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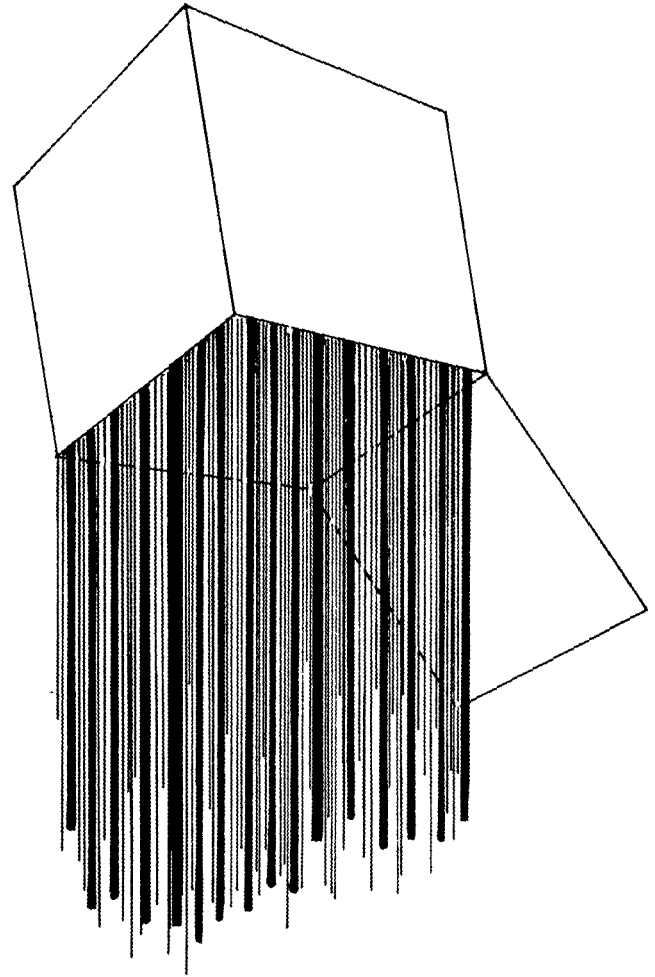
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Law and Technological Change: The Case of Weather Modification

Jamie Harris



Introduction

American society is profoundly technological and profoundly legalistic. We look to technology as the path to progress for a better life, and increasingly we seem to look to the legal system to control technological change and solve the many social problems that spin off from our "progress." However, a critical analysis of the role of the legal system in one episode of technological innovation does not give cause for an optimistic assessment of our apparent faith in the capacity of our legal institutions to guide technological change rationally under rules framed after representation of the whole gamut of relevant values and interests. The analysis presented here strongly suggests that our present legal system is fundamentally biased in certain structural ways which systematically favor technological values and discriminate against others. The result is that new technologies may be legitimized by the legal system and adopted by society without realistic consideration of important related problems.

These conclusions arise from a study of the role of the legal system in the development of weather modification technology. For the purpose of studying the role of the legal system in technological change, weather modification is an excellent example of innovation for several reasons. First, the development of capability to influence the weather is quite new and even still a matter of dispute. Thus the scientific basis for the techniques and evidence for or against their development are not settled. Secondly, unlike some technical innovations, such as organ transplants, where only a small part of the population is ever likely to be affected, it is quite clear that large numbers of people will be affected in many ways by any intentional weather modification. Third, even when just barely developed, weather modification technology caught the interest of government at various levels. Because of these three factors an analysis of the role of the legal system in the development of this technology is able to take account of three important questions: 1) What kind of scientific knowledge or other information enters legal decisions on the subject? 2) What kind of representation is given to diverse public interests? and 3) What is the impact of special interest politics on the legal system's performance?

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This study indicates that while the legal system has energetically contributed to the development of weather modification technology it has done so without assessment of the scientific merits of the question, without representation of a wide range of community values, and with great influence from pro-technology special interest politics.¹

The general conclusion that the legal system has consistently favored technological innovation in weather control will be developed in detail by focusing on the rule and policy making work of legislatures, courts, and legal commentators. For convenience discussion is

divided into three parts, each focusing on a different arena of legal activity. First we will look at Federal policy in the field of exposition and analysis, then turn to state legislation, and finally examine the courts and professional commentators. In each area after outlining the nature of the commitment to technology displayed in the policy and rules adopted, we will attempt to discuss the sources of that commitment.

Before beginning this task however, it would be useful to set forth some general background on weather, weather modification techniques, and some of the potential impacts of the new technology.

I. Weather and Weather Modification

Although the "weather" which impinges on people in their daily lives is usually perceived as a local phenomenon it must be recognized that all the weather we experience is part of an intricately interconnected global system. The global weather system circulates vast amounts of air, moisture, particulate matter and energy over the whole surface of the earth; a given mass of air in the stratosphere will circle the globe in about fifteen days at the latitude of the United States. Almost incalculable amounts of energy are absorbed in to the weather system from the sun and distributed by various mechanisms. For example, heat energy representing the energy required to vaporize sea water is released by the condensation which forms precipitation. It is estimated that through condensation a single thunderstorm can release as much energy as a megaton hydrogen bomb and that there are between 1,000 and 2,000 such thunderstorms on the earth every day. Thus the energy represented by daily thunderstorms alone is almost beyond comprehension.

It is hardly surprising therefore that weather and climate have played a vital role in shaping the nature and distribution of life as we know it as well as the physical features of the earth's environment. It is ironic that much of the concern that has led to greater attempts to understand the weather system has been stimulated by man's *unintentional* modification of weather and climate by pollution of the atmosphere, deforestation, urbanization and other activities. For example, it is estimated that due to man's phenomenal rate of consumption of combustible fuels in the last century the amount of carbon dioxide in the atmosphere has increased at about 3.2 per cent per year over the period.² The amount of carbon dioxide in the atmosphere has a direct influence on average temperatures of the earth because of its absorption of thermal radiation from the earth's surface.

Another source of inadvertent climate modification which has led to more intense study of the global weather system is the dust emitted by industry and other human activities. In 30 years dust content in the air at alpine Davos, Switzerland has increased 88 per cent and at Hawaii's Mauna Loa Observatory—thousands of miles from any significant concentration of heavy

industry—dust has increased 30 per cent in 10 years.³ Just what the potential future consequences of such increases may be are not known but both marked warming or cooling trends are proposed under differing theories.

Urbanization also is proving to have a significant impact on weather. With up to 30% less sunlight than surrounding rural areas cities also have significantly more fog and more rain than the countryside around them.⁴ Airflow and thermal characteristics of the urban environment are significantly altered by the concentration of pavement, buildings, and heat sources.

These and other kinds of inadvertent weather changes are not the subject of this paper, however, and hereafter all discussion of weather modification will refer to purposeful attempts to intervene in natural weather and climate processes.

It is, then, in the setting of a globally interconnected air-moisture-energy transfer mechanism in which man is already unintentionally making significant unknown interventions that the development of intentional weather modification techniques must be considered.

Through one means or another man has long attempted purposefully to influence the weather. Magical ceremony and religious supplication seem to have been the methods of longest standing.⁵ Various explosive and incendiary devices were frequently used by 19th century "scientists."⁶ Weather modification as an application of scientific knowledge of atmospheric phenomenon had its birth in the Massachusetts field laboratories of the General Electric Company in 1946. Atop Mt. Greylock in the Berkshires, Langmuir and Schaefer performed historic cloud seeding experiments based on a theory derived from prior studies of cloud physics. Their results seemed to confirm suggestions that artificial nucleation of super-cooled clouds could induce precipitation.⁷ In these early experiments dry ice crystals were used as artificial nuclei. However, further experimentation by G. E. scientists showed that silver iodide particles could also serve as nucleating agents in cold clouds. Because of availability and ease of distribution this is the substance most widely used and experimented with in "cloud seeding" today, though a large number of other materials have been found to be effective artificial ice nuclei.

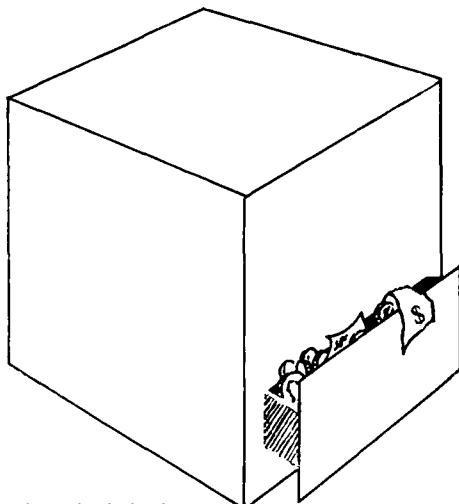
From these small beginnings, weather modification research has grown to sizeable proportions. Today the term weather modification embraces numerous activities, among which are:

1. Precipitation augmentation ("cloud seeding" or "rainmaking")
2. Fog dispersal
3. Hail suppression
4. Lightning suppression
5. Cyclone suppression
6. Modification or deflection of hurricanes

The various phases of weather modification have been taken over by different agencies and are at different stages of development. For example, the Department of Defense has been running "Project Stormfury"—an attempt to develop hurricane modification techniques—for a number of years. The U.S. Forest Service is interested in lightning suppression as a means of forest fire control while state and federal agricultural agencies are pursuing hail suppression as a means of reducing crop destruction. Though a great deal of study has been done in these latter areas, there is little significant evidence of successful intervention in natural processes.⁸ Claims based on supposed visually observed effects have been made, but sound statistical analysis has not yet produced verification.

Fog dispersal has been the concern of the Air Force and commercial airlines and seems fairly successful with certain kinds of fogs. Dispersal of super-cooled fog at many airports is now almost routine, but of little wider concern.⁹

For the present, this leaves attempts to manage precipitation as the most significant area of intentional weather modification both in popular understanding of the term and in actual application of research and technology. Widespread interest in "cloud seeding" followed almost immediately after the early G. E. experiments. In the early 1950's there was great flurry of private commercial "rainmaking" business. Practically anyone with an airplane, a pilot's license, and a silver iodide generator could become a rain maker. It is estimated that during these years as much as 10% of the land area of the nation was subject to such operations.¹⁰ Results were highly questionable, to say the least, especially when contrasted with the frequently extravagant claims of the hustling entrepreneurs. Accumulating evidence suggested that cloud seeding could even decrease precipitation in some situations.¹¹ By the late 1950's the business was practically dead.



In the meantime, however, the federal government had been aroused by the public interest in the matter and in addition to Department of Defense investigations during 1951-53, a President's Advisory Committee on Weather Control was created in 1953. This committee was given a Congressional mandate to evaluate experiments in weather modification and make a comprehensive report to the President. In 1956 this report was published in two volumes. The only positive verification of the effectiveness of cloud seeding found after three years of study was stated thusly:

"The statistical procedures employed indicated that the seeding of winter-type storm clouds in the mountainous areas of the western United States produced an average increase in precipitation of 10-15% from seeded storms with heavy odds that this increase was not the result of natural variation . . ."¹²

The findings of the report were debated back and forth with commercial operators on one side and skeptical scientists and statisticians on the other.

In 1958 Congress directed the National Science Foundation to begin a research program to study cloud physics and related weather modification problems including the development of reliable methods of evaluating experimental results. The NSF program continued for ten years at a level of approximately one to two million dollars per year. Private commercial operations, though much reduced from the level of the early 1950's, continued through the 1960's. Numerous public utilities in the West were customers of commercial operators in the hopes of increasing runoff from mountain watersheds behind hydro-electric generating stations. California's Pacific Gas and Electric Company is perhaps the outstanding example.

