving new norms that may substitute for or complement self-consciously adopted and enforced rules.

Coleman distinguishes between norms which are internalized by individuals where the sanctioning for nonconformity is an internal cost (e.g. guilt, anxiety, lowered conception of self worth, etc) and shared norms where the sanctioning for nonconformity comes from others who are part of the same group and exhibit social displeasure if a norm is broken. In either case, a person complies with the norm because the costs of breaking it are higher than the advantages. A person may, of course, internalize a shared norm in which case lack of conformity involves both internal psychic and external social costs.

Changing the assumption from "the absence of norms" to the "possibility of norms" leads to inquiring whether the appropriators in a particular setting share norms related to the use of a resource rather than presuming either that no norms exist or that norms always exist. It also leads to the pursuit of questions about the circumstances in which norms might emerge and those in which norms might be sufficient to avoid deficient equilibria. For a norm to be "shared" by a group, those in a group have to identify themselves as part of a group. One would expect that relatively small groups of appropriators whose families have lived in the same location for long periods of time might well have evolved shared norms related to the appropriateness of various activities.

Further, one can begin to identify aspects of the structure of a situation which would be conducive to the successful reliance on a shared norm rather than requiring a self-consciously devised and enforced rule. Coleman argues that the relative frequency that a person will be in the position of "sanctioner" versus "sanctionee" enables a theorist to predict who will accept a norm as legitimate and follow it. "A person who finds

himself in the position of actor, more often constrained by the norm than protected by it, will be less likely to accept it as legitimate, because, on balance, its existence is less likely to benefit him" (Coleman, 1987: 142). We can extend this logic to predict that in situations where most individuals are as likely to be constrained as benefited by the rule, norms may be a relatively stable form of regulation. Sugden (1986: 157) refers to a similar notion as cross-cutting asymmetry. When individuals have the same probability of being in diverse roles (the driver who arrives first at an intersection versus the driver who arrives second), the asymmetry in roles is perfectly crosscutting.

#### 4.4 From No Rules to Status Quo Rules

The assumption of "no rules" related to entry and use can be made if one wishes to model a single operational level situation without such rules for the purpose of investigating the equilibrium conditions in that situation. The purpose of the revised theory, however, is not to predict equilibria in a single operational level situation nor to explain the origin of a unique and final set of rules adopted in a constitutional situation. Rather, I wish to examine constitutional change as a developmental process in a multi-constitutional political system. Appropriators are located in a larger system with its sets of nested rules (by Condition 5 above). These rules may be silent in regard to entry and use of particular resources and permit appropriators to undertake efforts to create their own rules covering their own CPR. Or, the rules of the larger system may already limit entry or use patterns, but these limits may not be adequate given the nature of demand and the capacities of the CPR. Further, the initial rules developed by appropriators may not be adequate

over time because of erroneous judgements or because circumstances change to make rules inadequate.<sup>4</sup> The change to an assumption of status quo rules simply broadens the applicability of the revised theory from a situation where prior rules do not limit entry or use to a full set of situations where prior rules may or may not restrict entry and/or use patterns.

#### 4.5 From a Limited Set of Strategies to an Expanded Set

In many prior analyses of CPR dilemmas, the type of strategies included in the analysis has been limited to the quantity of resource units that each participant would appropriate independent of the action of others. In several recent dynamic analyses of CPR dilemmas, scholars have added a variety of contingent strategies which are important to include in future work. Several scholars (Lewis, 1969; Ullman-Margalit, 1977 and Sugden, 1986) base their analysis of the emergence of conventions in various dilemma situations on the use of contingent strategies. In addition to contingent strategies, I also wish to add a "level-shifting strategy" which occurs whenever individuals attempt to shift levels of analysis, and more important, levels of action, from operational to collective choice or constitutional choice and back again. Shift strategies have not been included overtly in prior work, but the concept is consistent with Buchanan's analysis of constitutional choice as a two-stage process.

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<sup>4</sup> The assumption of SQ rules is similar to that made by Buchanan in his analysis of continuing constitutional contracts (1975: Chapter 5).

#### 4.5.1 Level Shifting Strategies

An individual engages in level shifting whenever he or she begins to contemplate how to change any of the constraints on an operational situation (or, on a collective choice situation) that are potentially under the control of the participants. A groundwater pumper, for example, attempts to shift levels when he or she states to another pumper, "Hey, this race of ours to withdraw groundwater is going to destroy the basin and leave us all worse off than we could be. Why can't we agree upon a rule by which we all reduce our current withdrawals by some proportion so that we can use the resource for a much longer period of time?"

Any decision maker can shift levels of analysis in his or her own thinking at any point in time while engaged in action at a different level. Before an appropriator suggests a rule change to another appropriator, the first has already analyzed some of the consequences of adopting a revised set of rules. Shifting levels of analysis can be accomplished by any actor operating independently of others. That actor simply contemplates the opportunities and constraints that might be available at a different level for solving some of the problems occurring at a current level.

When the individual estimates that substantial benefits are likely to occur if others were to agree to shift levels and to change rules, the individual may then be willing to invest resources to try to convince others that they should all agree to shift levels and consider the constraints that are currently in effect. Shifting levels of action does not mean deciding to change the rules by making the shift. Shifting only enables those who shift to overtly contemplate a different set of rules (or other constraints that may be potentially under their control such as

making a major capital investment in the development of the resource itself). A possible result of a shift may be to return to the status quo rules.

The costs of shifting levels of action vary dramatically from one setting to another. In some settings the same individuals are involved in a constitutional level of action and in an operational level of action. Shifting levels may be accomplished at low costs. A group of appropriators discussing common problems at an operational level may somewhat naturally turn to a discussion of what could be done to solve a destruction, assignment or underinvestment problem they confront. Part of that discourse may be focused on enforcing their current rules more strictly. Another part of that discourse may include reference to alternative rules that might reassign the rights and duties of appropriators. After discussion, they may agree to keep the status quo rules or change to a different set of rules.

Formal procedures may be required to shift levels of action in some settings -- including petitions, referenda or special elections. Bureaucratic officials may control access to an arena in which rules and other constraints may be changed. Alternatively, judicial procedures may be used for this purposes. The cost of shifting levels of action and transforming an operational situation may be very high. In such cases, appropriators may continue to rely for long periods on rules which produce suboptimal equilibria because the expected costs of changing rules are higher than the benefits they could derive from a better set of rules. Alternatively, they may devise their own de facto rules which may even be blatantly illegal if discovered. Developing de facto rules outside formal channels may be less costly than trying to use formal channels.

It is through shifting levels of action that individuals may be able self-consciously to design rules to change the distribution of behavioral strategies in an operational (or collective choice) level. The absence of this strategy from prior analyses has led analysts to presume that participants themselves "had no way out" of their operational situations. But, while this may be a costly strategy to invoke in some settings, it is used far more frequently than scholars have presumed and is one of the important means for appropriators to extricate themselves from situations with suboptimal outcomes.

#### 4.5.2 Contingent Strategies

Another way out, available in some, but not all CPR dilemmas, is through contingent strategies at the same level of action. As soon as one approaches the CPR dilemma as an iterated situation, contingent strategies may be available which produce better equilibria than the suboptimal equilibria predicted in the standard analysis. Three general types of contingent strategies have been explored in the literature: (1) strategies involving reciprocity, (2) contingent strategies depending on role or position asymmetries, and (3) correlated strategies. Theorists argue that it is possible for individuals to adopt these contingent strategies and achieve better, more stable equilibria without conscious choice nor conscious dependence (at least initially) on normative assessments that such strategies are morally correct. Contingent strategies can be discovered through trial and error methods. Once one participant accidentally uses a contingent strategy, it is in the interests of others to replicate it (i.e., the equilibrium achieved is attractive). Once everyone follows the same contingent strategy, it is in no one's interest to adopt a different strategy (i.e., it is the best reply strategy to

itself). Thus, it may be sustained overtime entirely by self-interested action without norms or without the need to switch levels . The adoption of such contingent strategies is thought of as not having been "invented by anyone; it is not negotiated; no one consents to it. It simply evolves" (Sugden, 1986: 38).

#### 4.5.2.1 Strategies of Reciprocity

The first type of contingent strategy -- reciprocity -- involves one participant making choices about actions at time  $t + 1$  on the basis of information about the actions taken by other players in time  $t$  or earlier (Sugden, 1986: 104-121).<sup>5</sup> Tit-for-tat is probably the best known strategy of reciprocity (Axelrod, 1984). The simplest version of tit-for-tat in a 2-person, iterated Prisoners' Dilemma is a strategy that always "cooperates" on the first instance of an iterated sequence and then simply replicates in any one round the strategy chosen by the other player in the  $n - 1$  round. If two players are involved in an iterated PD game and they both follow a tit-for-tat strategy, they will avoid the deficient equilibrium and gain the benefit of cooperation as long as they continue to play. If someone following a tit-for-tat strategy meets someone who is following an "all defect" strategy, after the first round, both players will "defect" in every subsequent round and they do not avoid the suboptimal equilibrium.<sup>6</sup>

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<sup>5</sup> In this discussion, I am restricting my attention to reciprocity as narrowly defined by Sugden and others rather than to a broader concept involving communication, promises, and perhaps even shared norms (see Oakerson, 1988).

<sup>6</sup> The "trigger" strategies of Lewis and Cowens (1983) where every participant commits themselves to cooperate until any one person defects on any particular round and then to defect forever are also in this class of contingent strategies.

