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ORGANIZATION OF DECISION-MAKING ARRANGEMENTS AND  
THE DEVELOPMENT OF ATMOSPHERIC RESOURCES

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Human Use of the Atmosphere

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ORGANIZATION OF DECISION-MAKING ARRANGEMENTS AND  
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I

The Human Environment and Its Utilization

In beginning an exploration of the human uses of the atmosphere we might draw upon some of the conceptions used by Pierre Teilhard de Chardin as a point of departure. Teilhard has attempted to distinguish diverse aspects of the human environment by reference to the geosphere, the hydrosphere, the atmosphere, the biosphere and the noosphere. The geosphere has reference to the earth forms as that part of the human environment found predominantly in an inorganic liquid and solid state. The hydrosphere refers to the streams and bodies of water which flow over and through the outer crust of the geosphere and constitute the liquid pool and flow resources of the oceans, rivers, lakes and ground-water supplies. The atmosphere is the outermost concentric layer of the earth, a blanket of air, composed predominantly of the gases, nitrogen and oxygen. The atmosphere is a dynamic, turbulent gaseous mass held in a position of greatest density at the combined surfaces of the geosphere and hydrosphere and shades into interplanetary space only a relatively few miles beyond the earth's surface.

Teilhard, following the tradition of de Lamarck, identifies the biosphere as the film of life forms with its configuration of organisms

living in ecological communities which predominantly occupy positions in the upper hydrosphere, in a very shallow mantle at the surface of the geosphere and the lower atmosphere. All forms of life depend upon some slender thread of connection which enables them to make use of the atmosphere in nurturing the organic processes of life but no form of life, so far as I know, has been able to form a niche by which it can exclusively derive its continued sustenance in the atmosphere. The biosphere is nurtured and sustained by the conjunction of the geosphere, the hydrosphere and the atmosphere and by the essential processes of interaction occurring AMONG these spheres of the environment.

Human life occupies its position in the life-space of the biosphere; but Teilhard, Huxley and others have also given human life independent recognition as forming a separate dimension among earth forms. They refer to this human dimension of earth forms as the 'noosphere'. The noosphere constitutes that part of the earth which has been brought and shaped by human knowledge -- by human action or enterprise based upon human 'knowledge. The noosphere is represented by the configuration of man-made forms which has reshaped the geosphere, the hydrosphere, the biosphere and the atmosphere into a productive environment to serve human purposes and to improve the conditions and opportunities for human life.

Evidences of the massive transformations which have been wrought by human endeavor in reshaping the earth into the forms and patterns of a noosphere are at every hand. The forms and patterns of an agriculture, (i.e., the cultured biosphere), can be observed as the predominant feature of the landscape through the temperate zones of the earth. Human cities rise like mountains and sprawl with a stark realism which mutes and obliterates

the shades and tones of the surrounding biosphere. Networks of highways, railroads and lighted beacons cross the landscape in diverse sparkling, web-like patterns. These are the artifacts, the instruments and the products of human action.

The noosphere has other dimensions that are more specifically reflected in the actions of people engaged in their endeavors, the organizations that constitute those endeavors, and the conceptions that lie behind the actions which form the space -- time continuum of human enterprise. The political process is that part of the human endeavor concerned with structuring, regulating, controlling and generally with ordering the course of human action as each and every individual sustains his life amid the miscellaneous human endeavors which constitute the noosphere.

The raison d'etre of the political process is rooted in the human capability for developing) organizing and using knowledge. The political process is the basic arrangement for constituting human enterprise. It is the means for translating knowledge into action and thus in transforming the earth into a noosphere. The political process is the method for organizing, guiding and channeling activity into enterprise in the transformation of a state of nature into a state of human affairs.

Any consideration of the human use of the atmosphere involves an analysis of interaction between two systems -- the atmosphere as a resources system and the organization of human endeavor and of human action as a social system concerned with the utilization and exploitation of the resource system. This social systems can be viewed as an economy if the analysis is primarily concerned with the production and consumption of goods and services associated with the use, development and control of a resource system. This same system

can also be viewed as a political system or as a polity if the analysis is directed to the process for ordering decision-making arrangements among those involved in the use, development and control of a resource system. An economy is not functionally independent of a polity, and from a participant's point of view, both might best be conceptualized simply as a political economy. However, different analytical perspectives can be used in considering different properties of a social system as conceptually independent systems even though they are not functionally independent in an experiential sense.

Those involved in the use, development and control of resource systems must come to terms with the constraints and conditions of the social systems as well as the requirements of the resource system,. The technical feasibility of a course of action, i.e. the capacity to deal with the requirements of a resource system in relation to its systematic characteristics in order to produce the desired products or changes, is only one set of criteria involved in planning a resource development program. Standards of economic, financial, legal and political feasibility turn increasingly upon a capability for meeting the terms and conditions reflected in the constitution of a political economy as a social system organized to facilitate productive enterprise in the enhancement of human welfare.

The task of the social scientist, in an analysis of the human use of the atmosphere is to clarify behavioral regularities or systemic characteristics involved in the organization of the human endeavor. In undertaking an examination of the political dimensions involved in the human use of the atmospheric I shall sketch in broad outline some of the basic characteristics of political organization and then analyze problems in the development of atmospheric

resources in terms of the effect that the political process has and will continue to have upon the organization and conduct of human enterprises concerned with the human use of the atmosphere.

## II

### Basic Characteristics of Political Organization

#### The Political Context

The distinctive quality about human beings which has been so important in the development of the noosphere is their very extensive capacity for learning and their capability for organizing their learning through symbolic representations into complex information systems which can be transmitted from one to another in contemporary or in succeeding generations. The organization of learning in symbolic forms has led to the development of a human capacity for handling an increasing quantity of information as the frontiers of learning are extended and for assuming specialized roles in the development and use of information. New knowledge transformed into new technological capabilities are among the forces at work to shape the noosphere and to reshape the total human environment.

The capability for acquiring, organizing and handling very large amounts of information imposes a correlative requirement for exercising choices from among the large variety of opportunities that become available for taking alternative courses of action inherent in human knowledge. The problem of ordering the making of choices or the exercise of discretion has been resolved in human experience by the development of complex systems of decision rules assigning certain capabilities (rights, powers, privileges and immunities) and certain limitations (duties, liabilities, exposures and



disabilities) in relation to the actions which might be taken in the diverse circumstances of life, and by the development of a correlative set of institutional facilities (also organized on the basis of decision rules) for the development, maintenance, enforcement and revision of decision rules.

My use of the term "decision rules" in this context is synonymous with the concept of law in the broad sense that lawyers would refer to enforceable legal prescriptions, legal norms or legal propositions as law. This includes public and private law, criminal and civil law and all other fields of law. Property law, for example, is a system of decision rules assigning differential capabilities and limitations to persons regarding the acquisition, use, allocation and disposition of the valued objects or events which are subject to a property relationship. By virtue of the law of property, a proprietor (i.e., property owner) is assigned the authority (i.e., formal power or the formal assignment of capabilities and limitations for action) to make decisions commensurate with his lawful use and enjoyment of that property. The use of the term lawful implies that one's authority is conditioned by certain limitations in recognition of the commensurate authority of others. The correlative set of facilities for the development, enforcement and revision of decision rules (i.e., law) are the institutional facilities which constitute the government of a political system.

A political system has reference to all decision-making functions and includes reference to all decision rules concerning the allocation of authority for the exercise of discretion in all human conduct. The sub-structure of a political system is formed by the allocation and distribution

of power to persons to act or to control actions in the realization of diverse values in relation to other persons in a society. The law of property, for example, can be conceived as part of the political formula first in the sense that the law of property governs the assignment of authority applicable to the allocation, use, and reallocation of diverse resources. In addition, property owners are assigned capabilities for instituting certain undertakings to facilitate their mutual interests and for securing remedies to determine and to enforce their lawful interests. A serf holding a life estate to his cottage, for example, would have occupied an altogether different political position if he had access to the courts of the realm than if he had access only to the lord of the manor in seeking remedies in his situation. Property law is not only a basis for the exercise of productive capabilities in the conduct of economic enterprise but is also a significant basis for the exercise of capabilities in constituting, enforcing, and revising the structure of legal relationships as the enforceable decision rules operative in a social system.

