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THE RUDIMENTS OF A THEORY OF THE ORIGINS, SURVIVAL,
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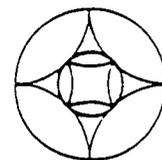
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CHAPTER 14
THE RUDIMENTS OF A THEORY OF THE ORIGINS, SURVIVAL,
AND PERFORMANCE OF COMMON PROPERTY INSTITUTIONS¹

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In the first chapter of the forthcoming volume, Essays on the Commons, Dan Bromley reminds us that there is "no such thing as a common property resource -- there are only resources controlled and managed as common property, or as state property, or as private property" [Bromley, in Bromley forthcoming]. Bromley stresses the confusion created when "resources over which no property rights have been recognized" are casually referred to as common property resources rather than as open access resources [see Ciracy-Wantrup and Bishop 1975]. A clear prediction can be made in situations where no one has a property right related to the flow of benefits from a resource. If the benefits are greater than the costs of obtaining them, open access resources will be overexploited and potentially destroyed. When property rights exist -- whether private property, state property, or common property -- overexploitation and destruction depend on how well the property rights regime copes with problems of allocating the costs and benefits of managing and governing a particular resource. In other words, property rights defining who has access, how much can be harvested, who can manage, and how rights are transferred are a necessary but not sufficient condition for avoiding overexploitation of a resources [see Schlager and E. Ostrom 1987].

The authors of the empirical chapters in Bromley [forthcoming] have heeded Bromley's advice. They have not presumed that all resources used jointly by multiple individuals are open-access resources. Instead, they have attempted to explore how decision-making arrangements -- to use the general concept of Oakerson's framework -- affect "who decides what in relation to whom"

[Oakerson, in Bromley forthcoming]. This effort to describe the decision-making arrangements that are operational, rather than presuming the absence of any authority relationships, has produced a rich set of cases describing successful indigenous, resource-management regimes as well as less successful resource-management regimes.

The effort summarized in Bromley [forthcoming] has brought together the work of anthropologists, biologists, economists, ecologists, political scientists, sociologists, and members of other disciplines. Anyone committed to interdisciplinary scholarship knows how difficult communication is when members of just two disciplines attempt to combine their skills. When members of more than half a dozen disciplines attempt to learn from each other, the problems of communication and cumulation are several orders of magnitude greater.

The success of this difficult enterprise is largely attributable to the goodwill and the substantial knowledge, skills, and hard work of the participants. A major contributing factor, in addition, has been the conceptual generality and organization brought to this effort by the framework presented by Oakerson in Chapter 3 [in Bromley forthcoming]. By identifying a common set of concepts and how these are thought to be related, Oakerson helped case study authors focus on the same set of conceptual variables and their relationships when they presented their empirical studies. Without this common framework, it is hard to imagine how any cumulation could have been derived from this effort. By the time of the Annapolis Conference, case study authors had participated in workshops where they discussed the framework and its significance for organizing their case materials and had distributed their papers in advance of the Annapolis conference [see Feeny 1986]. At the

Conference, it was thus possible to aim for and achieve a higher level of theoretical synthesis.

At the Conference, I attempted to note and discuss with participants propositions made concerning particular variables associated with the establishment of coordinated or organized strategies for managing common-pool resources. This chapter represents my effort to draw on these inductive hypotheses as the foundation for the development of a more general theory. Given my own background, it is not surprising to find that the type of theory I present has a close family resemblance to the work of political economists interested in the effect of institutional arrangements [see, for example, Bates 1983; Brennan and Buchanan 1985; Buchanan and Tullock 1962; North 1981; V. Ostrom 1987 and forthcoming; V. Ostrom, Feeny, and Picht 1988; Williamson 1985]. This chapter is, however, a blend of my own efforts to understand how institutional arrangements affect individuals incentives and behavior and the variables that the case authors identified as being important now that they had organized their analyses using a common framework.

The next section of this chapter is an effort to refine part of the Oakeron framework that referred to the technical and physical attributes of the resource. Most of the resources discussed by case study authors are common-pool resources. If one is to understand how various types of decision-making arrangements affect patterns of interactions and outcomes, it is important to ascertain in what ways common-pool resources resemble other types of "difficult" environments -- such as public goods -- and in what ways these environments are different.

The third section focuses on how "the tragedy of the commons" is avoided in many of the cases presented in Bromley [forthcoming]. Because those who

harvest from common-pool resources -- the appropriators -- organize themselves in at least a minimal way in all cases where common-property institutions are associated with successful management, the next question explored is how to explain the origin of appropriator organizations. The broad conceptual categories of the framework are now broken into their component parts and related theoretically. This leads to a discussion of the conditions that are not conducive to the emergence of some form of organization where the tragedy of the commons is not avoided. The last two theoretical sections develop propositions related to the survival and performance of organizations for governing and managing common-pool resources.

The conclusion of this chapter is in two parts. First, a brief review is presented of recent efforts to refine, extend, and test this theory. Second, a summary of the type of policies that donors and governments of developing countries could adopt consistent with this initial theory is provided.

Common-Pool Resources

To understand the opportunities and constraints that individuals using a property rights regime face, one also needs to distinguish among types of resources. Common-pool resources (CPRs) are sufficiently large, natural or man-made resources that it is costly to exclude anyone from obtaining subtractable resource-units. Two criteria are used to define a CPR: (1) the cost of achieving physical exclusion from the resource, and (2) the presence of subtractable resource-units [Gardner, Ostrom, and Walker 1990; see also Oakerson, in Bromley forthcoming; and Berkes et al. 1989].

