the Yuba City flood: a case study of weather modification litigation*

Dean E. Mann
Political Science Dept.
University of California
Santa Barbara

Abstract

In December 1955 a severe tropical storm caused severe flooding throughout Northern California with damage exceeding \$200,000,000. One area suffering large-scale flooding was at Yuba City, at the confluence of the Feather and Yuba Rivers. The levees broke and consequent damage was in the magnitude of \$65 million. Property-owners sought recompense through suits brought in the Superior Court of Sutter County against the State of California, Pacific Gas and Electric Company (PG&E), and North American Weather Consultants (NAWC).

PG&E, through its contracting agent, NAWC, had undertaken cloud seeding operations in three places in the high Sierras, one of which was in the Lake Almanor watershed in the Feather River system. NAWC had interrupted seeding activities in that area three days before the levees broke at Yuba City. Plaintiffs charged that PG&E and NAWC were negligent in the operation of their generators, had contributed to the total quantity of water produced by the watershed and therefore were legally liable, and that cloud seeding was ultra-hazardous activity so that those engaged in such activities were strictly liable for damages.

The suit was begun in 1958 and concluded in 1964. Trial before a judge only began in October 1963 and a decision was rendered in April 1964. The judge ruled that neither PG&E nor NAWC was liable. In accordance with an agreement among the parties no appeal was taken. Plaintiffs were successful, however, against the State, basing their claim for damages on the doctrine of inverse condemnation which holds that the State must recompense for damages incurred in the lawful exercise of its powers—in this case, the construction of levees.

The litigation raises important questions of public policy with regard to weather modification and these are considered in the light of this case.

Introduction

The branch of science having to do with weather modification is in its infancy relative to the centuries of scientific endeavor which has led up to it. Similarly, the law dealing with weather modification is in its infancy relative to the great body of law which governs human behavior. Both are in a rapid state of evolution, with the law endeavoring to provide substantial protection to the interests of all parties who are affected by the new weather technology.

Lacking prevision of what human consequences are likely to follow scientific discovery in atmospheric research, it is not surprising that practitioners of the law in the broadest sense—lawyers, judges, administrators, and legislators attempt to adopt old legal principles to new scientific phenomena. Since weather modification almost inevitably involves management of moisture, it is therefore understandable that some effort would be made to apply the laws of surface waters or subsurface water to the water carried in

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the atmosphere. Legal theories have been advanced, for example, to the effect that property owners have the right to "mine" the air above their property for its water, or that they have the right to "appropriate" waters as they flow over their land.

While such theories seem pathetically inadequate to deal with as meandering and unmeasurable a quantity as moisture in the atmosphere, they bespeak the novelty of the phenomena that both physical and social scientists are dealing with. He who lampoons such efforts need only turn his hand to devising a new procedure, a new principle, a new standard to realize the complexity of the subject.

The courts have ever been in the forefront of the development of new law. The conflicts of interest, rights, and of property are usually first tested in the courts as new technology is introduced. The contest of those who are vitally affected by the new technology and the decisions that are rendered by the courts are the lesson books out of which legislators and administrators ultimately learn what the social issues at stake are and which interests require protection or promotion.

To this date (1967) there has been relatively little litigation over the rights of cloud seeders to seed clouds as against the rights of those who have a stake in atmospheric phenomena, whether it be in the form of sunshine, rain, snow, hail, fog, hurricanes, or tornadoes. In the litigation that has taken place, no plaintiff has yet to win a case against a cloud seeder, although in one instance cloud seeders were enjoined against further operations.¹ In one case the court upheld cloud seeding on the grounds that the interests in additional rain of a water-short area were superior to the interests of vacation resort owners in clear skies.² In the three remaining cases, decisions favorable to the defendants were rendered on the grounds that no damage was attributable to cloud seeding nor to negligence in conducting cloud seeding operations.³ At this writing, two more cases are pending decisions.

The Yuba City flood

In the second half of December 1955 the northern and central portions of California were subjected to one of the most devastating storms in the state's recorded history. The storm covered an area of some 100,000 sq mi or over 60% of the gross area of the state. Nearly 1,000,000 acres of land were inundated, including many highly developed communities such as Stockton, Santa Cruz, Fresno and Santa Rosa. It was estimated that total direct losses resulting from the storm ran well over \$200,000,000, with untold indirect losses. Sixty-four lives were lost. Communication and transportation lines were severed over wide areas of the northern half of the state. Peak discharges of the rivers in Northern California were thought to have exceeded the levels of the legendary floods of 1861–1862.⁴

Nowhere were the results of this storm more tragic than in the area of Yuba City, lying at the confluence of the Feather and Yuba Rivers. Confident in the security presumably afforded by the levee system, the residents did not evacuate the city and therefore they received the full force of the storm water's fury. The 25-foot levees, constructed to provide protection against the periodic rampages of the two rivers, gave way, flood waters flowing out over 100,000 acres of land, causing damages that were estimated in the magnitude of \$65 million. Thirty-seven persons perished, 3,227 individuals were injured, 467 homes were totally destroyed and 5,745 homes damaged. 8,500 families suffered losses.⁵ Ironically, the city of Marysville, directly across the Feather River from Yuba City was evacuated but its levee system held firm.

Relief for those suffering from the flood in the Yuba City area was provided in large but inadequate amounts in view of the enormity of the disaster. The Red Cross alone spent in the neighborhood of \$4 million. The Salvation Army, the Mormon Church, Jewish organizations and federal agencies such as the U.S. Army Corps of Engineers, the U.S. Air Force through its local base, and federal lending agencies all gave assistance directly or in the form of loans.⁶

Not unnaturally the community undertook some soul-searching with regard to individual and collective responsibility for the calamity. On January 6, 1956, a grand jury was organized to inquire concerning responsibility for levee maintenance, flood warnings and remedial action once the flood had occurred. For nearly three months the Grand Jury deliberated, issuing its report on March 28, 1956. Its report distributed

¹ All footnotes appear on page 713.

the blame among three members of the Sutter County Board of Supervisors, five members of the Yuba City council, three commissioners of the Yuba City Levee District No. 1, and the State Division of Water Resources. The criticisms were founded on charges of failure to give adequate warnings of the danger; failure to take corrective action with regard to boils on the levees; failure of leadership; inability to interpret warnings; unfounded confidence in the levees and lack of coordination. The grand jury recommended the following steps be taken to avert similar disasters in the future: an improved warning system; a survey of the adequacy of the levee system; improved levees in the immediate disaster area; construction of Oroville Dam upstream on the Feather River; formation of a single state water agency; construction of dams on the Yuba and Bear Rivers; improvement in the civil defense organization and the communication system; plus additional technical improvements.⁷

Local and state officials protested these accusations, asserting that they were based on an assumed prescience which no one could be expected to have. State officials retorted that they were not in the business of flood warnings, but that they had nevertheless issued warnings which should have been heeded. Moreover, they argued that the breaking of the levees was not their responsibility but was attributable to levees constructed by the districts upstream.⁸ This latter contention was subjected to vigorous attack by the attorneys for the plaintiffs.

In the search for someone to blame, some of those damaged consulted their attorneys. For the most part the attorneys advised their clients that the chances of recovery were extremely small, since the defendants in such actions would almost certainly be public agencies. To sue the local levee districts would be self-defeating since they in effect would be suing themselves. In suing the state agencies they would be faced with the doctrine of sovereign immunity, to the effect that the state could not be sued unless it granted permission to do so, and that it was not liable for damages incurred in undertaking public responsibilities of a governmental nature.

A committee was appointed by the Yuba-Sutter Bar Association to investigate the legal grounds on which a suit might be lodged. The committee reported on March 5, 1956, and was pessimistic about the chances. It explored possible grounds such as negligence and inverse condemnation but concluded that there was insufficient backing for these legal theories. To quote the report, "It was the consensus of opinion with the local group that grounds sufficiently strong to assure success in any such litigation in the courts are not apparent."⁹ Attorneys were discouraged from filing suits based on flood damages.

Attorneys in one law firm were more optimistic, however. Clients who consulted with attorneys in the firm of Goldstein, Barceloux and Goldstein indicated an interest in exploring the legal possibilities and the attorneys accepted retainers on the payment of \$50 by each of the clients who wished to engage them. Within the 90 day period required under California law, attorneys in that firm filed claims with the State Board of Control. Upon rejection of those claims, they filed suit for damages of unspecified amounts before the Superior Courts of Sutter and Yuba Counties in 1958, against the State of California, Pacific Gas and Electric Company, and North American Weather Consultants. Subsequently suits were filed also against the federal government in the Federal District Court in San Francisco because of the alleged responsibility of the Army Corps of Engineers in the design and construction of the levee system. Ultimately, the suits in federal court were dismissed.

It is apparent that at the time the suit was filed virtually no one in the area of the flood damage was acquainted with the cloud seeding operations of Pacific Gas and Electric Company and North American Weather Consultants in the Lake Almanor area or saw implications of the cloud seeding for the suit. Those engaging in cloud seeding are required by state law to publish their intention to do so in the areas where they are going to operate. The obvious purpose of such publication is to advise the local residents of the fact, thus allowing them to protest. Questioning of a small sample of those who undertook the suit revealed that not one of the plaintiffs had been aware of cloud seeding. Not unnaturally, the clients left questions of whom should be sued and the issues on which to sue to their attorneys.

PG&E activity in weather modification

The interest of PG&E in meteorological phenomena was not new. It had established a meteorology department as early as 1937, the first utility to do so. Its principal interest at that time was in the prediction of weather for the purpose of estimating demand for natural gas. The meteorologists in PG&E followed the pioneering work of Vincent Schaefer and Bernard Vonnegut in the later 1940's but saw little practical application of their work and resisted urgings that they enter the field. Almost as a defensive measure according to one of their chief officials in that field, they embarked on experimental work in 1953.