The 1960's was a period of rapid growth in federal involvement in precipitation augmentation research. The Bureau of Reclamation in the Department of Interior has been the "lead" agency in the field. Starting out with a \$100,000 appropriation in 1962 the bureau now operates its program at about seven million dollars a year. "Project Skywater," as the research and development program is optimistically called, is run by the Bureau's Office of Atmospheric Water Resources in Denver, Colorado and is designed with early operational status as its major goal.¹³ In addition to a multitude of contracted research projects, "Project Skywater" involves three major operational pilot projects; one in the Sierra Nevada Mountains of California, one in the San Juan Mountains of Colorado, and one in the northern great plains states. Each pilot project is an aggressive attempt to produce increases in natural precipitation. Although as we shall see weather modification today is enthusiastically supported by many, it is still greeted with skepticism by numerous scientific observers. Evidence of effectiveness of weather

modification attempts has been subject to continuing debate. The basis of the problem is the inherent difficulty of measurement since even the maximum claimed artificial variations in precipitation are but a fraction of natural variability. Also, until recently very few of the recorded experiments were done with any kind of statistically sophisticated data recording. Complicating the measurement problem are serious remaining puzzles concerning the actual physical processes involved in natural precipitation. It would be fairly safe to say that the scientific community is split about 50-50 on whether or not there is acceptable proof of results at all. The most official pronouncement from a respected objective source to date was from the National Academy of Sciences:

“ . . . there is increasing but still ambiguous statistical evidence that precipitation from some types of clouds and storm systems can be modestly increased . . . The theoretical basis for seeding effects is still very crude because we still do not have an adequate understanding of the physical details of many basically important cloud processes.”¹⁴

This statement represents a middle position along a continuum of current opinion which ranges from scornful disbelief to enough strong conviction to support apparently profitable commercial activities.

Weather modification, then, is a technology still in an early formative stage. There appear to be few hard results, but knowledgeable predictions indicate potentially vast and perhaps rapidly approaching technical ability to alter weather phenomena.

What can be said of the potential effects of weather modification? Clearly it is hoped that precipitation increases will lead to increased usable water supplies and resulting economic benefits to agriculture, industry, and land developments. Another anticipated result is lessening some of the destructive effects of certain kinds of weather. However, the intended beneficial economic effects are not the only foreseeable consequences. Some attention should be given to the kinds of “side-effect” that may be induced.¹⁵

For all of man’s long experience with the weather very little is known about the influence of changes in weather on his behavior. However, there is information from which we can conclude that widespread weather modification would have impacts on human productivity, deviance and illness. Much more research must be done in these areas however:

Studies have shown, for example, that changes in temperature and precipitation influence productivity and the incidence of crime and illness. Much of the work, however, has related principally to particular places and particular times. As yet no theoretical models have been developed which have general application.¹⁶

Psychological or emotional impact of weather and weather modification is an issue upon which only the most rudimentary inquiries are beginning to be made.

It is clear that at least one part of the United States government anticipates and intends direct deleterious effects of some kinds of weather modification on human behavior. Recently attention has been drawn to the significant cloud seeding programs of United States military forces in South-East Asia. Evidently interference in crop production, movement of equipment and personnel, and dampening of enemy moral are intended to result from military weather modification.

A political problem of no small proportion can also be forecast should weather modification reach significant proportions. The problem is posed by the question—Will people be willing to trust decisions about weather making to the conscious designs of others? One commentator has half suggested the problem:

A hurricane, for example, might be headed for a large urban area, with a population of perhaps two million people. It might be possible to divert the storm away from that area, thus avoiding millions of dollars of property damage and perhaps major losses of life as well. Such a diversion, however, might be accomplished only at the cost of some property damage and loss of life elsewhere. . . . Can decisions about modifying major storms be left to operating agencies, or should they be placed in the hands of the President and his advisors?¹⁷

What would be the impact on political perceptions and the prospects for democratic government of having leaders “play God” in such a way with phenomena which in the popular mind have always been beyond human control?

Ecological effects of weather modification also demand consideration. We have only to recall the lesson of DDT and other hard pesticides to be warned that the hasty adoption of new technologies can lead to disastrous unintended ecological consequences.^{17a}

The National Science Foundation has noted that:

“Anything that has a general and significant effect upon plants and animals, making some more abundant, others less so, is of primary concern to mankind for it strikes at the very basis of human existence. Changes in weather and climate may be expected to have such effects.”¹⁸

It is therefore with some dismay that one learns that “there has so far not been a single biological field study completed and reported in the literature specifically designed to identify any aspect of the ecological effects of weather modification.”¹⁹

Nevertheless some predictions have been made based on other sources of ecological knowledge. A feel for the

30

“Will people be willing to trust decisions about weather making to the conscious design of others?”

variety of problems that can be expected to emerge may be provided by the following illustrative list.²⁰ It should be noted that all of these ecological problems are realistically foreseeable as a result of the kind of rain and snow making which is in advanced operational experiment stages today.

1. As noted above the most advanced operational programs today (and those based on the least contested scientific evidence) are the winter snow-pack augmentation programs conducted by the Bureau of Reclamation in mountainous areas of the western states. It is predicted that these programs could significantly affect big game mammals such as deer, bighorn sheep, mountain goats, antelope, and elk. These animals are critically dependent on partially snow covered winter ranges. The size of herds depends directly on the quality of available winter range areas and increasing snow fall in such areas would reduce their forage and support capacity. Consequently there would be either decreases in wildlife populations or need for increased artificial maintenance and feeding of herds. (More likely both could result.) It should be noted that in addition to their aesthetic value such animals are highly important to many western local economies.
2. Prolonged changes in weather and climate in a given area (even though relatively small variations) could easily result in localized species extinctions and consequent changes in the make-up of the eco-community. What appear to be minor weather changes can be exaggerated in their ecological effects by competition between species in which such minor changes may take on decisive significance. Even though localized species extinctions may seem insignificant, world-wide trends in this direction from a variety of causes are already alarming. The Food and Agricultural Organization (FAO) has pointed out that:
 . . . the genetic resources of the plants by which we live are dwindling rapidly and disastrously. As development proceeds in the less advanced as in the more advanced areas of the world, the reserves of genetic variation, stored in the primitive crop varieties which have been cultivated over hundreds or thousands of years . . . equipped with a seemingly inexhaustible range of variation, have been and are being displaced by high producing and uniform cultivars. . . . At a time when a continuing rise in productive efficiency is more essential than at any other for our very existence, plant breeding and plant introduction are rapidly being deprived of the very raw materials upon which they depend.²¹
3. Presently unpredictable effects on populations and distribution of insect pests, plant and animal diseases, and disease vectors of various types are to be expected as a result of weather modification.
4. Changes in lake and stream ecology are predicted as a result of changes in precipitation rates, water temperature, rates of flow, etc. Erosion and turbidity would be expected to be affected as would populations of micro-organisms, plants, insects, and the higher links of aquatic food chains.

5. It is expected that intervening human activities in response to weather modification would cause additional ecological effects. It has been shown, for example, that over-grazing of rangeland is very likely when livestock producers have an abundance of supplemental feed. This is because an abundance of such feed allows more animals to be kept through the non-grazing months. Hence it is likely, in the absence of careful range management, that precipitation increases in some western plains areas might lead to further deterioration of rangeland by increasing supplies of cultivated feed and hence the number of animals that the natural range forage has to support during the grazing season.
6. The direct effects of cloud seeding agents themselves also have to be considered. As noted above, silver-iodide is the major cloud seeding agent now in use. Silver is a highly toxic metal, especially to micro-organisms. It has been shown that a variety of organisms concentrate silver from their environment, but so far little is known about the effects of silver on these organisms. However, the widespread dispersal into the environment of a biologically concentratable toxic heavy metal is not an activity which many ecologists view with sanguinity.

These are only a few of the kinds of effects that competent observers have forecast as likely to flow from weather modification. The disconcerting theme that unifies all such discussions, however, is the appalling lack of knowledge. We simply do not know enough to confidently predict the consequences of widespread weather modification. This alone would seem to counsel caution in advancing the technology.

Having presented this all too brief background on weather, weather modification, and its potential results, I would like to move to the main concern of this paper—the role of the legal system in technological innovation in this field.

II The Role of the Legal System

The general conclusion that the legal system has favored development of weather control technology was stated in the introduction. We now turn to the discussion of that observation.

It is through the generation of rules and policy favorable to weather control (and technology in general) that the contribution of the legal system to technological innovation is made; at each major level of law making the policy and rules produced are almost without exception strongly pro-technology.

A. *The Federal Government*

As noted in the brief discussion of the development of weather modification technology, the federal govern-

“We simply do not know enough to confidently predict the consequences of widespread weather modifications.”

ment has played a leading role. While research in the field started in the private sector it was not long until the vast majority of all research was being done under the auspices of various federal agencies: the National Science Foundation, the Defense Department, the U. S. Forest Service in the Department of Agriculture, and especially the Bureau of Reclamation in the Department of Interior. The latter agency has the lion's share of all federal appropriation in the field.²² (It is interesting and perhaps significant to note that among all the numerous books and articles read in preparation of this paper, only one discusses the Bureau of Reclamation program in the field.) However, in addition to the direct financial commitment to research and development, two special features of the federal effort should be carefully noted.

In the first place, even though there have been repeated calls for legislation ever since the President's Advisory Committee Report in 1956, no general federal law concerning administration or regulation of weather modification has been passed. This sixteen year hiatus is quite remarkable when one considers the multiple agency federal involvement, the obvious potential interstate impact of weather modification, and the widespread recognition of the many potential “side effects” discussed above.

Not only has no regulatory legislation been enacted, there has been noticeable opposition to such proposals on the ground that they would place obstacles in the path of technological development. For example, in 1969, S 1182, the “Weather Modification Commission Act,” was introduced in the Senate. This bill called for the creation of a nine man commission “to study the need for regulation and coordination in the field and the appropriate areas of responsibility for the federal agencies.”²³ Putting aside the usual distaste for new commissions, this seems like a sensible beginning on a very complex governmental problem. Yet at least one commentator sympathetically notes, “this bill caused concern among some government and other people in the field who feel that it would unnecessarily delay development of weather modification.”²⁴

More important than the failure to adopt regulatory legislation however, is the nature of the affirmative action which has been taken. This brings us to the second point: the allocation of the federal effort in weather modification research and development is neither to agencies with special expertise in meteorological science nor to those charged with pursuit of anything like “pure science” in general. The NSF studies begun in 1958 were terminated by Congress in 1968 so that currently the agencies in charge of federal weather

modification research are all typical examples of the so-called “mission-oriented” bureaucracies. As noted above, the major agencies in the field are the Department of Defense, the Agriculture Department, and the Bureau of Reclamation. The intensive “applied science” orientation of these agencies is well known. Thus former Commissioner of Reclamation Floyd Dominy explained how scientific research is to be subordinated to “practical” technological goals in his bureau's Project Skywater:

“We aren't a research outfit; we are an action outfit. I decided to farm out all the research to others, to universities, to research firms. We'll put our engineering knowhow at the top to guide it.”²⁵

That engineering knowhow has itself been guided by the singleminded goal of early practical application of a precipitation augmentation technology “as rapidly as possible consistent with sound engineering principles.”²⁶

Given these two general observations one conclusion seems inescapable. The federal government has produced a policy of rapid development of weather modification with the least possible “interference” from either rigid scientific discipline or legal-administrative regulation. That policy is backed by the yearly expenditure of millions of dollars. It bears emphasizing that this policy preference was not and is not based on objective consideration of results of comprehensive scientific investigation. Indeed, at the time that the Bureau of Reclamation project was being given its first major appropriations meteorological scientists were cautioning against just such expansionist programs. For example in 1964 the Committee on Atmospheric Sciences of the National Academy of Sciences reported that on the basis of the best scientific evidence available “the initiation of large-scale operational weather modification programs would be premature.”²⁷ Similarly, the National Science Foundation noted in 1965 that \$1.1 million had been authorized for Project Skywater for fiscal year 1965 and stated that this happened at a time when “Many atmospheric scientists—perhaps the majority now engaged in research in this country—view the move toward large-scale engineering and development efforts in weather modification as premature.”²⁸ Nor has the state of scientific skepticism changed significantly in recent years,²⁹ though with the termination of the NSF research program the federal policy seems, if anything, to have shifted even more directly in favor of mission-oriented technology development.