For relatively small CPRs, a single family or small production unit may be technically able to enclose the entire resource and exclude others at a low

cost. For large and amorphous resources, such as ocean fisheries or the radio spectrum, it is extremely difficult, both technically and economically, to exclude potential beneficiaries from obtaining benefits from the resource. The cost of exclusion is affected by the size and type of the resource system's natural boundaries and the technology available to enclose them (fences, markers, electronic passwords and decoders, etc.). Entry and exit rules also affect the operational patterns of exclusion, but they must be tailored to the particular attributes of specific types of resources within a cultural and historical setting.

The definition of a CPR distinguishes between the flow of resource-units and the resource system producing the flow (Blomquist and E. Ostrom 1985). Resource-units are what individuals produce and/or appropriate from a resource system. Examples of resource-units include: fish harvested from a fishery, the animals fed on a grazing plot, wood and/or other usable plants harvested from a forest. Subtractability is a characteristic of the resource-unit appropriated from a CPR. The fish harvested by one boat are not there for someone else. Jointness of use is, however, a characteristic of the resource system. More than a single boat can harvest fish simultaneously on the same fishing grounds. More than one family production unit can graze animals on a commons, or harvest a variety of forest products from a forest.

Failure to make this distinction between the subtractability of the resource-units and the jointness of the resource system has contributed to past confusion about the attributes of common-pool resources. Common-pool resources and collective (or public) goods share one major attribute and differ in regard to a second. The relatively high cost of achieving physical exclusion is an attribute of both collective goods and CPRs. The theoretical

literature focusing specifically on the problem of free riders is relevant to the analysis of both collective goods and CPRs because the problem of free riding stems entirely from the difficulties of excluding beneficiaries from resources.

Collective goods and CPRs differ, however, in regard to jointness of consumption. Consumption units of collective goods are consumed without subtracting from the quantity available to others while consumption units of CPRs are subtractively consumed. The "crowding effect" or "over-use" problem of CPRs does not occur in regard to the use of such collective goods as a weather forecast or national defense.

The subtractability of the resource-unit leads to the possibility of approaching the limit of the number of resource-units produced by a CPR. When the CPR is a man-made structure, such as a bridge, approaching the limit of crossing units leads to congestion. When the CPR is a biological resource, such as a fishery or a forest area, approaching the limit of resource-units produces short-run externalities but may also destroy the resource. If the human demands made on a CPR are considerably lower than the quantity of resource-units available, many individuals can simultaneously use the CPR without adversely affecting each other or the long-run yield.

How is the Tragedy Avoided?

If a relatively large number of individuals make high demands on a single CPR, do not communicate with one another, and act independently taking only their own expected return into account, the "tragedy of the commons" [G. Hardin 1968] is likely to occur. The "tragedy" may take the simple form of overexploitation or the more complex form of destruction. Many of the cases

in Bromley [forthcoming] illustrate situations in which individuals do talk with one another about the long-run condition of their shared resource and take account of one another's actions when deciding on their own actions. If we are to move beyond the work of Hardin, we need to begin to specify the conditions that are conducive to the emergence of coordinated, rather than independent, actions by the individual users of a CPR.

In the following discussion, the set of individuals who withdraw resource-units from a CPR will be referred to as the appropriators of a CPR [Plott and Meyer 1975]. Appropriators may live in or nearby a CPR or far away and travel to the resource to harvest use-units. The group of individuals who appropriate from a CPR may remain latent or unorganized. Or, the appropriators may begin to discuss their problems with one another, recognize some commonly accepted rules for who has access to the CPR under what conditions, and develop some mechanisms for conflict resolution about the CPR. The forum for discussion and decision may be a local gathering place, a village council, or any other place where the users of the same CPR congregate from time to time to discuss their common problems.

Because organizational arrangements frequently emerge from the patterns of behavior which are informally agreed upon over long periods of time, it is difficult to determine when user groups are latent and when they are organized. The following definition provides demarcation criteria:

Appropriator Organization (AO): A set of appropriators is considered to be organized whenever they share common understandings about:

1. Who is and is not a member,
2. The type of access to a CPR conveyed by membership or other grounds for such rights (e.g., the rights, duties, liberties, and exposures of different individuals),

3. How decisions will be made that affect the development of coordinated strategies for appropriating from or providing for a CPR, and
4. How conflicts over these patterns will be resolved.

AOs vary from relatively informal organizations, meeting occasionally where appropriators discuss how their individual strategies affect one another, to formal organizations with written rules clearly specifying mutual rights and duties and procedures for making binding decisions on all members. An AO could be a village governed by local oligarchs or by open democratic processes. An AO may be a unit of local government where members of the local community select their own representatives and pass discretionary legislation about the use of the CPR and other matters.² A unit of local government that is primarily an administrative district of a central government is not included within the meaning of the term "Appropriator Organization."

When an organization is created by individuals, who are able to make sustained claims to exclude others from access and appropriation from their resource in external courts and administrative bodies, an AO is more stable. Examples of AOs organized by appropriators with less than full ownership rights are illustrated, however, in situations such as those described by Cordell and McKean in Bromley [forthcoming]. Many of these AOs have been rather ingenious in their efforts to control the CPRs on which their members' livelihood depends. Given the external legal orders in which they find themselves, they are exposed to greater uncertainty than if they could gain proprietorship rights in those external fora.