PG&E first employed North American Weather Consultants (NAWC) to undertake cloud seeding activities in the Mokelumne-Stanislaus river basins in 1953. This original project quickly became three as work was undertaken in the area of Bass Lake and in the Lake Almanor area on the Feather River. By 1955 all of these projects were in operation. The goal in each case was to increase the snow pack in order to increase the water supply available for PG&E generators downstream.

The Lake Almanor project was particularly attractive to PG&E because it had large storage facilities, especially at Lake Almanor itself. As of 1955 these facilities had capacity in the neighborhood of 600,000 acre feet. While increased precipitation might be obtained on all three of the projects, it was not certain that the storage facilities in the Mokelumne-Stanislaus or Bass Lake areas were sufficient to capture the increased run-off for purposes of power production.

By 1955 NAWC and PG&E were reasonably well convinced that their efforts were meeting with some success. In an evaluation report written at the conclusion of the 1955-56 season on the High Sierras, PG&E concluded that precipitation in the Lake Almanor target watersheds had increased on an average of 2.86 inches or 28.6% above normal. Run-off had increased, the report asserted, by 97,000 acre-feet, which accounted for replacement of power generated by steam costing \$305,842. Since the cost of the project was \$58,300, the net benefit to PG&E was \$247,542. While admitting that the means of measuring increased precipitation and run-off were somewhat crude and not totally reliable, the report concluded that these estimates were conservative.¹⁰

Subsequently, reviewing its five year program from 1953 to 1958, PG&E came up with a similarly optimistic report. It stated that, ". . . the great mass of evidence indicates that cloud seeding has produced substantial and economically worthwhile increases in precipitation and run-off." Target areas in the Lake Almanor region produced an increase of 2.07 inches of seasonal precipitation; the target areas in the other regions produced somewhat less. The average yearly increase in run-off from the three areas was in the magnitude of 150,000 acre-feet, yielding a net value of \$400,000. Conservatively it was estimated that at Lake Almanor alone there was an increase of 64,000 acre-feet on the average yearly with an average benefit-cost of 8.3 to 1. Through computer analysis it was concluded that there was an apparent increase for all seeded periods in the three areas of from 7 to 22% of average natural flow, or 12.1% of long term average precipitation for the seeded six months each year.¹¹

In selecting North American Weather Consultants as their agent for the conduct of their cloud seeding experiments, PG&E was engaging a firm that was reputed to be one of the most responsible and competent firms in the business. PG&E officials were acquainted with the reputation and the work of Robert Elliott and Eugene Bollay and placed confidence in them. Both were members of the American Meteorological Society. NAWC had had extensive operating experience in the Western states, almost to the point of monopolizing the business among the public utilities. Its clients had included Southern California Edison Co., Los Angeles County Flood Control District, Santa Barbara County Water Agency, the City of San Diego, and the Antelope Valley Water Development Corporation.

Weather events leading to the Yuba City flood

Rainfall for the month of December 1955 broke many existing records for the northern half of California. The first half of the month was a period of moderate to heavy rains which were produced by storms moving out of the west and northwest. Many stations received more than half their normal December rainfall by the 14th of the month. While not in themselves destructive, these antecedent rains, according to the Weather Bureau, "soaked the soil, filled the streams, and prepared the scene for destructive flooding."¹²

About the middle of the month, however, the weather pattern changed markedly. The wind shifted from the north-northwest to a southwesterly direction, bringing winds and accompanying storms from a low pressure system which had its center in the region of the Hawaiian Islands. The storms crossing over the California coast from this source may be divided into two phases. The first was weaker and covered the period from December 16 to December 20. Strong winds plus a moderate amount of tropical moisture produced very heavy rains over northern California.

The second phase began on December 21. Strong southwesterly winds and increased amounts of warm moist air produced the record amounts of precipitation. At Blue Canyon between December 21 and December 22 the 24-hour rainfall was 9.31 inches, a new record. The winds were exceptionally strong, reaching 90 mph in the San Francisco Bay Area. Relatively high temperatures were associated with these storms, adding to the precipitation and to the snow melt in the upper reaches of the Sierras. It was reported that in some higher elevations as much as 2-1/2 ft of snow melted away between December 20 and 23.

The Meteorology Department of PG&E maintained close surveillance of the changes in the weather picture. Their silver iodide generators were still in operation during most of the first phase of the storm activity. Their meteorologists observed the build-up of the low-pressure frontal system out in the Pacific and predicted that this system would be even more severe during the period after December 20 than the storms just past. As a result, on December 19 PG&E ordered the generators to be turned off.

Their motivation for turning off the generators at that time had two elements. They were convinced that the emission of silver iodide particles in warm storms was almost totally ineffective in increasing precipitation owing to the difficulty of transporting the particles to the elevations necessary for them to act as precipitation agents. The -5°C temperature at which the silver iodide began to be effective was at too high an elevation to be reached by ground generators.

Secondly, PG&E officials were concerned about the possibility of being accused of contributing to the severity of a storm and perhaps leaving themselves open for damage suits. They accurately foresaw the severity of the on-coming storm and took action to avoid even the appearance of being responsible for it.

The plaintiffs and their case

The attorneys for the plaintiffs were not aware of the cloud seeding activities of the Pacific Gas and Electric Company in the Sierra Nevada Range upstream on the headwaters of the Feather River until sometime during the period 1956-1957. Reginald Watt, the attorney responsible for the plaintiffs' case,* almost inadvertently learned of the cloud seeding activities of PG&E and NAWC through a luncheon conversation during a trial in Quincy, Calif. Perceiving a possible relationship between this cloud seeding and the Yuba City flood, he later sent a student to the Lake Almanor area to ascertain the nature of the activity. The student spoke with the generator operators, took pictures of their equipment and learned that the cloud seeding was ultimately the responsibility of PG&E.

Watt, who was variously described as one of the most imaginative, innovative lawyers and one of the best broken-field runners around, was a layman in meteorology and immediately undertook to inform himself about the state of the art. His quest led him to some obvious quacks, such as a fellow in Reno who was going to make rain from a tower erected in a supermarket. But it led him to others, such as Jack Hubbard, who had done rain suppression work for the cherry farmers in the state of Washington. Hubbard, who later became a professor of physical sciences at San Francisco State College, provided Watt a report on whether the activities of PG&E and NAWC could have been responsible for the flooding. He gave Watt technical information on the character of the storms, the requirements for cloud seeding to be effective, probable areas of precipitation, and possible lines of investigation. While Hubbard appeared to believe that the PG&E generators did cause some precipitation, he reports that he advised

* Frances Carr acted as co-counsel for the plaintiffs but appeared to take a less active role in preparation and actual trial of the case. References to Watt should be taken to include Mrs. Carr as co-counsel.

Watt that it would be difficult to isolate this from precipitation caused by natural nuclei, difficult to prove the location of the precipitation, and difficult to reverse the legal situation in which no plaintiff had ever won a case.

Watt was also led to the scientific reports on weather modification. He read of the scientific investigations of Vincent Schaefer and Bernard Vonnegut and the reports published by the National Science Foundation and the U.S. Advisory Committee on Weather Control.

Acquaintance with this literature and more information on the storm patterns and the programs of cloud seeding in the Feather River and Lake Almanor area convinced Watt that PG&E might well be included as a defendant in the suit for damages resulting from the flood. Moreover, the logic of the situation dictated that legal counsel for the plaintiffs include among the defendants any or all persons or interests who might have contributed to the disaster. To have excluded a potential contributor to the flood, particularly one as capable of making recompense as PG&E, would have opened the attorneys to charges of dereliction of duty in protecting their clients.

The result of these preliminary efforts led to the filing of the suit in Sutter County on September 10, 1958, naming the State of California, Pacific Gas and Electric Company and North American Weather Consultants as defendants in the action. There were eight causes of action which related exclusively to the State of California, having to do with the design, construction, and maintenance of the levee system in the Feather and Yuba river systems. Two causes of action concerned PG&E and North American Weather Consultants with regard to weather modification and a final cause of action concerned PG&E alone with regard to the management of some of its dams.

The ninth cause of action stated that PG&E maintained and operated artificial rain-making equipment from ten stations in the Sierra Nevada Mountains in areas draining into the portion of the Sacramento Flood Control Project where the levees broke. This cause of action alleged that PG&E and NAWC began operating facilities on December 15, 1955, until a short time before the break in the levees and that, "The collapse and breaking of the levees was proximately caused or contributed to by the negligent maintenance and operation of the rain-making equipment, and together with the escaping waters proximately resulted in damage to plaintiffs" as indicated in the submitted evidence regarding the extent of damage.

The tenth cause of action simply stated that artificial rain-making was an ultra-hazardous activity.

In preparing his case, Watt encountered some serious difficulties. One of these was internal to the law firm with which he was associated in the suit: Goldstein, Barceloux and Goldstein. It appears that the partners of the firm had little confidence in the weather modification aspect of the litigation. In effect, they wanted Watt to "jawbone" this phase of the case; in other words, to argue this phase without recourse to expensive expert testimony. Watt, on the other hand, felt that the chances of recovery were reasonably good and that it would be foolhardy to enter the court on this issue without expert witnesses. For the better part of a year from summer 1962 to summer 1963, Watt was engaged in trying to convince the firm of the correctness of his position. Ultimately, he was successful.

The second problem, closely related to the first, was that of obtaining expert witnesses who would testify in behalf of his clients. Once having decided to make cloud seeding an issue, Watt began to look for meteorologists to provide technical support. One of those whom he contacted was Dr. Irving Krick of Denver who was one of the most widely known practitioners in the field of commercial weather modification. Watt discovered, however, that Krick had already been contacted by the defendants' attorneys and was unavailable. Further search revealed that the leading meteorologists in this field had already been put on retainers by the defense. Moreover, the stake which commercial cloud seeders had in avoiding the kinds of suits which Watt was pressing made them very unlikely prospects indeed.