This one sided policy development requires explanation. At first look one might seek to subsume such a result under a general federal commitment to technological development. Thus one would look to such documents

as President Kennedy's Memorandum on Government Patent Policy of October 19, 1963. To the heads of all executive departments and agencies the President stressed that "the Government has a responsibility to foster the fullest exploitation of the inventions for the public benefit," and the "technological advances. . . (should be) brought into being in the shortest time possible."³⁰ But reflection would suggest that such a general policy statement may well be the result of cumulative specific policy choices rather than the cause of such choices. In the case of weather modification more revealing analysis is possible.

The strong pro-technology response of federal policy in the field of weather modification is best explained in terms of the identifiable political pressures and interests shaping legislative choices. It is reasonable to suggest that a neutral administrative policy (as opposed to a pure development policy) would be framed to consider a variety of values and interests including many such diffuse and general public concerns as ecology, financial integrity of operators, protection of the public from effects of possible deleterious substances emitted into the atmosphere by cloud seeders, aesthetic interests in weather, and, of primary concern, the vexing question of *who* shall make decisions that may change the weather for thousands or millions of people. While the history of regulatory agencies does not leave one entirely convinced of the prospects for their continuing dedicated service of public interests rather than special interest groups, at least at their birth the recognition of the diffuse or general public interests is supposed to be in the forefront. The mobilization, organization and communication of such interests to the law making body is necessary to get regulatory legislation passed. Quite simply, in spite of scientific concern, public awareness of weather modification and its various problems and prospects has not reached such a level as to stimulate the kind of organization and communication required. On the other hand there are identifiable highly organized special interests working for a narrow pro-technology policy, and the relevant federal law making institutions seem quite easily swayed by them.³¹

The strongest of these organized special interests seem to be of two basic types, each intertwined with the other. The development of federal policy in weather modification can be seen as a response to first, the special bureaucratic empire building interest of the mission agencies involved, and second to the special interest constituencies of those agencies. The illustration of this point will be made with reference to the Bureau of Reclamation since it is the lead agency in the field and the one about which there is substantial information available.³²

Weather modification research and development was brought within the domain of the Bureau of Reclamation by the political skill of former Commissioner Floyd Dominy. Until his retirement about two years ago, Dominy was reknowned in Washington as a consummate politician with many influential friends in Congress. One of these was Senator Francis Case of South Dakota who became interested in weather modification in 1960 after being approached by commercial cloud seeders in his state. Finding out about this interest, Dominy reacted quickly; he admits today that he worked to encourage Case and expand his agency by urging initiation of a Reclamation sponsored research and development program.³³ The early Congressional appropriations were spearheaded by Dominy and Case "with the understanding that a good portion of the work should go to South Dakota."³⁴ Today, although in retirement, Dominy is convinced that continuation of Project Skywater is vital to the bureau he loves; he sees a bright future for his former agency "if they don't take weather modification away from us."³⁵ The latter statement takes on considerable additional freight when compared to the statements of informed observers that the role of the Bureau of Reclamation may well be substantially completed and that serious thought should be given to dismantling the agency.³⁶

Not only does weather modification serve to expand the Bureau's empire, it is seen as holding out hope of correcting serious past errors and thus averting growing criticism of Reclamation. This was at least tacitly admitted by Mr. Dominy in testimony before the Senate Irrigation & Reclamation Sub-Committee during hearings on Project Skywater:

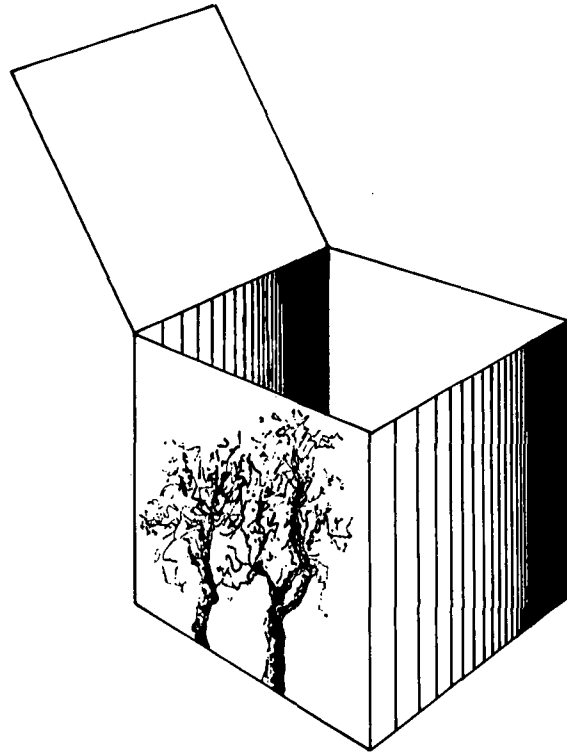
"The design of (Bureau of Reclamation) water facilities has been based upon historical records of streamflows. Failure to secure streamflow of the magnitude contemplated in the original plans has serious implications in terms of both service and financial commitments of the system. We are particularly aware of this situation now in the case of the Colorado River."³⁷

An even clearer example of the use of a technological development program as a defense of agency interests is seen in one of the three "pilot projects" currently in operation under Project Skywater. Pyramid Lake in the State of Nevada is fed by the Truckee River which heads in the Sierra Nevada Mountains of California. In turn the lake feeds one of the hottest controversies faced by the Bureau of Reclamation. In 1905 the Bureau built the Newlands Reclamation Project which draws its irrigation water from the Truckee River. Pyramid Lake has been shrinking steadily ever since. The lake is the sole commercial asset of any worth for the Piute Indian Reservation in which it is located. As the lake slowly dries up, so does the economic future of the Indians whose livelihood is largely dependent on the lake and the formerly bountiful supply of trout and recreational fishing that it once supported. The Indians and their representatives have been fighting a losing battle to save the lake for 67 years.³⁸

Thus, Pyramid Lake has been a source of considerable embarrassment for the Bureau and for the Secretaries of Interior who have to deal with the problem. The federal government and especially the Bureau of Reclamation have consistently refused any realistic protection of the Indians' rights and interests. But finally Project Skywater has allowed the Department and the Bureau to stand up and assert that they are doing something about the Pyramid Lake problem. They are doing one of their pilot projects in an attempt to increase winter snowpack in the headwaters region of the Truckee River thereby hoping to augment the water supply for Pyramid Lake. The top man in Project Skywater quite flatly states that the decision to undertake the Truckee pilot project was a political decision made by the top bureaucrats rather than a scientifically based choice.³⁹ "If they don't take weather modification away from us" echoes louder and louder.

Another indication of the dynamics of bureaucratic empire interests in shaping policy on weather modification is to be seen in the history of various proposals for general legislation on the subject.

While we noted above that there has not been considerable public organization in favor of regulation, failure of Congress to go beyond development project appropriations is not due to other types of bills not having been introduced. Another Capitol Hill friend of Commissioner Dominy's (and of Reclamation in general) is Senator Anderson of New Mexico. From 1960 to 1968 he introduced numerous bills on weather modification. Each one would have greatly expanded the Department of Interior's work in the field and created regulatory powers under the Secretary of Interior. These bills were routinely referred to the Senate Commerce Committee (Anderson sat on the Interior oriented Interior and Insular Affairs Committee) where, presumably under the influence of other agency interests, they quietly died without action.⁴⁰ The conflict between Interior and Commerce was emphasized sharply in 1966 when two bills were before the Senate. Senator Anderson's S. 2875 favored the Department of Interior as usual, while Senator Magnuson's S. 2916 called for extensive atmospheric research and development of a broad administrative regulation system under the Department of Commerce. Attempts at compromise were made to get around the agency rivalry (which sprung up in response to the proposals), but eventually the amended S. 2916, though passed in the Senate, died in the House.⁴¹ It is at least open to suggestion that the continuing conflict between potential parent agencies and their respective Congressional sponsors is a contributing cause to the continuing inability of Congress to agree on appropriate regulatory legislation. So far I have been discussing only the interests of the bureaucratic actors themselves. The eagerness of a mission bureaucracy to develop technological programs is not driven entirely by internal considerations of course. Special interests in the agency's constituencies also work for such policies where it serves their



purposes. Observation suggests that the constituency of the Bureau of Reclamation is especially interested in operational weather modification. Quite simply, the beneficiaries of Reclamation projects are the land owners and water users of the arid western states and the congressional representatives of those interests. The benefits of an aggressive development program in weather modification are of two types: in the short run money; and in the long run, perhaps, water. Anyone familiar with life in the West knows that water means money to landowners.

Short-run money comes primarily in the form of research contracting. It was noted above that Project Skywater began "with the understanding that a good portion of the work should go to South Dakota."⁴² It has. South Dakota (primarily the South Dakota School of Mines and Technology) has received more Project Skywater money—\$5,160,000—than any other state. Wyoming and Nevada, both dry states consistently supporting reclamation, are second and third in amount of money received, with \$3,900,000 and \$3,300,000 respectively as of 1969.⁴³ Former Chairman of the House Interior and Insular Affairs Committee, Wayne Aspinall of Colorado, a long time friend of Dominy and of reclamation, obtained for his State the largest number of individual contracts.⁴⁴ These include the contracts for one of the three big pilot projects, which, interestingly enough, is an attempt to increase snow fall in the headwaters of the San Juan River, which is a major tributary of the Colorado River. The third pilot project is being organized in South Dakota of all places. Thus does traditional American pork barrelling determine technological policy.

Aside from immediate money, the hope of future water production is the driving special interest behind federal weather modification policy. In the West water is the crucial constraint on almost every political and economic decision. The thirst of the western states and the intimate interrelation of agency and constituent interest in "rain making" is perhaps best dramatized along the Colorado River. The seven Colorado Basin States⁴⁵ have vied with each other for years over the muddy flows of the Southwest's great river. At one time Arizona even sent its National Guard to stop work on a dam being built to divert water to California. After years of political struggle, a seven State compact, and 1 year of court fighting, the Supreme Court finally allocated the flow of the Colorado River between the seven basin States in *Arizona v California*,⁴⁶ a decision that was a landmark in federal-state relations.⁴⁷ Billions of dollars have been spent or authorized to build the numerous reclamation projects in the seven states for diverting the waters in accordance with the *Arizona v California* allocation scheme. But now it appears that that allocation was based on an inaccurate prediction of the annual flows of the river and those at the end of the construction list face the possibility of nearly empty canals. In 1968, for example, Congress authorized 1.4 billion dollars for the giant Central Arizona Project after a 20 year political struggle. The CAP is to divert Arizona's allotted 1.2 million acre feet (maf) of water from the river and carry it to the Phoenix area. Yet at the time of passage of the act the Bureau itself estimated that by 1979 (when the project was to begin carrying water) only 1.1 maf of water would be available, and by 1990 only 500,000 acre-feet could be diverted due to increased upstream consumptive use. With decreasing amounts of water the economic feasibility of the CAP and many other projects will be seriously jeopardized if not destroyed altogether.⁴⁸ Yet huge investments in real estate, agriculture, industrial development, and urban growth (to say nothing of bureaucratic prestige) depend on the original CAP plans. The substantial financial interests backing the CAP are indicative of the power that stands behind water supply issues in the West: the Central Arizona Project Association is a lobbying group formed in 1947 and still in existence with plush offices in Phoenix and Washington, D.C. Its board of directors is heavily stocked with farming and farm related business interests, real estate interests, utilities, mayors, bankers and lawyers.⁴⁹ These interests along with their Bureau are caught in the muck of the diminishing river. This is the kind of special interest constituency that fuels Nevada Senator Bible's excitement in response to Bureau of Reclamation requests for weather modification appropriations:

"When the Bureau of Reclamation testified before our Appropriations Committee that an additional inch of precipitation above Glen Canyon (Bureau of Reclamation Dam on the Colorado River) would produce a runoff of 575,000 acre-feet, believe me, that sounded like something that should be accelerated without delay."⁵⁰

In summary, we have seen that the legal system has favored weather modification technology at the federal level by adoption of an affirmative policy of rapid development of practical weather control technique. This policy is being pursued "without delay." Overall administrative coordination which might seek to accommodate a wide range of potentially affected public interests is being avoided as an "interference." Similarly, strict scientific discipline, which would proceed more cautiously or even skeptically, is by-passed in favor of the engineering bias of mission agencies. This lop-sided pro-technology policy is explainable in terms of response to a multiplicity of highly organized special interests who have special access to law making bodies. In the case of the largest federal weather modification program the controlling agency itself has identifiable bureaucratic interests favoring the current policy and its powerful special interest constituency (Western land and water owners) are vitally concerned with any new source of water that might be developed.