The superstructure of a political system is defined by a system of decision rules which provide for the assignment of authority to certain agencies or officers (decision structures) to perform specialized decision-making functions in the government (i.e., maintenance, regulation, enforcement and revision of legal relationships) of a political system. These decision structures comprise the superstructure or government of a political system. They also perform an assortment of decision-making functions bearing upon the provision of a variety of goods and services for the collective benefit of the community of people served by those instrumentalities in addition to the maintenance of "law and order".

Different political systems have recourse to different structures of authority in defining political relationships and as a result give rise to different opportunities for people to make use of their own authority as persons, or as proprietors and to have recourse to other specialized authorities to pursue their individual and collective interests. The assignment of authority, and the terms and conditions applicable to the exercise of authority affect the feasibility and performance of any human undertaking. For this reason any consideration of the human dimensions of the atmosphere must have reference to the structure of authority and to the exercise and use of authority in the government of human affairs.

Any political system can be represented as a structure of authority. Following Lasswell, authority can be defined as formal power, as the assignment of capabilities (with correlative limitations) for action by legal prescriptions or norms. Law can be viewed as a political formula, performing the function of prescribing and describing the social order in detail. Authorities are formally assigned powers or decision-making capabilities by the political formula. The political formula represented as the formulation of a structure of authority is a formula for the distribution, exercise and control of decision-making capabilities in political systems.

Where a structure of authority is designed exclusively to control affairs within a specified jurisdiction and to be independent of all other structures of authority, a political system can be represented as being a sovereign state. Matters of mutual interest affecting sovereign states may only be decided by mutual agreement based upon appropriate authorization by those authorities which are assigned responsibility for dealing with such affairs.

To the extent that alternative institutional remedies are recognized as controlling in conflicts arising between "sovereign" states, new structures of authority representing broader communities of interest may be taking form.

From Teilhard's perspective we might characterize the political structure of the noosphere to be composed of a large number of independent nation-states (somewhat in excess of 125) claiming to exercise exclusive authority in the regulation and control of human enterprise and conduct within the territorial limits of those states except for such understandings as each has with others in dealing with matters of mutual interest. As a result the political structures in the noosphere form a configuration quite independent of various other forms and patterns of events which comprise the natural resource systems in the human environment. Many problems associated with the human use of the atmosphere cannot be readily confined to the Jurisdiction of single nation-states and thus require international agreement in accordance with the decision rules of international law.

The Structure and Use of Authority in a Political System (with Particular Reference to the U.S.A.)

The system of law Governing relationships among all of those who function in decision making positions in a political system is an extraordinarily complex structure. Few general treatises even purport to make a general examination of such relationships except studies like Blackstone's Commentaries or de Tocqueville's Democracy in America. This analysis Will be confined to the most general characteristics of a political system as reflected in American experience. The structure of authority for individual decision making will be examined first. Brief reference will then be made

to the conditions requiring collective decision-making capabilities. Third, the general structure of authority for collective decision making as reflected in the formal structure of government will be examined. Fourth, the use and exercise of authority in the conduct of affairs requiring collective decision-making capabilities will then be considered. Finally, brief reference will be made to the organization of private, mixed, and public enterprise systems in the American political economy.

#### The Structure of Authority for Individual Decision Making

All types of human relationships are governed by reference to decision rules applicable to different types of institutional arrangements in a society. Legal concepts of person, property, contract, agreement, association, torts, remedies, sanctions, due process are only some of the more important concepts applicable to the micro-structure of authority involved in inter-personal relationships.

In the development and use of any physical resource, property law performs the vital function of establishing the decision rules regarding the allocation, use, control and transfer of any resource and of the products which may be derived from that resource. In political terms) property law is a formula for the dispersion of power (the exercise of decision-making capabilities subject to limitations) to persons to undertake economic activity in the use and development of a resource. Where resources are not dealt with as free goods, property law will typically include preemption rules for the acquisition of a property right and the conditions under which that right may be held and transferred.

The simpler forms of property law are those applicable to objects

or events which are readily isolable in the sense that they can be easily delimited, bounded or packaged, subject to individual control and are not the source of external effects or consequences which impinge extensively upon others. Such property is typically held in exclusive individual ownership (i.e., severalty) with minimal necessity for public regulation.

The much more difficult problem in property law is the tasks of dealing with resources which are not isolable, which cannot be easily bounded or packaged, which cannot be subject to exclusive individual control, and which give rise to externalities which may significantly affect others. These are the characteristics most frequently associated with common pool or flow resources. Oil pools, fisheries, water resources in general, and atmospheric resources come within this general category. Until the development of barbed wire, which made the task of bounding large areas of land both technically and economically feasible, much of the open range was also subject to use for cattle grazing as a common property resource.

The law of common property typically includes reference to both the individual interests in the common property and to the community of interests shares by all of the individuals who have a lawful claim to the use of the common property. As long as the supply of the resource derived from the common pool is adequate to meet the lawful demands of all individual claimants, the rules of equity jurisprudence provide a means of resolving conflicts among claimants. Where the supply is not adequate to meet the demands of all potential claimants, property law will usually include pre-emption rules for an original allocation by queing arrangements (first in time; first in right) or by territorial proximity (e.g.. riparian rights), or some other such arrangement.

Where conditions of natural supply are inadequate to meet the demands of existing lawful claimants by limiting the original allocations, alternative strategies may become necessary either to ration the available supply or to increase the available supply. The function of rationing the demands or increasing the supply or a combination of both may require complex management strategies, and the use of technologically advanced production methods depending upon the nature of the problem.

The development of a system of property law to deal with common pool or flow resources can be further complicated if the ultimate consumptive product cannot be contained and must be dispersed under conditions which do not allow for marketing arrangements. The distribution of domestic water supplies can be marketed and it thus becomes technically feasible to institute pricing arrangements and to require consumers to pay in proportion to the demands they make upon the supply. Where the good or service enjoyed by the ultimate consumer cannot be contained and dispersed under marketing arrangements it must be provided under condition of common or collective use subject to public provision. Public ownership for the provision of public goods may also enter into the complex of proprietary interests associated with the development and use of a common pool or flow resource.

Private property law, the law of contracts, and the law of voluntary association authorize or enable persons to undertake a variety of lawful arrangements with one another. These can vary from the relatively simple transactions of buying and selling to the more complex undertakings such as devising a rather elaborate authority structure for the organization and conduct of a private enterprise involving a large number of voluntarily associated interests. The modern corporation is perhaps the most advanced

example of such an association of individual interests organized on the basis of voluntary arrangements.

The basic decision rule applicable to the exercise of authority by private proprietary interests in the conduct of transaction or mutual undertaking is the rule of willing consent or of voluntary enforcement. The consummation of a private exchange between a buyer and seller is based upon this rule. So is the general law of contracts. Laws bearing upon private associations, including the modern corporation, are based upon a mixed structure of rules. The basic rules bearing upon entry to and exit from such an association invariably presume voluntary agreement or willing consent. Within the constraint of this rule, many private associations develop a much more complex structure of decision rules in the conduct of affairs within the association. These usually include reference to different forces of majority voting in combination with a constrained and limited structure of one-man rule governing principal-agent relationships.

The rule of willing consent is most appropriate in facilitating agreeable arrangements. However, the rule is subject to serious limitations in dealing with areas of disagreement. As a result, all forms of law dealing with the micro-structure of person-person relationships in the American political system authorize persons to seek remedies and gain access to decision structures which can make decisions in the absence of willing consent. Governmental institutions are the particular institutional facilities created for the deliberate purpose of making decisions in the absence of voluntary agreement and willing consent. In effect, the remedies that a person may seek through the institutional facilities of government are those that enable him to make use of decision-making arrangements where decisions



can be taken and performances can be required without reference to the willing consent of each person.

#### Conditions Requiring Collective Decision-Making Capabilities

Where a structure of authority relaxes the requirement of willing consent and permits decisions to be taken and performances to be required without reference to the willing consent of each person a sensitive problem is created in the structuring of human relationships. Elements of force and coercion are implied as anyone may be presented with the circumstances where if he does not do something contrary to his individual judgment he will be penalized for the failure to do so. Such a person may be required to do something bad, from his point of view, and if he fails to do so he is often threatened with a penalty in the form of some greater deprivation. This is a choice among bads and such choices are apt to give rise to unstable human relationships.