The person whom Watt discovered in 1962 and finally relied on as his principal technical expert on the effects of cloud seeding the 1955 storms was Dr. Maurice Garbell. Garbell was chiefly an aeronautical engineer by training and experience, but he had acquired considerable familiarity with meteorology through his professional

work. He worked chiefly as a consultant, having had as clients United Airlines, the Civil Aeronautics Board, and the armed services. He was a member of the American Meteorological Society although he was not certified as a consulting meteorologist by that body. It does not appear that he previously had had direct experience with artificial nucleation although he demonstrated a familiarity with the principles involved.

The difficulty in preparing the case lay in the fact that Watt was unable to employ Garbell until but a few months before the trial began in October 1963. This difficulty was immediately borne out by a challenge which the defense made to one of Watt's principal lines of argument. (Discussed below).

Preparation by the defense

The defendants in the case were represented by two law firms, Bronson, Bronson, and McKinnon of San Francisco for PG&E; and Price, Postel and Parma of Santa Barbara for North American Weather Consultants. The attorneys who worked directly on the case were Edward Morris and Clarke Gaines for the San Francisco and Santa Barbara firms, respectively. It is clear, however, that Morris carried the burden of preparing the case for the defendants since NAWC was in no position to finance the very considerable undertaking that was involved in preparation for the trial.

Like Watt, Morris was no meteorologist and had to inform himself on the subject of cloud seeding and weather modification. This he proceeded to do, both by personal study and by intimate association with leading figures in the weather modification field. In effect, he became a very capable meteorologist. He undertook extensive field investigations, and conducted cloud seeding experiments on his own. That he successfully prepared himself is suggested by the fact that he later became president of the Weather Control Research Association, a group which brought together the leading figures in the field of weather modification.

Through Robert Elliott of NAWC, Morris was put in close contact with the experts in artificial nucleation. These included such figures as Dr. Vincent Schaefer, the pioneer and best known scientist in the field, who ultimately provided expert testimony for the defense. Others were Dr. Bernard Vonnegut, formerly of General Electric and later of the Arthur D. Little, Co.; Dr. Herbert Reisbol, Bechtel Corporation and formerly of the Bureau of Reclamation; Dr. Walter Garstka of the Bureau of Reclamation; Dr. Fred Decker of Oregon State University; Dr. Richard A. Schleusener of Colorado State University; and Francis J. Parsons, Jr., of PG&E.

In preparing to defend against the suit, the lawyers for PG&E and NAWC were faced with a general charge of having negligently operated the silver iodide generators in the Lake Almanor region in such a fashion as to increase the flow of water in the Feather River system, thus contributing to the break in the levees at Yuba City and below. The defense contended, however, that the charge lacked the specificity which would allow the defense to prepare to meet the general allegation. Throughout the pre-trial proceedings PG&E and NAWC attempted to obtain a more detailed specification, in general without success. One attorney for PG&E described the inclusion of PG&E as a defendant as a simple "fishing expedition." Edward Morris protested in 1960, for example, in arguing for the court's acceptance of PG&E's demurrer, "Seriously, we feel that they first brought this lawsuit because they heard that PG&E, sometime before this flood, was conducting these cloud seeding operations, and they've decided to sue. That's all they have, is just a hunch, and they have no other facts to go on. Now we want to find out what is their case about. They've had four and a half years to get ready and I'd think by now they'd at least know what one of these things look like."¹³

PG&E and NAWC contended that the plaintiffs had simply not demonstrated a probable basis in evidence for the allegation of responsibility on the part of the defendants. There was no assertion as to causation linking the cloud seeding activities with the damage to the property in the Yuba City area; no evidence with regard to negligence; no indication as to whether the artificially induced rain was the proximate cause or a contributing factor; no indication of how much the defendants contributed to the damage; no allegation of negligence in rain-making was specified. Further the defendants argued in demurrer that the contention that artificial nucleation of clouds was ultra-hazardous activity was a matter of law, and not a matter of evidence. More-

over, there was no evidence presented to demonstrate that rain-making was in fact an activity that could fall within the definition of ultra-hazardous activity.

The response of the plaintiffs was that they were obliged to demonstrate that PG&E and NAWC had in fact increased the rainfall and run-off in the Feather River system during the devastating storms of December 1955. In their view, the burden of proof then shifted to the defense with regard to the amount of rainfall and run-off produced and whether PG&E contributed to the proximate cause of the breaks of the levees in the Yuba City area. The defense objected to this interpretation on the grounds that even if one poured only one bucket of water into the river it would then be his obligation to demonstrate that it was not that bucket which caused the breaks in the levees.

In an exchange during the pre-trial proceedings just prior to the trial, the burdens of the two parties were clarified.¹⁴

Watt: All I've done is bring it [the suit] against the PG&E which was doing the cloud seeding in an attempt to increase the amount of water in their dozens of reservoirs in the Feather River watershed.

The Court: I say, when he's done this, I think there is inferentially proof of the fact sufficiently to make an inference on it, and I think the burden of proof does shift to the defendant.

Morris: To show. . . .

The Court: I think he [Watt, the attorney for the plaintiffs] has to show that there's some substantial amount of water.

Watt: We're ready to do that.

Morris: All right. Now, that's the point. You must show that there is a substantial amount of water.

Subsequent to some additional interchange, Morris stated, "Then that means that the plaintiffs would show that there was a substantial amount of water produced there or there was substantial amount of water there at Gum Tree [where the most serious break occurred] more than there would have been had PG&E not been operating its cloud seeding at its dams."

The Court: Yes.

Pre-trial proceedings

The filing of the complaint began a series of pre-trial proceedings which were to consume over five years' time until the case actually went to trial in October 1963. The reasons for the long delay in trying the case are numerous, only partially relating to the complexity of factual issues themselves.

Part of the delay was attributable to the difficulty of finding a judge who would be willing to sit on the case. It was generally thought that the trial on the issue of liability would take from six months to two years. The State of California objected to a local judge sitting on the case, as it had a right to do under California law since property within that county was at issue; it was therefore necessary to look elsewhere. The attorneys for the litigants requested the Judicial Council of the State to assist them in selecting another judge. One was found who was acceptable to both sides but he was unwilling to serve since the case would require his absence from his young family for too long a period of time. It was not until 1960 that the judge who finally heard the case was found. He was Judge John P. MacMurray, the judge of the Superior Court of Inyo County. Having a less demanding docket in his less populous county (located at the eastern base of Mount Whitney), somewhat older and therefore less tied down by family responsibilities, and well-known as an intelligent, hard-working judge, he was welcomed by both parties.

A second factor contributing to the delay in hearing the case was the changing character of California law. It must be remembered that the State of California was a major defendant in this suit and much of the preparation of the plaintiffs' case was directed toward the State. Of particular importance was the changing legal situation with regard to the doctrine of sovereign immunity as applied in actions of inverse condemnation.

The doctrine of sovereign immunity is based on the idea that the State may not be sued unless the State has agreed to subject itself to such suits. The notion was traceable to the tradition that the monarch could not be sued, and was incorporated in the

common law of the United States and of the State of California from its English origin. The state legislature in California had made numerous exceptions to the general rule, however, thus permitting individuals to gain recompense for damages caused by the State or its agents in certain circumstances.

Reginald Watt, among others, had subjected this doctrine to sustained attack in cases which had been appealed to the Supreme Court of the State of California. In 1961, during the pre-trial proceedings, the Supreme Court finally overturned the doctrine in the case of *Muskopf v. Corning Hospital District* (1961).¹⁵ The Court found the doctrine "an anachronism, without rational basis" and that it existed "only by force of inertia."

This decision, in its effect, essentially removed from the state a defense that it had previously relied on during the pre-trial discussions. The State was forced to shift the burden of defense to other bases and thereby weakened its case.

The action of inverse condemnation grows out of the concept of eminent domain. The California Constitution forbids the State to take property without compensation. The State must condemn the land and demonstrate to the satisfaction of a court that the property is being taken for a public purpose. Inverse condemnation, however, involves situations in which the State damages, takes, or otherwise makes less useful private property through the exercise of its lawful powers and then is sued by the individual property owner for compensation for such taking or damaging. Moreover, it may be argued, that when the State authorizes another party to undertake a given activity which results in a taking or damaging of private property, the State may be held liable in the same manner as if it took or damaged the property itself.

Cases were coming before the Supreme Court of California on this issue as well, some of which Watt had a hand in preparing and others in which he submitted briefs as *amicus curiae*. In the latter category was the case of *Youngblood v. Los Angeles Flood Control District*, decided in 1961.¹⁶ This case involved a revetment constructed by the Los Angeles Flood Control District which, when it became clogged with debris, caused water that was backed up to flow on to the lands of private parties and thereby cause damage. In discussing the doctrine of inverse condemnation, the Court maintained that the public agency was responsible for taking and damaging private property "if it constructs a watercourse in a negligent manner and such a watercourse is the proximate cause of the property owner's loss." The public agency would be held responsible if an improvement was faulty in the sense of a failure to appreciate the probability that in functioning as deliberately conceived, it would result in the damage. The principles of public agency responsibility with regard to works deliberately but negligently conceived to deal with a problem had obvious significance for the case of the plaintiffs in the case of *Adams v. California*.

Even broader significance was attached to the case of *Frustruck v. Fairfax*, decided in 1963.¹⁷ This case involved damage to private property as the result of the failure of a culvert constructed by the city of Fairfax to handle the waters diverted by the development of a new subdivision. Even though the subdivision was developed by a private party, the public agency was held liable because of its role in approving subdivision plans. The Court said, "The basis of liability is its failure, in the exercise of its governmental power, to appreciate the probability that the drainage system . . . , functioning as deliberately conceived, and as altered and maintained by the diversion of waters from their normal channels, would result in some damage to private property."

The plaintiffs found further support from this case for their view that the State would be held liable for its part in the authorization, construction, maintenance, and operation of the levee system on the Feather River. They also found ammunition for their claim that the State was in same measure liable for whatever damage may have been occasioned by the cloud seeding operations of NAWC and PG&E because the State had granted a license to NAWC for the purpose of engaging in cloud seeding activities.