The importance of these strategies is that their use in some situations enables individuals to avoid suboptimal outcomes. Thus, they represent one way out of some dilemmas without having to pay the cost of switching levels in order to adopt new rules at the constitutional level. Where the costs of switching to a constitutional level of action are very high, forms of reciprocity may be the only feasible means available to appropriators to avoid some CPR dilemmas.

Successful use of strategies of reciprocity is, however, limited to relatively narrow set of CPR action situations and highly vulnerable to small changes in key attributes of such situations. For them to be stable equilibria, several conditions must be met. First, the probability that the situation will be continued for a long time into the future must be high. Second, the probability of players' making mistakes (choosing the defect strategy when they intended to cooperate) must be very low. In a severe CPR dilemma where everyone is worried that the resource is about to be destroyed, the first condition is not met. A fear that the "resource is about to be destroyed" is a self-fulfilling prophecy in most situations unless there is substantial, conscious intervention to change the rules of access and use and to enforce them well.<sup>7</sup>

In a CPR dilemma where the number of appropriators is greater than ten or so, the second condition is not met. In Sugden's words :

Suppose that in any game there is a 'true' interpretation of the convention [what cooperation means], but that each player has a

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<sup>7</sup> See Speck and Hadlock (1946) for a revealing description of the behavior of the Malacite Indians who witnessed white trappers coming in and taking out so many beavers that it became apparent that the beaver resources, husbanded for centuries by the Indians, were being destroyed. Given that the beavers were about to "run out," the Indians changed their prior strategies rapidly and trapped as many beaver as they could.

small chance, say 0.05 of misinterpreting it. An arrangement of reciprocal co-operation will be established if all members of A interpret the convention correct. (It is possible that reciprocal co-operation might be established in other circumstances, but only by a fortunate accident.) If the number of players in A is  $q$ , the probability that all A-players will interpret the convention correctly is  $0.95^q$ . If  $q = 1$ , this probability is 0.95; if  $q = 10$  it is 0.60, if  $q = 50$  it is only 0.08. (In Hume's case, with  $q = 1000$ , the probability is less than one in a thousand million million million!) (Sugden, 1986: 137).

Given that what it means to "cooperate" in most real world CPR dilemmas is far more complex than simply choosing C over D, Sugden's assumption that the probability of error for any one individual = 0.05 is certainly reasonable. Cooperation in some settings means harvesting a limited proportion of what one has harvested in the past. The time cycle for limiting harvest efforts is usually a full season or a year. Hitting the exact quantitative limit without overshooting (which could be interpreted as defecting) or undershooting (which is not in one's interest) is most difficult.

Further, exactly who is "in" the group is quite ambiguous in many natural settings until self-conscious constitutional deliberations have occurred to define who is and who is not a member of a group having access and use rights to a CPR. The problem is compounded still further by the difficulty of learning about and interpreting the strategies of others. If all the fishers using an inshore fishery happen to land their boats at the same dock and watch each other's catch being unloaded, they may be able to gain a fairly accurate estimate of each other's strategies. But how are the fishers to interpret the fisher who lands large quantities of fish early in the season? Is he eager to get his quota and then go on to other endeavors, or is he planning to "defect" by not limiting his harvest for

the year? If fishers sell fish at more than one dock, how can they even gain an estimate of what strategies others are following.

#### 4.5.2.2 Position Contingent Strategies

A second type of contingent strategies can be called position contingency. In many situations individuals may find themselves in any of several positions at different times. One may, for example, be the first person to arrive at a location versus being the last person to arrive at the same location. There is a class of strategies available to individuals in iterated situations that exploit asymmetries in positions that various persons may assume over the course of time. If individuals are as likely to be first as they are second or last to arrive at some location, the unself-conscious adoption of a convention that the first person to arrive gets to use the location will work to everyone's advantage in reducing the time and effort that would be invested in trying to lay claim to different locations.<sup>8</sup>

Contingent strategies based on differences in position probably do evolve in some CPR situations without self-conscious design, but they are limited by some of the same constraints as strategies of reciprocity discussed above. What action is to be taken when a person occupies a position must be unambiguous both to the person and to others. Secondly, since some positions confer higher levels of benefit in some situations,

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<sup>8</sup> Sugden argues that many property rules, including those based on possession may evolve over time in an iterated situation in which the roles of "possessor" and "challenger" become well accepted positions. He argues that a convention will emerge in many situations that roughly approximates "when in the position of possessor fight anyone who challenges and when in the role of challenger, do not fight anyone who appears ready to fight."

participants may have temptations to cheat by claiming they hold a position that they do not hold. If being first to stake a claim gives substantial benefits, some individuals will attempt to get others to accept a fake claim. As soon as faking a position turns out to be successful for some, others will turn to the same strategy and the "evolved contingent strategy" collapses as a stable equilibrium.

#### 4.5.2.3 Correlated Strategies

A third type of contingent strategy are called "correlated strategies" by Aumann (1973; 1981). Correlated strategies may be adopted by individuals in an operational situation when there are external events (including random events) to which they can correlate their actions.<sup>9</sup> If one irrigator diverts water from an irrigation canal on a Monday, and a second irrigator diverts water on a Tuesday, and so on through the week, it is easy to see how a small group of irrigators might arrive at a rotation strategy as an effective means of allocating a scarce resource with very little cost in determining who can use at what time. So long as there are not more irrigators than days of the week, and so long as one day's water suffices for a week, such a correlated strategy might evolve without any need for a change in the constitutional rules.

#### 4.6 Spontaneous Orders vs. Designed Orders in a Multi-Constitutional Political System

In the above section five assumptions were altered from the usual assumptions made in the "standard" theory of CPR dilemmas. The resulting

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<sup>9</sup> Aumann's analysis has focused entirely on external random events. The concept can, however, be extended to nonrandom, external events such as days of the week, etc.

set of assumptions, which will form the foundation for a revised theory of CPR dilemmas, is similar, but not identical, to the assumptions underlying theories of spontaneous orders (Schotter, 1981; Hayek, 1973; Menger, 1963). A spontaneous order theorist would assume that individuals are fallible but can learn and that individuals are characterized by asymmetrical attributes (Assumptions 1 and 2 above). The position of a spontaneous order theorists toward norms is ambiguous. Richard Sugden, for example, goes to great length to show how a spontaneous order based on contingent strategies would emerge and become stable based entirely on self-interest without any reliance on principles of right and wrong. Once they have emerged, however, Sugden argues that they may become infused with a moral dimension. Those who follow a contingent strategy may now think that everyone who is in the same situation should follow the same contingent strategy. Spontaneous order theorists would see no need for the switching strategy introduced in Section 4.5.1 since their conception of order is viewed entirely as an emergent property and involves no conscious choice of rules.

Since spontaneous order theorists have been able to demonstrate that individuals can achieve better equilibria than the standard suboptimal one in iterated dilemma problems similar to those of the CPR dilemma, why is there a need to adopt a set of assumptions that varies at all from the assumptions that would be used in this relatively successful and rapidly developing theoretical tradition? The work of spontaneous order theorists is an important development in modern social theory and one which I find analytically and normatively attractive in many ways. But it is an insufficient theory for explaining the empirical phenomena of relevance here.

One manner in which the theory is insufficient is the extremely narrow set of situations in which it is applicable. As discussed above, norms of reciprocity lead to a stable equilibrium only in very small groups. Norms of reciprocity are extremely sensitive to the probability of error and this is, in turn, sensitive to group size. By the time a group contains 50 members, the probability of someone making an erroneous move in every round is very high.

In Southern California, for example, groundwater producers ranging in number from 300 to 1,000 have used level switching strategies to design and redesign constitutional rules in a multi-constitutional political system. These groundwater producers have been able to develop over time a stable pattern of behavior in the world of action which now leads to better equilibria over the extremely suboptimal equilibria of 30 to 40 years ago. These same producers tried many strategies to encourage voluntary reductions in water production to protect their fragile and highly valuable natural resource. But it was only when they renegotiated their fundamental property rights, in this instance using the facilities of the court system, that pumpers were willing to reduce their own use of the basin knowing that everyone else was also reducing their use. Further, without the public instruments created by concurrent constitutional arrangements, the task of designing their own micro-constitution would have been much more difficult. To explain this empirical phenomena requires an assumption that individuals can undertake analysis of the problems they face at several levels of analysis and in light of that analysis may elect to switch levels of action in order to change rules at a constitutional level that affect their behavior at an operational level. Which set of rules individuals are likely to use at a constitutional level also depends on whether they do share a set of norms and the content of those norms.

Secondly, the theory is insufficient due to the one-way flow of causation built into at least some versions of spontaneous order theories. In the work of Richard Sugden, for example, he asserts a definite causal progression. First, conventions emerge backed up entirely by self-interest. Second, norms are added to reinforce these conventions. Third, legal sanctions follow (where needed) to fortify self-interest. There is no particular reason why the order has to progress in this fashion. In fact, when individuals are confronted with very difficult problems and engage in self-conscious design of their own rules to deal with these difficult problems, the order may go the other direction. First, individuals may design rules which they think and hope will help them achieve a better solution in the world of action. Then, because the rules are their own rules, they may attach normative weight to following them. If they appear to work, they may then follow them because of self-interest as well as because of normative and legal prescription. I would not want to argue that this latter order is itself the only causal order. In the world of experience we may find that individuals start with a shift to the constituting of new rules before they try out various contingent strategies or the reverse. They may even start from shared norms about which type of actions are right and wrong and try to devise strategies or change rules to conform to their normative principles.