The crucial point to be noted is the structural advantage given to the organized pro-technology interests within the federal legal system. Through the existence and intervention of a similarly interested mission bureaucracy and its Congressional supporters, these interests have highly and specially favorable access to the legislature.

B. State Legislation

Of the fifty States, 29 have been found to have some kind of legislation directly concerning weather modification activities.⁵¹ Since we have seen that there is no federal regulation of weather modification activities it should be noted that absence of any state regulation means absence of *any* regulation.

Only four of the 29 States having legislation depart from the pattern of pro-technology found across the nation. Maryland, a state not known for its water shortages, prohibits weather modification within its boundaries.⁵² Two states, Pennsylvania and West Virginia, likewise not frequently drought-ridden, have enacted laws that have been criticized as "obviously hostile to weather modification."⁵³ This "obvious hostility" is manifested by law prescribing a license requirement, financial responsibility requirements for operators, and the creation of an administrative board empowered to award compensation damages:

"Any licensee who causes a drought as determined by the board shall compensate farmers for damages. Any licensee who by causing heavy downpours or storms which shall cause damage to lands as determined by the board shall compensate farmers and property owners for such damage."⁵⁴

The other maverick state is Hawaii which authorizes only investigation of the feasibility of weather modification.⁵⁵

Putting aside these minor aberrations the dominant feature of the state laws is their encouragement of weather modification. This is done first by minimizing

governmental interference with experimenters. Regulations tend to be minimal; frequently little more than registration is necessary to obtain a license, if, indeed, a license is even required. For example, since 1951 a license has been required to attempt weather control in California. But even today, to obtain a license from the State Water Resource Board all one has to do is file certain information and pay a nominal fee. The Board has neither authority nor duty to review qualifications of applicants, nor to regulate where and when experiments shall take place.⁵⁶

Another method of State encouragement of weather technology takes the form of definite legislative policy statements. Thus Wyoming law declares that the State has "sovereign rights" to atmospheric moisture over its territory and that research and experimentation in weather modification "shall be encouraged."⁵⁷

Oklahoma's legislature has declared that atmospheric water is a natural resource open to exploitation.⁵⁸

Nebraska law declares: The state of Nebraska claims its sovereign right to the use, for the best interests of its residents, of the moisture contained in the clouds and atmosphere within its sovereign state boundaries.^{58a}

That such frequently made legislative claims are utterly ludicrous in light of the realities of an interconnected global weather system should be immediately clear.

An early advocate of weather modification in Oklahoma, one State Senator Pruett, placed a bill before the legislature suggesting yet a third approach to State encouragement of technology. The proposal stated:

"any rain that may be superinduced by the use of dry ice. . . is hereby declared to be the Act of God, and no person can predicate any claim for damages on a rain so produced, and the Board of Agriculture and those acting under and by their authority shall be free from all injunction remedies in the execution of the provisions of this Act."⁵⁹

Such sweeping immunity from liability has not been granted to weather modifiers. However State laws do offer practical limitation of liability to would-be rain makers in several ways and this may be of considerable importance in encouraging development of the technology. Texas, for example, has legislatively denied any claims against weather modifiers based on the doctrine of strict liability.⁶⁰ One is reminded of 19th Century New England courts refusing to adopt the principle of *Rylands v Fletcher* in mill pond dam bursting cases. As of 1968, before adoption of the Texas, Pennsylvania, and West Virginia laws mentioned, one writer examining the 23 State laws then in existence found "no statutes which purport to affect the liability of operators."⁶¹ The reply that would-be plaintiffs are still left free to pursue remedies under standard common law or equitable doctrines in the courts is superficial. Given the almost insuperable problems of proof⁶² and the observed fact that "not one of the suggested (common law) doctrines really fits the weather modification model,"⁶³ the practical result is bound to be a great strategic advantage to the developers and users of the technology when litigation arises.

Finally, some states have adopted overt legal aids to the further elaboration of weather control technique. Several state laws enable local government units to undertake weather modification projects and finance them out of local tax revenues. For example, California law provides:

"Any county, city, city and county, district, authority or other public corporation or agency which has the power to produce, conserve, control or supply water for beneficial purposes shall have the power to engage in practices designed to produce, induce, increase or control rainfall or other precipitation for the general benefit of the territory within it."⁶⁴

Similarly, North Dakota authorizes the creation of county wide weather control Commissions and gives these commissions power to levy a property assessment to finance their operations.⁶⁵ Nebraska goes even further in authorizing the creation of single purpose weather modification districts—similar to irrigation districts—with powers of tax assessment. Boundaries of these districts need not follow existing political divisions.⁶⁶

Thus, in many significant ways the predominant trend in state legislation on weather modification is toward hastening technological experimentation and development. Interference by government is extremely limited; in fact in several states government is itself actively engaged in the experimentation process. Forums for consideration or protection of interests other than increased precipitation are practically non-existent. While affirmatively encouraging experimentation, state laws with few exceptions do not create new methods of protecting those potentially damaged.

The policy developed by state legislatures should clearly be understood as reflecting the influence of the same kind of constituency interests identified in the federal program developments. It is to be noted that the only states with limiting statutes are states where water supply is not a significant problem (except as to the quality of the water supply). In the dry states where water is vital to fortune the laws have been hospitable. Without exhaustive search for evidence we can strongly suggest that agricultural and real estate interests exercise considerable influence in such states through powerful water and irrigation boards. Another interesting set of actors in some states appears to be public utility companies who seek more run-off from mountain water sheds behind their hydro-electric dams. Pacific Gas and Electric Company of California has been one of the long time experimenters in the field and no doubt has considerable influence on California law.

It should also be noted that the federal research grant program discussed above might be an incentive to the enactment of encouraging state laws at least in the Bureau of Reclamation's 17 State western empire. State legislatures would be loath to cut off the flow of federal grants by restriction of experimentation.

C. Courts and Commentators—the legal profession generally.

We have seen that weather modification law made in legislative arenas has been almost uniformly and quite narrowly pro-technology. Interests other than the immediate concern for precipitation increase and resulting monetary values have not been accounted for, with the limited exception (in a few states) of possible damage to property. We have seen how this legal response is a result of the political pressures of organized special interests that have been in positions to influence the relevant legislative bodies of the legal system. We now turn to a consideration of what, for convenience, we may call judicial lawmaking. Our focus will be on courts and commentators, those two parts of the legal system which contribute to law making through authoritative pronouncements of ‘discovered’ law on one hand, and more or less respected analysis, criticism, and suggestion on the other. It is convenient to treat the two together here partly because of their clear mutual responsiveness and dependency and partly because of the paucity of actual court decisions on the subject of weather modification.

It is generally thought that the law making of courts and the associated work of legal scholarship are not normally subject to direct influence by the kind of political lobby pressures we have seen working in the legislative field. One might assume therefore, that the response to weather modification of the non-legislative branches of the legal system might be somewhat more balanced between technological and non-technological interests. Such an assumption would be contrary to the facts. The following brief survey of the cases and literature shows that the response of the judicial branch of the legal system has been at least as narrowly pro-technology as that of the legislatures.

When the possibility of weather modification first began to emerge as a realistic one lawyers realized the potential for conflict inherent in the use of such technology. As “law, like nature, abhors a vacuum,”⁶⁷ it was not long before legal scholars began to write on the subject. From the earliest articles, however, there has been consistent unquestioning commitment to technological “progress” in weather control. Ellul has described the modern commitment to technology generally:

“Technological automatism may not be judged or questioned; immediate use must be found for the most recent, efficient, and technical process . . . The worst reproach modern society can level is the charge that some person or system is impeding this technical automatism.”⁶⁸

Legal scholars and courts have avoided the possibility of being so reproached. They seem to have conceived their role simply in terms of doing everything possible to manipulate rules and institutions to facilitate rapid development of the new technology.

Thus even sacred institutions are not to stand in the way. After observing that “it is of utmost importance that further development in the field be encouraged,”

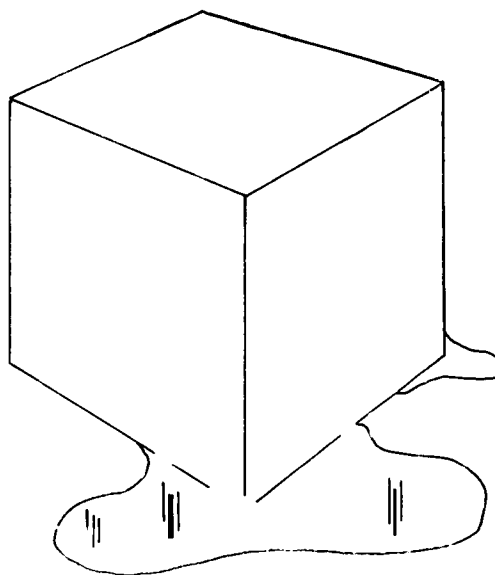
one early legal writer suggesting lines for development of state legislation in the 1950’s said,

“Under the American free-enterprise industrial system, competition is considered one of the significant factors making for material progress . . . No extended economic analysis is intended here, except to suggest that in an infant industry, such as rainmaking, it is difficult and possibly unwise to prevent pioneers from acquiring a favored position . . . In cases where a rainmaker has amassed the capital and the ‘know-how’ for properly evaluating his own work, a good case may be made for giving him a priority for a limited period of time . . . a limited protected position might well be a better stimulus to further development than allowing free competition.”⁶⁹

Another typical writer glowingly pictures the “rivers flowing through the skies”⁷⁰ and concludes a second article by observing:

“There is no doubt that this system (the existing legal scheme c. 1969-70) has its defects, but the fact that we have used it as our legal framework for weather changing testifies to its advantages. It is fair to say that this system has not unduly hampered the growth of weather modification. Unfortunately neither has it fostered the field, and that is what is needed.”⁷¹

One article⁷² displays a virtual sacrifice of legal reasoning on the altar of technological progress. The authors discuss the variety of common law doctrines previously suggested as analogies for use in analyzing private law liability problems potentially arising from weather modification. They then construct a theoretical continuum of these doctrines according to their liability outcomes. One extreme is occupied by the “natural rights theory which would practically foreclose weather modification.” The other extreme is the *ferae naturae*, oil and gas, and surface water set, i.e. the “capture right” doctrines, whereby there would be virtually unlimited scope for weather modifiers. Then there is a compromise group of doctrines centering around riparian analogies which suggest the imposition of a ‘reasonableness’ test. Without explaining the selectivity of their value scales, the authors assert that “such compromises present superior solutions because they strike a balance between



protection of property and technological advancement.”⁷³ Then comes the coup. While the compromise solutions are superior they are unfortunately impossible to apply because of the miserable state of scientific knowledge and consequent impossibility of proof. There being (a priori?) “no basis” for prohibition of cloud seeding, “by process of elimination only the policy of unrestrained weather control activity by all landowners remains to define the weathermaker’s liability . . .”⁷⁴ In passing the authors also note their conviction that “a non-liability principle is also desirable in light of potential benefits which may result from experimentation.”⁷⁵

Many of the articles are not so blatant as these examples, but still display the same unquestioning commitment to technological development without consideration of alternative interests. The goal of the work is explained as facilitating “sane logical development” or “applying the legal rules permitting the capture and reasonable use for the water in the air.”⁷⁶

Several major articles do not make explicit statements in favor of technology, but nevertheless display a clear attitude of inevitability about it. Thus one of the earliest writers on the subject says:

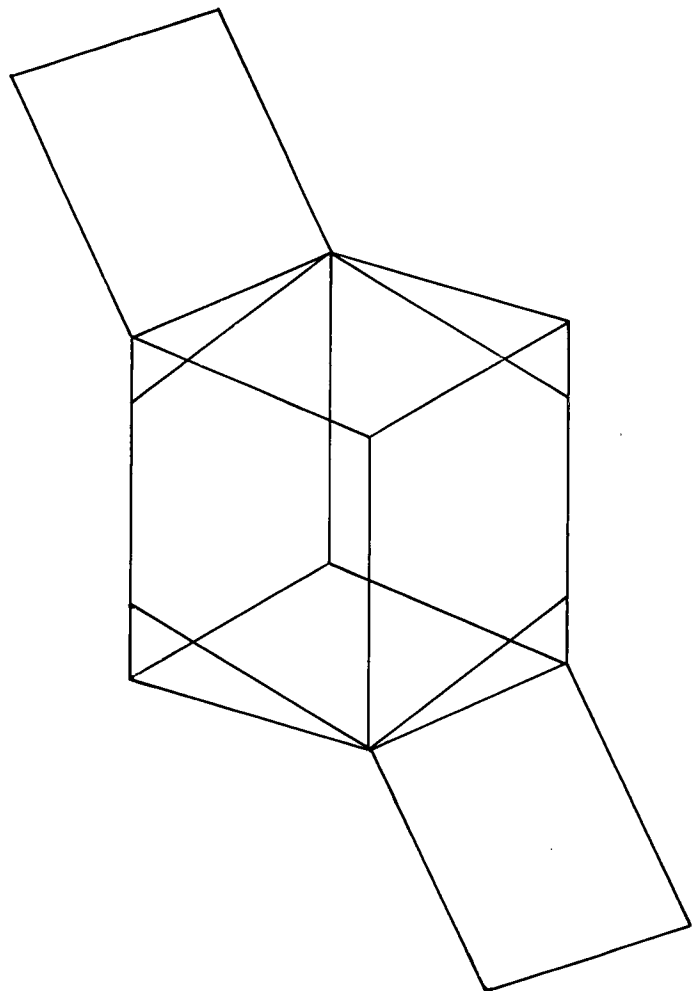
“That experimentation and research in the modification and control of weather will continue until its possibilities are fully explored, and that legal obstructions *must* somehow be removed, are virtually certain.”

(emphasis added)⁷⁷

In the climate created by such commentary, a one-sided response of courts faced with baffling questions of weather modification is not surprising. There have been very few reported court decisions concerning weather modification, but the impact of these few is definitely favorable to technological development. The earliest reported case found was *Slutsky v New York City*⁷⁸ which arose from attempts by the City of New York to increase precipitation on its watershed in the Catskill Mountains. A resort owner in the area sought an injunction on the grounds that increased rainfall would harm his resort business. The court adopted a rough nuisance-like balancing test and concluded that the landowner had no rights in clouds, their moisture, or the natural state of the weather, at least when balanced against the needs of the City for water. The injunction was denied.

Plaintiffs seeking damages have encountered an immense problem of proof. The most celebrated damages case involved cloud seeding in the Sierra Nevada Mountains.⁷⁹ The extraordinary problems of proof are discussed by counsel for defendant in a recent article.⁸⁰ The plaintiffs had the advantage of numerous public statements made by both the commercial operator and its customer, Pacific Gas and Electric Co., advertising the effectiveness of their cloud seeding techniques. Even so, the plaintiffs failed to make out their case. Similarly, failure of proof was the reason for denying an injunction in a Pennsylvania case where the judge was evidently quite sympathetic to the plaintiffs.⁸¹

The only case found where plaintiffs succeeded against “rain makers” was a Texas case (*Southwest Weather Research, Inc. v Jones*)⁸² in which certain ranchers obtained a preliminary injunction against a hail suppression project over neighboring lands. Their theory was that the rainfall on their own lands would also be suppressed. The trial and decision of the case is worth comment because even though the plaintiffs got an injunction, the case and scholarly writing immediately following it are still favorable to technological change in a perverse way. In the trial both parties introduced a confusing array of conflicting expert testimony. Confronted with what seemed to be unfathomable scientific riddles the court finally decided the case on the basis of “eyewitness testimony.” Several of



plaintiffs' witnesses testified that they saw clouds dissipate after they were seeded. No knowledgeable meteorologist would accept such "evidence" as establishing anything, but it was all the court had to go on and a case demanded decision. The injunction was issued. The basic irrationality of the decision is emphasized by the action of the Texas Supreme Court. The injunction was upheld, but modified so as to prohibit seeding only directly over plaintiffs' lands.

The decision was commented upon by numerous writers and generally criticized as not inquiring into the "reasonableness" of the activities as against plaintiffs' absolute claims of right.⁸³ However, the failure of the comment writers to recognize or discuss the clear institutional incapacity shown by such a case is significant. The *Southwest Weather Research* case strongly suggests that traditional legal institutions may well be incapable of providing rational solutions to problems of weather modification because of informational inadequacies, lack of expertise, and the inappropriateness of courts attempting to undertake administrative functions in a complex scientific field. Technological innovation is facilitated by the complacent notion that existing legal institutions are capable of handling complex problems likely to be created by the technology's use.

Although some of the more recent writing in the field has recognized the inappropriateness of courts as a forum for issues of weather modification.⁸⁴ It suffices to say that most of the literature is solidly in the complacent mold.

Thus, the decisions of courts and the scholarly writing concerning weather modification have been overwhelmingly pro-technology in minimizing impediments to development of weather modification techniques. In marked similarity to the result noticed in the trends of state legislation, the only competing value expressed (and that only to a limited extent) is occasional notice of claims of private property owners. This notice is confined generally to appeals to a vague and undefined "reasonableness" test.

At first consideration this may seem to be a surprising finding, for, as noted above, it is often suggested that courts are the branch of the legal system where wealthy or specially organized interests have the least special advantages to bring to bear on lawmaking. Whereas everyone knows that legislatures respond primarily to organized special interest groups and lobbying tactics, there is a mythology that courts and the surrounding legal scholarship of the profession are relatively well insulated from such raw force. Hence, says the mythology, courts are more equally balanced between organized interests and competing diffuse public interests. The "flavor of equality" thought to infuse the courts and the work of scholarly commentators is supposed to offer chances for the poor or unorganized

or non-professional to influence policy that they would not be able to affect in the political arena. See, for example, Dolbeare's study of the role of courts in urban politics, finding that courts tend to be used for political purposes most frequently by isolated interests.⁸⁵ Similarly, a well known environmental lawyer (who began his work before recent proliferation of environmental organizations) confides that his strategy of defending the environment was based on using the courts to the fullest extent possible to create rules and publicity that might later lead to success in political channels.⁸⁶

How does it happen, then, that the goals of the various pro-technology special interests we have seen at work in the legislative arenas have equally triumphed in the non-legislative branch of the legal system? Surely the simple political pressure model will not explain this result. Rather the answer lies in more subtle structural biases of the judicial system of decision making, biases which prevent effective representation of the kinds of values and interests that might be found ranged opposite the value of technological development.

The first such systematic bias is found in the nature of the intellectual work lawyers (we use the term to include judges too) traditionally do. When confronted with a problem lawyers typically use a very narrow intellectual approach. The problem is defined only in terms of "legal issues." This results in the approach to "solutions" primarily through manipulation of a set of traditionally recognized doctrines or categories. Weber referred to this phenomenon of the legal system as "autonomy"—the tendency to seek principles of normative ordering exclusively from within the existing framework of doctrines. Aspects of a problem not related to an existing doctrine are all too often just left out of the analysis.

The strength of this tendency of legal thinking is demonstrated quite clearly in the materials reviewed. The articles generally begin with perfunctory observations to the effect that everyone is concerned about the weather (but little discussion of why or in what ways, which might after all be relevant to rule making about weather). The analyses are thereafter confined to a search through existing law and institutions for appropriate "analogies"—existing legal principles or structures that could be stretched or warped to fit totally new but narrowly defined problems.

Legal scholars interested in weather modification embarked on heroic excursions through the common law searching for these "analogies." It was simply assumed from the start that "property" was a relevant category. In fact, most of the legal writers defined their whole view of the problem only in terms of property and balancing property rights with the need to advance science and technology.⁸⁷ Thus property rights of some kind had to be found, and "Who Owns the Clouds?"⁸⁸ became the question of the day. Dusty old common law doctrines like *ad coelum* were brushed off to suggest

“Who owns the clouds?” becomes the question of the day.”

that landowners obviously own the clouds over their property, while *ferae naturae* was named as suggesting that whoever “captured” the clouds clearly should “own” them and their moisture. Another theory appealed to was a sort of “natural rights” doctrine, i.e. one who owns property has a right to the enjoyment of the natural precipitation that might fall on it.

This latter theory, of course, was the one upholding the temporary injunction in the *South West Weather Research, Inc.* case,⁸⁹ the one case in which “rain making” was enjoined. As noted above, there were numerous published comments on the case.⁹⁰ They are illuminating examples of “autonomy.” We have noted the disquieting obliviousness of the authors to both the scientific absurdity of the case and the fact that realistically the outcome probably didn’t make any difference whatsoever. The writers of these articles did energetically quibble with doctrinal aspects of the decision however. Did the court in effect adopt a trespass theory or was it nuisance? Was the scope of the injunction consistent with the theory adopted? Which theory was more appropriate? What other property or liability doctrines are applicable? That weather modification might involve important human values unrelated to land ownership and that these might be or should be of interest to the legal system did not seem to be apparent.

The search for analogies continued. In addition to theories drawn strictly from land ownership various writers have looked for analogies in water law (riparian rights, prior appropriation, surface, and percolating ground water), oil and gas law, and the usual gamut of tort liability theories from negligence through ultra-hazardous activity⁹¹ (although the latter is uniformly rejected as a roadblock to progress). The conclusions have varied, but the method has been the same.

Nor have the more recent and superficially more enlightened commentaries departed from this mold. For example, two recent writers discuss the earlier material on private law doctrines and conclude that they are inadequate. The authors cite “the difficulties inherent in resolving problems by borrowing established doctrine from supposedly ‘analogous’ situations. . .”⁹² Yet they still see “the critical area of liability for damages” as the only problem worthy of their consideration and after finding present state and federal legislation insufficient propose a “different legal approach.” This creative new approach turns out to be another analogy. The Atomic Energy Commission Act is cited practically in full with the insertion of the words weather modification in place of “atomic energy.”⁹² In place of the search for an infinitely elastic common law analogy we are given a search for an infinitely elastic institutional structure analogy.

We suggested above that this traditional intellectual technique of the legal profession was a bias that contributed to the one-sidedness of the rules and policy we discovered. At first glance it may seem anomalous that adherence to a traditional intellectual approach to problems through application of equally traditional categories and doctrines should result in a strong bias in favor of technological change. Yet the anomaly is only superficial. The extremely narrow definition of problems which results from the legal approach is conducive to change because it reduces the friction that might result from intellectual approaches embracing a wider range of potentially affected values. In economic terms, the traditional method of legal analysis assures that the externalities for which a new technological enterprise will be accountable are kept to a minimum. An historical example of this same phenomenon has already been suggested. In 1868 the landmark case of *Rylands v Fletcher*⁹⁴ was decided in England. The decision held liable for damages without proof of negligence the builder of a pond whose water mysteriously flooded a neighboring colliery. The new doctrine stated in that case was emphatically rejected by almost all American jurisdictions in the years following. Both judges and commentators participated in this rejection in favor of the then traditional negligence doctrines. Even in the cases seemingly most analogous to the factual setting of *Rylands v Fletcher*, e.g. bursting mill pond dams, liability was found only on proof of negligence. Prosser suggests a reason for such rejection which is particularly relevant to the present point:

“Dangerous enterprises, involving a high degree of risk to others, were clearly indispensable to the industrial and commercial development of a new country and it was considered that the interests of those in the vicinity of such enterprises must give way to them, and that too great a burden must not be placed on them.”⁹⁵

In other words, adherence to traditional doctrines helped further technological change by narrowly construing responsibility for externalities.