Before judge or jury?

An important consideration in the minds of both the attorneys for the plaintiffs and for the defendants was whether the case should be tried before a judge alone or with a jury. At one time or another during the pre-trial phase, both sides gave some consideration to having a jury but finally rejected the jury in favor of the judge.

The principal consideration in the minds of both parties was the competence of a jury to comprehend the complex technical information which would be introduced into the trial. The defense made a careful assessment of the likely jurors in Sutter County. There were only 12,000 registered voters in the county; those who served might have to do so for as long as one year; they could not have worked for the State, PG&E or NAWC, and could have had no relationship, through either family or employment, with the plaintiffs. The defense ended up with a list of around 400 potential jurors, of whom only 120 said they could serve for a year when polled by the defense attorneys. Of these, all but approximately 10 were women, and the latter were principally employed at the level of grocery store clerk or packing house worker. Both sides felt that citizens of this educational level and experience were not qualified to sit on such a difficult case.

The willingness to dispense with the jury also reflected the attorneys' confidence in the judge. Under certain circumstances, where a judge might have been reluctant to decide against such a large number of plaintiffs who obviously had sustained real injury, the defense might have insisted on a jury to relieve him of that burden. In this case both parties were confident they had a strong, even a "fearless" judge.

A crucial consideration for the plaintiffs was the attitude of the community. Only 150 of the thousands of people whose property was damaged by the flood were litigants. The community was generally hostile (in the view of the attorneys) to the suit, in part because of the feeling that it was futile. But the plaintiff's attorneys were concerned that those who had not sued and had sustained injury—and these would undoubtedly be represented on the jury—would likely take the attitude that since they would not recover damages, neither should the plaintiffs.

Still a third consideration was that of cost. If the plaintiffs asked for a jury the cost involved would be at the rate of \$10 per day per juror plus costs of travel, for a minimum of \$120/day for 12 jurors. Moreover, the plaintiffs would have to deposit in advance the money for payment of the jury. This would constitute an obvious hardship for the plaintiffs who were limited financially in the preparation of their case. The defendants, notably PG&E and the State, would of course be better equipped to defray the costs, which would be extraordinarily high if the trial lasted an entire year.

Finally, the law with regard to trying damage suits was changed in California as of September 1, 1963. Under the new law it was possible to try the question of liability only, leaving for later proceedings the question of the extent of damage to the plaintiffs, assuming they were able to demonstrate the legal liability of the defendants. With this change, the question of whether it would be possible to influence a susceptible jury with tales of anguish and grief told by the plaintiffs became moot. The issue before the court would be the issue of liability alone, and this would be based on technical evidence and an understanding of the law. On this issue, the plaintiffs felt the judge would be more competent and superior to a jury.

The pre-trial order

On October 8, 1963, Judge MacMurray issued a formal Pre-Trial Order in which he stated the causes of action against the State, PG&E and NAWC, and the contentions of the plaintiffs and the defendants. In essence, the plaintiffs alleged that PG&E had negligently operated nine silver iodide generators prior to their being turned off on December 19. Negligence consisted of engaging in activity which reasonable men would not engage in because of the risks to the community. It involved failure to foresee these risks and therefore to exercise due care to avoid unreasonable danger. Defendants were alleged to have done this by increasing the precipitation and, therefore, the run-off in the Feather River system, resulting in a supply of water that was beyond the capacity of the Feather River system to contain it. The plaintiffs argued that all of the water created by the cloud seeding was not impounded behind the existing dams, but some escaped and contributed to the high flows at Yuba City and below where the two most serious breaks occurred. Specifically, the cloud seeding by PG&E and NAWC prior to December 19 affected the base flow of the river and also saturated the soil, thus helping to fill up the voluminous upstream and leveed channel storage space so that when the rains of the 22nd and 23rd came, the run-off did not perform these functions but flowed downstream on top of the water already there from the rains of the 15th to the 19th. The total

volume of water flowed at a higher velocity and at a higher elevation and created the destructive flood crests of the 23rd.

The plaintiffs further alleged that cloud seeding by its very nature was an ultra-hazardous activity which subjected defendants to strict or absolute liability for any and all damages which occurred relating to their activities. The application of this doctrine would mean that the issue of negligence would be irrelevant since the exercise of due care would not affect liability.

Strict liability, as a legal concept, refers to liability for actions which in themselves involve no departure from acceptable moral standards nor reasonable standards of care or intent, but nevertheless expose the community to peril. The conduct does not suggest negligence, but rather deliberate efforts to achieve some end which at the same time subjects the community to danger. As a matter of social policy, those engaging in such activity must bear the responsibility for damages that may be incurred.

The doctrine was particularly applicable to "ultra-hazardous activity" which was defined in Prosser's *Law of Torts* as one which "'necessarily involves a risk of serious harm to the person, land or chattels of others which cannot be eliminated by the exercise of utmost care' and 'is not a matter of common usage.'" ¹⁸ This doctrine stressed not only the activity but also the circumstances under which it was engaged in. Thus, blasting, which might be considered "ultra-hazardous" in the city, and call for the application of the rule of strict liability, might not be considered such in the open fields where the rules of negligence might be applied. Activities which might be considered ultra-hazardous have included the use of explosives, inflammatory liquids, blasting, accumulation of sewage, and noxious gases.

As support for this contention, the plaintiffs drew upon a report by the Division of Water Resources which stated: ¹⁹

"Applying the foregoing principles of law to the artificial precipitation of rainfall, it appears that such activity falls squarely within the definition of "ultra-hazardous activity" and that one who engages in such an enterprise would be held to account for any damage proximately resulting therefrom without regard to his actual intent or negligence, unless it were to be said that in a particular case the necessity or utility is so great as to justify reasonable risk. Of course this would depend upon all of the surrounding circumstances which are impossible to predict."

The plaintiffs contended, finally, that PG&E had negligently operated some of its dams in view of the cloud seeding activities in which it was engaged. They argued that PG&E had failed to operate dams in their systems in such a way as to provide sufficient storage for the increased run-off. Instead of using these dams to reduce flow in the streams, they spilled water owing to failure to provide adequate storage. Moreover, PG&E could reasonably have been expected to foresee the flood, since it had shut off its own generators in expectation of it.

Summarizing the pre-trial contentions of PG&E, Judge MacMurray stated the following as the affirmative defenses:

1. Rainstorms caused the damages.
2. An act of God.
3. Complaints by the plaintiffs failed to state facts sufficient to constitute a cause of action.
4. Cloud seeding was done by an independent contractor of PG&E [which presumably would make NAWC culpable but not PG&E.]
5. Contributory negligence and assumption of risk on the part of the plaintiffs.
6. NAWC contended that the fire-damaged conditions of the watersheds added to the damages to the levees.
7. No artificially induced rain fell outside the Lake Almanor watershed during the period from December 15-19. Besides those dates little if any precipitation was produced by the operations of the cloud seeding generators.

The issues, as stated by Judge MacMurray, were the following with respect to PG&E and NAWC:

1. Negligence, if any, on the part of PG&E and NAWC.
2. Extraordinary and unusual force of nature or act of God which would excuse liability.
3. Strict liability for the conduct of ultra-hazardous operations, if any.
4. Contributory negligence of plaintiffs, if any.
5. Assumption of risks by plaintiffs, if any.
6. Whether NAWC was an independent contractor in its operations as a cloud seeder in such a relationship as to exonerate PG&E from liability.

The trial

The trial actually began on October 8, 1963. Because of the assumed widespread community interest in the trial and the remodeling going on at the Sutter County Court House, the proceedings were held in the community hall of a local housing center in Yuba City. Signs were posted at strategic intersections to direct the expected crowds to the spacious chambers. The general community interest was badly over-estimated, however. During the first three days of the trial, reported the Marysville-Yuba City *Appeal-Democrat*, only one of the plaintiffs attended each day, and each day it was a different one. There were no other spectators.

The local newspaper carried news stories on page one for the first weeks of the trial, and occasionally an article appeared on page one later on, but by the time the trial concluded on January 21, 1964, notices of the proceedings were generally relegated to interior pages. Infrequently news items or commentary were found in other newspapers, such as the San Francisco *Chronicle*, which carried articles on October 11 and 15. As might be expected these articles, while reasonably accurate descriptions of the proceedings, were summary and superficial accounts of the testimony presented by the witnesses.

The plaintiff's witness

The first and indeed the only witness to appear personally for the plaintiffs on the issue of liability resulting from weather modification was Dr. Maurice Garbell.* Dr. Garbell was to occupy the witness stand for a total of eight days during which he testified on the technical aspects of cloud seeding, gave expert testimony on the character of the storm and the effects of cloud seeding in the December 1955 storms, and subjected himself to intensive cross-examination by Edward Morris. Dr. Garbell, it was generally agreed, was extremely articulate and self-assured. One of the plaintiffs recalled him as a "real actor."

A crucial motion was made virtually at the outset of his appearance which probably materially affected the results in the case. While Dr. Garbell was describing the storms of December 15 to 19 he expressed the conclusion that the generators of PG&E and NAWC from the Mokelumne-Stanislus to the Mount Lassen area increased the precipitation in the Feather River system in the magnitude of 10–15%.

Dr. Garbell was following a line of argument that the cloud seeding in the Mokelumne-Stanislus project "contaminated" the Feather River system by means of silver iodide (AgI) crystals which were blown north by the southeasterly wind at the lower level. After being driven over 100 miles, these crystals were carried aloft above the Feather River system where precipitation was caused.

