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Roar, the Whine, the Boom and the Law: Some Legal Concerns about the SST

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Propeller driven airplanes are noisy, jets are noisier still and supersonic jets may be the noisiest of all. The first commercial jet flight in the United States occurred in October of 1958, and now jets constitute the largest number of aircraft used by commercial airlines.\(^1\) About eleven years earlier (October, 1947), the first reported sonic boom had been created by a military aircraft which exceeded the speed of sound during a test flight.\(^2\) Even so, the possibility of a commercial supersonic transport (SST) was not seriously considered by the aviation industry until 1959.\(^3\) The law, however, had anticipated science and the first legal article dealing with the sonic boom had already appeared in 1958.\(^4\)

The operation of commercial jet transports and the prospects of a commercial supersonic transport have increased public concern about rising noise levels near airports and about sonic booms at

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\(^{2}\) E. Emme, Aeronautics and Astronautics 58 (1961).


places far distant from airports. Former President Lyndon B. Johnson described excessive aircraft noise as an "environmental pollutant" and called upon the heads of departments and agencies to do something about it. A newspaper article attributes the term "decibel pollution" to the Public Health Service and views with alarm the possible harmful effects to public health from the wide variety of noisemakers, including jet aircraft, which assail the human ear.

It is indeed true that we are exposed to a great deal of noise. A few examples will serve to emphasize the point. Sound is measured in decibels and the level of normal conversation at three feet is 65 decibels. A food blender in the home may generate 93 decibels; a subway 95; an outboard motor 102; a power mower 107; and a jet plane taking-off 150. Researchers have killed mice with 175 decibels and lengthy exposure to industrial noise at 80 decibels has caused hearing loss; a daily exposure to 105 decibels will eventually cause hearing loss to everyone so exposed. Rock and roll establishments peak at 100 to 115 decibels. Motorcycles, power saws and snowmobiles also assault the ear with terrible intensity, and the din shows no sign of abating.

Noise is defined as "unwanted sound"—a subjective test. The inclusion in the previous paragraph of such ordinary items as blenders, outboard motors, power mowers and power saws suggests that we are all willing to put up with very loud sounds if the sound-source is otherwise advantageous to us. The loud sound then is not considered to be a noise; it is welcomed, or tolerated, as the by-product of a labor-saving device or as a form of entertainment in itself. Rock and roll music is a delight to teenagers while it is literally deafening to many adults. One man's music may well be another man's earache.

The public balances utility, or desirability, against accompanying noise in accepting, or rejecting, many appliances and machines

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5 Memorandum from President Lyndon B. Johnson to Heads of Departments and Agencies, Mar. 22, 1967.
7 Noise—The Fourth Pollution, 3 HEALTH SERVICES WORLD, July-Aug., 1968 at 18.
8 OFFICE OF SCIENCE AND TECHNOLOGY, EXECUTIVE OFFICE OF THE PRESIDENT, THE ALLEVIATION OF JET AIRCRAFT NOISE NEAR AIRPORTS 13 (1966) [hereinafter referred to as O.S.T. REPORT].
9 In Griggs v. Allegheny County, 369 U.S. 84 (1962), a leading case in this field, Mr. Griggs recovered a substantial amount because his home was made uninhabitable by the noise from a nearby airport. He later sold the property to an Episcopal Church whose congregation has since been bothered only a few times on Sunday mornings. On those occasions the pastor says that "we simply stop and say a little silent prayer for the pilot." The Age of Noise, TIME, Mar. 16, 1962, at 65.
found in daily use. Widespread use of a noisy device indicates public acceptance. It should be noted that courts have often used a similar balancing in cases involving competing interests. Courts, however, generally balance private interests against the public interest and decide on a course of action favorable to the latter. Noise, including aircraft noise, has been and will continue to be treated in this manner in litigation. Some noise from jet aircraft is unavoidable and such noise will usually be held acceptable in the public interest.

It has been suggested that the noise level created by the operation of an SST will be unacceptable. Among other things, we are told that a transcontinental SST may create a sonic boom more than fifty miles wide running the entire length of the United States, wreaking property damage and general havoc as it flies. After a brief discussion of the SST program in Congress, this article will be concerned with the legal ramifications of the operation of the SST at airports and while in flight.

THE SST PROGRAM AND CONGRESS

Formal interest in the development of a commercial SST program for the United States did not begin until early 1960 when the Bureau of Flight Standards of the Federal Aviation Agency (FAA) established a Supersonic Transport Group to study the airworthiness, operations and maintenance standards of the SST. The group submitted its report to the FAA on March 20, 1961. Although not presenting a specific program for adoption, the report strongly recommended continued study by government and industry to identify, minimize or resolve problems dealing with sonic booms, supersonic aircraft design and operational standards. The report also explored possible bases for a government-industry relationship in the development of an SST.