The significance of narrow definition of legal problems in the process of technological development can also be seen by contrasting the limited property-liability focus of legal work on weather modification with other possible intellectual approaches to the problem. For example, a systematic ecological approach to weather modification describes a vastly more complex and subtle range of problems, and in the process draws our attention to a much wider range of values.⁹⁶ The ecological approach demands consideration of the fact that all parts of a living eco-system are inter-related and inter-dependent in ways we may not yet understand. It urges us to recognize that any intervention in a natural system such as the weather is bound to have perhaps

unknowable effects displaced in time and space from our present interventionist activities. The atmosphere is seen as not just a source of water supply. It is one of the crucial determinants of every living eco-system and vital to both local and regional environmental balances. For a similar intellectual approach to technological change see Wesley Marx's discussion of the emerging technologies of ocean exploration and exploitation in *The Frail Oceans*. His starting point for suggesting guidelines for human intervention in the oceans is the concept that the oceans are an "environment" rather than merely a "resource."⁹⁷ By conceptualizing the sea as an environment attention is drawn to the complex internal network of life, energy, stability and change, and a fuller appreciation of the effects of human activities—both good and bad—may be hoped for. The result is a rather more cautious set of prescriptions than those we have seen produced for weather modification. I would argue that it is imperative that rules for guidance of weather modification (and here I mean both intentional and unintentional) be developed from a similar conceptualization of the atmosphere as an environment rather than merely a resource. Unfortunately, even in fields outside the law, it seems that "resource" thinking predominates.⁹⁸

From an expanded perspective of the atmosphere artificial manipulation of the weather naturally involves much more than just a contest between different sets of landowners over precipitation "rights." Likewise, an approach that would seek out a wide range of human interests in weather through a careful inter-disciplinary social science study would raise manifold difficulties for quick development of technology. It is interesting to note one such study pertaining to weather modification was attempted by a special committee of the National Science Foundation shortly before the termination of the NSF research program.⁹⁹ The Task Group on Human Dimensions of the Atmosphere was composed of natural and social scientists who studied a wide range of human interactions with climate and weather. Their primary conclusion in almost every area of the study—health, economic production, psychology, political behavior, etc.—was, as we have previously noted, that virtually nothing is presently known about the influence of weather on human behavior and human values.

It is not at all far-fetched to suggest that a truly sound system of normative ordering concerning intervention in the weather must be based on such knowledge. But by proceeding with the drastically circumscribed methods of traditional legal thinking, the legal system has avoided the necessity of waiting for the complex investigations that would be required to gain understanding of such difficult questions; the legal system thereby helps speed a new technology into practice long before we know enough to understand its potential effects or to control it effectively.

Such a systematic failure seems almost built in to the legal profession by certain important aspects of legal

education. Reisman has noted the "unidimensional" nature of much of the legal academician's "intellectual craftsmanship."¹⁰⁰ He also suggests that this feature of professional legal scholarship seems to serve an important function within at least the academic corners of the profession—it allows easy ranking of members by their performance of a fairly standardized task. Those who go outside the standardized mode are quite often seen as heretics. Thus, the ability to extend one's intellectual powers creatively into fields of knowledge outside the law is not ranked highly in law school faculty recruitment.¹⁰¹ Legal education perpetuates the myopic approach to complex problems of change by failure to reach for new sources of ideas and principles:

"And yet in the main, the ties between the law schools and the other social sciences have remained fragmentary and at times even frivolous, mere snippets thrown into a collection of cases and materials to show that the professor is *au courant*."¹⁰²

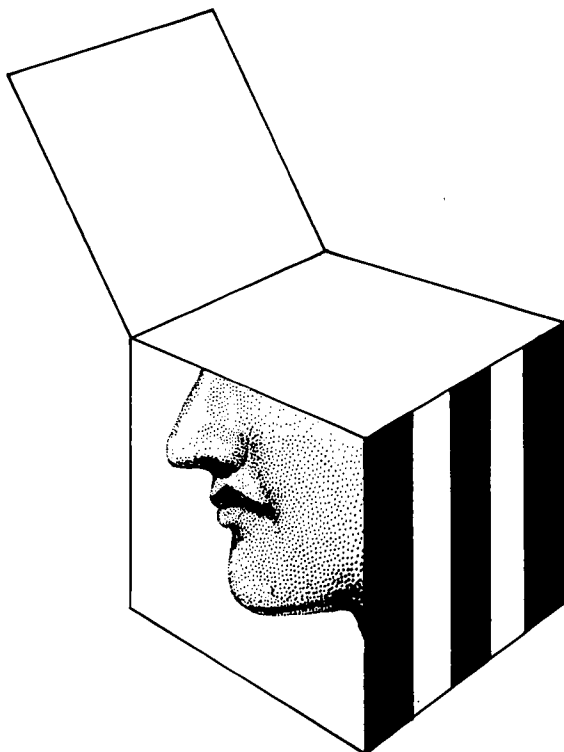
What Reisman says of social sciences can only be amplified when it comes to natural sciences.

There is a second important source of bias in the legal system that contributes to the results we have seen. This bias lies deep in the structure of the judicial process itself and in the related relationship of lawyers as a professional group to the same kind of organized interests which wield special power in the legislative halls. To discuss this point we must return to an analysis of the kinds of interests and values that may be involved in weather modification choices.

Interests or values that might be invoked in opposition to weather modification technology are largely unorganized and seemingly abstract or amorphous. Opposition to weather modification technology is associated with concern for ecological balances, a quasi-religious desire to preserve natural processes, fear of adopting new technologies with insufficient knowledge of possible adverse consequences,¹⁰³ reluctance to entrust decisions about weather to political or other authority, and, not infrequently, a vague sense of opposition to the increasing dominion of technology over life in general. Such interests are not likely to be backed by significant economic resources. More importantly, however, they are unlikely to be organized around any specific common purpose. Advancement of such values does not result in direct monetary or other tangible gain; in fact in some cases economic loss is perceived by many people as a result of successful implementation of such values.

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We have already seen the kind of interests that line up in favor of rapid development of technology in this field. Among these were the mission bureaucracies of the federal government, land owners in arid parts of the country to whom increased precipitation means increased value of land and related investments, hydro-electric utility companies, municipalities, and agricultural interests. To most of these interests ownership of property that may be directly affected by



weather modification leads to the perception of potential direct economic gains derivable through application of expanded technology. Costs to be borne by similar economic interests are sometimes thrown in the balance; costs to be borne by counter-technology interests are not.

In the case of identifiable pro-technology interests there is both existing political and economic power and the likelihood of increasing that power through the economic benefits potentially derivable from the technology. More importantly, it will immediately be seen that the central organizing feature of the pro-technology interests is property. By focusing its inquiries on property, therefore, the judicial system is assured of limiting its field of vision entirely to the range of values and interests most likely to favor technological development.

This observation raises the essential question. Is it merely accidental that the traditional legal constructs used by lawyers in defining and analyzing "legal" problems of weather modification revolve around property? The answer of course is no.

A simple view of why the focus on property is a result of systematic bias rather than accident could be a straight economic one. Certainly the legal profession is biased toward property interests of various kinds simply because they tend to be the interests which are sufficiently organized and have the money to pay for legal services in a fee system. One can add to this simple assertion refinements directed toward social class distinctions and professional role norms and, reaching a "neo-Marxist synthesis," hope to explain much of the observed bias of the system. Thus we would point to such cozy get-togethers of lawyers and special interest representatives as that displayed in a recent published symposium on weather modification.¹⁰⁴ Lawyers, commercial weather modifiers, insurance agents, and land owners were the main participants in the three day event, all apparently urging each other "to get down to business." But viewing the lawyer as a hired gun working for the highest bidder doesn't explain all. At the very least there is still the question of why the bias in favor of pro-technology interests should be so strong even among the scholars who supposedly are independent of market pressures. Perhaps there is a more subtle cause at work.

The search for this cause leads us to look chiefly at the interaction between the structure of the judicial process and legal thinking. In the first place we must recall the idea of "autonomy" of the legal system, suggested by Max Weber and well illustrated by the legal materials on weather modification. The legal system tends to define problems in terms of a traditional body of doctrine and categories. This body of doctrine and categories is transmitted primarily through legal training and the courts. It is commonplace to point out that the education of lawyers focuses primarily on the study of what courts do. It is therefore vital to recognize the kind of structural analysis of the work of courts as done by Gallanter.¹⁰⁵ As his typology of litigants suggests, those who use the courts frequently and repeatedly tend to be predominantly those who go to court to vindicate property rights of one kind or another. They tend to be organized, wealthy interests with existing resources to protect or enlarge through repeated use of the law. This fact leads to two related results. In the first place the most frequent and continuing lawyer-client relationships tend to be those where the client is such a property interested "repeat player." Secondly, the civil work of courts which so shapes the education and conceptual apparatus of lawyers is predominantly concerned with the problems of property interests. Thus in a sense the very intellectual tools of the legal profession become tied to the special interests of those who are frequent and repeated litigators. The traditional body of doctrine

“Legal education perpetuates the myopic approach to complex problems of change by failure to reach for new sources of ideas and principles.”

and ideas used by legal thinkers in defining problems and reasoning to solutions is that which has been developed largely in response to the problems of those who use law and courts to vindicate interests in property.

Further reflection suggests that in a larger sense the whole process of judicial decision making is shaped to respond to immediate, concrete, organized, interests of which “property” happens to be merely the usual common denominator. The fundamental parameters of judicial process point in this direction. The adversary system, for example, requires focus of evidence and argument toward opposing concrete positions. More importantly the nature of the decisions called for by the process is illustrative of this point. While practical outcomes and awards often smack of compromise, in theory issues are decided all or nothing; whatever one side wins the other side loses. The all or nothing decision determines concrete “rights” rather than harmonizing abstract “values.” This is another way of stating the observation that it is the business of the judicial process to decide “cases” rather than to solve problems.

Perhaps the purest distillation of this structural point may be seen in the confused federal law of standing. More than merely a threshold procedural question, standing goes to the very heart of the definition of judicial decision—making by focusing attention on the nature of the claims that a court is willing to entertain.

The writing on this subject is too voluminous and well known to cite, but we can note that in recent years the leading edge of developing principles of standing has been in suits brought “in the public interest” to test various governmental decisions.¹⁰⁶ In spite of loosening of the older technicalities, the central feature of the requirement of standing is still the complaining party’s

allegation of injury in fact—not interest in a problem, not a concern for a particular social value, not a desire to protect a general public interest. Injury, in both phenomenological and legal senses, necessarily implies an organized or concrete subject of the harm. Thus even when the Supreme Court says that the alleged injury may be to aesthetic values,¹⁰⁷ it appears to mean that standing will be granted only to a party who claims not merely to represent aesthetic values, but to have such a direct articulated claim to the values such that the *party*, not merely the value itself, is injured or diminished by the action complained of. This appears to be the fundamental rationale of the most recent case in the field.¹⁰⁸

The significance of this seemingly abstract point is that even in its liberalized form, the doctrine of standing remains an important part of the very definition of judicial process in our system. The judicial process of decision and rule making extends only to situations where a person or group can and will go forward to articulate a sufficient nexus with an interest or value to be able to establish at status as personally injured rather than merely a status as representative. Delimited in this way the judicial process is surrounded by systematic barriers to effective consideration of values or interests which are vague, amorphous, unorganized, speculative, spiritual, aesthetic, in short, barriers to consideration of the kinds of values that might oppose technological development in weather control and other fields. That such a fundamental definition of the judicial process is in fact widely held may be inferred from the jocularly contemptuous reception given to Mr. Justice Douglas’ suggestion in a recent dissent that environmental objects

be given a kind of *in rem* standing in court to be represented by any interested party demonstrating competence to undertake the task.¹⁰⁹

It may well be that judicial process should be constrained by such parameters in spite of the various biases created. There is no reason to assume that every decision making system must extend its methods to encompass all aspects of every kind or problem. Different systems of decision making may be appropriate for different kinds of problems. However the biases must be recognized if for no other reason than to be sure that biases of one system are corrected somewhere else. For the present inquiry the importance of the inherent bias of the judicial process of decision may be summarized as follows: The basic design of judicial decision making is such that barriers are created to consideration of unorganized nonconcrete interests and values. In everyday working terms this means that the great bulk of the work of courts involves only organized special interests of which property is the most frequent common denominator. It is the work of the courts that creates and transmits the body of doctrine and categories that lawyers receive as their training and use as their intellectual tools. When such basic intellectual methods of the profession are joined with the “neo-Marxist synthesis” of economic and social influence, it is easy to see how the methodological bias of the legal system is transformed smoothly into substantive bias. The result is a profoundly one-sided set of rules and prescriptions for handling a new technology, largely by intellectual default.