The defense attorneys had learned that such a line of argument might be developed and were prepared to counter it. Immediately Clarke Gaines, the attorney for NAWC, was on his feet to object on the grounds that the entire pre-trial proceedings of the case, including the pre-trial order itself, were based on allegations regarding the effects of the nine generators in the Lake Almanor area. No basis had been established which would have justified the inclusion of the Mokelumne-Stanislus project as having any effect on the Feather River system. The fact that Gaines objected was part of the strategy of PG&E and NAWC. Gaines argued that his client, NAWC, was a small company with very limited resources, and it would be an imposition after five years of

* It should be noted, however, that Watt read into the record a deposition taken from Charles P. Smith of PG&E in which the latter testified about the Company's reports on the cloud seeding projects. These reports, as indicated earlier, supported the plaintiff's position that the cloud seeding had been effective.

pre-trial during which the plaintiffs had ample opportunity to lay a foundation for their case, to then enter the courtroom with a new set of allegations. Permission to include the southern project as having an effect on the floods on the Feather River would mean a significant delay in the case since the defense would be put to the expense of doing field investigations—as it had done in the Lake Almanor area—and making detailed studies of weather patterns in the southern area.

The attorneys for the plaintiff maintained that they introduced this new element in the case at such a late date because they had realized the significance of the contamination factor only during the summer of 1963 and were therefore not in a position to press this point earlier. In a sense, the defense interpretation was complementary; it was their view that the plaintiffs took the new tack only because they realized that the wind patterns at the Lake Almanor site would not support their argument and it was therefore necessary to embark on an entirely new theory based on the southern projects.

Judge MacMurray reserved judgment on this motion but ultimately ruled in favor of the defendants, thus forcing the plaintiffs to shift the burden of their testimony away from the Mokelumne-Stanislaus to the Lake Almanor area, where the defense had made extensive preparations. Moreover, in the eyes of the defense attorneys, Dr. Garbell was forced to revise his testimony on wind patterns and the direction in which the AgI was carried in order to support the plaintiff's contention that the AgI stayed within the Feather River watershed and increased the precipitation therein.

In his initial testimony Dr. Garbell testified that there were two dominant wind patterns during the period from December 18 to December 22. One was at the lower level, consisting of warm, moist air and moving from the south-southeast so as to parallel the north-southwestern flank of the Sierra Nevada range. This layer of air was about 1,000 ft thick. Above this layer was cold air moving from the southwest at high velocity, upwards of 80 to 100 mph. The emphasis on these wind directions was important to the plaintiff's case in demonstrating how the lower wind pattern could carry the AgI crystals northward and upon reaching the upper and cooler air masses nucleate the moisture in the upper levels, and cause precipitation in the Feather River system.

Since this line of argument was effectively cut off by the defense motion, it appeared that Dr. Garbell then shifted his testimony with regard to the wind direction of the air at the upper levels. If the wind direction had indeed been from 225°, all of the precipitation allegedly caused by the silver iodide from the Lake Almanor watershed would have fallen within the watershed and would have been held by the Lake Almanor dam. In his subsequent testimony he therefore testified—or so it appeared—that the wind direction was 240° and that much of the precipitation would have fallen outside the Lake Almanor watershed and into the main stem of the Feather River.

Watt led Dr. Garbell through a discussion of the manner in which the silver iodide smoke was emitted from the generators, drifted with the lower air movement until caught up in convection cells through which they were rapidly lifted to the elevations of the cooler air where the process of nucleation could begin. The crucial questions, then, were the extent to which such cells were present, the rate of ascent of the plume of silver iodide smoke, the level at which the required temperatures were found, and the time required for the AgI to cause the moisture to crystalize around the AgI. The rates at which these processes occurred determined whether the precipitation would have fallen within the watershed or would have been blown out of it.

For the plaintiffs it was necessary to show that all of these processes took place at a rapid rate and that there was a minimum dispersion of the AgI plume as it was transmitted aloft. Dr. Garbell contended that whereas there was some lateral movement of the AgI plume with the surface wind, the AgI crystals were quickly caught up in convection cells and ascended at the rate of five meters per second. Relating elevation and temperature changes, he calculated that the -5°C level where artificial nucleation presumably would begin would be reached at the 8,000-ft level on December 18 and at the 9,000-ft level on December 19. At the 8,000 ft level, the AgI crystals would have traveled a maximum of 23 miles from one of the generators. Moreover, he contended that the nucleation process would begin immediately the moment the AgI crystals attained the necessary temperature level.

Dr. Garbell functioned for the plaintiffs as an expert witness on general meteorology as well. In this regard he expressed an opinion to the effect that a reasonably competent

meteorologist could have predicted storms of the magnitude of the late December 1955 storms from the records of the Weather Bureau. He believed that the signs of a severe storm were sufficiently clear that the PG&E and NAWC could have predicted what was coming. Moreover, he concluded that the state of California should have recognized the possibilities of such storms and the consequent floods because of the historical records of floods. This testimony was designed to demonstrate the state's liability for planning, constructing, and operating an inadequate levee system.

The defense, in addition to attacking Dr. Garbell's testimony directly, relied on two witnesses. The first of these was Dr. Vincent Schaefer, the world renowned pioneer in artificial nucleation. The second was Dr. Arnold Court, Professor of Climatology at San Fernando Valley State College in Southern California, with a lifetime of experience in various phases of climatology, including cloud seeding, but most importantly, an expert in statistical analysis.

The defense strategy was designed to force the plaintiffs to demonstrate a basis for claiming a causal relationship between rainfall produced by artificial nucleation and flooding, while casting suspicion on any such claim. For example, although the initial allegations referred to nine generators in the Lake Almanor area which caused the increased precipitation, Morris succeeded in reducing the number of generators that conceivably could have made a contribution to the floodwaters to four. The second approach in its strategy was to minimize the effect of the cloud seeding by NAWC, even assuming that any of the AgI had reached the elevation necessary for the process to begin.

As might be expected, the defense initially attacked Dr. Garbell's credibility as an expert on meteorology. Morris pointed out that while he was a member of the American Meteorology Society, he was not qualified as a certified consulting meteorologist and had had no practical experience in the field of artificial nucleation.

In cross-examination, Morris closely examined Dr. Garbell on the manner in which AgI crystals might achieve the proper temperature levels for artificial nucleation to begin. The issue largely concerned the model of the air mass that was pictured crossing the crest of the Sierras. Garbell had originally used a stable model in which there would be little convection activity. This model suited the argument he had attempted to develop with regard to the possible contamination of the Feather River system by the Mokelumne-Stanislus project. The AgI crystals, he contended, would have been carried northward by the lower-level air mass and then lifted by convection cells to points above the Feather River drainage area. The elimination of these projects forestalled this line of argument.

With the issues restricted to the effects of the nine generators at Lake Almanor it appears that Dr. Garbell then adopted a model of an unstable air mass. [The defense contended that the existence of a divided regime—a southern one that was stable and a northern one that was unstable—was unlikely.] The defense, for purposes of pursuing the necessary calculations about temperature levels and nucleation times with the plaintiff's witness, accepted this model for the purposes of argument. Later, it challenged the unstable model in its entirety.

In such an air mass convection cells would be prevalent. Dr. Garbell contended that the rate of unstable ascent was rapid—five meters per second—a view challenged by the defense, which argued that the rate was more likely three meters per second. But an unstable air mass is usually associated with higher temperatures on being lifted over the mountains, thus requiring a greater elevation for the AgI crystals to achieve the -5° temperatures. For estimating temperature levels it appears that Dr. Garbell then used a stable air mass model which would provide lower temperatures at lower elevation. Morris endeavored to point out the discrepancies in the assumptions about the model being used. If the temperatures necessary for nucleation were higher and the wind were of the speed and direction indicated, Morris attempted to show that all precipitation would have blown either out of the watershed entirely or into the area draining into Lake Almanor.

The defense attempted to demonstrate that the -5°C level was much higher than the elevations indicated by Dr. Garbell. Using Weather Bureau temperature records and analyzing upper air charts, Morris led Dr. Garbell to agree that the -5°C level would have

been at 10,000 from December 18 and 11,000 ft on December 19, adjusting for decline in temperature with increase in ground elevation. Moreover, Morris challenged Garbell's use of minimum rather than mean temperatures for making calculations of the elevation at the -5°C level. Subsequently, Dr. Garbell repudiated these estimates under redirect examination by Watt, asserting that isotherms, or lines connecting two or more points where temperature readings are made, provide only a rough approximation of temperatures at any given place since they are calculated from widely separated locations. His revised testimony placed the -5°C temperatures at 8,000 and 9,000 ft, respectively.

Morris also attacked the apparent shift in Garbell's statements about wind direction. He contended that the wind direction indeed had been 240° but not until December 21 and 22 whereas the weather records at Oakland demonstrated that for December 18 and 19 the wind direction was clearly 225° . With the latter wind direction prevailing until the time the generators were shut off, all precipitation caused by cloud seeding would have fallen within the Lake Almanor drainage.

Motion for non-suit

At the conclusion of Dr. Garbell's testimony, Gaines made a motion for a non-suit on the grounds that the plaintiffs had failed to demonstrate the legal culpability of NAWC and PG&E with their own witnesses and it was, therefore, unnecessary for the defendants to go to the trouble of presenting a positive defense. Gaines pleaded the unfortunate situation of NAWC, a small company with limited financial resources. It had already gone through one of the longest pre-trials in California's history. It had only recently lost its insurance as a result of this litigation and no private company could be a self-insurer in this business. Moreover, NAWC had already lost considerable business and "had operated under a sword" ever since the litigation began.

The chances of Judge McMurray granting the non-suit motion appeared to be slight, partially because of the merits of the plaintiff's case, but also because of the probability of an appeal, regardless of the outcome. Judge McMurray appeared to be anxious to insure that the trial court would present a complete record to the appeals court and that the case would not be remanded to the trial court because of judicial error. The motion for non-suit was denied.

Witness for the defense

The first defense witness was Dr. Vincent Schaefer, who testified both on the science of artificial nucleation in general and the specific scientific questions involved in this litigation. From all accounts, it appears that he was a most impressive witness.