Since anyone may find himself in such a situation it is rational for each person in a society to have serious concern about the definition of the structure of authority for making governmental or public decisions, about his access to such decision-making arrangements and about his voice in the making of these decisions. Something of a paradox arises from the circumstances that a system of law and order based exclusively upon a rule of willing consent is not a stable arrangement either. Anyone who could exercise an absolute and complete veto in relation to any claim or demand which might be made upon him would be free to operate with complete disregard for the lawful interests of all others. A holdout in this situation could capture the lion's share of the existing wealth if others were sufficiently

naive to continue to conform to the lawful norms of conduct in deference to the holdout's position. Instead one would expect the law of the highwayman (take what you can get) quickly to replace the law of the market in the absence of governmental institutions capable of making and enforcing decisions taken on other bases than willing consent.

The same type of holdout position can be exercised in any common-pool or flow-resource situation, and in any situation involving the collective use or enjoyment of a public good. If 100 private proprietors have equal access to an oil pool, for example, the one which can pump the most can capture the biggest share. He has no incentive to agree to a Joint arrangement for rationing and scheduling production unless all others can be bound to such a production agreement and unless its terms can be enforced upon all producers without regard to the willing consent of each and every producer. Yet all producers may enjoy a greater aggregate product and a more economic return if such production agreements can be maintained and enforced over the long-run.

A public-good situation has an analogous structure. Since individuals cannot be excluded from enjoying the benefits which are derived from the provision of a public good they can freely enjoy its provision without regard to the necessity of paying for the costs of providing such a good. As a result public goods cannot be provided on the basis of a consumer's willing consent to pay his proportion of the cost. There would be every incentive for each consumer to hold out, and to become a free-loader. As a result most public goods depend upon taxation or some other form of compulsory pricing as the means for financing the conduct of enterprises in the public sector.

The sensitivity of the task in shaping the structure of authority for the government of a political system is not diminished by the circumstances that such arrangements may be quite rational from a self-interested individual perspective. The use of governmental arrangements to reach decisions can lead to results which leaves each individual better off and to which each individual would willingly agree if the opportunity to exercise a holdout position here precluded by relying upon a decision rule requiring less than unanimous consent. As Buchanan and Tullock have demonstrated, it is possible to conceptualize the circumstance where a community of individuals would unanimously agree to a set of decision rules or to a constitutional arrangement where each would willingly abandon his individual right to an ultimate veto in favor of an alternative set of decision rules. The theory of the social contract found in the works of Hobbes, Locke and Rousseau is based upon similar analysis.

The difficulty arises from the circumstance that the decision rules requiring less than willing consent create an opportunity to use the coercive capabilities inherent in governmental decision making to secure advantage for some people at the cost of other people. In the extreme case, governments can become instruments of tyrannical exploitation. The formulation of the general structure of authority for collective decision-making arrangements as reflected in the constitution of governmental institutions is important both from the perspective of the decision-making capabilities which can be exercised and the opportunities for recourse to remedial action on the part of those who are aggrieved by decisions which have been taken.

## The General Structure of Authority for Collective Decision-Making Arrangements

The general structure of authority for the organization of collective decision-making arrangements in the United States is formulated on the basis of a complex body of constitutional law which divides the exercise of authority both on a horizontal and on a vertical basis, and places substantial limitations upon every assignment of authority. The federal structure of American system of government represents the horizontal division of authority; and the separation of powers within each unit of government represents the vertical division of authority. For our purposes we need only to sketch the bare outlines of this system in order to indicate the institutional facilities which are available for making decisions under requirements of other than willing consent and the conditions which are applicable to the use of these institutional facilities. These arrangements are generally used to govern the conduct of public agencies or enterprises engaged in the provision of various public goods and services in the public sector of our political economy as well as the maintenance of law and order in the government of all other social relationships.

The governmental superstructure of the American political system is divided into two sets of jurisdictions with some measure of specialization reflected in the assignment of exclusive authority to the national government but with substantial redundancy in the availability of alternative sets of political institutions for seeking remedies and solutions which require the use of governmental authority. If one set becomes inaccessible, the other may become available in seeking a new political solution to a problem.

In the case of the states, an additional substructure of local jurisdictions gives rise to a third level of authority which, in some instances, approximates a sufficient level of independence to be considered another autonomous set of political institutions. In California, for example,

the state constitution extends authority to any city with a population of more than 3,500 people to formulate its own charter for the government of municipal affairs and limits legislative prerogative to the approval or the disapproval of such a charter as a whole without authority to revise and amend. The constitution and reconstitution of the structure of authority at the state and local levels is generally beyond the reach of authorities in the national government. Thus, substantial elements of independence are permitted in the search for alternative political solutions and in the exercise of countervailing power to prevent easy dominance of any one set of authorities over matters of substantial conflict among heterogeneous interests in the American political community.

The structure of authority in each governmental Jurisdiction in the United States is usually divided among several different agencies which are independently assigned responsibility for the exercise of authority over specialized functions in the process of governmental decision making. Typically this division of authority is represented as a tripartite division between the legislative, executive and Judicial branches of government, but recognition should also be given to the reservations of authority bearing upon popular participation in the political process by the election and recall of officials, referenda, legislation by initiative petition as well as the numerous other constitutional provisions bearing upon the rights and immunities which persons may exercise in the political process. The implications of this complexly differentiated structure of authority for the government of the American political system can be examined in relation to the opportunities which become available and the burdens that are assumed by those who seek political solutions to problems through the exercise of public authority.

## The Exercise and Use of Authority in the Conduct of Affairs Requiring Collective Decision-Making Capabilities

The simplest case of a public enterprise organized to exercise collective decision-making capabilities is a single-purpose public district established to serve a single community of people. Such a district would usually be established to include those who would benefit and to exclude those who would not benefit from the provision of a public or collective good. Legislation for a ground-water basin replenishment district, for example, would include provision for taking account of the physical boundaries of a ground-water basin in formulating the political boundaries of the district. While petitioners might remonstrate against inclusion within the district, decisions to incorporate the district and to establish its boundaries would normally be made by some form of quasi-Judicial proceedings to assess the appropriateness of the proposal, to determine its conformity to the legal criteria and then be subject to approval by the affected population by some majority-vote formula. A holdout would not be free to sustain his position.

In addition such a district would normally have the authority to levy a tax or to require the payment of a compulsory fee or assessment for services rendered in order to finance the provision of its services. Again, a groundwater basin replenishment district might be granted authority to levy a tax upon property within the district or to collect a so-called "pump tax" as a compulsory charge levied upon ground-water production. A potential holdout would not be free to abstain from the payment of such charges.

The political quid pro quo for the exercise of these coercive powers

in the conduct of a local public enterprise is usually arranged by providing the community of people who are included within its Jurisdiction with a voice in its government. The government of such an enterprise is usually vested with a governing board composed of representatives elected by the local population. In addition, approval of the local electorate may be required to authorize the construction of major works, the creation of indebtedness, and the levy of special assessments or taxes.

If such a district already exists as a legal and political entity, the self-governing arrangement of its internal structure may permit the people served by such a public district to devise agreeable solutions and at the same time avoid the holdout problem inherent in the rule requiring the willing consent of each and every affected party. However, it is important to recognize that such enterprises are not regulated by the economic force of market competition in the provision of their services but are regulated by recourse to legal and political processes. The first order of political control occurs within the self-governing arrangements for organizing the government of a district's internal affairs. Each such public enterprise may also be regulated by recourse to political and legal remedies through the external public authorities which occupy positions of authority in the formal structure of government within either the state government, the federal government or both. All legislation authorizing the creation of public districts is enacted by state legislatures.

Any party who is sufficiently aggrieved to be willing to pay the costs involved may seek a variety of different remedies from public administrative authorities with regulatory responsibility concerning the organization and operation of such districts, from state or federal courts depending

upon the issues involved, and from legislative bodies having appropriate Jurisdiction in such matters. The legal and political costs of sustaining a public enterprise in the presence of substantial conflict and disagreement can be relatively high, given the availability of a large variety of legal and political remedies. Those responsible for organizing and operating a public enterprise in the American political system have substantial incentive to attempt to work out an agreeable solution even though the rule of willing consent cannot be sustained in an absolute sense.