III Conclusions

It has been argued throughout this paper that our legal institutions tend systematically to ignore public interests in contributing to the hasty adoption of new technologies. There are, of course, examples of new technologies to which the model presented here may seem not to apply. An illustrative case is the sad history of cable television, a new technology which has been almost completely kept out of use in some states (Connecticut being a timely prime example) by effective legal opposition. However, it must be noticed that the opposition to cable television has come almost entirely from highly organized and vocal interests who will suffer competitively if it is adopted—namely local television broadcasting stations. Thus even though the outcome has been different—i.e. technological innovation largely stifled instead of hastened—the fact that the legal response to new technologies is predominantly controlled by private special interests seems to remain; the central fact is the lack of influence of unorganized but nonetheless important public interests. In each legal arena systematic structural biases favor special interest actors.

Greater judicial activism to protect public interests is much advocated today. In light of this trend it is perhaps the failure of the judicial process that stands out as the most significant observation of this appraisal of our legal

apparatus. In the first place we noted a strong suggestion of plain institutional incapacity to produce rational results in regulation of complex new technologies. Both the complexity of the information involved in a weather modification controversy and the episodic nature of any court’s involvement with such issues militate against development of ability to handle factual questions realistically. The same problems prevent courts from providing meaningful administrative guidance. The result of complacent ignorance of these institutional incapacities is basically thoughtless adjudication such as that shown by the truncated injunction based on “eye-witness” testimony in the *South West Weather Research* case,¹¹⁰ and equally thoughtless commentary, such as the recommendation that courts adopt a complete non-liability to handle the difficult scientific information involved.¹¹¹

Secondly, we noted the failure of the judicial process to discover adequate new ideas or intellectual perspectives for decisions about new technologies. The search for analogies from existing doctrines constrains judicial and scholarly thinking and forces the creation of law within an artificially narrow structure of ideas. Many relevant values and interests remain unconsidered.

Finally we saw that even that narrow range of doctrines and ideas which do enter into the judicial rule making process are largely the creation of a process in which the very interests most likely to be narrowly pro-technology have fundamental advantages because of the nature of judicial process and its relation to the intellectual work of the legal profession.

Observations not unlike these have been made before in other fields. Mr. Justice Brandeis wrote:

The unwritten law possesses capacity for growth; and has often satisfied new demands for justice by invoking analogies or by expanding a rule or principle . . . But with the increasing complexity of society, the public interests tends to become omnipresent; and the problems presented by new demands for justice cease to be simple. Then the creation or recognition by courts of a new private right may work serious injury to the general public, unless the boundaries of the right are definitely established and wisely guarded. In order to reconcile the new private right with the public interest, it may be necessary to prescribe limitations and rules for its enjoyment and also to provide administrative machinery for enforcing the rules. It is largely for this reason that, in the effort to meet the many new demands for justice incident to a rapidly changing civilization, resort to legislation has latterly been had with increasing frequency.¹¹²

With this final suggestion to remand the matter to the legislatures the pessimistic outlook comes full circle. For in the legislatures the naked political force of special interest has carried the day. It is *possible* for Congress to give careful scrutiny to scientific and humanistic questions raised by weather modification, but it has not done so. It is *possible* for Congress to create a rational administrative scheme to consider and protect diverse public interests, but it has not done so.

Thus, with respect to the three questions we offered at the beginning of this paper, the appraisal of the relation

of law and technological change is not a happy one. Rational use of scientific evidence to inform the law has not occurred. Broad representation of a wide range of public interests is systematically stifled. Special interest politics plays a determinative role in policy development. And, most importantly, in these respects the various branches of the legal system do not correct each other, one cancelling the bias of the others. Rather the effects of structural bias of the legal system are cumulative. Are we compelled to accept a totally pessimistic outlook? Do these conclusions mean that with respect to the problems of new technologies the environmental law movement is a futile gesture? I think not. The analysis presented here, rather than sounding doom, merely indicates ultimate strategies. This is because the paradigm described at length in this paper as the normal relation of the legal system to technological change does occasionally break down. Periodically public concern and mobilization of diffuse interests reach a critical level and a change is thrust into the picture through the legislatures. I would suggest that the episodic nature of change in the basic model I have described in this paper may be understood as the rough political analogue of the process of change in 'normal' science by scientific "revolutions" as described by Kuhn.¹¹³ The National Environmental Policy Act of 1969¹¹⁴ and the spate of other environmental legislation of the last few years appear to be a partial "breakdown" in the paradigm as I have described it. This breakdown has resulted from widespread public alarm about and organization around general common interests of the kind which normally are not well represented in the legal system.

I submit, therefore, that the realistic strategy of the environmental law movement for dealing with new technologies is not to rely ultimately on existing legal institutions to regulate technology in the public interest. Rather, the indicated strategy is essentially political—to use the legal system to generate the alarm and public organization that will lead to further "breakdown" of the normal paradigm.

Two examples from the work of well known environmental law groups suggest that such a basic strategy has in fact been chosen.

Environmental Defense Fund, Inc. (EDF) is now a nationally known organization which organizes scientists and lawyers for a cooperative attack on many types of environmental problems. It is significant, I think, that EDF was founded in an attempt to use the legal system to expose disastrous "side effects" of a pesticide technology adopted years earlier without sufficient safeguards. The strategy was to use the courts as a forum from which to reach the public with alarming scientific information to stimulate concern and organization.¹¹⁵ It is clear that efforts such as these were instrumental in bringing about increased public awareness of problems of new technologies that led to such legislation as the National Environmental Policy Act.

Natural Resources Defense Council, Inc. (NRDC), is a newer environmental law group which has been very active in asserting public interests in various new energy technologies such as offshore drilling and nuclear reactors. In this activity NRDC has relied heavily on NEPA.

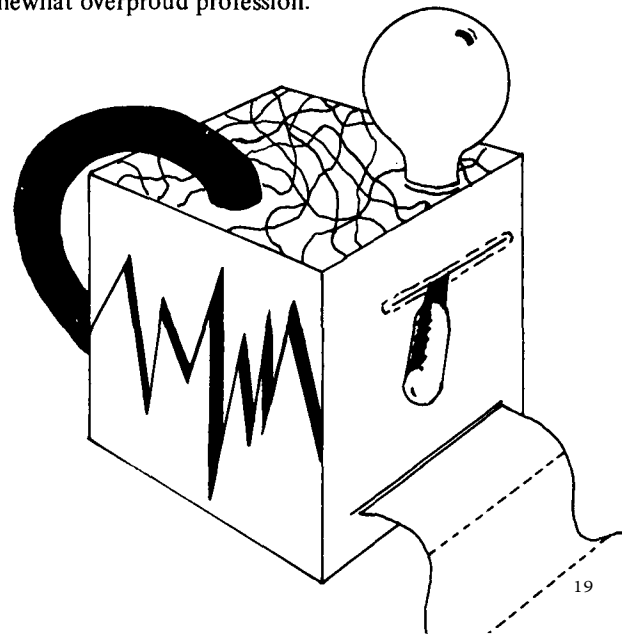
NRDC states that its primary objective is "to provide a central, national focus for lawyers, scientists and concerned citizens in the effort to make our courts and administrative agencies effective instruments of environmental protection."¹¹⁶ A more realistic statement of objectives with respect to a new technology is implicitly given in a description of the purposes of one of the group's legal proceedings.¹¹⁷

The United States still does not have a coherent and reasoned energy policy . . .

NRDC has pressed the government to develop a rational and coherent energy policy. As part of the effort to force the government to consider fully the consequences of energy development, NRDC filed suit in December 1971, seeking to enjoin the lease of more than 300,000 acres in the Gulf of Mexico for off-shore oil and gas drilling. . . . (The leases by the Department were cancelled and the judgment affirmed.) . . . This is an important initial victory. What is most important is to assure that Interior now takes its NEPA mandate seriously and that any future lease proposal contains an adequate discussion of the reasonable alternatives to the proposed action which will aid in developing a more rational national energy policy. Out of the process we should in time move toward a more coherent energy policy for the nation.¹¹⁸

Thus the true objective is not to rely on the courts for protective regulation of new technologies, but to use the courts as pressure points and educational forums forcing negotiation and reassessment by the proponents of technology and encouraging education and organization of the public. 'Out of the process we should in time move toward' a more balanced technology policy for the nation.

In the meantime, examples of the utter failure of the legal system to produce balanced policy, such as the case of weather modification, must, I think, perplex and humble a somewhat overproud profession.



1. Hovering over the inquiry are the ideas of Jacques Ellul, as most forcefully set forth in *The Technological Society*. Ellul is known as the primary proponent of the idea of "technological determinism." Briefly stated the notion of technological determinism suggests that technology has achieved such a dominant position in modern society that it has taken control of human effort and imagination directing them exclusively toward the further expansion of the control of technique over every aspect of human existence. The general conclusion of this paper is consistent with Ellul's observation that:

Modern men are so enthusiastic about technique, so assured of its superiority, so immersed in the technical milieu, that without exception they are oriented toward technical progress. They all work at it. . . . *The Technological Society*, (1964), p. 85.

The underlying question is whether the biased contribution of the legal system to technological innovation is a matter of inevitability as the idea of technological determinism suggests, or rather a result of systematic but rationally identifiable (and controllable) features of the legal system itself. No explicit answer to this question will be given.

2. Gates "Weather Modification in the Service of Mankind: Promise or Peril?" in Helfrich ed. *The Environmental Crisis* (1970), p. 35.

3. *Ibid*, p. 39.

4. *Ibid*, p. 37.

5. So far as is known, the first court decision on the subject of weather modification in this country involved the religious method. In the late 1800's a severe drought in upstate New York encouraged the local minister, one Duncan McLeod, to call together his congregation for a special prayer meeting to ask for rain. Several hours after a meeting of energetic supplication a near cyclone ripped the township with winds and drenched it with rain. A bridge was washed out and Phinneas Dodd's barn was destroyed by fire after being struck by lightning. Mr. Dodd, by the way, had refused to attend the prayer meeting. Dodd sued the minister for \$5,000, but the defense persuaded the court that the defendants' prayers had been for rain only and therefore the lightning and fire had been purely acts of God. Reported in Johnson, "The General Legal Setting," in Taubenfeld, ed. *Weather Modification and the Law*, (1968), hereinafter cited as Taubenfeld (1968), p. 77.

6. For a brief review of such attempts see Fleagle, "Background and Present Status of Weather Modification," in Fleagle, ed. *Weather Modification: Science and Public Policy*, (1969), hereinafter cited as Fleagle, pp. 3-9.

7. See Hobbs, *The Physics of Natural Precipitation Processes, and Techniques of Cloud Modification*, in Fleagle, pp. 18-42.

8. L. J. Batten, "The Scientific Aspects of Weather Modification," in Taubenfeld, ed. *Controlling the Weather*, (1970), hereinafter cited as Taubenfeld (1970), pp. 37-41.

9. *Id.* pp. 33-34.

10. Fleagle, p. 11.

11. Batten, *supra*, note 5, in Taubenfeld (1970), p. 35-36.

12. U.S. Advisory Committee on Weather Control, *Final Report*, Two Volumes, Washington, D.C., (1957) Vol. I. p. vi.

13. National Science Foundation (hereinafter NSF), *Weather Modification Research, Seventh Annual Report*, (1965), p. 57, and see generally, Bureau of Reclamation, *Project Skywater-Annual Reports*, Washington, D.C.

14. National Academy of Sciences, *Weather and Climate Modification: Problems and Prospects*, Washington, D. C., (1966), Part I, p. 13.

15. In discussions of new technologies or the externalities of almost any enterprise the term "side-effects" is frequently encountered. Actually it is a value-laden misnomer. All consequences that flow from a certain act in an identifiable casual sequence are equally central to an evaluation of the act except when a particular value judgment focuses attention selectively. Thus, only when the value of economic return is the primary concern can the other consequences to be discussed be called 'side effects.'