Underlying the work of spontaneous order theorists is a deep commitment to the capability of humans to govern themselves and an aversion to the predominant view in much of the recent work by social scientists that only "the" state can solve problems. I share both the commitment and the aversion. The revised theory of CPR dilemmas posits a broader array of instruments available to achieve self-governance at least in open and

competitive polities. Instead of viewing the only public instrument available to citizens as being one, national-level government, which is given the mystical name of "the state," we need to view the public sector as being composed of compound layers of governance systems each with its own constitutional foundations (V. Ostrom, 1987). Further, the process of constituting new orders is continuing all the time as human beings face new problems and have to shift levels to create new constitutional rules to adjust to the changing situations they face in the everyday world.

Using the assumption of the revised theory of CPR dilemmas, four mechanisms are potentially available to help individuals evolve behavioral strategies which, if followed by all individuals, produce better equilibria than predicted by the standard theory. The four potentially reinforcing mechanisms that keep individuals from deviating from strategies leading to improved joint equilibria are:

- (1) Contingent strategies -- Self interest keeps individuals from deviating once everyone is using the same contingent strategy.
- (2) Shared norms -- Even if there is an advantage to deviation, once others are following the strategy, the expected external costs of disapproval are higher than the benefits of deviating.
- (3) Internal norms -- Even if there is an advantage to deviation, once others are following the strategy, the expected internal costs of guilt and lowered self-image are higher than the benefits of deviating.
- (4) Enforced rules -- Even if there is an advantage to deviation, once others are following the strategy, the expected external costs related to discovery and punishment are higher than the benefits of deviating.

Any one of the above four may be the initial source of a better equilibrium for a group of appropriators. In complex situations where the appropriators are dependent on jointly following many behavioral

regularities, and where they are self-governing, it is highly likely that all four mechanisms reinforce one another.

Whether the revised CPR dilemma theory is valuable can only be assessed in light of its capacity to offer a better explanation of empirical phenomena than either the standard CPR theory (which predicts that individuals will be stuck with suboptimal equilibria unless an external government imposes a solution upon them) or the spontaneous order theory (which presumes that individuals, without engaging in discourse or self-conscious design, will accidentally discover stable, equilibria producing strategies that are better than those predicted by the standard theory). Thus, we now need to turn to an initial formulation of a theoretical structure to be built on these revised assumptions.

## 5. The Working Parts

### 5.1 The Individual as a Benefit/Cost Analyzer

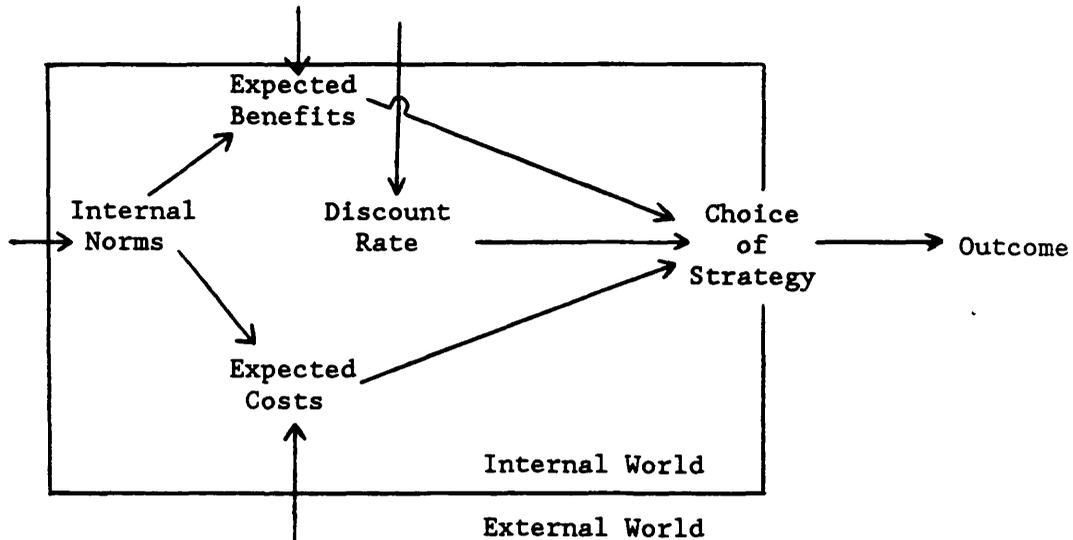
If the emphasis in a theoretical explanation is to be placed on the elements that comprise the situation, but the active force is the decision-maker, one must find ways of linking the model of the situation to the model of the actor. One needs overt theoretical links that enable one to relate how external variables affect the internal benefit/cost analysis of the individual. Otherwise a theory remains untestable.

We will adopt the classical political economy view that an individual's choice of strategy in any particular situation depends on how the individual views and weighs the benefits and costs of various strategies (see Radnitzky, 1987, for an excellent discussion of the concept of rational action). How the individual places a value on benefits and

costs depends on the internalized norms of an individual which he or she may share with others in a situation. Whether a social sanction, for example, will be perceived as a cost depends on how the individual values social relationships with others in a community. Some actions may not even be contemplated because the individual has internalized a norm (such as telling the truth). The internal costs of taking some actions are so high that the individual does not seriously consider them. In calculating a choice of strategy in an iterated situation, the discount rate of the individual is also taken into account. Thus, four internal variables (expected benefits, expected costs, internalized norms, and the discount rate) affect the choice of strategy in any situation. Each of these four internal variables are affected by many external variables reflecting aspects of the CPR, attributes of the appropriators using the CPR, the past behavioral patterns of those appropriators, the status quo (or contemplated) rules, and the external economy.

The diagram in Figure 1 is a sketch of the relationship between the internal world of analysis and choice and the external world of constraints and opportunities. The internal model remains the same across many different situations. It is the specific configuration of external variables that leads to different choices of strategy and different outcomes. The set of strategies bridges the internal and external world. The actual set of strategies available to an individual at any particular time is determined largely by the external world but internal calculations may remove some strategies from the set actually considered by an individual. A person who is deeply committed to keeping all promises, for example, will not even consider breaking a promise in most situations.

Figure 1

The Internal World of Individual Choice

## 5.2 The External World of Constitutional Choice

Let us now embed the internal world of choice in a constitutional situation. I turn first to the constitutional situation for two reasons. First, it underlies the operational situation at all times and provides some of the structure of the operational situation. Secondly, participants in the operational situation may shift levels of analysis while in an operational situation to think about alternative ways of organizing their appropriation activities. Thus, the constitutional situation is like a hidden mechanism which affects an operational situation, can be revealed by a shift to that level of analysis, and can be operated on or changed by a shift to that level of action.

For now, I will not discuss the intermediate level -- the collective choice level -- between the operational world and the world of constitutional choice. In the simplest situations, individuals rely on direct renegotiation of their basic rules rather than on the creation of a separate, collective choice mechanism to carry on the choice of everyday rules within the set of rules created at a constitutional level. Once we understand the relationship between these two levels in the simplest possible situations, we can proceed to examine a three-level analysis including the world of collective choice.

In the constitutional situation, one can think of the alternatives available to an individual as: (1) support the continuance of the status quo, constitutional rules or (2) support a change to an alternative set of constitutional rules. While more than one alternative may be considered at a time, one can assume that the ultimate decision will be between one alternative set of rules and the status quo set of rules. The alternatives are conceptualized as "support" rather than as "choose" since no single individual makes a constitutional choice in other than totally monocratic constitutional systems that are outside the frame of relevance for this theory. Thus, whether a change in constitutional rules is made or not depends on the decision rule being used at the constitutional level of action.

The external variables that impinge most directly on the choice process of an individual in a constitutional situation are shown in Figure 2 surrounding the internal model of the individual. The relationships expressed in this flow diagram can also be expressed in the following equations.

$$(1) Ac = f_1(d, EB - EC)$$

$$(2) EB = f_2(n, Bar - Bsq)$$

$$(3) EC = f_3(n, G + E + T)$$

$$(4) d = f_4(O)$$

$$(5) n = f_5(SN), \text{ where}$$

Ac - the action chosen by an individual in the constitutional situation -- to support the choice of an alternative set of constitutional rules or sticking with the current set of rules.

EB - the benefits that an individual expects to receive from Ac.

EC - the costs that an individual expects to receive from Ac.

d - the discount rate of the individual.

Bar - an individual's estimate of the flow of future benefits under alternate constitutional rules.

Bsq - an individual's estimate of the flow of future benefits under the status quo rules.

n - the internal norms that an individual uses to weight external benefits and costs.

G - an individual's estimate of the net costs of internal governance likely to result from the adoption of the alternative rules.