At the other end of the continuum among the possible structures used in the conduct of public enterprises is the organization of a governmental agency created within the general structure of a state government or the federal government. The same general principles apply in both realms except that the structure of state authority is usually much more dispersed than the structure of authority in the American federal or national government. Reference to the general requirements imposed by the structure of authority in the federal government for establishing and maintaining the legal and political feasibility of a public enterprise operating as a federal agency, thus, provides us with a somewhat simpler arrangement than exists in many of the states.

The creation of any new public program at the federal level would generally require authorization as new legislation. The requirement of establishing its initial political feasibility would thus always come prior to establishment of its legal feasibility in organizing a public enterprise at the federal level to undertake the provision of a public service.

The political costs of launching a new program through the federal government may come very high. The enactment of legislation normally requires



authorization by both Congress and the President. Both represent constituencies based upon the national political community. Instead of assuming that political decisions are made by a simple majority vote in the American political system, the political formula requires something in excess of a simple majority and is arranged to facilitate those decisions which represent a much higher order of agreement.

Representation in the House of Representatives is based upon one formula and in the Senate upon another. The President is elected on the basis of a variant formula that has usually been reflected in a majority of the votes cast in a presidential election. The terms of office for election to each of these offices also vary from each other. Even when the decision rules of the American system of government are fully relaxed to meet the minimum authorized requirement for taking public action, the combined effect is to require support by more than a simple majority by requiring the concurrence of different majorities.

The formal arrangements for processing decisions in both the legislative and executive establishments are such that matters involving substantial disagreement tend to be delayed, and matters involving substantial agreement tend to be facilitated. Those who become the political champions of a measure in attempting to advance it through the political arenas of the federal government are confronted with a substantial task of devising appropriate strategies of persuasion, and of negotiating accommodations with a variety of interests. The political rhetoric used in the national political community is apt to take the form of gross oversimplification in mounting "campaigns" and "crusades" for various causes and "wars" against various conditions. Good and evil are portrayed in black and white.

Recourse to such rhetoric simply reflects the high cost of public decision making and the relative insensitivity of public decision-making processes to the articulation of consumer demands for the provision of some new public good or service. Undertaking the provision of a new public good is thus apt to be delayed until a clear and present demand is emphatically expressed. A threshold must be reached in the level of demand before public authorities can be successfully activated. These costs are, of course, much lower where decision rules can be relaxed to a simple majority vote than if a unanimous vote would be required.

Any imperfections in the quality of public decision making which derive from the overly simplified rhetoric and the tendency to repress adverse information in the interests of political expediency may lead to unanticipated (i.e. unanticipated by the character of the decision.) even though the consequence may have been anticipated by many individual analysts on the basis of their specialized knowledge consequences which remain to be remedied in the course of subsequent experience. Again, the political process affords a number of alternative arrangements to provide remedies for aggrieved parties. The first recourse may be to a consideration of "grievances" and "problems" by the administrative agency responsible for the conduct of a program. The courts provide other means for the redress of grievances. With the reluctance of federal courts to entertain actions against federal administrative agencies, a party may turn to a member of Congress to function as an ombudsman in considering his grievance.

Those responsible for the maintenance of the political viability of a public enterprise conducted within the structure of the federal government over a long period of time are confronted with the task of sustaining a whole

series of decisions on a continuing basis through both the executive and legislative establishments and of meeting any challenge which may arise within the courts. Decisions affecting program planning, budgeting expenditures, personnel, litigation, and many other matters must be processed through different decision structures within the executive establishment. Annual appropriations, grievances, hearings and investigations, new authorizations, and modifications in legislation must be processed through different committees and offices in the legislative establishment. Frequently the feasibility of a federal undertaking may depend upon contractual agreements, understandings or working arrangements with other federal agencies functioning as public enterprises and with a variety of state and local governmental enterprises.

Those responsible for the conduct of public enterprises cannot afford to win a battle and lose the war. They must be concerned with sustaining the political feasibility of their enterprise through the changing political fortunes of those officials who may come to dominate the different decision structures which have potential veto power over the continuity and success of the enterprise. The political complexion of the House of Representatives may change every two years, the Presidency, every four years and the Senate, in staggered terms over six year periods. The long-term viability of any public enterprise in the federal government depends upon continued success in sustaining a favorable course of essential political decisions under all of these changing circumstances and amid the changing political fortunes of the partisans who aspire to public office in the federal government.

The political terms and conditions for maintaining the legal and political feasibility of a public enterprise operating within a highly

dispersed structure of authority thus require the establishment of an independent base of political support which provide arrangements for sustaining a level of agreement substantially in excess of a simple, majority-vote coalition. Most public entrepreneurs functioning within the American system of government are thus forced to win support and agreement among their clientele and among collateral agencies which act jointly in providing services to that clientele. In the vernacular terms of the American language, most public entrepreneurs find "cultivating the political grass-roots" a necessary condition to assume the survival of their public enterprise.

Given these political terms and conditions which derive from the exercise of authority in a system of government based upon substantial dispersion of authority, each public enterprise whether organized as an agency within a Moore general system of government or as a self-governing municipal or quasi-municipal corporation operates with the essential political responsibility of sustaining its own survival as a going concern. This responsibility imposes an obligation that such an enterprise must independently formulate its program within the parameters established by all authorities capable of exercising potential veto positions.

The risks are too great to rely only upon the course of formal decisions by those public authorities capable of exercising potential veto positions. As a result those responsible for the conduct of most public enterprises operating within the framework of the American system of government find it necessary to build their political base by constituting an ad hoc political community of relevant interests. This political community is organized essentially as a voluntary association of interested parties

functioning as a political circle or a series of political circles with overlapping membership. The basic decision rule used among these political circles concerned Keith the conduct of public enterprises is the same rule of willing consent used in private associations. If decisions can be reached either at the conference table or in a series of interrelated negotiations on the basis of the willing consent or agreement of all those involved then the prospects for sustaining a favorable course of decision by established political authorities is greatly enhanced and the general risks of political decision making can be held to a relative minimum.

If some set of interests are not being adequately represented in the course of decisions, those who are aggrieved must establish their own bargaining position by being able to invoke a veto at some point within the structure of authority which affects the political viability of any program or enterprise. Once such a veto point is established a new parameter is built into the relevant de facto political constitution of a particular enterprise. The composition of its political continuity and participation in its negotiating circles are usually modified to accommodate the new set of interests. Under these circumstances, the structure of decision making in an American system of public enterprises tends to approach a relatively high level of agreement or consensus. Under limited short-term exigencies, the rule of consensus can be relaxed toward the minimal condition of a simple majority. Any substantial decision taken in the face of general disagreement cannot be easily sustained for long. The political risks are very high. The American political system places a premium upon finding agreeable solutions but it is possible to take disagreeable decisions in the short-run. The costs of sustaining such decisions will soar unless

agreeable accommodations can be reached in the long-run.

### The Organization of Private, Public and Mixed Enterprise Systems

The structure of authority inherent in the American political system gives rise to a great diversity of enterprise systems. In the private sector, enterprise systems are universally recognized as "industries in which a variety of firms serve a common product market. A similar phenomenon can be recognized in the public sector where a variety of different public agencies -- federal, state and local -- coordinate their actions to provide a single type of public service. The provision of many public services may also involve the participation of both public agencies and private enterprises in a mixed enterprise system.

Where private enterprises are organized to produce and distribute marketable commodities a great variety of firms may enter the field in an effort to satisfy the various demands of diverse populations. Each firm is free to seek out its own market. The relationship of one firm to another is adjusted and regulated by the force of market competition. The market, thus, is the primary instrumentality for coordinating and governing the relationships among a multiplicity of firms in private industries. Governmental institutions serve only as a second-order system of regulation by policing and enforcing performance of market transactions and by providing remedial action regarding any inherent imperfections in the structure of market arrangements.

While economists have given a great deal of attention to studies of private industries, relatively little attention has been given to public enterprise systems that cut across the several different levels of

governmental jurisdiction or to mixed enterprise systems composed of diverse forms of public and private enterprises.