Examples of long-run success in managing CPRs subject to high levels of use, such as the Japanese villages described by McKean in Bromley [forthcoming], involve the establishment of an AO meeting the criteria stated

above [see E. Ostrom 1990]. This leads me to conjecture that the development of an AO is a second necessary, but not sufficient, condition for avoiding the tragedy of the commons through the actions of local appropriators themselves.³

Given the importance of AOs, we need to examine the factors associated with the emergence of some form of organization. It is obvious from the cases in Bromley [forthcoming] that organizations do not always emerge whenever they are needed. Three of the five fishing villages studied by Fikret Berkes, for example, did not have an AO. Many of the neighboring villages to the one described by Wade did not have an AO. Consequently, we need to examine the conditions that are conducive for the emergence of an organization. At the Annapolis Conference several participants helped to identify a set of variables that appeared to affect the likelihood of the origin of one or more AOs related to a common-pool resource.⁴ These variables relate to attributes of the CPR, the relationships between use and supply, and to attributes of the appropriators. The variables discussed at the Annapolis conference are reproduced in Table 1.

Table 1

Variables Mentioned by Case Authors as Being Associated
with the Emergence of Appropriator Organizations

A. Variables Related to the Resource:

1. **Size:** The boundaries of the CPR are sufficiently small, given the transportation and communication technology available, that appropriators can develop accurate knowledge of external boundaries and internal micro-environments.
2. **Clear-cut boundaries:** The boundaries of the CPR are sufficiently distinct that appropriators can develop accurate knowledge of the external boundaries.
3. **Indicators of CPR conditions:** Reliable indicators of the condition of the CPR can be obtained as a result of regular use.

B. Variables Related to the Relationship Between Demand and Supply:

1. **Scarcity:** The amount of resource-units extracted from the CPR are sufficiently high that users are aware that their withdrawal patterns are interdependent.
2. **Asset structure:** The legal claims that some members of a group can sustain are sufficiently large that they are motivated to pay a major share of the initial organizational costs of creating or restructuring an organization.

C. Variables Related to the Appropriators:

1. **Size:** The number of appropriators is sufficiently small that the costs of communication and decision making are relatively low.
2. **Residence:** Appropriators permanently reside near or "in" the CPR.
3. **Degree of homogeneity:** Appropriators are not strongly divided by:
 - a. Natural boundaries;
 - b. Different, conflictual use patterns;
 - c. Different perceptions of the risks of long-term extraction from the CPR;

- d. Cultural antagonisms; and/or
 - e. Substantially different exposures to risk (e.g., upstream versus downstream users).
4. **Existing organization:** The appropriators have some prior experience with at least minimal levels of organization due to:
- a. The presence of a general purpose organizational structure, such as a village council or a cooperative organization.
 - b. The presence of a specialized organizational structure related to this resource without prior management responsibilities, such as a boating club.
 - c. The presence of nearby organizations that have helped others to solve similar CPR management problems.
5. **Ownership status:** The rights that appropriators have to access, use, and, potentially, to the exclusion of others, are sustainable and certain.
6. **Degree of centralization:** The appropriators are not prevented from exercising local initiative by a centralized government.

* * * *

Towards the Rudiments of a Theory of
the Origins of Appropriator Organizations

This is a long list of variables. Many of these variables do play an important role in specific cases, but such a list of specific variables is too unwieldy to allow for further theory development and testing. To develop a theory of the emergence of some form of user organization, we need to develop a smaller set of key variables.

In this effort, we can also draw on previous theoretical work related to the theory of constitutional choice.⁵ An AO can be conceptualized as a small polity constituted by appropriators for the purpose of gaining a joint benefit

(the regulation of the CPR). A central assumption of the theory of constitutional choice is that the costs of decision making involved in arriving at a set of coordinated strategies for the members of a collectivity are greater than the costs of decision making involved when each and every person is free to adopt his or her own independent strategies. In deciding whether or not to create a new polity -- in our case a new AO -- it is presumed necessary for individuals to examine not only the expected benefits to be derived from the coordinated strategies of the collectivity but also the expected costs in time and resources devoted to decision making and the expected, potential deprivations imposed on individuals by the polity itself.

A general proposition of the theory of constitutional choice is that a group of individuals will constitute a new polity when the perceived benefits to be gained from the enterprise are greater than the total estimated decision-making costs of the enterprise using a particular set of rules [Buchanan and Tullock 1962]. By thinking in a more general fashion about the list of variables shown in Table 1, the same general proposition can be made regarding the emergence of an AO. AOs do not emerge unless perceived benefits of organization exceed the perceived cost of organization.

If a CPR is a valuable resource worth the costs of managing it, the perception that benefits exceed costs is more likely when participants have relatively full and accurate information about: (1) the physical structure of a resource, (2) the past actions of other appropriators, (3) the relationship of demand to yield, (4) the benefits and costs of various actions and outcomes impinging on different individuals and firms, and (5) the likelihood that other participants will keep promises. The specific variables in Table 1 can be viewed as variables that enhance the information that individuals possess

about both the benefits and costs of constituting a new organization. With this view of how these variables are important to the emergence of AOs, we can now make the following more general propositions:

Individuals will tend to switch from independent strategies for exploiting a CPR to more costly, coordinated strategies when they share a common understanding that:

1. Continuance of their independent strategies will seriously harm an important resource for their survival,
2. Coordinated strategies exist that effectively reduce the risk of serious harm to the CPR,
3. Most of the other appropriators from the CPR can be counted on to change strategies if they promise to do so, and
4. The cost of decision making about future coordinated strategies is less than the benefits to be derived from the adoption of coordinated strategies.