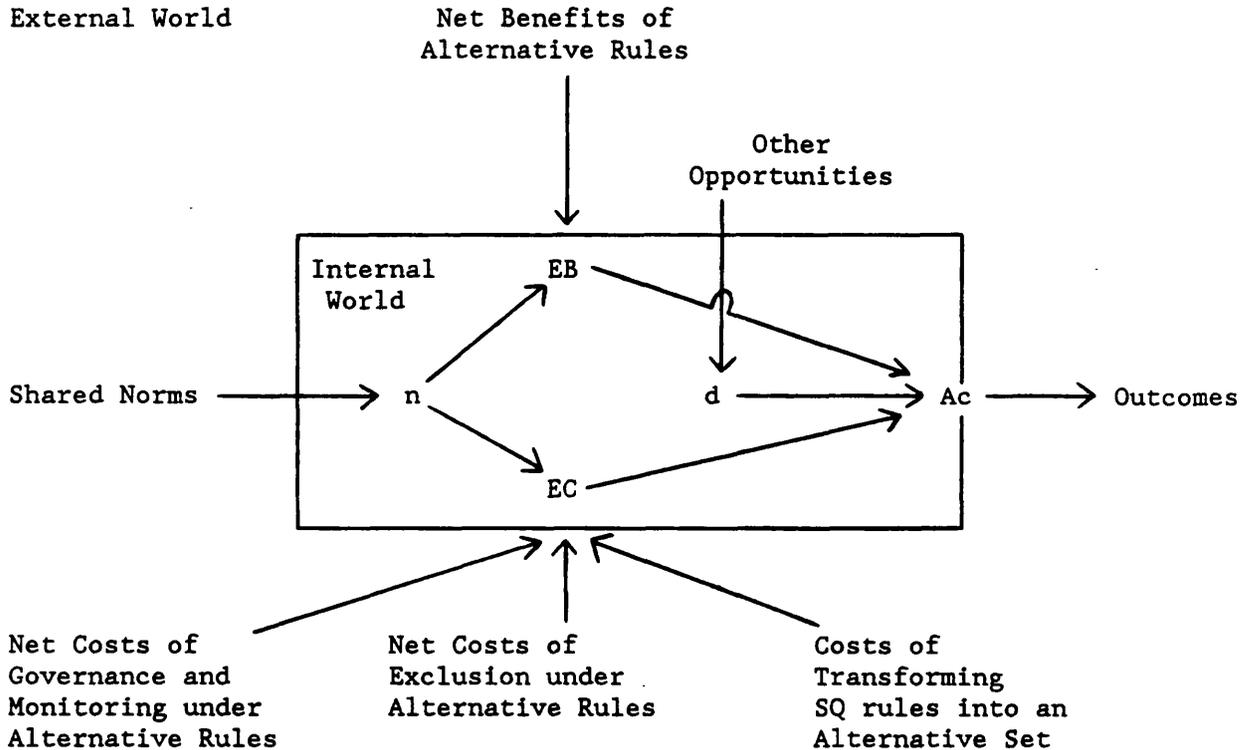
E - an individual's estimate of the net costs of exclusion likely to result from the adoption of the alternative rules.

T - an individual's estimate of the costs involved in attempting to change rules.

O - other opportunities available.

SN - the set of norms shared in a community.

Figure 2

External Variables Affecting Internal World of Individual Choice

The set of variables included above are conceptualized at a very general level. Many specific factors in particular environments will affect the level and shape of both the benefit and cost curves and their relationships. In the initial analysis to follow, we will temporarily assume symmetry among appropriators in order to pay primary attention to the general nature of the calculus involved at the constitutional level. Once this analysis is complete, we will introduce asymmetry to examine how this affects the benefit/cost analysis of various types of appropriators. In this initial analysis, we do not explore how either norms or a discount rate affect the evaluation of benefits and costs nor how external variables affect these two internal papers. This analysis will be undertaken in future work.

### 5.2.1 Expected Benefits

The most important internal factor affecting expected benefits in a CPR situation is the current condition of the resource itself and the yield that the resource is likely to produce over the future, given different patterns of use.<sup>10</sup> As discussed above, at least five types of suboptimality may be involved in a CPR dilemma problem: (1) potential destruction, (2) rent dissipation, (3) suboptimal assignment, (4) crowding, and (5) underinvestment. In many empirical situations, aspects of these five problems occur together. To focus our analysis, we will initially assume that the problem facing a group of appropriators is that of excessive withdrawal with a threat of destruction. This is the problem that has captured the most interest since the work of Garrett Hardin. It is the also the problem that scholars and others are likely to think of first in relation to the problem of the commons.

In a potential destruction problem or "an endangered commons situation" (Blomquist, 1987) past patterns of withdrawal have exceeded the sustainable yield of the resource.<sup>11</sup> If the current levels of withdrawal were to continue or increase, it is likely that the resource itself would be severely damaged or destroyed. The ease with which destruction can occur varies with the specific type of resource.

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<sup>10</sup> Changes in external factors such as market prices can dramatically affect estimation of benefits and costs. For now, we will presume that the external world is relatively unchanging.

<sup>11</sup> The sustainable yield of a resource is the amount of resource units which can be withdrawn each year without destroying the resource. The optimal economic yield may be less or greater than this.

In a potential destruction problem, the status quo rules may allow anyone access to the resource without limits placed on the quantity, timing, or location of use. Such a CPR dilemma situation is most appropriately called an "open access" CPR. The status quo rules may, alternatively, provide a clear definition and limit on who has access but may allow too many appropriators access to the resource or allow excessive withdrawals. In either case, the status quo rules are not limiting the quantity of resource units withdrawn from the resource to a sufficiently low level to sustain a continued flow of resource units over time.

When appropriators using an endangered resource are in a constitutional situation, each makes two estimates of future benefits. First, each appropriator estimates the flow of future benefits assuming that the status quo rules were to stay in force. This benefit flow depends on how many resource units each appropriator thinks he or she can withdraw in each future period and how much each appropriator thinks that others will also attempt to withdraw in each period. The length of time until the resource is exhausted depends both on current conditions and on the presumed withdrawal rates of all appropriators under the status quo rules. Continuing with the status quo rules in relation to a potential destruction problem can also be thought of as a "mining option."

The second estimate that each appropriator makes in a constitutional situation is the flow of future benefits likely under alternative rule systems that either restrict the number of appropriators who have access to the CPR, the quantity of withdrawals each can make, or both. Which alternative rules are contemplated depend on the knowledge that appropriators have about alternative rule systems and the legitimacy (both internal and external) of various rule systems. In a setting where

considerable experimentation has occurred with diverse rules, one could expect that appropriators will be able to learn about the effects of a variety of rule systems by learning about the experiences of others. In a setting where little experimentation is allowed, the repertoire of potential rules will be smaller and may not contain some rules which could lead to more optimal results than the rules considered. If no rules are proposed which increase the expected benefits to be derived from the CPR beyond those of the "mining" option, then the appropriators would all support the status quo rules. No one would try to change rules. They would simply return to the operational situation and mine the CPR.

Let us posit a situation in which the estimated benefits from an alternative set of rules exceed the benefits to be derived from continuing with the status quo rules ( $B_{ar} - B_{sq} > 0$ ). In such a situation, whether an appropriator supports a change in rules or not depends on an estimate of the cost involved in changing the rules and on the marginal costs of exclusion and internal governance involved in the change of rules.

### 5.2.2 Expected Costs

Three broad types of costs are involved in a constitutional situation. The first cost is the cost of transforming the rules themselves composed both of costs involved in relating to authorities external to the appropriators and internal costs involved in making constitutional choices. This is an "up front" cost that has to be paid before the rules are actually changed. Thus if the expected costs of transforming the rules is higher than the net benefits to be gained by changing to an alternative rules system, no further cost calculation will be made. Appropriators will

stay with an "inefficient" set of constitutional rules because the costs of changing those rules are higher than the benefits to be received after the change.

In addition to the costs of transforming the rules, there are also marginal calculations to be made about the future costs of excluding those who want to use the resource from access and monitoring the patterns of use and calculations to be made about future governance costs.<sup>12</sup> Of course, it is possible that an alternative set of rules may lower these costs as well as increase them depending upon what the status quo rules are and the congruence of various rule systems with shared norms.

#### 5.2.2.1 Transformation Costs

Transformation costs are costs that are expended to change rules. These may apply to relations with and within a group. External transformation costs that groups within a broader constitutional system need to pay to other governance structures to attempt a change in constitutional rules. External transformation costs may be paid simply for needed services related to constitutional choice such as the provision of an appropriate arena for constitutional decision-making or for key information needed in the process. External transformation costs may also be paid simply to achieve permission to engage in micro-constitutional choice. In addition to assuming that net benefits are to be gained from changing rules, let us also assume that  $\text{Bar} - \text{Bsq} - \text{G} - \text{E} > 0$ .

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<sup>12</sup> The analysis of costs draws heavily on previous work of scholars working on property rights and transaction costs including Alchian and Demsetz (1973), Coase (1960), De Alessi (1980; 1987), Williamson (1975; 1979; 1985), North (1978; 1981), Davis and North (1971), and Feeny (1982).

External transformation costs are frequently paid in the currency of time -- the time that it takes to invoke regular procedures to achieve micro-constitutional changes. If a special election has to be called, how much time must elapse between initial notice and final election? How much time must be spent in gathering signatures? How much time must be spent in bureaucratic offices explaining the problem and what is wanted? How much time will elapse between an initial request and a final decision?

While time is a major element involved in external transformation costs, it is not by any means the only element. Regular donations of funds may be needed to gain the required "autonomy" to make one's own internal constitutional choices. The "free cities" of Europe purchased their "freedom" by paying large financial tributes to reigning monarchs. In some settings, the funds involved are illegal bribes paid to officials of the surrounding governance system to let appropriators decide upon rules related to their own CPR.<sup>13</sup> Autonomy may be gained simply by distance from governance centers. Remote villages have traditionally had a higher level of autonomy in making their own internal constitutional choices than villages located near to governance centers.