The postal service is one of the few fully monopolized public services in the American political economy. Police services, by contrast, are typically provided by a variety of agencies operating at all different levels of government and functioning, as a closely coordinated system of law enforcement agencies. The Federal Bureau of Investigation is the principal but not the exclusive policing agency at the national level. The coast guard, the border patrol, military police, postal inspectors, and the secret service are among the other agencies functioning as policing agencies in the context of the national government. States typically maintain either an integrated state police force or sustain several forces including a state police or highway patrol, state conservation officers or game wardens and state fire marshalls or fire wardens. At the local level a county sheriff typically has jurisdiction as the law enforcement officer for each county in the United States and each municipality usually maintains its own separate police force. In addition to these public agencies providing police services, a host of private agencies ranging from national firms such as the Pinkerton and Burns agencies to a variety of private detective and private patrol agencies do a law enforcement business in communities throughout the United States.

The nexus of relationships among these diverse police agencies cannot be characterized as single hierarchy of relationships. Rather each agency is as relatively independent of each other agency as independent business firms functioning in a market economy. Each agency is free to undertake cooperative arrangements with each other agency when their mutual advantage

is facilitated by cooperative arrangements. As a result police agencies throughout the United States cooperate in developing and sustaining joint information, communication and identification services and in undertaking coordinated Law enforcement programs. At the same time each agency is at liberty to sustain an arm's length relationship with other agencies when interests are not-facilitated by cooperative arrangements. One agency is not free to impose its decisions upon another agency by direct administrative action. Even where a local police officer might be using the cloak of his office to violate federal law, for example, the appropriate remedy would be to institute criminal proceedings since administrative remedies normally available within a single hierarchy of authority cannot be directly used by federal police officials to discipline a local police officer.

What might be characterized as the American water industry is composed of a complex configuration of agencies functioning at all different levels of government and providing diverse types of water services. In those regions of the United States with the more highly developed water resource systems, it is not unusual to observe the operation of several different water systems functioning concurrently under the jurisdiction of several independent agencies of government within a single watershed. Typically these systems would include a river management system to provide for various in-the-channel uses of a river system including navigation, flood control, recreation, fish culture, power production, and other related purposes. In addition water distribution systems are separately designed and managed to transport and distribute water for various on-the-land uses. A distribution system will often be complemented by two independent discharge systems: one



for storm sewers and another for sanitation sewers. Either of these discharge systems may in turn be interconnected with the natural supply system to permit the reuse of discharge water.

Large-scale, waterworks projects in major river systems are usually constructed and operated by either the U. S. Corps of Engineers or the U. S. Bureau of Reclamation. However, the construction of such works by a state, local or private agency is not unusual. The management of distribution systems are apt to be divided between wholesalers which operate major aqueducts, and storage reservoirs and local distributors which supply water to the ultimate consumer. Separate retail organizations are usually used to provide water for domestic and municipal purposes, and for agricultural purposes. Similar patterns of organization are likely to exist among agencies responsible for the operation of storm drains and sanitation sewers. Flood control districts usually operate quite independently of sanitation districts.

In the case of the California water industry, the U. S. Corps of Engineers and the U. S. Bureau of Reclamation operate project facilities representing an investment of approximately one billion dollars each. The California State Department of Water Resources is becoming the third major large-scale producer with a system of works which will represent an investment of approximately two billion dollars when completed in the 1970's. The Metropolitan Water District of Southern California is the largest water wholesaler in California serving an area with a population of nearly 10 million people. Its present investment in plant and equipment amounts to more than a half billion dollars and a 1.3 billion dollar expansion program is currently being planned. The Los Angeles Department

of Water and Power, the San Francisco Municipal Water Department and the East Bay Municipal Utility District are relatively large-scale water producers each operating projects at headwaters in the Sierra Nevadas with large aqueducts transporting water to the principal centers of population served by these municipal water supply systems. In addition several hundred public water districts and municipalities operate their separate water supply and distribution systems. Approximately 1500 cooperative, non-profit mutual water companies provide water service to their subscribers at cost. Relatively few profit-making public utility companies function within the California water industry. The California water industry is an "industry" composed predominantly of public enterprises with no single agency exercising a dominant position of control within the industry.

Many other public services are provided by a similar configuration of public enterprise or mixed enterprise systems. Educational services, the construction and maintenance of streets, roads and highways, transportation services, the regulation of economic activities, the provision of public health services, fire protection, land use planning and development are but a few of the services organized through highly differentiated public or mixed enterprise systems. These patterns are characteristic of American public administration in general.

Do these highly fragmented public and mixed enterprise systems make sense or do they represent the accidental accretion of history with no more sense of system or design than an accumulation of patchwork. The patchwork character of these systems is evident, but can a patchwork system represent a rational solution to the problems of public organization for the provision of public services. Any private industry can be

conceptualized as a patchwork of individual enterprises but most economists would contend that the force of market competition requires each unit to adapt to changing conditions and to maintain a high level of efficiency in its own operation if it is to survive. But, what about public enterprise systems?

The alternative to a diversified public enterprise system would be the integration of the diverse agencies into a unitary, hierarchical structure operating through a single chain of command with ultimate responsibility to a chief executive for coordinating all activities involved in the administration and provision of public services. Such a system would imply that all activities can be ordered to reflect a linear scale of preferences. In an ideal hierarchy, if A dominates the decisions of B, and B the decisions of C, then A always dominates the decisions of C. Such a linear ordering also implies that the values reflected in the policies of A dominate the values reflected in the policies of B, those of B dominate those of C and consequently those of A dominate those of C. An unqualified hierarchy of authority, therefore, reflects an unqualified hierarchy in a scale of preferences or in a scale of values.

Hierarchical arrangements are unquestionably necessary when actions must be sustained in relation to a linear process where the function of A depends upon the function of B and C in providing a unitary product or in sustaining a unitary production process. A uniform level of service in the provision of a public service throughout a domain is such a unitary product. However, if a population has preference schedules which are diversely ordered among individuals and aggregated into heterogeneous social groupings, then there may be an advantage to organization for the provision of public services in a

highly diversified and differentiated system of public enterprises.

Let us assume, for example, that the national government has an exclusive jurisdiction and were to conduct weather modification programs through a single agency. How would the agency define its mission? If it defined its mission to attempt to eliminate extremes in weather, this objective might not be consonant with the welfare of those who depend upon diverse weather conditions to enhance their welfare. If it defined its mission as the maximization of the aggregate social welfare of the nation, how would it seek to measure social welfare as an aggregation of diverse preferences? If reliance were placed exclusively upon the political process as reflected in a national legislative body for determining preferences, the voting rules would tend to obscure the diversity of individual preferences among the population or the heterogeneity of preferences among different communities by a requirement of majority voting among legislators representing all areas of the nation. In other words, majority voting is designed to facilitate collective decision making and to iron out the diversity of interests among any collectivity. Majority voting masks the heterogeneity of interests existing in any voting population.

Disaggregation of the diverse interests into independent organizations representing different communities of interest might provide a better solution. These independent public entities would then be free to work out agreeable terms and conditions with one another regarding the conduct of weather modification programs to arrange for diverse mixes in the results produced. One area may want to increase the yield of precipitation; another might wish to avoid hail damage; still another may wish to suppress lightning strikes and the accompanying fire hazards. All three results may be desired-in some areas but

with modified priorities to conform to the maturation of crops. In this way, diverse public entities organized at the local level and free to specify their own preferences for collective goods might assume better results measured in aggregate public satisfaction.

Local units of government within the American federal system tend to take on the structure of interests reflected in a buyer's cooperative or a consumer's cooperative with the capability for levying taxes and assessments and otherwise exercising governmental decision-making capabilities in providing services to a local community. Where local interests vary and diverge from one another, such agencies are free to pursue divergent interests in relation to state and national agencies. Thus, the American federal system tends to allow for some elements of independence in the articulation of consumer interests and consumer preferences in arranging the product mix to be supplied by the different production agencies. There a local agency is too small to organize for the production of a public service at an efficient economy of scale, it can retain its advantage in satisfying the special level of service preferred by its patrons and contract for the production of an appropriate level of service by a larger unit of government or by a private enterprise.