Let us now discuss how these general propositions are related to the specific variables in Table 1.

Common Understanding of the Problem

Whether appropriators share a common understanding that continuing independent strategies will seriously harm a resource important for their survival depends on the size and performance of the resource itself and on the actions of appropriators. If the resource is relatively small (A1), the boundaries are easy to determine (A2), and reliable indicators of its conditions are present (A3), appropriators can begin to develop a consistent understanding of the amount and value of the yield of the CPR. Users need relatively good information about the amount of the yield or reliable and sensitive indicators about the condition of the CPR. How fast this type of information is obtained and synthesized depends heavily on the type of

resource involved and the level of scientific knowledge used [Gilles and Jamtgaard 1981].

If appropriators live in a small community (C1) near to the CPR (C2), they would have a relatively accurate picture of each other's withdrawal practices.⁶ Further, open communication about the problems they face, as well as potential solutions, is enhanced when users live in a small community. This is consistent with a major finding from the research of scholars who have constructed commons laboratory experiments of commons situations. When communication is unconstrained in laboratory CPRs, participants are far more likely to devise joint strategies that achieve higher joint outcomes than when communication is constrained [see Wilson 1985; E. Ostrom and Walker 1990; and the review of laboratory experimentation in Feeny, in Bromley forthcoming].

As users come to recognize through communication that demands are close to or are exceeding the yield (B1), then one can expect that users will share an understanding that the continuance of their independent strategies will seriously harm the CPR. This recognition is not sufficient for a change from individual to coordinated strategies. The users must also place a high value on the CPR itself in terms of their own economic and social survival.

Common Understanding of Alternatives for Coordination

Appropriators must be able to conceptualize the possibility of alternative strategies that might avoid this harm. The capacity to think about alternative coordinated strategies is affected by the prior experience that users have had with other forms of local organization (4a and 4b), knowledge about the experiences of other groups trying to solve similar problems (4c), the certainty of their own status as owners (5), and a capacity to take local initiative (6). One would expect appropriators with little or no common

experience with or knowledge of successful efforts to achieve coordinated strategies to have greater difficulties in developing strategies to manage a CPR.

Common Perception of Mutual Trust and Reciprocity

Further, participants need assurance that if they change to more costly, coordinated strategies, others will do likewise. This is the central argument in the work of Oakerson [in Bromley forthcoming, and 1988] and Runge [in Bromley forthcoming, and 1981, 1984], who stress the importance of assurance of mutual promise-keeping in solving CPR problems. Given the structure of the commons dilemma as it is frequently modeled, this is the problem that each individual must be assured that he or she will not be the "sucker" who adopts the most costly coordinated strategies (cooperates) while others yield to their "temptation" not to cooperate and continue their own practices. Assurance may also be obtained through reliance on formal police, formal surveillance and investigations, and formal courts. Use of formal legal methods to gain assurance is costly, however, and appropriators can reduce the costs of assurance dramatically if they are willing to develop relationships of trust and reciprocity among themselves [R. McKean 1975].

Mutual trust has been conceptualized as an asset that individuals build over time by engaging in mutually beneficial transactions that cannot be consummated in an immediate quid pro quo exchange in which they have kept their respective promises and obligations [see Breton and Wintrobe 1982; see also Posner 1980]. Perceptions concerning the likelihood that other users will follow an agreed upon coordinated strategy are affected by all of the factors related to the group (C1, C2, C3a, C3b, C3c, C3d) and prior experience with local organization (C4a and C4b).

Common Perceptions that Decision-Making Costs Do Not Exceed Benefits

Users would also need to share an expectation that future decision-making costs about coordinated strategies will not exceed the benefits to be derived from the use of coordinated strategies. Expectations about decision-making costs are affected by all of the characteristics of a group and prior experience and knowledge about organization arrangements. Almost all theories of organization posit that decision-making costs rise with the size of the group making decisions (C1). One would expect that the greater the homogeneity of the group, the lower the costs of arriving at decisions. Decision-making costs are also lowered if some individuals are willing and able to undertake entrepreneurial efforts to get organized or to persuade an existing organization to include the CPR within its frame of interest [Olson 1965].

When the Tragedy is Not Avoided

By focusing on the conditions necessary for the emergence of coordinated strategies to use a CPR, the four propositions developed above also help to explain why so many CPRs have been destroyed or are suffering severe problems of degradation. One can reverse the direction of the propositions in the following shortened version:

Appropriators will continue independent strategies for exploiting a CPR unless they share a common understanding and perception of:
 (1) the nature of the problem, (2) the alternatives for coordination available to them, (3) the likelihood of mutual trust and reciprocity, and (4) expected decision-making costs less than the benefits to be derived.

Given this statement of the problem, one understands why individuals continue independent strategies for exploiting many CPRs. Unless creative efforts are expended to create large-scale user group organizations, such as

international special regimes, independent, exploitative strategies are a dominant strategy for all participants. Problems of controlling ocean fisheries, migratory wildlife, and international air pollution are several orders of difficulty greater than localized common-pool problems such as grazing lands, irrigation projects, inshore fisheries, etc.