The quantity of external transformation costs that a group of appropriators must pay is a monotonically increasing function of the level of autonomy that the appropriators have from the surrounding multi-

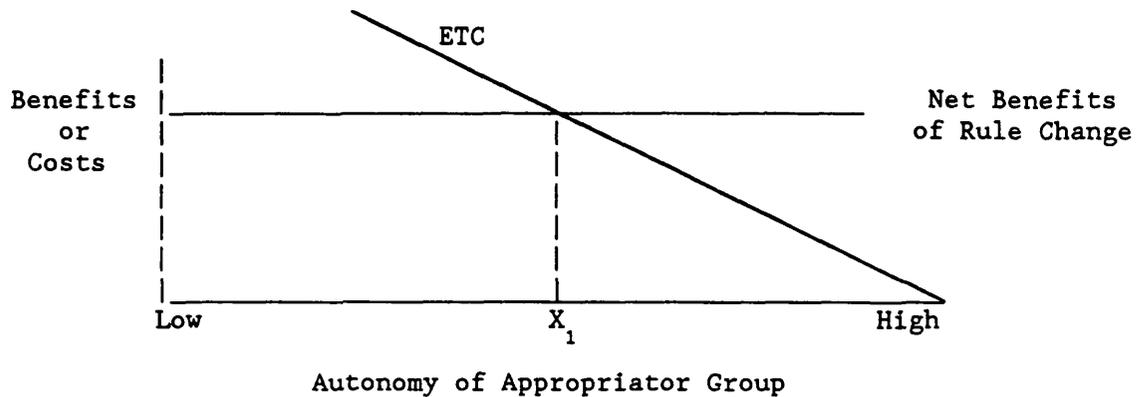
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<sup>13</sup> See Wade (forthcoming) for an intriguing analysis of a CPR irrigation system in India which was managed entirely outside the formal, legal, governance system of India and sustained by paying regular bribes to regional and national governmental officials.

constitutional political systems. If the appropriators are granted substantial legal autonomy to carry on their own internal constitutional choices and the appropriators do not need to pay for services from larger governance systems, then the appropriators are characterized by high levels of autonomy. If the external governance structure limits the number of constitutional decisions that local appropriators can take without prior approval and/or the local appropriators need services that can be provided only by larger governance structures, the local appropriators have low autonomy.

The relationship between autonomy and external costs of transformation are illustrated in Figure 3. Autonomy is measured along the horizontal axis and costs and benefits of a change are measured along the vertical axis. Net benefits of an alternative set of rules is posited to be positive and unaffected by the autonomy of a group. External transformation costs (ETC) will be higher in groups with low levels of autonomy and fall as the levels of autonomy in appropriator groups rises. In a constitutional situation, appropriators who have high levels of autonomy will proceed to change their status quo rules to an alternative set of rules. An individual in a group whose autonomy is located to the right of  $X_1$ , will support a change in rules as total expected benefits will exceed expected costs. Appropriators in groups to the left of  $X_1$  will not, however, support a change in rules as the external costs of transformation exceed the benefits they could derive from an internal change in rules.

Figure 3

Autonomy and External Transformation Costs

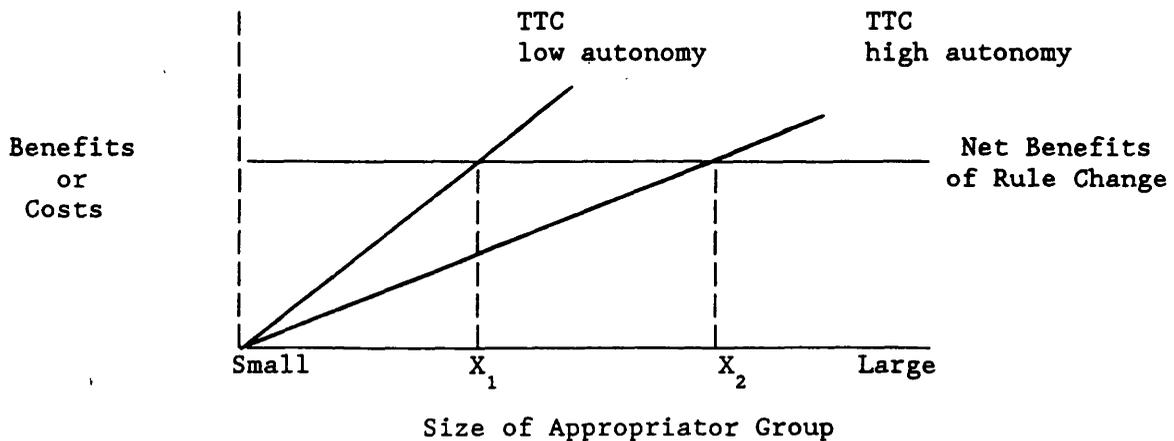
Internal transformation costs are the decision making costs that the appropriators themselves will have to spend coming to a decision about whether to try to change rules or not. These are the types of costs that were originally analyzed by Buchanan and Tullock (1961) in The Calculus of Consent. From that analysis, internal decision making costs are composed both of the resources devoted to decision making and the deprivation costs that can be imposed by one coalition of decision makers on others in the group. In the current analysis, we will concentrate on total internal decision making costs rather than the components and posit that all appropriators under analysis are using a decision-rule at the constitutional level that is greater than a simple majority rule but less than absolute unanimity. With this type of decision rule, the major component of the internal transformation costs are the resources devoted to coming to an agreement.

Holding decision rules constant, the other two factors that affect the level and shape of internal transformation costs are the size of a group

and its heterogeneity in relationship to the rules being considered. Having assumed relative symmetry of interest, the major factor to be examined at this point is the size of the group. Internal transformation costs are directly related to the size of the group. The larger the group the greater the time and effort involved in coming to a constitutional decision whatever it be. We can combine the external and internal costs of transformation into total transformation costs (TTC) and examine the dual effect of size of group and autonomy. The size of an appropriator group is measured along the horizontal axis and benefits and costs is measured along the vertical axis. Assume a given net benefit itself unaffected by group size. TTC are affected both by the number of participants in a group and the autonomy of the group. TTC rise with the size of the group and they rise faster in low autonomy groups than in high autonomy groups. Illustrative total transformation costs curves for two types of groups are shown in Figure 4: for groups with low autonomy and for groups with high autonomy.

Figure 4

Size, Autonomy and Transformation Costs



Appropriators in small groups with considerable autonomy are most likely to transform status quo rules into a more efficient set of alternative rules while appropriators in large groups with low autonomy are least likely to make the transformation. An individual in a low autonomy group whose size is located to the left of  $X_1$  in Figure 4 will support a rule change while an individual in a group whose size is located to the right of  $X_1$  will not support a rule change. Individuals located in high autonomy groups much larger than that represented by  $X_1$  will still support a rule change. It is only those individuals located in high autonomy groups whose size exceeds  $X_2$  who will not support an attempt to make a change in the status quo rules.

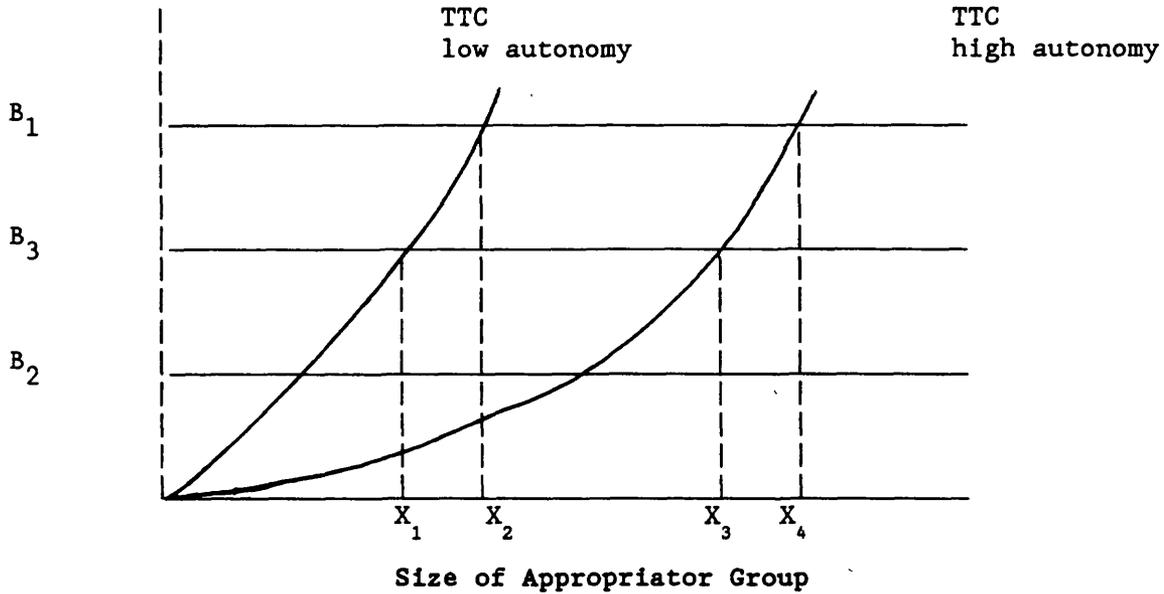
Now let us change the assumption of symmetry of all relevant interests to that of asymmetry of asset structure keeping the decision rule used by appropriators at the constitutional level to something greater than simple majority but less than absolute majority. Let us examine constitutional situations where some subgroup of appropriators are currently withdrawing a major proportion of the resource units produced by the CPR. We will call this group the major appropriators. If the resource were destroyed, the major appropriators would be hurt the most. Similarly, if the resource were to be sustained over the long run, the major appropriators would continue to reap comparatively larger benefits from the flow of resource units. If the change in rules involves a proportionate cutback for all appropriators, the major appropriators will reap a higher benefit level from the change of rules than will the minor appropriators. Everyone benefits from a proportionate cutback but the major appropriators gain the most.