In the provision of many public services the essential factors which require collective action may be 1) the need to determine the appropriate level of service to satisfy community preferences, and 2) the capability of levying taxes or assessments against all beneficiaries. When these conditions are satisfied, substantial diversity can be tolerated in the organizational arrangement of the producing unit. The best size and organization of a public agency functioning essentially as a buyer's cooperative

may be quite independent of the best size and organization to give the most efficient scale of production.

The situation may also exist where the greatest efficiency of production is to be realized in the organization of relatively small-scale enterprises. For example, it would probably be highly inefficient to organize only one university to serve 200 million Americans. Yet, the national community may have common interests which are not adequately satisfied by relying exclusively upon the states to specify their product mix in higher education. This problem can be solved, not by a political reorganization of the university system into an integrated national bureaucracy, but by the national government establishing a program to reflect its requirements through cooperative arrangements with the mixed system of enterprises which constitute the American system of higher education.

The federal government, for example, may have a much greater demand for foreign language training than the individual states would have. The demand can be satisfied by an increased federal expenditure for foreign language training fellowships and for aid to expand the level of foreign language training program is among American universities. The federal government, in such cases) is acting as a buyer working with established producers to secure a modified product mix which will best serve the interests of the national community as well as serving the diverse interests of the different states. This pattern of accommodation may be much more efficient than an integrated solution relying upon a hierarchically organized system of public administration to develop, manage and control an educational system.

Efficiency is usually enhanced if the costs of providing for any good or service can be directly assessed against the beneficiary. In the private

sector, this function is performed by the price paid for a good or service. Under ordinary circumstances the price paid by the buyer would at least cover the marginal costs involved in the production and distribution of a particular good or service. The nonmarketability of many public goods and services precludes the use of direct pricing mechanisms in the public economy. However, the assignment of costs to beneficiaries is most closely approximated when a local governmental jurisdiction assumes the basic responsibility for financing a locally variable product or- a locally variable level of service. Where no basic redistribution of income is being attempted, financial obligation should be commensurate with the benefit received. A local agency organized on a scale to include the community of beneficiaries then, would be the best unit for assigning the financial obligation for the provision of a public service subject to variable provision.

In the context of this general examination of enterprise systems, we might anticipate that a mixed enterprise system will best meet the needs of a future atmospheric resource development industry. Demands for services at the local level are apt to be highly variable from one area or region of the United States to another. Where landholdings are small, some form of public organization will be required to avoid the holdout problem. Unless private producers act in a way that interferes with one another's performance, substantial latitude can be preserved for private enterprise to produce weather modification services and to develop atmospheric resources generally. No significant welfare function in the reinstitution of income would appear to be involved in the development of atmospheric resources. If costs are to be assignable to beneficiaries, the buyer units should be appropriately organized to reflect the service being procured. Those buying water supply

augmentation might, for example, be organized differently than those buying forest fire preventative services.

We can also anticipate that an industry requiring significant elements of public organization will pose perplexing problems of adjustment and accommodation which will require extensive reliance upon the public decision-making facilities at every level of government. Market arrangements will not suffice. A first order of accommodation can occur in the context of friendly rivalry and cooperative negotiation of mutual interests as occur in other public and mixed enterprise systems. However, conflicts which cannot be resolved successfully by mutual accommodation will require the use of governmental decision-making facilities to sustain a workable solution. If the political costs are to be kept within reasonable bounds, such solutions must also be an agreeable solution to those who are involved.

The discussion in the next section of this paper will be more specifically related to the conditions involved in the development of atmospheric resources and to the problems associated with the design and organization of institutional arrangements for the development of atmospheric resources.

### III

#### A Political Analysis of Problems in the Development of Atmospheric Resources

##### The Atmosphere as an Admixture of Goods and Bads

Human use of the atmosphere is no new condition. All species in the biosphere, as indicated in the introduction, maintain some connection with the atmosphere and its resources. Very large numbers of species make direct use of the atmosphere as the source of their essential supply of oxygen.



Humans are no different than other species which rely directly upon the atmosphere for their supply of oxygen, and for the discharge of carbon dioxide and other waste products of human metabolism.

Human use of the atmosphere has long included the creation of artificial atmospheric conditions by bounding airspace in some form of "shelter" and then regulating the airspace for control of temperature, humidity and for the presence of toxic materials including plant pollens. Shelters and their regulated airspace are increasing both in size and in the variety and quality of control. Enclosed malls in large shopping centers today provide protection from different atmospheric "elements" on a continuous basis. Such encapsulated airspaces can be expected to grow both in size and frequency of use.

The contemporary "political" problems associated with the use of atmospheric resources are usually of quite different magnitudes. These are the problems which involve the larger-scale dynamics of atmospheric conditions and the potentialities that control over these large-scale atmospheric conditions have for human welfare.

The atmosphere in a state of nature behaves as a dynamic system which sustains a flow of both goods and bads when measured by the criteria of human evaluation. Hail, lightning, tornadoes, hurricanes and other atmospheric phenomena can be the source of major destruction to human values. On the other hand, the atmosphere performs the essential work of distilling and transporting nearly all of the potable water supplies found upon the land masses of the earth. A major political question is whether the developing technology of weather modification can be used to modify atmospheric conditions to increase the yield of precipitation under certain conditions and to decrease the magnitude of turbulence and the yield of bads under other

conditions. An economic advance in human welfare can occur wherever human intervention increases the yield of goods in excess of aggregate costs or decreases the yield of injuries or bads with the same net result.

Difficulties arise from circumstances that are good at one time and place but may create injuries and losses at another time and place. Increased precipitation at the time of harvest may be as detrimental to agriculture as decreased precipitation during the early growing season. The harvest of one crop, cherries for example, may coincide with the growing season for many other crops. Men may be willing to take the calculated risk and tolerate the losses suffered by an "act of God", but they may not be as tolerant of losses suffered as a consequence of the actions of other men.

The atmosphere also performs important utilities in regulating temperatures upon the earth within relatively narrow tolerances, and as a consequence the atmosphere substantially affects conditions for the habitation of life upon the earth. The extent that weather modification may have a favorable or unfavorable effect upon temperature regulation in relation to increasing precipitation or ameliorating the intensity of storm patterns is a matter for speculation.

Many existing forms of human endeavor have taken account of climatic probabilities in making locational decisions. What are the costs of dislocation if probabilities bearing upon climatic conditions are altered by human action? Who pays for the costs and who reaps the benefits?

The atmosphere is used as a transportation and communication media that serves a large variety of other human utilities and disutilities. Much of modern industry is based upon processes of combustion to provide the principal sources of energy and to perform many of the processes of physical

and chemical transformation which serve as means of production. These processes normally depend upon the atmosphere as the principal source of oxygen to supply the combustion process and to carry away the load of waste gases and other waste chemicals which can be discharged into the atmosphere.

Humans may have a relatively low threshold in response to some chemicals wasted into the atmosphere and have a relatively high tolerance for other chemicals. Highly toxic compounds discharged by metallurgical industries, for example, may have the effect of producing substantial damages within the immediate vicinity of a plant. In other situations similar wastes may become toxic only when higher thresholds are reached. Toxic by-products may be also released by photosynthetic chemical transformations which take place under natural atmospheric conditions. Radioactive waste produced by nuclear explosions are but one of the more perplexing problems concerning the pollution of the atmosphere through its function as a medium of transport.

In addition to these transport functions performed by the atmosphere we should not fail to recognize that "air transport" with the development of the "airplane" has become a major mode of commercial transportation in the movement of persons and products about the earth's surface. The uses of the atmosphere for such purposes must be taken into a proper accounting in dealing with the use and development of atmospheric resources. The development of air transport which moves at supersonic speed will also be accompanied by atmospheric disturbances in the form of high-intensity sound waves which may be capable of causing substantial damages as well as producing inconvenient annoyances.

This incomplete and sketchy inventory of the human uses of the atmosphere merely serves to indicate the lack of conscious self-awareness which exists

in relation to the use and development of atmospheric resources. !We need a more complete inventory of present uses made of the atmosphere and an assessment of the future potentialities of pending uses which can be derived either from existing technologies or from pending technological developments.