Dr. Schaefer was first questioned on the crucial issue of the time required for artificial nucleation to take place. He informed the court that the process of artificial nucleation required from between 14 to 21 minutes for the ice crystals to achieve sufficient mass to begin to fall. During these minutes, the ice crystals were being blown rapidly away from the place where the AgI crystals were first emitted. It was Schaefer's opinion that any AgI crystals that may have gotten into the atmosphere at the higher levels would have been carried beyond the drainage areas of the Feather River and could have had no effect on the precipitation in that river system.

Dr. Schaefer contended that while nucleation may begin to occur at the -4°C level, most crystals did not become active until they reached the -10°C or -15°C level. This suggested that the time for effective cloudseeding to begin would have been even longer than had been suggested by Dr. Garbell's testimony since those temperatures were achieved at considerably higher elevation.

On the question of seeding the warm-type storm, Dr. Schaefer was equally damaging to the plaintiff's contention. He argued that where actual nucleation was occurring, AgI crystals had no effect at all. He said a warm-type storm could not be seeded effectively, owing to the number of down-drafts, the large quantities of rain and generally gusty conditions.

Finally, Morris asked Dr. Schaefer about the impact of the quantity of AgI crystals emitted by the generators through December 19. Schaefer expressed the opinion that had AgI crystals actually gotten into the atmosphere at the higher levels, they would have been carried beyond the Feather River watershed. He further concluded that that quantity of AgI could not be considered either hazardous or ultra-hazardous. The results might prove interesting, he asserted, but hardly hazardous.

The second expert witness for the defense was Dr. Arnold Court who testified on the validity of the claims of the cloud seeders with regard to the results of their experimentation and operations. Dr. Court was called upon by the defense specifically to refute the records of significant increase in precipitation found in the PG&E reports. Dr. Court cast doubts on the validity of the cloud-seeders' claims because of the difficulty of establishing sufficiently controlled conditions. He agreed it would be necessary for a longer period of intensive experimentation to obtain adequate proof of their claims. In particular, it would be necessary to randomize the selection of storms to seed or periods in which to seed because it was not possible to predict whether one storm might not actually produce more precipitation than another.

He pointed to the difficulties in obtaining adequate measurements of precipitation or run-off owing to faulty measurement devices and networks, changes in ground cover, and differences in soil moisture conditions. Using the statistics on which PG&E and NAWC had relied in evaluating the effects of their cloud seeding activities, he felt that it would be possible to demonstrate that there was greater precipitation when no cloud seeding occurred than during cloud seeding. He observed that PG&E personnel seemed to be imbued with the idea that cloud seeding could produce additional amounts of rain and were determined to prove it. Only later did PG&E have a statistician analyze more carefully the results of their project.

To buttress further his case, Morris himself presented evidence in which he attempted to calculate the amount of water which the AgI crystals might have generated in the run-off area in which Dr. Garbell asserted the increased precipitation fell. He determined the watershed area over which the AgI crystals from the generators would have drifted and concluded that only one-third of the watershed would have been outside the area draining into Lake Almanor. This was essentially the Indian Creek watershed. He calculated the percentage of water in that watershed for the given time period which was attributable to cloud seeding at the rate of 15%. He further estimated the time at which the water had to be in the river in order for it to have contributed to the break at Yuba City and Nicolaus. The result of these calculations was a total of 572 acre-feet.

He compared this miniscule amount with the estimated 600,000 cfs passing Yuba City on the Feather River at the time of break and ridiculed the contention that this amount could have contributed in any significant degree to the breaking of the levees. Dramatically displaying a small jar of AgI crystals before the Court, he asserted that this was the quantity of crystals emitted by all of the generators for a period of 50 hours before they were turned off. These, he said, could hardly be considered an element in the causation of the levee failures. He cited the testimony of General Hardin of the Army Corps of Engineers to the effect that even a reduction of 52,000 acre feet at the time of the break would not have made any difference.

Referring to the testimony of another expert witness for the plaintiffs, Walter B. Grimes, who testified on the flood aspects of the case, Morris calculated that all the precipitation caused by the artificial nucleation would have been in the river by early evening, December 19. This water would have passed by the subsequent break at Yuba City no later than the morning of December 21 or 39 hours later. Since the break occurred on the night of December 22 when the crest reached its peak, any water contributed by the cloud seeding project would long since have passed that point. [This view was not challenged by Watt but he was prepared to argue that earlier rain produced by the generators had primed the soil and thus magnified the quantities of water which went into the river and subsequently caused the flood damage.]

Morris was prepared to use, if necessary, an argument to the effect that the artificial nucleation efforts of PG&E and NAWC, if they produced any precipitation at all, actually *reduced* rather than added to the stream flow that led to the flood. This subtle argument was based on the contention that whatever precipitation caused by the AgI crystals fell in the form of snow and created or added to an already existing snow pack. This snow pack allegedly acted as a kind of blotter or sponge which absorbed subsequent precipitation in the form of rain. The defense was prepared to argue, therefore, that the cloud seeding had the effect of reducing the water flowing in the Feather River system at the time of the Yuba City break. [Watt was prepared to counter this argument by

contending that the earlier rains had sluiced off the snow so that later precipitation fell on bare ground and was quickly converted to run-off.]

In summing up, Morris pointed to the public policy implications of a decision which placed the burden of responsibility on the cloud seeders. He said, "If it is branded by the courts as ultra-hazardous, it will be shunned by research organizations and universities. The insurance industry will undoubtedly refuse to underwrite it and private enterprise will no longer be able to engage in it." Since few organizations would be self-insurers, and since the insurance industry would be loathe to support such a risky enterprise, further investigation of the potential benefits of weather modification would be curtailed.

Negotiating a settlement

Sometime during the presentation of evidence by witnesses for the plaintiffs and the defense, attorneys for each side began a series of discussions that led to the final disposition of the case. Just when these negotiations began remains unclear owing to differences in the recollections of the attorneys, but there is general agreement about the character of these discussions and the motives behind them.

From the standpoint of PG&E, the important goal to be achieved was a favorable decision and the avoidance of an appeal. Attorneys for PG&E discussed the strategy with the insurance companies which would ultimately be called upon to pay the bills if PG&E were held responsible for flood damage. The possibility of an appeal from an adverse decision was explored as was the possibility of reversal for judicial error. A new trial would require more pre-trial proceedings with the obvious probability that the plaintiffs would include the Mokelumne-Stanislus project in its list of allegations. Inclusion of that project would necessitate extensive preparations through field investigations, all of which would involve considerable expense. Under these circumstances PG&E management and their insurers advised negotiations toward a settlement.

Morris and Gaines were convinced that Watt could be approached on a settlement on the basis of the way the trial was going. They were certain that Dr. Garbell's testimony had been entirely refuted and that Dr. Schaefer's testimony was absolutely devastating to

the plaintiff's case. Moreover, it appeared that the plaintiff's case against the state of California was going relatively well and that there was a real possibility of winning on that front. From the standpoint of strategy, they felt that Watt might be apt to pull back on what appeared to be a weak case in favor of concentrating on a stronger case.

Watt's viewpoint was somewhat different but with some elements of similarity. He did not view his chances against PG&E and NAWC as pessimistically as Morris and Gaines; indeed, he felt that there was a very good possibility of winning. As a practical matter, he believed that the court could not rule against PG&E without ruling against the State. If the court ruled against the State, however, he concluded it was not particularly important that it rule against PG&E and NAWC since his clients could still collect damages from the State. Moreover, he may have felt that it was better strategy to concentrate his efforts on what appeared to be the stronger case.

The bargaining situation for Watt was complicated by the fact that he was not able to locate all of his clients and obtain their agreement to settle. The agreements with his clients gave him no open-ended option to settle as he felt desirable. It was necessary, therefore, to find an arrangement that would not leave him open to a charge of not having consulted with his clients with regard to such a major decision.

Both sides showed a willingness to negotiate and an agreement was arrived at long before the conclusion of the trial, which ran on into January 1964 covering the suit against the State. The agreement was to the effect that if PG&E and NAWC won, the attorneys for the plaintiffs simply would fail to take an appeal within the thirty days permitted by law. If, however, the plaintiffs won, there would be no contingent agreement and PG&E and NAWC would be free to take whatever steps they thought necessary to defend their interests. For agreeing to such an arrangement, the defense agreed to pay the attorneys for the plaintiffs sufficient to justify their efforts in prosecuting the case. In the parlance of the legal profession, the defendants "bought up an appeal." This arrangement also applied to the 50 dams operated by PG&E which the plaintiffs had alleged that PG&E had mismanaged.

The agreement explained the curious turn the litigation took toward its conclusion. Morris had a battery of noted experts ready to testify (those referred to earlier) but none of them was called. Robert Elliott was prepared to testify but did not do so. While Morris could not be absolutely certain of the result, inasmuch as Judge MacMurray had to rule on the merits of the case, it appeared that he was sufficiently confident that he no longer felt the need for their evidence.

On the other hand, Watt clearly desisted from attacking the defendants' case. When Morris presented evidence that a very negligible quantity of water could have been produced by the AgI crystals, even supposing that some of them had caused precipitation over an area not draining into Lake Almanor but still within the Feather River watershed, Watt made no effort to demonstrate what quantity might have been precipitated. Defense witnesses were subjected to no cross-examination and the attorneys for the plaintiffs made no summation at the end of the case on the issue of cloud seeding.

The result was therefore a virtually foregone conclusion and it was no surprise when Judge MacMurray, who was aware of the negotiations and the agreement but not a party to them, handed down the following decision in April 1964:²⁰

Plaintiffs may not recover against the Pacific Gas and Electric Company or North American Weather Consultants as they have failed in their burden of proof.

The Court found that neither PG&E nor NAWC

produced any significant increase in rainfall or snowfall outside of the Lake Almanor watershed. The effects of cloud seeding were limited to the pre-determined target area which drains only into Lake Almanor. Lake Almanor never spilled at any time before or during the flood; accordingly, any increase produced by cloud seeding was successfully impounded by that Pacific Gas and Electric Company lake.

The breaking of the levees was neither proximally caused nor contributed to either by the maintenance or by the operation of the artificial rainmaking equipment of any defendant in this lawsuit.