The general principles involved in solving large-scale CPR problems are similar to those involved in dealing with smaller resource systems. The processes of gaining a common understanding and devising workable coordinated strategies are, however, far more difficult and costly for large-scale common-pool problems. Institutional designs relying on nested structures of smaller organizations within larger organizations are most likely needed [see Coward 1980; Bendor and Mookerjee 1985]. The development of such structures, when the resource crosses jurisdictional boundaries (or, even worse, exists outside all jurisdictional boundaries), is costly and difficult [see Thomson, Feeny, and Oakerson, in Bromley forthcoming].

On the Survival of Appropriator Organizations

The creation of an organization and the development of coordinated strategies for using a common-pool resource are no guarantee that an organization can survive over time. Many efforts to achieve coordinated strategies have collapsed after a few years. The initial perceptions of the nature of the problem, the alternatives for coordination, the likelihood of mutual trust, and the costs of decision making may be altered by experience. Is it possible to posit the variables that may be conducive to the survival of an AO, once it has emerged through the slow accretion of common understandings

or has been consciously designed by individuals trying to solve a specific problem? Yes, I think we can.

Six general propositions can be stated as a means of summarizing more specific variables discussed at the Annapolis Conference. An Appropriator Organization is more likely to survive if:

1. The organization devises a small set of simple rules related to access and use patterns agreed to by appropriators.
2. The enforcement of these rules is shared by all appropriators supplemented by some "official" observers and enforcers.
3. The organization is constituted with internally adaptive mechanisms.
4. The appropriators from the CPR are able to sustain legal claims as owners of the CPR.
5. The organization is nested in a set of larger organizations in which it is perceived as legitimate.
6. The organization is not subjected to rapid exogenous change.

Let us discuss each of these propositions in turn.

A Small Set of Simple Rules

The development of a small set of simple rules agreed to by appropriators has many survival advantages. The key advantage is that participants can remember the rules and transmit them to new participants over time. The constraints that social systems use to structure behavior -- rules -- are constraints only to the extent that humans can understand what is and is not allowed and can transmit this information over time [see V. Ostrom 1980, 1986; and E. Ostrom 1986]. To the extent that rules are backed up by physical constraints (e.g., fences or governors on motors), it is easier for individuals to follow a rule without actually knowing it and to be sure that behavior is in conformance with rules. Most rules, however, are constraints

only in so far as humans learn them, follow them almost automatically, tell others about them, and know whether others are following them.

The fewer rules used to organize activities (relative to the complexity of the activities), the more likely that individuals can understand, remember, and follow them. Further, the fewer and less ambiguous rules are, the higher will be the agreement among all participants about what is and what is not an infraction. At the Annapolis conference we discussed the multiple functions of the simple rule: "You must live locally to use this system."⁷ This simple rule has the following results:

- o It is extremely easy to learn, remember, and transmit.
- o Following this rule enhances the local knowledge that appropriators have about the resource.
- o Following this rule enhances the possibility for reciprocity and trust among participants because they have a higher probability of knowing one another and engaging in other transactions.
- o Following this rule reduces decision-making costs about who can or cannot use the system.
- o Following this rule reduces enforcement costs since a stranger will be obvious to most participants.

An unchanging rule that a grazing commons will be open for use between the same dates every year (and closed otherwise) is a low cost rule for coordinating behavior of large numbers of appropriators who may live miles apart during much of a year [see Gilles, Hammoudi, and Mahdi, in Bromley forthcoming]. Assigning a single individual in a residential community the responsibility for announcing the dates for opening and closing of a commons [see McKean, in Bromley forthcoming] is a more flexible and equally clear rule of access, but may be difficult to use when appropriators live far apart without modern modes of communication.

Dual Enforcement

That the rules of an AO are enforced by the appropriators themselves backed up by some "official" enforcers also appears to be an important condition for survival. The long serving village institutions described by McKean in Bromley [forthcoming] illustrates this clearly. One or two participants simply forgetting to follow the rule without anyone saying anything can be the beginning of the end. Once some participants unconsciously (or consciously) forget to follow the rules, and no one says or does anything to them, others observe the lack of sanctions and are less inclined to follow the rules themselves.

Dual enforcement is a mutually reinforcing process. No AO can hire enough guards to see all the boundaries of a CPR and all of the activities of users. Users are the effective "public eyes" [Jacobs 1961] that cover more of the territory than official guards could ever see. If users know, understand, and have agreed to a simple set of rules, and if they use social sanctions against one another for rule infractions of various kinds, there is a higher probability that a rule infraction will not go unnoticed and unsanctioned. Further, if social sanctions are backed up by official guards, this helps everyone remember the rules and gives the social sanctions more weight.

Internally Adaptive Mechanisms

Two aspects of adaptability were discussed at Annapolis. The first had to do with the capacity of an AO to use multiple decision rules and to relate these to different types of problems. Many conference participants articulated a need for at least three types of authority rules that would:

1. Create a position for a single individual who is authorized to make decisions for the AO related to important and rapidly changing conditions.

2. Create a council (either representative or a full assembly) where major problems can be discussed, general rules formulated (particularly those related to distribution and problems of equity), and penalties assessed.
3. Rely on broad consensus and/or formal rules requiring extraordinary majorities for deciding on actions that may involve considerable sacrifice or penalties.