It is in the interest of major appropriators to pay higher transformation costs (both internal and external) than minor appropriators.<sup>14</sup> Thus, appropriator groups where major appropriators are present may undertake more costly transformations than appropriator groups with no major appropriators will not. To illustrate this in Figure 5, three benefit levels are arrayed.  $B_1$  is the benefit level perceived by major appropriators and  $B_2$  is the benefit level perceived by minor appropriators.  $B_3$  is the benefit level that would exist if no asymmetry were present. For low autonomy groups with symmetry, members of groups whose size was smaller than  $X_1$  would support a transformation of the rules while groups up to  $X_2$  who had asymmetrical benefit curves would be able to muster the transformation costs from those who would receive higher benefits. For high autonomy groups with symmetry, members of groups whose size was smaller than  $X_3$  would support a transformation of the rules while groups up to  $X_4$  in size who had asymmetrical benefit curves would be able to transform their rules if those receiving the greater benefits paid the costs of transformation.

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<sup>14</sup> It needs to be stressed that this analysis is based on the assumption that the alternate rules benefit the major appropriators more than the minor appropriators. If the alternate rules take away rights from the major appropriators, more than proportionate to the minor appropriators, the major appropriators would prefer to block the rule change rather than support it.

Figure 5

Size, Asymmetry of Assets, and Transformation Costs

## 5.2.2.2 Exclusion Costs

Whenever a group of appropriators is facing a potential destruction problem and is contemplating a variety of rules that may restrict future entry and use of the resource, part of the calculus related to contemplating different rules has to do with the costs of excluding those with no or lesser rights from using the resource.<sup>15</sup> Exclusion costs include the resources devoted to detecting unauthorized users and denying them access to the resource (see Field, 1985; 1986). Exclusion activities are frequently undertaken by the appropriators themselves either as they go about their normal activities (such as fishermen who watch out for boats

<sup>15</sup> Exclusion is obviously a strategy which can harm those who are excluded. The similarity of the analytical structure of CPR problems to those of cartels, must be kept in mind. The consequences of diverse ways of achieving exclusion will be examined in future work.

owned by outsiders) or as a special job into which appropriators rotate (such as irrigators who each are responsible for inspecting an irrigation canal for a specified period of time). Exclusion activities may also be undertaken by external officials who either act independently of local appropriators or are called upon by local appropriators to eject an unauthorized user and potentially press charges in a formal court. It is the latter type of activity that is frequently presumed to be the major activity involved in exclusion. Empirically, however, it appears that in many CPRs it is the appropriators themselves who undertake many of the exclusion activities.

Exclusion costs are largely affected by the size and physical attributes of the resource itself, the technology available for exclusion, and the legitimacy afforded micro-constitutional rules by external authorities and users. The larger the resource, the greater the costs of "fencing" and/or patrolling the boundaries to insure that no one enters the resource. For many natural resources, such as fisheries, fencing is physically impossible. Even maintaining effective markers may be quite costly. Inshore fisheries, particularly those located in lagoons or bays, involve much lower exclusion costs than offshore fisheries. For resources such as groundwater basins or oil pools, the resource units move underground to the area which is most heavily pumped. Even determining the physical boundaries of such resources requires expensive geologic studies. However, once the boundaries are well established, the presence of a well may be hard to disguise and the primary "cost" of exclusion is the legal action required to stop an unauthorized user from continuing to use a resource.

Thus, in addition to the physical attributes of the resource that affect the costs of exclusion, how rules established in a micro-constitutional system will be enforced or not enforced by authorities of the surrounding jurisdictions is a key aspect of the estimation of future exclusion costs. Studies of how local villages have organized inshore fisheries in many parts of the world document various forms of sea tenure that fishermen have developed through both self-conscious micro-constitutional processes as well as through evolutionary changes that are probably best thought of as evolved contingent strategies. In those areas where a regional and/or national government is supportive of locally developed property systems, such as in Turkey, local appropriators are able to count on the help of government officials to help exclude outside fishers if the threats of local appropriators are not sufficient. In such settings, appropriators contemplating a change in the status quo rules to tighten up who had access to a CPR, can count on relatively low cost assistance from the surrounding governmental entities if local exclusion activities were insufficient to enforce the change in rules (see Berkes, 1987).

In those areas where national governments are unaware of the property rights that local fishermen have developed for themselves (such as in many Third World countries or even in Nova Scotia) future exclusion costs can become very high (Davis, 1984; Cordell and McKean, 1987). In fact, prior micro-constitutions negotiated in remote locations involving both low transformation costs and low exclusion costs may become untenable at later junctures if these areas become attractive to external users who have the backing of a regional or national government. Some national governments have provided considerable economic support to the development of modern

fishing fleets that have then successfully "invaded" inshore fisheries that were previously "owned" by local fishermen. Without the advantage of being ignored or given legitimacy, a small group of local appropriators faces very high costs in trying to exclude well financed and governmentally supported users who do not have local property rights. Thus, exclusion costs are a dual function of various attributes of the resource and of the willingness of surrounding governance structure to devote moderate support to enforce exclusion beyond those provided by the appropriators themselves.

#### 5.2.2.3 Governance and Internal Monitoring Costs

The third major type of cost that appropriators will consider when contemplating changes in property rules in a constitutional situation relates to future governance and internal monitoring costs. If the status quo rules involve few or no restrictions on the quantity, time, or location of withdrawals and the alternative rules involve many such restrictions, a major consideration is how to enforce these restrictions, how to provide conflict resolution mechanisms to handle the conflicts likely to erupt over these restrictions, and how to make decisions in the future about the modification of these restrictions. Even if the status quo rules already involve many restrictions and the alternative rules are themselves a modification of these restrictions, the same considerations apply: how much more (or less) time and energy will be devoted to monitoring the activities of the appropriators, the joint effect of their activities on the resource, resolving conflicts over use, and in making future decisions about the resource itself?

The level of these costs depend on: (1) the particular rules being contemplated, (2) the physical attributes of the resource system itself,

(3) the type of norms shared in a community or their absence, (4) the number, symmetry, and dispersion of the appropriators themselves, and (5) the facilities available in surrounding governance structure. In this paper, these factors can be discussed only briefly.

In attempting to negotiate a change in property rules to avoid a destruction problem, appropriators will be searching for rules that limit the quantity of resource units withdrawn in relation to the stages in the cycle during which resource units are withdrawn. The latter can usually be accomplished by a combination of season openings and closings and restrictions on the sex and/or size of the species withdrawn from the pool. Season openings and closing that hold for all authorized appropriators tend to minimize future monitoring costs as anyone found withdrawing units before or after the "official" season is unambiguously breaking the rule. Similarly, a wide variety of rules of rotation also tend to involve low monitoring costs. If each irrigator from a canal is assigned a particular time slot, each irrigator is motivated to be sure to receive their full time slot of water and to be sure that the next irrigator does not try to take water too early. Thus, at the time of a switch from one irrigator to the next, both are likely to be present and to insure by their presence that the rules are followed. Rules which assign a limit which can be produced across an entire season or year are much more costly to enforce even though they may also be more efficient rules for achieving regulation. Whether it is economically feasible to use quantity limits (which in turn may be marketable), depends largely on the type of records that either are or can be routinely kept and making the information in those records available to all appropriators.

Many attributes of the physical system or the technology in use also affect the cost of monitoring the activities of authorized users. Factors that enhance the capacity of users to see or hear one another as they are engaged in appropriation activities tend to lower these costs. Even if appropriators do not hear or see one another while they are withdrawing resource units, if they all return to the same location at the end of their activities so that the quantity of resource units each has acquired is open for casual inspection, monitoring costs will tend to be low. The presence of a shared norm that rules decided upon by the appropriators themselves need to be followed, will offset many physical disadvantages in monitoring a particular resource. Shared norms related to the legitimacy of the rules and their need to be followed reduce the costs of monitoring and their absence increases those costs.

The size of the appropriator group and its dispersion will positively affect future monitoring and governance costs. The availability of low cost facilities for recording and disseminating information about regulated activities may offset, to a large extent, the costs associated with monitoring the activities of a large and dispersed group. The collection and verification of data on water production levels by an external water master and their publication on an annual basis, for example, has kept the monitoring costs of rules established in micro-constitutions amazing low as will be discussed below.

### 5.3 The Linkage of Constitutional and Operational Level Situations

The constitutional situation -- as a level of analysis -- always lies beneath operational level situations. How deeply buried and forgotten the constitutional level of analysis may be at any particular point in time

depends on how well the current set of rules work for appropriators. When a set of rules generates behavior yielding outcomes that most appropriators consider to be beneficial, no one will spend much time contemplating whether other rules might help them generate a still better set of outcomes. The aphorism that "if it ain't broke, don't fix it" applies to the capital structure involved in constitutional decisions as well as the capital structure involved in equipment. On the other hand, when the set of rules is generating behavior yielding outcomes that many appropriators consider to be harmful, individual appropriators -- particularly major appropriators -- are likely to begin thinking about the various benefits and costs involved at the constitutional level. When a preliminary calculus conducted in someone's head leads to a conclusion that some rules exist that would produce greater future benefits than future costs, the proposal to switch to a different level of action will be made.

Appropriator groups with substantial autonomy will be likely to switch from operational situations to constitutional situations more frequently than appropriator groups without substantial autonomy. This is due largely to the higher transformation costs that a group with low autonomy will have to pay to make choices at the constitutional level. Further, groups with high levels of autonomy can afford to experiment with constitutional rules because they can change them more frequently than groups with low levels of autonomy. The choice of what turns out to be a disastrously bad property rule is not so devastating in the long run if a group can change that rule without having to pay high transformation costs. Some of the costs of trial and error at the constitutional level can be reduced if similar groups also have substantial autonomy and are also experimenting with diverse forms of property rules. Communication about the effects of

various rules tried by others in similar situations can augment the knowledge gained within the group about the effects of various kinds of rules on behavior and outcome.