In accordance with their previous agreement, the attorneys for the plaintiffs did not appeal the decision as it applied to PG&E and NAWC.

At the same time Judge MacMurray ruled against the State of California with regard to its responsibility for the design, construction, and maintenance of the levee system on the Feather River system. On the legal ground of inverse condemnation, the Court held the damages recoverable, contending that "Plaintiffs may also recover in strict liability against the State of California as strict liability must be imposed when a failure occurs in a levee system constructed and maintained to protect the lives and property of people in the area when such failure occurs under reasonably foreseeable circumstances."

The State of California considered the possibility of appealing the Superior Court decision. The State employed Edward Morris to look into the record of State successes and failures in appeals involving liability in water cases. Morris' investigation revealed that the State had never won an appeal. Consequently, the State decided against an appeal. The plaintiffs had originally claimed damages in excess of \$13 million. The figure on which the parties agreed to settle was \$6.3 million.

Implications for public policy

The case of *Adams et al. v. California* presents considerable difficulty for the observer who attempts to generalize on the basis of it. Any case, whether in law, medicine, or administration, seldom demarcates or delineates a field in its entirety. It may provide insights and new ways of looking at things; it may rule out certain approaches that had been thought viable; it may lead to new hypotheses about certain phenomena; and it may indicate certain conditions under which certain relationships are observed.

This case is not entirely satisfactory because of the fact that the full legal implications of artificial nucleation were not explored. The Court finally concluded that there was insufficient evidence pointing to a causal relationship between the damages sustained by those on whose land the Feather River poured and the silver iodide crystals emitted by the generators far upstream on the headwaters of the Feather River. The plaintiffs had not demonstrated that the defendants had behaved negligently by not using proper care and prudence in operating and maintaining their system of generators.

The decision of the Court was based on insufficient proof of causation. It is, therefore, possible only to speculate about the question of whether cloud seeding activity is or is not ultra-hazardous activity. By implication, at least, the Court appeared to take the position that artificial nucleation of clouds was not in and of itself ultra-hazardous activity against which the argument of prudence and reasonable precaution would be unavailing. The mere fact that cloud seeding activity was taking place at the time a storm was occurring, and during which damage was sustained, would not constitute proof of harm-causing activity for which the operator would be liable. It would be necessary to demonstrate the relationship, prove that his actions had damaging consequences for others not only in kind but also in quantity, and that reasonable care had not been exercised. The defense had contended that California law had never included water as an ultra-hazardous substance or any technique for its management as ultra-hazardous. Moreover, the statutory provisions in the California Code appeared to encourage the technique, a fact that strongly indicated that the California Legislature did not consider it ultra-hazardous. In view of the modest increases attributed to cloud seeding—in the magnitude of 10–15%—it may be questioned whether the practice cannot be controlled with the exercise of due care. But the answer remains unclear. In the *Restatement Second of Torts*, Sec. 519 and 521 there are statements on the principle of "abnormally dangerous activities." In describing such activities, a number of factors are to be considered: 1) the degree of risk involved, 2) whether the gravity of the harm which may result from it is likely to be great, 3) whether the risk can be eliminated with the exercise of reasonable care, 4) whether the activity is of common usage, 5) whether the activity is appropriate to the place where carried on, and 6) the value of the activity to the community. Whether cloud seeding in the Lake Almanor area in 1955 would have constituted "abnormally dangerous activity" in terms of these criteria is difficult to say. What another court might decide under similar conditions using standards such as the above it is impossible to say.

A further complicating factor lay in the fact that the weather modification operators were co-defendants with others whose culpability was (at least in hindsight) more readily demonstrable. It is reasonable to speculate about what the result might have been had PG&E and NAWC been the only defendants. Over 150 plaintiffs who had suffered grievous injury for which they could never hope to obtain full compensation were

asking for some redress. Would the social consequences of a decision that denied them redress have been too unacceptable to the Court and therefore have led to a different conclusion? It is not an unwarranted assumption that the courts must consider social consequences and it was convenient that the Court could turn to a public agency, the State of California, as the chief culprit. [Indeed, there are those who argue that the State of California lost this case unnecessarily; that other lines of legal defense would have availed the State more than those adopted. This is a moot point, but the logic of the position suggested here is that *someone* had to pay, and the State was the more logical one, particularly in view of the recently pronounced views of the Supreme Court on inverse condemnation.]

Still another difficulty in generalizing from this case is that no appeal on the legal issues at stake was taken. On the *facts*, the Court decided that PG&E and NAWC were not responsible for any damages resulting from the flood. But the legal implications of altering the quantity of water precipitated over a given area were not directly examined. Had the case been appealed, the basis for the appeal might have provided additional light.

These reservations regarding the suitability of generalizations drawn from this case do not preclude some interesting speculations about the nature of the litigation that is likely to develop in the field of weather modification. In the first place, in view of the complexities of water management in the United States today, it may be questioned whether the law of weather modification will develop unrelated to general water law dealing with surface waters.²¹ Water is intensively managed throughout the country and by a wide diversity of private and public entities: public utilities, major government agencies, private individuals, and local public districts. Moreover, their purposes and methods of operation are diverse and sometimes in conflict. The consequences of changing weather, more specifically precipitation patterns, to any appreciable extent are likely to be felt and to be affected by not only the primary actors, those engaged in cloud seeding, but also by those who manage dams, who channel the water in streams, who divert the water for various purposes, who alter the ground cover, or in other ways manage water. Cases coming before the courts are likely to be complex, involving numerous parties as litigants simply because cloud seeding seldom will be perceived as the sole activity leading to untoward results, but will be one of many.

A second observation stems from the rather ironic situation in which the defendants found themselves in this case. PG&E had invested its capital in cloud seeding in the hope of increasing precipitation in the form of snow-pack and appeared to be convinced by the results of the NAWC operations that such increases had been obtained. NAWC existed because of the conviction of its scientists that artificial nucleation of clouds could produce appreciable increases in precipitation. Yet in this case, they were arguing that no such results had been obtained. Notwithstanding the reasonableness of the decision in this instance, it is probable that this stance will be the line of defense for future litigants in tort actions of this type. It will be a rational defense because of the infancy of the science of weather modification. As Professor Court demonstrated in his testimony, there simply is not sufficiently reliable evidence with regard to the effectiveness of weather modification techniques. Even admitting that cloud seeding effectiveness has been demonstrated statistically to the satisfaction of weather scientists, it is quite another matter to demonstrate its effectiveness in any given storm under any given conditions. Is a change in rainfall patterns in a given area over a long period of time during which cloud seeding has taken place evidence that a court will accept that cloud seeding has been the agent of change? May the changes not merely reflect secular trends in the region? If the rainfall patterns change in any given region, but not in others closely related to it historically in terms of rainfall patterns, is this sufficient evidence for a court to demonstrate causation? May it not be a short-run variation which will be evened out over a longer period of time?

The problem for the plaintiff in such cases, unless the plaintiff has large reserves of water, is that he must think in the short-run. A two-year decline in rainfall in some cultivated areas can be disastrous. But can he demonstrate that the decline is the result of cloud seeding taking place upwind of his property? Will the cloud seeder be able to take refuge in a statistical defense which may ignore very real cases of injury?

A not totally dissimilar problem is presented by the sudden disaster such as that occurring at Yuba City in 1955. A violent storm is a unique occurrence; however, one may demonstrate that such storms follow a periodicity of 10, 50, or 100 years. The Weather Bureau now essays to predict weather for five days and may improve this to 30 days in the foreseeable future. But it cannot predict the severity of a storm nor where the consequences are likely to be the most serious. If cloud seeding takes place during a storm pattern where it is likely to be effective and a severe storm ensues, to what extent is the cloud seeder responsible? No one is able to predict the severity or extent of the storm with any degree of accuracy and therefore it is difficult for those damaged by the storm to demonstrate the extent to which the cloud seeders are culpable.

A third question relates to the competence of a court to deal with issues of this kind without the benefit of administrative investigation and findings. There seems no reason to doubt the justice of the findings in this case but given the complex factual issues that are likely to come before the courts and the equally difficult issues of legal responsibility, there seems little question but that administrative proceedings based on the gradual acquisition of technical information and legal expertise will greatly assist the courts in assigning responsibility in cases of this kind.²²

Clearly related to this is the question of the statutory basis for administrative decision making. Legislation pending before Congress is designed to provide some public policy with regard to the operation of weather modification projects. S 373, (90th Congress, 1st session, 1967) contains language which would forbid weather modification operational activities which were designed to affect the atmosphere more than 150 miles from its source without advance notice being transmitted to Congress. In general, the proposed law encourages experimentation and authorizes various federal agencies to engage in studies regarding the circumstances under which the United States or private parties would be held liable for damages attributable to weather modification activities. It would further authorize extensive inquiries into the social and economic consequences of weather modification.

H.R. 5734 (90th Congress, 1st session, 1967) envisions a much expanded program of weather modification both at the experimental and operational levels and authorizes extensive programs and research centers. It would authorize the United States to compensate for injuries resulting from weather modification projects in the interest of encouraging experimentation. Perhaps the most far-reaching consequence would be a provision empowering the Secretary of the Interior to issue licenses, and to establish technical and financial qualifications of applicants. The Secretary would have extensive authority over the timing and extent of weather modification activities. This licensing power could probably effectively nullify state laws which regulate such activities.

In the State of California, there have been rumblings with regard to the public policy implications of weather modification activities. The Department of Water Resources considers that it has no discretion whatsoever with regard to the issuance of licenses. It cannot inquire into qualifications of applicants or the character of their operations. Hearings are provided only for revocation or suspension of licenses. Recognizing the highly experimental character of weather modification and the rapidly evolving technology, the State Legislature provided that the applicant be given a license but that the Department could revoke and suspend the license to protect the public. The reporting features of the statute provide the means by which the Department may inform itself concerning the character of the license holders and the nature of their operations.²³

It is perfectly clear that the publication of information in the newspapers concerning weather modification activities provides virtually no protection for those whose interests may be affected. Few persons are aware of the projects and few perceive any vital interest in the character of their operations. Moreover, they would be unlikely to take action to prevent or alter the character of these operations unless a real, immediate, and direct threat were evident. Essentially, this means that the ordinary citizen finds his interests protected only by expensive suits for damages once the damages have been caused. Only some system of public responsibility can provide this kind of protection.