This implies that even though AO rules should be as simple and as few as possible, the governance structure of an organization should be relatively complex if it is to survive over a long time period [Coward 1980].

The second aspect of adaptability has to do with the capacity of an AO to change its own structure over time. An organization that can change its own rules regarding membership, access to and use of the CPR, collection of information, and the incentives and sanctions to be used, has a higher probability of being able to survive in a changing environment than one that must continue to use the same rules for internal organization over time. This aspect of adaptability is closely related to what W. Ross Ashby [1956] referred to as ultrastability.

Ownership

For survival, participants at the Annapolis conference argued that those who are the users of a CPR should also be the owners of the CPR. Although cases such as the one described by Cordell and McKean [in Bromley, forthcoming] illustrate instances where individuals with few claims to property rights have developed rather ingenious ways to manage a CPR, the same cases also illustrate the marginal character of these AOs. While the swamp-fishermen view each other as "co-owners" of the resource, outsiders perceive them as having no legal claims to the resource. Conflicts among residential users can be worked out within their own de facto legal framework. Conflicts

between residential users and "outsiders" cannot be worked out locally and must be settled within a de jure legal system. In his introduction, Bromley [forthcoming] stresses the problems involved when only de facto ownership is exercised by participants.

Nesting of an AO in a Larger System

A fifth proposition has to do with the nesting of an AO within a set of larger organizations and authorities for dealing with problems beyond the boundaries of the AO. This is particularly critical when the CPR itself is large and AOs are organized around subparts. If those on a tertiary channel of a large irrigation system organize an AO to keep their channels clear and to regulate the opening of valves, they also need to be able to communicate effectively with the operators of the headwaters from time to time [see Uphoff 1984, 1986].

Nesting of organizational arrangements in federated structures of various kinds may also enable participants to cope with hold-out problems more effectively in large groups. Once an AO grows large, informal sanctioning among members becomes more difficult. Building a larger organization from smaller units, however, enables participants to monitor and impose informal sanctions on each other within a smaller organization. If a member organization begins to lag behind, on the other hand, the larger organization can stimulate conformance.

Even when a particular AO is effectively organized to deal with the internal problems of a CPR, many events from outside the system can affect the operation of the CPR. Local appropriators need mechanisms for effective communication with larger organizations to cope with these problems. External organizations or authorities can provide essential inputs to the decision

making undertaken at the AO level. Examples include scientific information, capital fund raising, modern technological training (where this is really needed), and supplemental conflict resolution mechanisms (available when the AO cannot resolve its own conflicts successfully).

Lack of Simultaneous Exogenous Changes

An AO is more likely to survive over time if it is fortunate enough not to have to cope with many, simultaneous changes in key exogenous variables such as population, technology, number of appropriators, external demands, relationship to central authorities, etc. All large changes in exogenous variables threaten the capacity of individuals to learn fast enough about the change to make adaptive responses as Bromley [forthcoming] points out. The faster and greater the amount of the change, the higher the probability that an AO cannot respond rapidly enough.

Is Survival Sufficient?

Simple survival of an AO is not a sufficient condition for effective performance.⁸ The survival of an AO over a long time leads one to presume that the AO is doing something well. The key question is what is it doing well? For some AOs, the answer may be that the only thing they are doing well is surviving. Unless AOs are in highly competitive environments sustaining selection pressures that tend to eliminate inefficient and inequitable AOs, we cannot presume that those that survive are performing well. If AOs were firms in a highly competitive market, the theory of market processes would enable us to infer that survivors use efficient, long-term strategies (even though the survivors may not have selected these strategies consciously) [Alchian 1950].

Some AOs have extraordinary powers not available to private firms in a competitive market. These powers enable such AOs to survive even though performing poorly. AOs that can enforce membership and contributions to collective actions (e.g., have public powers to coerce and sanction) can survive even when most of their members do not evaluate them as performing efficiently or equitably. It is even possible for a long-surviving AO to generate more costs than benefits. The latter can occur when membership is coerced and the costs of exit are high. Many AOs organized in the public sector can coerce membership, and exit may involve extraordinary costs. Consequently, it is especially important not to presume that surviving local governments automatically perform well.

AOs operating over a long time period without full governmental powers -- established and maintained primarily through voluntary agreement -- are most likely to generate more benefits than they impose costs. It is hard to imagine how strictly voluntary AOs could survive unless net benefits are positive. In a strictly voluntary association, members can leave the AO at any point they perceive costs of participation to exceed benefits. Yet a positive benefit/cost ratio is not equivalent to high performance.

What is Good Performance for an AO?

In Oakerson's framework paper [in Bromley forthcoming], he defined two criteria that could be used to evaluate the outcomes of user interactions related to the CPR: efficiency and equity. The first aspect of efficiency mentioned by Oakerson is whether appropriators have achieved an optimal rate of use. A less rigorous efficiency criterion is that appropriators are not exceeding the sustainable yield. A second aspect of efficiency has to do with

the difference between the benefits resulting from the operation of an AO and the decision making and potential deprivation costs of the AO. A minimal efficiency criterion is that this difference is positive. A comparative efficiency criterion can be used to explore whether the difference between the benefits and costs of an AO in one setting is as large or larger than that of another AO in a similar setting. Two questions are involved in using the criterion of equity: First, is the distribution of the costs roughly similar to the distribution of benefits? Second, are there patterns of redistribution that appropriators wish to achieve at this level of organization?