Efforts to engage in constitutional choice will also be enhanced if there are individuals who will benefit to a larger extent than others from a successful effort to change constitutional rules. In the above analysis, we identified major appropriators as being more likely to bear a higher proportion of the costs of transforming suboptimal operational situations because they would capture a higher proportion of the benefits from the change. Thus, part of the entrepreneurship involved in constituting and reconstituting effective CPR operational situations is likely to be carried by major appropriators. Outside individuals may also fill the role of entrepreneurs in CPR situations. If the appropriators themselves organize and create leadership positions, these may be filled by nonappropriators who are dependent upon the productivity of the CPR for their own future income and rewards. If these nonappropriators are able to keep some of the "residuals" from an improved constitutional order, they will be motivated to search out new ways of organizing the use of the CPR that are more efficient. Without some source of entrepreneurship, appropriators may continue to work within a given set of rules even when they are producing harmful consequences because no one is motivated to pay the up-front and, at times, substantial costs of attempting a transformation of the situation.

We can thus begin to state the factors likely to enhance the probabilities that CPR dilemma situations will be transformed into productive CPR situations by the appropriators themselves without external

imposition. At least five major factors appear to be conducive to efficient self-organization and transformation. These are:

1. Relatively accurate information is available about the structure and flow characteristics of the resource.
2. Appropriators can communicate with one another, have a minimal level of trust and shared norms, and relatively congruent interests.
3. Transformation costs are relatively low.
4. Appropriators know about the effects of diverse rules on behavior and outcome.
5. A source of entrepreneurship is available either within the set of appropriators or in the surrounding governance structures.

Any one of these factors may be the result of quite diverse circumstances. The information condition -- the first -- depends on many specific attributes of the resource, the appropriators, and information produced in regular or special ways (see discussion on pages 17 and 18 above). Communication and trust may be easily established in small groups so one can expect relatively small groups of appropriators to organize themselves more frequently than large groups. However, where large groups are able to establish communication networks at relatively low costs, even quite large groups may be able to engage in effective constitutional choice. Transformation costs may be relatively low when the CPR is located in a remote region and no one else pays any attention to what the appropriators there do. Or, transformation costs may be relatively low when general recognition is given to the right of appropriators to engage in constitutional decision making.

Using a revised theory of CPR dilemmas, we have been able to identify an initial list of factors which can explain why some CPR dilemmas become "tragedies of the commons" and why others do not. Substantial further

theoretical and empirical work is needed to more fully develop the theoretical structure and to examine its empirical relevance. In this initial paper, I have attempted to provide a theoretical overview of what I see as a much larger endeavor. In the next section of this paper, I would like to apply some of the ideas developed above to explain why inshore fishers in many of the coastal states of the U.S. have been relatively unsuccessful in avoiding CPR dilemmas while groundwater producers in at least one region of the U.S. -- Southern California -- have successfully engaged in constitutional decision making to avoid tragic results.

#### 6. Contrasting Experiences in Constitutional Choice

Within the same country, especially a federal polity, the costs of transforming operational situations by changing underlying constitutional rules may vary dramatically from one region to another and from one policy area to another. Within the U.S., the regulation of inshore fisheries has involved the national government to a greater extent than the regulation of groundwater. The national government, as well as many state governments, has followed an overt policy in regard to the regulation of inshore fisheries of mandating the rights of all citizens to have access to most inshore fisheries. In regard to underground water, state governments have had a more dominant role and state water laws vary dramatically from one state to another. California water law is a blend of an earlier Spanish legal tradition overlaid by a series of major state court decisions and by efforts of local water producers to create a diversity of special districts using rules tailored to particular situations. The different legal systems related to inshore fisheries and groundwater basin management have led to

quite different outcomes in regard to micro-constitutional choice processes. Only a brief discussion of these two multi-constitutional political systems is possible in this paper.

#### 6.1 Inshore Fisheries Remain Open Access Resources In Spite of Local Efforts to Develop Micro-Constitutions

Compared to ocean fisheries, inshore fisheries are far more likely to meet the first condition -- adequate information -- conducive to self-organization. While the information available about mobile biological species under intensive harvesting is always uncertain and costly to obtain, local fishers frequently acquire excellent time and place information about the conditions of a inshore fishery. Further, information about the volume of withdrawals and number of appropriators is available as a by-product of commercial sales.

Some, but not all, inshore fisheries meet the second condition of communication, trust, and relative congruence of interest. When a set of fishers all come from a single village, predominately use one technology, and are relatively congruent in their interests, they are more likely to develop their own property rules (Acheson, 1975; Wilson, 1977; Davis, 1984). As Johnson and Libecap (1982) stress, however, fishers always vary in regard to skill. Rules which do not allow those with higher levels of skill to gain financial advantage from their skill will meet with strong resistance no matter how the rules are proposed. In addition to skill asymmetries, fishers may also vary substantially in terms of the amount of capital they have invested and in terms of their technology. Thus internal transformation costs of changing their own rules tend to be high in any inshore fishery where asymmetries are substantial. Further, the external

transformation costs involved in gaining approval of locally negotiated rules have been extremely high for most major U.S. inshore fisheries. Thus, the third condition is rarely met in most inshore fisheries in the U.S. The dominant empirical finding is that most inshore fisheries are suffering severe rent dissipation and many face potential destruction problems (Bell, 1972; Agnello and Donnelly, 1975).

Johnson and Libecap summarize the reasons for these high external transformation costs:

Both federal and state governments emphasize the right of all citizens to access fisheries and other wildlife. They refuse to assign private territorial rights to areas large enough to cover migratory species. Moreover, informal voluntary efforts to control entry are opposed by the Justice Department and the Federal Trade Commission as violations of the Sherman Act. Further, antitrust actions have been taken against fishermen unions along the Gulf and Pacific Coasts when they attempted to regulate prices and limit entry (Johnson and Libecap, 1982: 1,006).

Court cases in Washington, California, Hawaii, and the Gulf states of Texas and Louisiana related to sardine, tuna, shrimp and oysters eliminated the agreements negotiated within unions and other associations to limit access to a commercial fishery and to restrict patterns of use as well (see court cases cited in Johnson and Libecap, 1982: 1,008). Thus, after paying the high internal transformation costs associated with negotiating property rules when interests are asymmetrical, fishers had even higher external transformation costs imposed on them. Outlawing agreements among the appropriators themselves leaves few options to appropriators other than: (1) to engage in competitive races to harvest as much as they can or (2) to lobby state agencies, who assert the prerogative to make property rules for all fishermen in a state, for rules to prevent rent dissipation and/or extinction of valuable commercial species.

Turning the task of developing property rules for inshore fisheries over to state agencies and prohibiting local constitutional choice processes does not solve the problem of developing effective property rules related to inshore fisheries. State regulatory agencies face a more heterogeneous set of conditions and appropriators when regulating for an entire state than any single group of fishers do. In some cases, such as along the Gulf coast and the north eastern coast, no single state agency has jurisdiction over the full range of migratory fish. Lobbying is an expensive activity and when the level of conflict over proposed rules is high, the costs of coming to decisions at a state capital are also very high. Everyone can agree to rules which restrict entry during some seasons of the year, but further restrictions on who has access, how large a harvest should be allowed, and how the harvest should be distributed across appropriators is much more difficult to achieve the larger and more heterogeneous the interests that are clustered together.

Obviously state and national governments have a distinct interest in preventing collusive agreements among the appropriators of any CPR that leads to monopolistic practices and to the exclusion of legitimate interests from participating in effective constitutional fora. But the policies pursued by national and state governments to prevent local self-organization has precluded the development of efficient rules related to almost all inshore fisheries in the United States.

## **6.2 Groundwater Basins in Southern California are Transformed from Commons Dilemmas to Managed Commons through Micro-Constitutional Processes**

A comparison of the experiences of water appropriators using four groundwater basins underlying the Los Angeles and Orange County

metropolitan areas written by William Blomquist (1987) provides a contrasting experience in constitutional choice to that described by Johnson and Libecap. Until a quarter of a century ago, the accepted water law through all of California in relation to groundwater was based on a riparian-type doctrine. Any overlying land owner was authorized to withdraw as much groundwater from beneath his or her land as could be put to beneficial use. In the growing metropolitan areas of southern California this eventually led to severe competition to use as much water as one could get before it was captured by everyone else. These basins were considered to be in a "crisis" condition by the California Division of Water Resources shortly after the termination of the second World War.

Several of the basins examined in Blomquist's study were located adjacent to the sea and severe overdrafts led to salt-water intrusion. The intrusion adversely affected not only the quality of the water contained in the basin but the viability of the basin itself to be used as a "natural reservoir" in regulating extremes in demand and supply which are regularly a part of any water supply system. Replacing the natural reservoir with surface reservoirs would have been very costly. Consequently, it was in the joint interest of most water producers to transform the property rules related to each groundwater basin even though each water producer would suffer short-term costs as a result of such a transformation.

The strategies of constitutional choice related to the four basins -- Raymond Basin, West Basin, Central Basin, and Orange County Basin -- were generally similar with some important differences. One key step taken in all four basins was the development of a forum for the gathering and exchange of information among the participants. In all four basins, the basic constitutional agreements for how the basin was to be regulated and

property rights assigned were negotiated by water producers (who were themselves a mixture of private and public enterprises) and officials of local jurisdictions directly involved in each basin. California is a state which provides a wide variety of institutional mechanisms that allow for substantial creativity in the crafting of new special districts and other negotiated settlements to cope with local problems.