Presumably the public has an equally vital interest in continued experimentation in weather modification. Indeed, in the West generally, there is a strong predisposition

in favor of anyone who can augment the water supply. To what extent does litigation of this kind point the way to new problems or new opportunities in this field?

One immediate and obvious concern on the part of the weather modification operators was the means of protecting oneself in the event of such litigation. During the course of this litigation, North American Weather Consultants lost its insurance which was subsequently restored. It appears that insurance companies insuring PG&E also raised questions about the desirability of continuing such risky operations.

Insuring those engaged in weather modification may contain no more elements of risk than insuring many other scientific enterprises, but there are elements of novelty and uncertainty which cause insurers not having familiarity with it to show considerable reluctance to provide coverage. Most firms are little interested in it because there is little volume of business, little history with regard to premiums or losses, and no basis for standardization of policies. Indeed, it requires a company with considerable proficiency and buying power in the insurance market to provide the base coverage and to go to Lloyds of London to provide the excess limits.

Litigation such as the *Adams* case stimulated the formation of the Weather Control Research Association, now called the Weather Modification Association (WMA), whose members are those engaged in weather modification activities. The WMA, under the leadership of Edward Morris, has been working toward attaining an insurance "package" which will be available on a standardized basis to all of its members. Such arrangements will facilitate the acquisition of insurance by the operators and will provide the insurers with confidence about the standards being followed by the practitioners.

According to one insurance official with some experience negotiating this kind of insurance, the WMA can improve the insurance buying power of its members by establishing standards of proficiency and ethics for its members. The threat of expulsion or censure by the Association might provide sufficient leverage to guarantee high professional standards. If public and private agencies elected to do business principally with its members, its capacity to raise professional standards would be greatly strengthened.

Indeed, this litigation may have had some effect in providing a greater impulse toward acquiring more reliable evidence on the results of weather modification programs. It is interesting, for example, that PG&E has undertaken on its own extensive experimental weather modification activity in the Lake Almanor area while closing down its other projects.²⁴ PG&E meteorologists express the view that the litigation caused PG&E to embark on randomized experiments in accordance with the recommendations of statisticians who raised objections. The company has intensified its measurement program to provide greater certainty about the quantities of water produced by the seeding operations. The goal is to know whether the technique is profitable but also to provide PG&E with better information in the event it is sued again for negligence.

Defense attorneys painted an extremely black picture of the consequences that a verdict for the plaintiff would have entrained for the future of weather modification. But it is not difficult to imagine a set of circumstances in which a weather modifier may be held liable for damages resulting from cloud seeding. Will such a decision spell the end of weather modification? Such a result is hardly likely. Rather, an adverse decision, like a threat of such in the *Adams* case, will probably stimulate even greater attention to standards of performance, control mechanisms, and measuring proficiency. All of which will stimulate scientific endeavor rather than retard it. Moreover, as one insurance executive expressed it, an adverse decision may scare off some insurance firms for a short time but will not permanently discourage coverage.

It will be noted that many of the issues stated by Judge MacMurray in the Pre-Trial Order were not actually considered in deciding this case. Whether these are important elements in future litigation can, therefore, not be seriously examined. Some of these related to contributory negligence or assumption of risk and involve the extent to which those damaged are responsible for the damage owing to their own actions, and the extent to which liability does not attach when those damaged have deliberately undertaken risks. In this case, the risk was in living in the shadow of levees rising over 20 ft in height, and where there was a history of flooding. The results of this case for the State of California would suggest that the assumption of risk argument is an inadequate defense.

PG&E argued in pre-trial memoranda that NAWC was an independent contractor, providing a service to PG&E. NAWC, according to PG&E, had operating control over the projects while PG&E exercised only supervisory powers. PG&E occasionally decided when the generators should be turned off and checked to see that the work was being carried on, but beyond these functions allowed NAWC to use its own judgment. Moreover, NAWC used its own equipment and personnel, performed a unique function based on its own skills, and charged for the jobs it performed. On these counts, PG&E asked the Court to absolve it of responsibility. NAWC did not contest this point because of the concern that prospective clients might believe that NAWC service to them would leave them open to similar lawsuits. The decision provides no information on this significant question for the cloud seeding companies.

Finally, note should be taken of the cost of this litigation for PG&E and NAWC. The cost of lost business to NAWC can never be calculated, but certain direct costs can be stated. Costs of preparation, attorneys fees, fees for expert witnesses, and the cost of settlement can be conservatively estimated in the neighborhood of \$300,000. It was probably higher and could have risen much higher had the trial court's decision been appealed. That PG&E and its insurers could withstand the cost of this case goes without saying, although such expenses even for a corporate giant like PG&E are not lightly assumed. The implications for NAWC were far more serious, holding out the possibility of its complete destruction.

Footnotes

¹ *Southwest Weather Research, Inc., et al. v. Jim Duncan et al.*, No. 5351, Court of Civil Appeals of Texas, El Paso, Nov 26, 1958.

² *Slutsky et al. v. City of New York*, 97 N. Y. Supp. 2d 238, May 11, 1950.

³ For a summary of these cases see report prepared by Howard Taubenfeld, Special Commission on Weather Modification, National Science Foundation, *Weather Modification: Law, Controls, Operations*, 1966.

⁴ State of California, Department of Water Resources, Division of Design and Construction, *Flood Flows and Stages in Sacramento and Northern San Joaquin Valleys, 1954-1956*, Bulletin No. 16, February, 1957.

⁵ U.S. Department of Commerce, Weather Bureau, *Monthly Weather Review*, "Flood Producing Rains in Northern and Central California, December 16-26, 1955" by Robert O. Cole and John P. Scanton.

⁶ Marysville-Yuba City *Appeal-Democrat*, various issues January-March 1956.

⁷ *Ibid.*, March 29, 1956.

⁸ *Ibid.*, March 31, 1956.

⁹ *Ibid.*, March 6, 1956.

¹⁰ Pacific Gas and Electric Company, *Report on the High Sierras Cloud Seeding Projects*, Winter 1955-56, September 25, 1956.

¹¹ Pacific Gas and Electric Company, Meteorological Office, *1953-1958 Report on Five Years of Cloud Seeding Operations Over High Sierra Watersheds*, 1958.

¹² U.S. Department of Commerce, *loc. cit.*

¹³ Transcript, *Pre-Trial Conference*, August 22, 1960.

¹⁴ *Ibid.*, August 14-15, 1963.

¹⁵ 55 C.2d, 211, 213, 11 C.R. 89, 359 P.2d 457.

¹⁶ 56 C.2d 603, 611, 15 C.R. 904, 364 P.2d 840.

¹⁷ 212 C.A. 2d. 345, 357, 364, 28 C.R. 357.

¹⁸ William L. Prosser, *Law of Torts*, St. Paul, Minnesota, West Publishing Company, 1964, p. 527, citing Paragraph 520, *Restatement of the Law of Torts*, Vol. III, American Law Institute Publishers, St. Paul, 1938.

¹⁹ *Legal Report on Liabilities Involved in Creation of Artificial Rainfall and Powers of the State to Regulate the Same*, Appendix I, August, 1950, and November, 1953, p. 1-23.

²⁰ *Adams et al. v. State of California et al.*, Docket No. 10112, Sutter County Superior Court, April 6, 1964.

²¹ See Howard J. Taubenfeld, National Science Foundation, Special Commission on Weather Modification, *Weather Modification: Law, Controls, Operations*, 1966.

²² For a discussion of some of these alternatives, see Fremont J. Lyden and George A. Shipman, "Public Policy Issues Raised by Weather Modification: Possible Alternative Strategies for Government Action," in W. R. Derrick, ed., *Human Dimensions of Weather Modification*, Department of Geography Research Paper No. 105, University of Chicago, Chicago, 1966, pp. 289-303.

²³ Information supplied by the Department of Water Resources, The Resources Agency, as of March 20, 1967.

²⁴ See Donald L. Eberly, "Weather Modification and the Operations of an Electric Power Utility: The Pacific Gas and Electric Company's Test Program" in Sewell, *op. cit.*, pp. 209-226.

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3. State of California, Department of Public Works, Division of Water Resources, *Floods of December, 1955 in California*, January, 1956.
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12. Interviews with:
 1. Edward Morris, Esq., Bronson, Bronson & McKinnon, San Francisco, Calif.
 2. Reginald Watt, Esq., Chico, Calif.
 3. Frances Carr, Esq., Perkins, Carr and Anderson, Sacramento, Calif.
 4. Clarke Gaines, Esq., Price, Postel and Parma, Santa Barbara, Calif.
 5. Gary Ricks, Esq., formerly of Bronson, Bronson, and McKinnon, San Francisco, now of Price, Postel and Parma, Santa Barbara, Calif.
 6. Judge John P. MacMurray, Inyo County, Independence, Calif.
 7. Robert Elliott, North American Weather Consultants, Santa Barbara, Calif.
 8. Leon Hunsaker, meteorologist, Pacific Gas and Electric, San Francisco, Calif.
 9. Charles P. Smith, Pres. & Gen. Manager of Pacific Gas Transmission Co.
 10. Gavin Craig, Chief Counsel, California Water Rights Board, Sacramento, Calif.
 11. Verne Cline, Dept. of Water Resources, Sacramento, Calif.
 12. Robin Reynolds, Dept. of Water Resources, Sacramento, Calif.
 13. Jack Wright, Marsh and McClennon, San Francisco, Calif.
 14. Ten plaintiffs presently residing in Yuba City, Calif.