In November of 1961, the FAA created the Supersonic Transport Advisory Group (composed of private citizens) which was to recommend a specific program for the SST. Their report of December, 1962, advised the FAA to urge that the federal government participate with industry in research leading to the development of a commercial SST. A supplementary report from the Group sug-

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gested certain bases upon which a workable relationship between
government and industry could be achieved in the development,
operation and use of the SST.\textsuperscript{13}

Concurrently, Congress, motivated by considerations of the
prestige which inheres in aeronautical superiority and the effect
upon the balance of payments if we failed to develop an SST to
compete on the world market, was exploring the need for an SST.\textsuperscript{14}
Although the United States already had military aircraft with super-
sonic capabilities, it was apparent that the aircraft were not designed
to be converted to civil commercial transport, nor susceptible to
such conversion.\textsuperscript{15}

On June 5, 1963, President John F. Kennedy, in an address at
the United States Air Force Academy, declared that the govern-
ment would proceed to develop an SST with private industry.\textsuperscript{16}
Later that month the President sought a commitment of sixty mil-
lion dollars to finance the initial phase of the SST development\textsuperscript{17}—
designing the aircraft. Shortly thereafter, Congress granted the
request for funds.\textsuperscript{18}

In August of 1963, the FAA undertook the program for the
development of the SST, with the announced objectives of develop-
ing a transport with:

a) operational characteristics which will insure maximum safety and
adaptability to airport communities and air routes of the world.

b) economic characteristics equal to, or better than, current subsonic
jet transports now engaged in transcontinental and international
operations.\textsuperscript{19}

The first step in this program was to invite industry to partic-
iperate with government in the actual development and manufacture
of an SST. Accordingly, the FAA issued its Request for Proposals
for the Development of a Commercial Supersonic Transport, dated

\textsuperscript{13} FAA, Supersonic Transport Advisory Group, Supplementary Report (May,
1963).

\textsuperscript{14} See \textit{House Comm. on Science and Astronautics, Supersonic Air Transports},
H.R. Rep. No. 2041, 86th Cong., 2d Sess. (Jun. 30, 1960); \textit{see also Hearings on
"Supersonic Air Transports" Before a Subcomm. of the House Comm. on Science and

\textsuperscript{15} See \textit{Hearings on "Supersonic Air Transports" Before a Subcomm. of the House

\textsuperscript{16} \textit{Public Papers of the Presidents, John F. Kennedy}, 1963, at 439, 440-41
(1964).

\textsuperscript{17} \textit{Id.} at 475-77.

\textsuperscript{18} \textit{Congress Provides $60 Million For Supersonic Transport, 1963 Cong. Q. Al-
manac} 502.

\textsuperscript{19} FAA, Request for Proposals for the Development of a Commercial Supersonic
August 15, 1963. The concern of the government at that time, as it has been throughout the program, appeared to be two-fold; namely, the necessity for the United States to develop an SST, and the need for governmental assistance to the aviation industry for research and development to that end.

While industry was seeking to develop the design for the transport, two federal agencies (National Aeronautics and Space Administration (NASA) and the FAA) were assigned prime responsibility for the implementation of the total program. As described in hearings before the House Appropriations Committee:

The NASA role in the national supersonic transport program is to provide the underlying technology which will be required to construct a supersonic transport which is economically attractive to our airlines. The role of FAA is that of developing the supersonic transport based on this technology.20

It should be noted that notwithstanding these repeated commitments to an SST, the actual program contained safeguards, dealing with costs, which might stop further development. If the ultimate construction costs were to make the sale price prohibitive, then the program for development of the SST would be terminated.21 Certainly, if no private manufacturer were willing to undertake actual production, the program would likewise be halted.

The subsequent history of the competition by private manufacturers for SST contracts, and the method of selection of the contractors for the airframe (awarded to Boeing Company22) and the engine (awarded to General Electric Company23) is of little moment. What is significant, however, is the commitment by the United States government to develop the SST, and to participate in a unique contract with industry in which the government not only is to subsidize the development of the commercial SST, but is also to share royalties on sales of aircraft and aircraft parts under certain conditions.24

The SST developmental program has drawn criticism25 and has

23 Id.
25 E.g., 179 Cong. Rec. 14550 (daily ed. Nov. 3, 1966) (remarks of Representa-
even resulted in the formation of a private citizen’s protest group known as the Civic League Against the Sonic Boom. Criticism has ranged from concern over the irreparable damage that might be caused by sonic booms (a concern arising from the concept that the injured party will have no way of knowing or proving that a particular aircraft is responsible for the damage) to the question of the right to be free from unreasonable, high decibel level noises. Inevitably, opponents of the SST have also challenged the justification for government spending in this program when other needs seemed to be more demanding.

Objectors to the SST and others did launch a successful attack on the noise levels which accompany current jet traffic, and those foreseen for the proposed SST. The culmination of their efforts occurred in the Summer of 1968 when Congress amended the Federal Aviation Act of 1958 in order “[to] afford present and future relief and protection to the public from unnecessary aircraft noise and sonic boom.” This statute requires the Administrator of the FAA, after consultation with the Secretary of Transportation, to prescribe and amend standards for the measurement of aircraft noise and sonic boom, and to promulgate appropriate rules and regulations for the control and abatement thereof.