In three of the basins -- all except Orange County -- one or more of the major appropriators initiated a law suit using equity procedures which accomplished several important tasks. The court became a legal forum for engaging a constitutional process to renegotiate their property rights. The court appointed a watermaster who was empowered to obtain essential information from all parties and distributed to all parties. Once a report and recommendation had been issued by the watermaster, committees of attorneys and engineers representing the major parties met in the shadow of the court to negotiate a contingent contract which became effective when parties representing a high proportion (75 to 80 percent) had signed the negotiated settlement. The contract involved an agreement to: (1) a proportionate cutback in production, (2) the creation of firm (and marketable) rights to a defined amount of water per year, and (3) the establishment of an exchange pool whereby those with substantial water rights could lease them to those with few water rights. Other local entrepreneurship led to the creation of several special districts including one covering both West and Central Basin. The West and Central Basin Water Replenishment District has used a pump tax on groundwater production in these two basins to further regulate demand and supply conditions in the basins.

A different strategy was followed in Orange County where local appropriators formed the Orange County Water District (OCWD) in 1933 empowered to undertake the management of the basin, conservation of the water contained in the basin, and reclamation of water for replenishment purposes (Blomquist, 1987: Ch. 8). Instead of limiting production, as appropriators did in the three other basins, the OCWD has pursued an aggressive policy to enhance the supply of water to the basin. The power to impose a pump tax was added to the organic legislation authorizing the creation of the district (the constitution of the district) in 1953 and the pump tax has been used to purchase replenishment water to replace the water withdrawn from the basin.

Today, all four basins are off the "crisis" list, salt-water intrusion has been stopped in the three which had exposed coast lines, and the costs of water to users in these basins is substantially lower than it would have been if local constitutional efforts had been stymied by the State of California or national authorities. The basin management costs in the four basins vary from a low of \$3.50 per acre-foot in Raymond Basin, to around \$75.00 an acre-foot in West and Central Basins and \$150.00 an acre-foot in Orange County. The total costs of the water currently being used in each of these basins varies from a low of \$185 in Raymond Basin to a high of \$268 in Orange County. If the basins had been destroyed and water users were required to use surface water entirely, the costs of water in all four basins would be close to \$750 per acre-foot (Blomquist, 1987: Figure 9-10). Thus, all four basins have developed more efficient micro-constitutions than the alternative they would have faced if they had continued their race to use up the groundwater. It also appears that the three basins that invested in the negotiation of firm water rights and the establishment of

self-imposed limits on use, have evolved more efficient settlements than Orange County which has self-consciously tried to manage the basin without defining water rights and limiting the quantity that each appropriator could withdraw.

The appropriators in these four basins faced many problems which had to be overcome in the development of their local micro-constitutions. Only Raymond Basin involved a small number of appropriators -- 31 when they started litigation and 17 currently. Both West and Central Basins started with over 700 appropriators and Orange County started with over 1000 producers. The basins, except Raymond, were large and very little information was known about the underlying geologic structure, quantity of inflow, and quantity of withdrawals. Today, reports are published each year in each of the basins giving up-to-date information on water conditions and excellent information has been acquired through the years on the geologic structure of the basins. Major appropriators in each of the basins took a key entrepreneurial role in getting local action started. The City of Pasadena accounted for nearly half of the total production from Raymond Basin and bore the major brunt of the initial cost of litigation there to achieve firm water rights. Nineteen parties (out of 700) accounted for 84 percent of the production from West Basin. These parties included such diverse enterprises as city water departments, private water companies, and industrial users. The time frame of these corporate actors was long. Central basin was somewhat less concentrated but 17 parties (out of 750) accounted for half of the total production from that basin. The production patterns in Orange County were more scattered with many large agricultural users, but the Irvine Ranch bore the heavy entrepreneurial costs early in the process.

The multi-constitutional environment present in southern California during the past fifty years provided institutional facilities which enabled appropriators who were engaged in difficult and internally costly processes of constitutional negotiation to succeed where many others have failed. Let us return to the five factors discussed on pages 60 and 61. First, in regard to information, appropriators in these basins started off with very poor information about their basins, but were able to obtain information from national (USGS) and state (Division of Water Resources) studies through cost-sharing arrangements and to develop local capabilities to record and distribution information widely. Second, because local appropriators were able to establish local associations to exchange information, they developed a minimal level of trust and shared norms. All had congruent interests in reducing the threat of destruction and few faced internal divisions of a substantial order.

Third, the absolute transformation costs involved in these processes were high but the arenas for transforming these systems were open. (It is expensive to use a court or to establish special districts by petition and special elections.) In these cases, the benefits to be derived were extremely high and thus the relative transformation costs were low. Fourth, since considerable experimentation was occurring generally in southern California regarding various rules for constituting micro polities, appropriators did know and discuss many different rules that they might use in regulating their basins. Fifth, sources of entrepreneurship existed in all four basins and in the surrounding multi-constitutional system. Public entrepreneurship flourishes in a multi-constitutional system such as the one which has developed in California. Thus, all five factors were present in the four successful cases examined by Blomquist.

Colleagues at the Workshop in Political Theory and Policy Analysis have just initiated a study which will include several additional groundwater basins in California which have not been as successful as the four initially studied by Blomquist. In that study we will be attempting to ascertain which of the above factors were present and which were absent in the rest of the basins to be included so that we can provide a further empirical analysis of the relevance of the revised theory of commons dilemmas discussed in this paper.

#### 7. Policy Implications of This Approach

While the major thrust of this effort to build a revised theory of CPR dilemmas is to provide a better explanation of empirical experience, important policy implications also are involved. The bottom up approach of examining micro-constitutional processes in a multi-constitutional political system stresses both that it is possible for humans to design their own institutions tailored to the specific conditions and problems they are facing and that many political systems are better viewed as compound, constitutional systems than as solitary constitutional orders. The dominant way of thinking about political systems in both economics and political science to view the entire system from top down as if there were only a single governmental firm -- the state -- regulating everything.

Illustrative of this view is an article by Elizabeth Rolph (1983) describing four efforts to achieve regulation in relationship to common-pool resources. One of the four efforts included in her analysis is the set of groundwater basins discussed in Section 6.2 above. Having described the general problem of overuse in relationship to such resources,

Rolph indicates that "the government (any of the three branches) is called upon to allocate user rights as a means of limiting a production or a consumption activity. . ." (Rolph, 1983: 51). In regard to the groundwater users, she indicated that "they turned to the government for a program that would limit use equitably among the existing users" (Ibid.). She was puzzled by what appeared to her to be a contradiction in that users are allowed to acquire private property rights to what is a public or a communal resource. She argues that "if the government had foreseen a future shortage of the resource, it might have laid claim to it in 'the beginning,' before any users had made investments. . ." (Ibid.). As she puzzles about options, she asks:

As the government steps in to limit use, should it simply allocate complete property rights to a small sub-group of the users while stripping the rest of their limited communal rights? Alternatively, should it take the resource from its present users and redistribute it? Or should it first take away and then sell back the resource to its present users? (Rolph, 1983: 51-52).

What I find remarkable about Rolph's observations in regard to the groundwater cases is that the only policy actor that she sees as being relevant is the amorphous fictive entity called "the government." The users are viewed as turning to "the government for a program" rather than struggling themselves across a bargaining table for extended periods trying to find a formula that will meet their needs. She presumes that if "the government" had only foreseen a "shortage of the resource" it could have "laid claim to it." This presumption carries the implication that, if "the government" had owned it from the beginning, shortages would not have occurred. State governments have "laid claim" to inshore fishery resources. State ownership has not resolved the problems of overuse in relation to inshore fisheries.

The dominant image that social scientists bring to the analysis of common-pool problems has the perverse effect of supporting increased centralization of political authority. First, the individuals using a common-pool resource are viewed as if they were in a trap and cannot get out without some external authority imposing a solution. Scholar after scholar has puzzled about the enigmatic results of rigorous analysis that the "only" rational strategy for an individual to pursue in a commons dilemma is to withdraw as much resource units as possible, even though this leads to mutual disaster in the long run. If our view of human rationality is limited to a one-level representation of a multi-leveled world, who is really trapped -- the individuals conducting the analysis or the individuals coping with common-pool resource problems.

Second, the term "the government" is a mythical black box used to describe the activities of many individuals in many arenas in their complex efforts to try to find solutions to problems. Rolph can observe processes, such as those involved in the southern California groundwater basins, and talk about "the government" as an external actor instead of talking about the efforts of the users themselves to make use of public decision-making facilities in order to reconstitute their own rules. Does it facilitate human understanding to describe activities which involve negotiating and drafting contingent contracts and creating of new limited purpose, special districts in a multi-constitutional political system as pertaining to "the government" or "the state"? My answer is No. Lumping together the diversity of activities and enterprises existing in a multi-constitutional federal system as "a state" creates allusions that increasingly distance themselves from social reality. When the most distant political authorities act upon such conceptions, we can expect tragedies of the commons to reach gargantuan proportions.

Over the course of human history, most humans have lived in polities where authority was imposed and little freedom existed to engage in self-governance. Federal polities, because of their multi-constitutional foundations, do provide public facilities that enable humans to govern themselves to a greater extent than centralized regimes. Without an adequate theoretical base to analyze the experience in such polities, modern social science cannot be an effective empirical science. What is needed now, more than ever, are social science modes of analysis that lay foundations on which a self-governing society is built.

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