16. National Science Foundation (hereinafter NSF), *Human Dimensions of the Atmosphere* (1968), p. 9.

17. *Ibid*, p. 7.

17a. See e.g. Carson, *The Silent Spring* and other well known works on the subject.

18. NSF, *Weather and Climate Modification*, Report of the Special Commission on Weather Modification, NSF Report No. 66-3, (1966), p. 18.

19. Cooper and Jolly, *Ecological Effects of Weather Modification: A Problem Analysis*, Univ. of Michigan, School of Natural Resources, p. 8 (1969).

20. All the examples are taken from Cooper and Jolly, *supra*, note 11f. *passim*.

21. As quoted in Cooper and Jolly, p. 121, 122.

22. Appropriations for the Bureau of Reclamation program grew from \$100,000 in 1962 to \$6,692,000 in 1971.

23. R. Johnson, "Federal Organization for Control of Weather Modification," 10 Nat. Res. J. 222, (1970), p. 247.

24. *Op. Cit.*

25. As quoted in Berkman and Viscusi, *Damming the West, the Nader Task Force Report on the Bureau of Reclamation*, Preliminary Draft, Center for the Study of Responsive Law, (1971), hereinafter cited as *Damming the West*, p. 74.

26. NSF, "Weather Modification Research, Seventh Annual Report," (1965), p. 57.

27. National Academy of Sciences: National Research Council, *Scientific Problems of Weather Modification*, (1964), as quoted in Darling and Milton, *Future Environments of North America*, (1966), p. 88.

28. NSF, "Weather Modification Research, Sixth Annual Report," p. 6. (1964).

29. "The fact is that the state of knowledge in precipitation modification is such that any announced specific goals are almost irrelevant. The output of current precipitation modification research is knowledge, not water."

Myron Tribus, Chairman of the Federal Council for Science and Technology, as quoted in *Damming the West*, p. 73-74.

30. Memorandum of Oct. 10, 1963, 3 C.F.R. 861, 864, (59-63 Comp.).

31. This is of course a familiar enough political theme. For a discussion of similar phenomena in a different context see Almond, *The American People and Foreign Policy*, (1960), ch. VII.
32. The discussion which follows is based largely on my own research as a contributing writer for *Damming the West*.
33. *Damming the West*, p. 69.
34. *Id.* p. 74.
35. *Id.* p. 82.
36. Personal Communication, former Secretary of Interior Stewart L. Udall, June, 1970, and *Damming the West*, *passim*.
37. Hearings before the Subcommittee on Irrigation and Reclamation of the Senate Committee on Interior and Insular Affairs, "A Program for Increasing Precipitation on the Colorado River Basin," 88th Cong. 2d Sess. p. 22 (1964).
38. *Damming the West*, pp. 191-194.
39. *Id.* p. 81.
40. Corbridge and Moses, "Weather Modification: Law and Administration," 8 Nat. Res. J. 207, (1968), p. 221-225.
41. *Id.* p. 224.
42. Luna B. Leopold, Research Hydrologist, U.S.G.S., quoted in *Damming the West*, p. 74.
43. *Damming the West*, p. 75.
44. Op. Cit.
45. Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming.
46. *Arizona v. California*, 373 U.S. 546, 83 Sup. Ct. 1463).
47. The waters of the Colorado River are subject to further allocation requirements under a treaty with Mexico, the U.S.-Mexican "Water Treaty," 59 Stat. 1219; TS 994; 3 UNTS 313, (1944).
48. *Damming the West*, p. 142-144.
49. *Id.* p. 131.
50. Remarks of Senator Alan Bible, (D-Nev.), Senate Hearings "A Program for INcreasing Precipitation. . . ." Op. Cit. *supra*, note 28, p. 20.
51. See collection of state statutes in David, "Strategies for State Regulation of Weather Modification," in Taubenfeld (1970), pp. 216-218.
52. Md. Ann. Code, art. 66C, § 110A (Supp. 1969), expired by its own terms, Sept. 1, 1971, no new enactment to date.
53. Davis, *supra*, note 42, p. 203.
54. Pa. Stat. Ann. tit. 3 § 14 (Supp. 1969); W. Va. Code, § 29-2B-13 (Supp. 1969).
55. Hawaii Rev. Stat. § 174-5(8) (1968).
56. See Cal. Water Code § §400-415 (West 1956), as amended, (Supp. 1969), and discussion in Sato, "The Role of Local Governmental Units in Weather Modification," in Taubenfeld, (1970), pp. 242-243.
57. Wyo. Stat. Ann. §9-267(b) (1957).
58. Okla. Stat. Ann. tit. 82, §1078, n. § §2(I), 2(V) (Supp. 1969).
- 58a. Rev. Stat. Neb. §2-2401 (1) (Reissue of 1970).
59. Quoted in Ball, "Shaping the Law of Weather Control," 58 Yale Law Journal 213, (1949), p. 241.
60. Tex. Rev. Civ. Stat. art. 8280-12 §18 (Supp. 1970)
61. Corbridge and Moses, *supra*, note 31, p. 219.
62. See Morris, "Preparation and Trial of Weather Modification Litigation," in Taubenfeld, ed., *Weather Modification and the Law*, (1968), hereinafter cited as Taubenfeld (1968), p. 163 et. seq.
63. Corbridge and Moses, *supra*, note 31, p. 217.
64. Cal. Gov't. Code §53063, enacted 1955.
65. N. D. Code Ann. §2-07-06 et. seq. (Supp. 1969).
66. Neb. Rev. Stat. § §2-2428 to 2-2449, (1943).
67. Ball, *supra*, note 50, p. 227.
68. Ellul, *supra*, note 1, p. 80-81
69. Silverton, "Weather Modification and State Policy," in *Current Trends in State Legislation, 1953-54*, Legislature Research Center, Univ. of Mich. (1954), p. 8, 35, 36.
70. Davis, "Special Problems of Liability and Water Resources Law," in Taubenfeld (1968), p. 104.
71. Davis, "State Regulation of Weather Modification," 12 Ariz. L. Rev. 35, (1971), p. 69.
72. Graver and Erickson, "The Weathermaker and the Law," 1 S. D. L. Rev. 105, (1956).
73. *Id.* p. 117.
74. Op. Cit.
75. *Id.* p. 118.
76. Oppenheimer, "Legal Aspects of Weather Modification," 1958 Ins. L. J. 314, (1958), using analysis with an uncanny similarity to that of Graver and Erickson, *supra*, note 63.
77. Ball, *supra*, note 50, p. 237.
78. 197 Misc. 730, 97 N. Y. S. 2d 238, (Sup. Ct. N.Y. 1950).
79. *Adams v California*, No. 10112, (Super. Ct. Sutter Cty, Cal., April 6, 1954).
80. Morris, *Supra*, note 53.
81. *Pennsylvania Natural Weather Assoc. v Blue Ridge Weather Modification Assoc.*, 44 Pa. D. & C. 2d 749, (C. P. Fulton cty. 1968). The court said, "Every landowner has a property right in the clouds and the water in them." (at 759-760).
82. 327 S.W. 2d 417, (Sup. Ct. Tex. 1959).

83. See for example, 4 Vill. L. R. 603, (1969); 37 Tex. L. Rev. 799, (1959); and 14 S. W. L. J. 425, (1960). Each of these articles favors application of a *Slutsky*-type reasonableness test to avoid impeding the advancement of science.
84. One excellent recent article is Frenzen, "Weather Modification: Law and Policy," 12 B. C. Ind. & Comm. L. Rev. 503, (1971).
85. Dolbeare, *Trial Courts in Urban Politics*, (1967), p. 63.
86. "Sue the Bastards!" is the motto of Victor Yannecone, an organizer of the Environmental Defense Fund, which has continued this strategy. Pers. Comm. Mr. Yannecone, Oct. 1969.
87. See above, notes 63-67 and accompanying text.
88. "Who Owns the Clouds," 1 Stan. L. J. 43, (1948).
89. *Supra*, note 73.
90. See note 74 and 1960 Duke L.J. 303, (1960); 12 Baylor L. R. 113, (1960); and 4 S. Tex. L. J. 400, (1959).
91. See for example Graver and Erickson, *supra*, note 63; Oppenheimer, *supra*, note 67; and Stark, "Weather Modification: Water at Three Cents per Acre-foot," 45 Calif. L. R. 698 (1957).
92. Corbridge and Moses, *supra*, note 31, p. 217.
93. *Id.* pp. 227-231.
94. L. R. 3 H. L. 330, (1868).
95. Prosser, *Handbook on the Law of Torts*, (3d Ed. 1964). p 523.
96. Cooper and Jolly, "Ecological Effects of Weather Modification: A Problem Analysis," Bureau of Reclamation, May, 1969.
97. W. Marx, *The Frail Ocean*, (1967).
98. "Viewed most broadly, the planning and decisionmaking questions involving use of the atmosphere as a resource should be of the same type as questions arising from the use of any other resource—water, land or minerals." Hufschmidt, *Needs for Research on Planning and Decisionmaking Aspects of Human uses of the Atmosphere*, in NSF, "Human Dimensions of the Atmosphere," Wash. D. C. (1968).
99. NSF, *Human Dimensions of the Atmosphere*, Washington, D.C. (1968).
100. Riesman, "Law and Sociology, Recruitment Training and Collegueship," in Evan, W.M. ed. *Law and Sociology, Exploratory Essays*, 1962, p. 20.
101. Riesman, "Some Observations on Legal Education," 1968 Wisc. L. Rev. 63, at 71.
102. *Id.* P. 74.
103. As the examples of persistent pesticides, leaded gasoline, and mercury pollution amply demonstrate, this is no frivolous concern.
104. Taubenfeld (1968).
105. Galanter, "Why the 'Haves' Come Out Ahead," unpublished essay, Yale Univ. Nov., 1971.
106. Most notably *Flast v. Cohen* 392 U.S. 83 (1968); *Scenic Hudson Preservation Conf. v. FPC*, 354, F. 2d 608, (2d Cir. 1965); *Parker v. U.S.* 307 F.Supp. 685, (D.C. Col. 1969); *Assoc. of Data Processing Services Organizations, Inc. v. Camp*, 397 U.S. 111, (1970); *Barlow v. Collins*, 397 U.S. 159, (1970); and *Sierra Club v. Morton*, 433 F. 2d 24, (9th Cir. 1970); *aff'd Sierra Club v. Morton*, 404 U.S. 814 (1972).
107. Mr. Justice Douglas' dicta in *Camp* and *Barlow*, *supra*, note 96.
108. *Sierra Club v. Morton*, *supra*, not 96, affirming dismissal of Sierra Club's suit to enjoin granting of U. S. Forest Service special use permits for building a large resort development in the Mineral Kind Valley of the Sierra Nevada Mountains. The dismissal was based on the Club's failure to demonstrate that its members would be injured by the project.
109. *Sierra Club v. Morton*, dissenting opinion, 92 Sup. Ct., at 1369-76.
110. See text, *supra* at notes 73, 74.
111. See text, *supra* at notes 63-67.
112. *International News Service v. Assoc. Press*, 248 U.S. 215, (1918), 262-263, dissenting opinion.
113. T. Kuhn, *The Structure of Scientific Revolutions*, (1962).
114. 42 U.S.C.A. §4321 et. seq. (1971 Pocket Part).
115. See "DDT Goes to Trial in Madison," *Bioscience*, Vo. 19, No. 9 (Sept. 1969) p. 809 and comments of EDF organizer Victor Yonnecone to this writer, *supra*, note.
116. NRDC Newsletter, Vol. 1, No. 1, (Spring, 1971) p. 2.
117. NRDC was joined by the Sierra Club and Friends of the Earth, Inc. in *NRDC v. Morton* F.Supp., 3 ERC 1473, (D.D.C. 1971); *aff'd* F 2d 3 ERC 1558 (D.C. Cir. 1972).
118. NRDC Newsletter, Vol. 1, No. 3, (Fall, 1971), p. 1.