At the Annapolis meetings several factors -- in addition to those identified as conducive to emergence and to survival -- were identified that enhance the performance of AOs in governing and managing CPRs. One set of conditions is concerned with the "match" of the membership of the AO and that of the appropriators. A second consideration involves the relationship between the incidence of benefits and the incidence of costs derived from the operation of the AO. A third factor is the knowledge generated by appropriators about the CPR and about user preferences, benefits, and costs. While these might possibly be stated in propositional form, my understanding of what is involved is not yet sufficient to do so, and I will simply discuss each of these conditions in turn.

The Match of Membership of the AO and the Appropriators

A key factor that affects the long-run performance of organizational arrangements is whether organizations can be established and maintained whose boundaries are roughly coterminous with those of the CPR and its appropriators. This is NOT easy to accomplish in natural settings.⁹ Most communities are simultaneously concerned with many types of problems. The

boundaries most relevant for managing a particular CPR may not be the same as those most relevant for managing another CPR or some types of pure collective goods. Even assuming a considerable amount of discretion in establishing AOs, it is unlikely that the boundaries of any private or public AO will exactly match those of a particular resource system. In governmental systems, where jurisdictional boundaries are firmly established from the center and citizens are discouraged from establishing local organizations with quasi-public powers, the likelihood of even a rough match between the most relevant organizational arrangement and the CPR is low.

Mismatches can take two forms. The first form involves the case where a AO is considerably larger than the CPR. A possible outcome of this mismatch is total indifference by the larger unit to the problems of regulating the CPR. Even assuming that appropriators were effectively represented in a democratic process in the larger unit, poor performance can be predicted. Individuals living outside the boundaries of the CPR would have little or no information about what was happening in the CPR and would certainly not want to support policies that might require them to pay taxes to support activities within the CPR.

A second type of mismatch would occur if the organization attempting to regulate the CPR is substantially smaller than the CPR in territory or number of appropriators. If an AO could gain the cooperation of only a small subset of those actually using a CPR, this small subset would be the only one contributing to the regulatory program. Those who did not cooperate by changing their withdrawal patterns or through contributions to support investments in the CPR would gain substantially without contributing their fair share. If the number of noncooperators were large, those who initially

might be willing to cooperate might not be willing to cooperate over the long run. Although a mismatch of the first type is likely to result in an over-investment in collective activities and projects, a mismatch of the second type is likely to result in an under-investment in collective activities and projects. We must be careful, however, to examine operational patterns of relationships before presuming a mismatch. While no single, formal organizational unit may exist with similar boundaries, informal arrangements among organizations may enable appropriators to develop effective, informal organizational arrangements that roughly match the boundaries of a CPR.

The Relationship Between the Incidence of Benefits and Costs

A second consideration is the relation of the rules used for the distribution of costs and of benefits. Many of the simple rules adopted as a means of long-term survival are not optimal rules in the sense of maximal efficiency. Roumasset [1985], for example, points out that the simple rule used on many long-surviving irrigation systems of allocating water based on the amount of land owned can lead to inefficiency. If the system is large, the cost of getting water to parcels at the end of the system is much higher than getting water to parcels at the head of the system. The rule allocating water has to be looked at, however, in relation to the rule requiring labor or other inputs. When farmers are required to invest substantial quantities of their own labor to maintain irrigation systems, rules relating the amount of labor required to the amount of water received are relatively typical [Tang 1989]. Thus, a rule that is inefficient when used to allocate water on a system where no inputs are required, may be quite efficient when used to allocate water on a system where substantial inputs are required based on the

same formula as water allocations [see also Bromley et al. 1980, for a discussion of equitable distributions].

The Type of Knowledge Generated

It is conceivable that individuals will organize an AO that survives for some time without detailed information about the characteristics of the CPR and use patterns. It is inconceivable, however, that such an AO can perform efficiently or equitably without such information. Without detailed knowledge about the yield patterns of the CPR, rules that reduce the quantity of use-units that participants are allowed to withdraw may be more or less stringent than needed to manage the CPR efficiently. Even when appropriators are able to obtain relatively reliable information about the characteristics of their CPR, they may not obtain valid information about the actual use patterns of various appropriators over time. Appropriators are not motivated to reveal the full extent of their use since such information may lead others to try to limit their activities. Unless the CPR is small and easy to understand, and each user can easily monitor the use patterns of others, obtaining accurate information is far from a trivial problem.

Some of the technical knowledge needed about the physical structure of a CPR may be provided by larger public or private agencies who provide experts to map the CPR and describe its yield patterns. A key question, however, is whether this information is made available to the appropriators themselves or only to central agencies who are not involved in the day-to-day operation of the CPR system. It is a common practice of donor agencies to make technical reports to the bureaus of central governments and not to the appropriators themselves. Institutional arrangements used in developed countries, such as those of a Watermaster associated with equity courts, provide technical

information about the CPR and about use patterns to all participants [see Blomquist and E. Ostrom 1985], but such arrangements are used infrequently in the developing world.