In any such inventory we need to know something of the magnitude of existing and potential demand in relation to existing and potential conditions of supply for the various different demands and of the pattern of interaction among the different potential uses. What are the relative inelasticities of supply so that an increased demand or use results in an impairment of the conditions of supply? When such a condition is reached, policies of free development must begin to give way to policies of controlled development. A knowledge regarding the conditions of interaction between demand and supply has an important bearing upon the choice of policies to maintain demand-supply equilibrium at the tolerances which permit an optimal pattern of development.

#### Patterns of Interaction and Interdependency Among Potential Uses

We also need to know something of the pattern of interaction among the different potential uses of the atmosphere and the effect that these patterns of interaction have upon the general resource economy of the atmosphere. How, for example, will efforts at weather modification to reduce storm damage affect the atmosphere's yield in the precipitation of water, its regulation of temperatures, its use for air transportation, and its capacity to discharge diverse waste loads? Conversely, how do efforts to increase the atmospheric yield in precipitation of water affect storm

patterns and intensities and the other patterns of use which form a part of the total configuration of demands made upon the atmosphere?

The patterns of interaction among diverse uses can be either complementary and facilitative or alternative and conflicting. Other uses might be independent of one another with no interaction between two or more different patterns of use. Where a development or course of action for one purpose increases the available supply conditions for another use the two uses are complementary or facilitative. Under certain conditions, weather modification programs undertaken for one purpose might be facilitative in increasing yields for other purposes. Conflicting or alternative uses give rise to the circumstances where an increase in one use will impair or partially impair the use of a resource for another purpose.

Interaction among uses implies interdependencies which must be taken into account by any enterprise or agency undertaking progress concerned with the development of atmospheric resources. Where one type of use impairs, excludes, injures or destroys an alternative use serious problems of conflict are apt to arise. Where one type of use facilitates another, problems may also arise in assuring the appropriate level of development which will take account of the joint yield or pay-off for both purposes. Where one set of users are able to enjoy the benefits of a windfall produced by others, a problem of under-investment and under-expenditure and consequently of underdevelopment may provide an industry.

Questions about levels and elasticities of demand, levels and elasticities of supplies affecting each pattern of use, of the interactions and interdependencies among diverse patterns of use, and of the configuration of beneficial, indifferent and harmful consequences of different courses of

action will abound in any effort to undertake the development of atmospheric resources. Answers to some of these questions can be anticipated in advance. Some questions may only occur as problems arise in the course of experience. It is necessary to proceed with caution, attempting to anticipate the flow of consequences as accurately as possible but with an appreciation that elements of uncertainty and risk will plague any efforts to advance new ventures in the development of atmospheric resources. These problems will have to be solved by appropriate decision-making arrangements in light of experience. But those who venture must know the opportunities and risks inherent in the structure of the political system as well as the probable meteorological consequences of intervening in the atmosphere to affect its potential yield of goods and bads.

The Design and Organization of Institutional Arrangements For the Development of Atmospheric Resources

The atmosphere yields a mixed bag of goods -- of good and bads -- of substantial significance for human welfare. We shall now turn to an examination of some of the problems involved in constituting the diverse range of human activities concerned with the use and development of atmospheric resources. The common-pool characteristics of the atmosphere which pose the most fundamental problems will be examined first. We can turn, second, to conception of the common property relationships involved -- to the problems concerning individual use of a common property, and to the conception of the communities of interests inherent in development of common property resources. Some of the opportunities available within existing structures of institutional arrangements for undertaking the development of atmospheric

resources will then be examined,

#### The Atmosphere as a Common-Pool, Flow Resource

The atmosphere as a natural resource meets all of the conditions of a common-pool, flow resource. The resource is not easily isolable except within the controlled airspace of a shelter, and as a consequence it cannot be easily bounded or packaged. The resource in most of its aspects is subject only to a limited degree of control. Spill-over and interdependency effects abound among the diverse, Joint and alternative uses which can be made of the atmosphere.

The atmosphere as a common-pool, flow resource has some of the most perplexing characteristics of any of the common pool resource, at least as perplexing as those of the oceans. First, the atmosphere has no distinct and definitive boundaries for distinguishing sub-units. Water resource systems are formed into natural watersheds which provide definitive boundary conditions for organizing management programs. There are no such boundaries for easily characterizing micro-climates and sub-systems in the atmosphere. The concept of an airshed has limited utility even as an analogy. Instead the atmosphere is a dynamic system subject to changing velocities and patterns of flow under varying conditions of pressure and carrying capacities.

Yet, the field of effects or the scope of the consequences which flow from any course of action affecting atmospheric conditions are not without limits. It is doubtful that air pollution from Southern California has any appreciable effect upon Santa Fe, New Mexico, for example. Knowledge regarding the field of effects would provide us with the first tools for the

specification of proximate boundary conditions applicable to atmospheric resource development. The political process will provide alternative remedies so that those who may be adversely affected can present their case and seek appropriate remedies to take account of their interests. Exposure to such actions are a necessary risk of doing business in a field of endeavor where action is taken with only limited awareness of the likely consequences.

While the risks may be high in undertaking programs of atmospheric resource development in the absence of adequate knowledge, the incentives for action may also be high. An aggravated air pollution problem in Southern California may call for alleviation without being able to specify the technical criteria most appropriate for defining the field of effects or for formulating the precise boundaries of the community of interest appropriate to a smog-control program.

The task of specifying boundary conditions appropriate to the field of effect produced by one form of action in the use and development of atmospheric resources may be quite independent of the boundary conditions appropriate to another pattern of use and development. As a result different scales of organization and different forms of enterprise may be appropriate to different types of development. It is probably not unreasonable to expect that the configuration of enterprises associated with the use and development of atmospheric resources will be at least as highly differentiated as the mixture of enterprises which presently constitute the American water industry.

#### Common Property Relationships in the Use and Development of Common-Pool Resources

All common-pool or flow resources which are lawfully subject to use and



development by persons making independent claims upon the resource are conceived as common properties. The conception of a common property, as indicated in a previous section, usually includes reference both to the individual interests in the common-pool or flow resource and to the community of interests which are shared in such a resource. One has reference to the elements and relationships comprising the subsets of interests; the other has reference to the universal set of interests associated with a common-pool or flow resource.

The law relating to rights in common property includes reference to concepts which imply significant variations in the methods for conceptualizing the various interests involved. The concept of res nullius has usually been applied to the rights of persons to make use of the atmosphere or of the ocean. This concept implies a negative community -- an undefined, ambiguous universal set involved in the development of a common-property resource. On the basis of this concept the property is defined as belonging to no one and subject to use by everyone. The relationships among different users can, however, be adjudicated under equity Jurisprudence allowing for the application of rules of reason in reaching equitable solutions to conflicts of interest. Some such rules were once applied in the location of windmills, for example, where the construction of a new mill might adversely affect the operation of an established mill.

The doctrine of res nullius is a doctrine applicable to the use of a resource as essentially a free good. Willful injury, malfeasance, unreasonable or wasteful uses or methods of use provided the basis for governing relationships among various users without the necessity for defining the community of interests inherent in the common property situation. Much of the contemporary law regarding the use and development of the atmosphere

has not advanced beyond the conceptions inherent in the doctrine of res nullius.

The concept of res communes implies an increasing capacity to define and delimit the community of interests shared by those who have established a right to use a common property. Each has a right to use, no one owns the resource in particular, but the universal set is subject to a more finite and less ambiguous relationship. The reciprocal sets of interests including both the rights to use and the limitations and obligations of use are subject to increasing specification. In the relatively simple common-pool problem such as those associated with the use of a definable ground-water basin the reciprocal property rights may be subject to determinate solution through adjudication. The rights in a common property under such circumstances can be converted into an exclusive right to a divisible share in the common property once the universal set can be discretely defined.

This solution is not readily available under conditions where public solutions are required either to undertake the management of a production program to increase the supply of goods to be derived from a common-pool resource system, to provide some good subject to public provision (i.e., a nondivisible, nonmarketable good or service)) or a combination of both these production and consumption characteristics. Under these circumstances a part of the universal set of interests shared among the community of interests to a common property is subject to public proprietorship in one form or another. Where public and private interests are shared in a common property resource, the law of property no longer provides an adequate solution to the organization of institutional arrangements for resource development. Recourse to public

solutions, at least in part, are necessary and the traditions of public law bearing upon the organization and government of public enterprises becomes an essential element in institutional framework for shaping public solutions.