Conflict can be an important feedback mechanism for the participants in an AO about how past efforts (or projected future efforts) affect the interests and behaviors of different participants. AOs vary to the extent to which they use conflict creatively to gain information about problems perceived by different participants. If conflict is suppressed, key information about the effects of past actions is lost. If conflict is encouraged, valuable resources are spent in potentially harmful disputes. The development of effective conflict resolution mechanisms within an AO is also an important aspect of its capacity to achieve efficient and equitable performance.

Conclusion

In the above sections, the rudiments of a theory of the origins, survival, and performance of organization to manage common-pool resources have been presented. This represents an effort to integrate the findings made by specific case study authors, speculations made at Conference where the chapters of Bromley [forthcoming] were intensively discussed, and a broad political-economic approach to the study of institutions. Since the first draft of this chapter was circulated, a number of important books have been or will soon be published that contain still further empirical support for the propositions of the theory sketched above [Ascher and Healy 1990; Berkes 1989; Fortmann and Bruce 1988; Marchak 1987; McCay and Acheson 1987; V. Ostrom, Feeny, and Picht 1988; Pinkerton 1989; Wade 1987]. In all of the cases described in these volumes, overexploitation of common-pool resources occurred

when open access prevailed either because no set of individuals had property rights or because state property was treated as open-access property.

Appropriator organizations were able in many instances -- but not all -- to manage CPRs effectively. Where AOs failed to develop, did not survive, or performed inadequately, it would appear that one or more of the variables identified above were responsible.

Obviously, much more work is needed to make this rudimentary theory a more rigorously developed theory and to test its implications precisely rather than generally. Many scholars are engaged in this effort as an International Association for the Study of Common Property has now been established and will have its first international meeting in the fall of 1990. In several recent works, some of the propositions developed above have been developed in a more formal method or given a more precise empirical test [see Gardner and E. Ostrom 1990; Weissing and E. Ostrom 1990; Walker, Gardner, and E. Ostrom 1990; Tang 1989; E. Ostrom 1990]. It is an exciting time to be participating in an evolving interdisciplinary effort to understand how institutional arrangements affect the capacity of individuals to engage in self-governance and self-management of common-pool resources.

These theoretical and empirical efforts translate into policy proposals. At the Annapolis Conference, for example, participants strongly articulated a view of the type of policies that donors and governments of developing countries should adopt consistent with our evolving understanding. The participants recommended to donors and policymakers in developing countries that they abandon current presumptions that local rules and customs are lacking for most common-pool resource systems. Instead, the participants urged that the burden of proof should rest with donors and policymakers to

demonstrate the absence of local customs and rules regulating common-pool resources before intervening to impose external rules on existing systems.

The advice in a nutshell was:

- o If a people have lived in close relationship with a relatively small common-pool resource system over a long period of time, they have probably evolved some system to limit and regulate use patterns.
- o Before one imposes new rules on local systems, inquiries should be made to determine if some rules and customs do not already exist.
- o If some customs and rules do exist, study these carefully in order to understand how they affect use patterns over time.
- o Propose new rules only after you have convinced yourself that either:
 1. no rules and customs exist,
 2. the rules and customs that do exist are not effective in achieving regulation or produce substantial inefficiency and/or inequity, and
 3. you are thoroughly familiar with the configuration of institutions in existence in a polity that may affect how new rules operate in practice.
- o Maintaining and enforcing new rules depends upon people finding those rules to be an acceptable way of ordering their relationships with one another as a community.
- o New rules cannot vary dramatically from the existing repertoire of rules in use or they will exist only on paper and not in the minds of those who must understand rules to make them work.

We can hope that this message will be heard.

NOTES

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2. See Bromley et al. [1980] for a review of literature about irrigation associations in many different Third World countries. Most irrigation associations would be included within the concept of an Appropriator Organization.
3. The first necessary but not sufficient condition for avoiding the tragedy of the commons is the establishment of property rights limiting who can use, how much can be withdrawn, who can manage, and how rights are transferred.
4. The variables listed in Table 1 were mentioned by participants as being important as either enhancing or hindering efforts to achieve organized coordination of some sort. None of them were identified as either necessary and sufficient conditions for or against the emergence of an AO. Cultural divisions are not, for example, a sufficient condition for not achieving organization. Many successful AOs include membership that crosses ethnic and linguistic barriers. On the other hand, when individuals from cultural traditions who are deeply suspicious and antagonistic to one another try to solve CPR problems, they have more to overcome in developing mutual trust than when a set of individuals all come from the same cultural background [see discussion in Bromley et al. 1980].
5. See Buchanan and Tullock [1962] for an important general theory of constitutional choice and V. Ostrom and E. Ostrom [1977] and E. Ostrom [1989] for earlier efforts to apply the theory of constitutional choice to the analysis of CPRs. See also V. Ostrom [1982, 1986] and Roumasset [1985].
6. See Berkes and Kislalioglu [1989] for an analysis of the relative efficiency and equity of small-scale fisheries and a summary of literature on the evolution of community-based resource-management systems.
7. Several of the cases in Bromley [forthcoming] use this rule including McKean, Campbell and Godoy, Berkes, Cordell and McKean, and Wade.

8. Several recent analyses have stressed the importance of not equating survival and optimality [see Binger and Hoffman 1989, and March and Olsen 1989].
9. I do wish to stress that there are many forms of organization that accomplish this rough correspondence. Robert Wade [1987] has shown how local organization based on a village structure in India is able to encompass most of the affected irrigators even though the organization is village-based rather than irrigation channel-based.

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