Circumstances requiring public solutions need not, however, call for Exclusive preemption and occupation of a resource system by any single public authority. Concurrent occupation of a resource system by private proprietary interests as well as diverse public proprietary interests may be most conducive to an incremental solution of resource problems in light of changing conditions. Solutions need not be devised on the basis of a model postulating ideal solutions. Instead solutions can be attempted, a step at a time, in light of accumulated experience without attempting to reach ultimate or final solutions.

The field of water-resource development provides the most extensive experience in the use of mixed private and public institutional arrangements for the development of common-pool and flow resources. This experience is not directly applicable to problems concerning the development of atmospheric resources. However, many of the basic concepts can be used subject to appropriate modification to deal with the distinctive circumstances associated with the development of atmospheric resources as distinguished from water resources.

#### Some Opportunities Available Within Existing Institutional Arrangements

In turning to a consideration of some of the opportunities available within existing institutional arrangements for undertaking the development of atmospheric resources, we shall give brief attention to programs concerned with 1) weather modification to increase yields of water supply 2) weather

modification to decrease the extent of storm damage and 3) air pollution control.

Where institutional arrangements and production facilities are already well developed to assure rather full control over the hydrologic behavior of different river courses and watershed basins, private entrepreneurs should be confronted with minimal difficulty in undertaking weather modification programs. Existing water supply agencies are the potential buyers for such services. More frequently than not these agencies are organized as public enterprises capable of sustaining a flow of revenues whether through service charges or from tax levies. Where major water producers are not free to levy a tax upon local beneficiaries, these producers are usually parties to contractual arrangements with wholesale or distribution agencies, organized as public water districts or as municipal water supply systems, which can exercise the power of taxation and provide an appropriate flow of revenues. If weather modification programs assure an incremental water supply at less cost than alternative sources of supply, minimal difficulties would be anticipated in accommodating this incremental source of supply into the production schedule of the primary water production agencies in response to normal growths in demand. In many areas of the western United States where demands for water are relatively high in relation to local supplies, whole watershed areas are held in public ownership where water production is a principal element in the watershed management program. These circumstances should tend to minimize conflict over actions to increase precipitation and the normal operations of diverse land owners. In turn, reservoirs operated by the principal water production agencies would be available to minimize the risks of flooding in the lower flood plains of a river system and of producing damages for which weather modifiers might be held responsible.

Experience gained on the basis of these more fortuitous circumstances should serve as a basis for the expansion of weather modification programs to increase the yield of precipitation under other conditions as the demands for water grow. Private enterprise in weather modification is not precluded as long as public agencies are available to function as the buyers of the increased yield of water produced by weather modification. The problem of dealing with potential 'holdouts in a highly fragmented water industry composed of numerous individual proprietors would probably preclude effective marketing arrangements until such water producers were organized as some type of public enterprise capable of charging for water services without regard for the willing consent of each and every water producer.

Questions bearing upon conflict and rivalry among competing private entrepreneurs engaged in weather modification efforts would have to be resolved through other institutional facilities in light of increasing experience. Presumably, private proprietors engaged in weather modification might interfere with each other's operations and impinge adversely upon innocent third parties to such an extent that decisions might be taken to preempt the field of weather modification, as a matter of public policy, for exclusive development and control by public agencies directly responsive to control by governmental authorities. Decisions regarding optimal patterns of organization concerning economies of scale among production agencies operating weather modification programs can only be decided in light of much more extensive experience and knowledge. These decisions can be taken in due course as added experience is acquired. In the meantime, the organization of the water industry in many areas of the United States provides an appropriate organizational structure to contract for the service of private

entrepreneurs engaged in weather modification.

Similar situations exist regarding the conduct of weather modification programs to alleviate storm damages. Large expanses of area in the western United States are under the jurisdiction either of the Bureau of Land Management in the U. S. Department of the Interior or of the Forest Service in the U. S. Department of Agriculture. Both agencies operate fire prevention programs in forest and watershed areas. Several large timber companies maintain similar programs on private forest lands and still other areas are organized as fire prevention districts with authority to tax local land owners for the operation of fire prevention programs.

Agencies operating fire prevention programs on timber lands or on watersheds provide the necessary institutional structures to be able to pay for weather modification programs in order to reduce fire losses produced by lightning strikes. Presumably such agencies would be prepared to contract for such services wherever a net savings could be demonstrated through the prevention of fire losses.

Still other opportunities may exist regarding potential savings in storm damage insurance as a justification for public expenditures to prevent storm damage associated with hail storms, wind damage, tornadoes and hurricanes. Where such insurance is provided through private firms, a rating system might be used to calculate insurance risks with reference to the preventative actions being taken to reduce storm damages. Ordinary fire insurance is based upon such a rating system which takes account of publicly-operated water-supply and fire-fighting facilities in establishing the price of fire insurance for each locality. Presumably additional expenditures for weather modification programs would be justified whenever such efforts would result in a net

savings in the combined expenditures or outlay for storm prevention and storm insurance.

The same principle can also be applied to public insurance programs concerned with various forms of insurance against the loss of crops by storm damage. Potential savings realized in the costs of crop insurance payments would justify added expenditures for the prevention of storm damages.

Within the course of the last two decades a number of local government Agencies have undertaken air pollution control programs. Those usually have been stimulated by public demand in areas where problems of air pollution have been the most aggravated. The experience which has been derived from these programs should be subject to careful evaluation. What alternative strategies have been used to control air pollution? What have been the results of these efforts? What are the economies of scale in the conduct of these programs? Do weather modification programs offer any opportunities to prevent atmospheric stagnation and the consequent diminution of the atmosphere's carrying capacity in the discharge of waste products? Answers to these questions would provide important increments to an expanding knowledge regarding the use of atmospheric resources based upon the experience derived from existing patterns of organizational arrangements.

The existing structure of institutional arrangements provide a basis for taking the first steps in the development of atmospheric resources. Concepts associated with the development of common property resources and the organization of public and mixed enterprise systems will help guide the way to further solutions.

Long-Term Prospects

More than a century ago, pioneers advancing into the arid regions of the American West, found it necessary to design and organize new institutional arrangements for the development and use of water resources. Some of their solutions were drawn from the concepts of mining law; some were drawn from the law of municipal corporations and adapted to the problems of human enterprise in a desert region. The institutional arrangements which form the contemporary structure of the California water industry were fashioned as incremental solutions to water problems over the course of more than a century of experience with life in a desert region. The deserts have been watered by human enterprise and the improbable prospect of a major megapolis developing in a desert has become a reality.

The realm of the noosphere as characterized by Teilhard and Huxley represents the incremental accumulation of piece-meal solutions in the building of civilization as men have advanced through time along their diverse paths of learning and development. There are no master planners to plot the course of civilization. The most that men can do is to use the best of their capabilities in building upon the knowledge and technology that is available in fashioning workable environment which affords the promise of a better life. The bits and pieces become a part of a whole fabric by virtue of a coordinated unfolding of the works, the technology and the operations that affect the physical transformation of resource systems, and by virtue of the incremental addition of agreements, decisions and their implementing actions which affect a social transformation in the organization



of human society.

Every new physical solution, every new technological development must be accompanied by a new political solution, a new institutional arrangement. Meeting the criteria of technical feasibility is only one condition to be met in developing any resource system as a part of the human endeavor. The criteria of economic feasibility, financial feasibility, legal feasibility, and political feasibility must all be met. These criteria relate primarily to the coordination and integration of each new enterprise into the institutional configuration of human society as a going concern.

The organization of appropriate institutional arrangements to undertake the development of atmospheric resources will undoubtedly require pioneering into new political realms. In the long-run, national arrangement will not suffice. International arrangements will be required to deal with the continental and global dimensions of atmospheric phenomena. These innovations will have to be fashioned from the familiar tools at hand. New institutions must always be fashioned from the old if we are to sustain the continuity of human enterprise and human civilization.

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