There was little doubt that the bill would be favorably acted upon by Congress since the testimony appeared uncontradicted that it was in the national interest to abate noise arising from aircraft operations. Members of Congress, representatives of federal agencies, city and county associations, airport operators, aircraft associations, transport associations, as well as critics of the SST program all joined in urging the passage of this bill. In fact, the measure passed in the House 312-0 and by voice vote in the Senate. Perhaps more significant, however, is the number of amendments

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26 The group, headed by Dr. William Shurcliff, has its headquarters in Cambridge, Massachusetts.
31 Id.
and varying legislative proposals relating to noise abatement and SST development which were offered but yielded to the final bill.

One amendment, by Representative Lester L. Wolff (D-N.Y.), would have prohibited commercial aircraft flights over land areas in the United States until the sonic boom problem had been solved; but the amendment was rejected. Another amendment, co-sponsored by Senators Clifford P. Case (R-N.J.) and William Proxmire (D-Wis.), provided for a two-year scientific investigation of the sonic boom and its effects to be conducted by the FAA in consultation with seven federal departments and agencies. It would also have banned all non-military flights at supersonic speeds over the United States, its territories and possessions (except those performed in connection with the government study), until Congress, after reviewing the results of the investigation, determined whether the prohibition against supersonic overflights should be continued. This amendment was defeated in the Senate.

Other bills introduced in the Ninetieth Congress dealing with noise abatement and the SST included bills which authorized the federal government to reimburse: (1) air carriers for expenses they incurred in modifying or purchasing aircraft designed to comply with government noise regulation, (2) airport owners or operators for costs of modifying airports to comply with government noise regulations and (3) states or municipalities for costs of acquiring land surrounding airports in order to reduce the effects of noise. These bills, along with others, also contained provisions authorizing the establishment of noise abatement rules and regulations. There were also bills which proposed provisions for the conduct of noise research by the Department of Transportation. It appears, however, that such authority already exists in sections 307 and 312 of the Federal Aviation Act of 1958, and the research is in fact being conducted. Still another bill proposed an amendment to the Federal Airport Act to permit grant-in-aid funds to be applied to projects for the control of jet aircraft-created noise in classrooms of schools in close proximity to public airports.

Two bills which mounted a more serious attack upon the SST were proposed by Representative Roman C. Pucinski (D-Ill.). The first would have amended the Federal Aviation Act of 1958, to prescribe specifically the liability of the United States for “Taking of Easements in Navigable Airspace.” The bill stated:

The United States shall be liable in any case in which it is established (1) that an easement in airspace has been taken as the result of the operation of aircraft in accordance with air traffic rules prescribed by the Administrator governing the navigation of aircraft through the navigable airspace of the United States and (2) the person entitled thereto has not received just compensation for the taking of such easement.

The courts have never held that the United States Government can be sued for a “taking” caused by a flight merely because the flight has occurred in accordance with rules and regulations prescribed by the federal agencies. Apparently Congress has not chosen to include such a standard in our aeronautics program.

The second proposal attempted to amend section 610 of the Federal Aviation Act of 1958 to establish minimum standards for the operation of civil supersonic aircraft through the navigable airspace of the United States by adding the following:

c) It shall be unlawful to operate any civil supersonic aircraft in air transportation through navigable airspace of the United States which would generate sonic boom overpressures exceeding one and five-tenths pounds per square foot on the ground directly beneath the flight path.

d) It shall be unlawful to operate any civil supersonic aircraft into or out of the United States airports unless it can be demonstrated that ground noise level generated by such civil supersonic aircraft is substantially lower than that generated by long-range subsonic jet aircraft . . .

One other approach to the SST program was a proposal to establish a private, non-governmental corporation, subsequent to the development of the SST, to be responsible for the commercial production and sale of the airplane. The failure of the bill to pass leaves the commercial production and sale as an eventual responsibility of the aviation industry, with the government merely sharing on a specified royalty basis.

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46 See p. 200 infra.
Already in the Ninety-First Congress, on February 7, 1969, Senator Jacob Javits (R-N.Y.) on behalf of Senator Clifford Case (R-N.J.) introduced a bill\(^4\) which appears to parallel the defeated proposed amendment of 1968 imposing a two-year ban on non-military flights over the United States (its territories and possessions), if the flight is to be operated in such a way as to produce sonic booms. The ban would except flights involved in a study, by the FAA and other agencies,\(^5\) to determine the levels of exposure to sonic boom which are detrimental to the health and welfare of any persons.

The most significant factor affecting the timetable and the current status of the SST program was the pronouncement by President Richard M. Nixon during his first month in office, directing the Department of Transportation to establish a committee to investigate all aspects of the SST program.\(^5\)

It seems certain that eventually there will be a commercial SST. It may be delayed, or postponed, but the national commitment in terms of public and private effort makes abandonment unlikely. Therefore, a review of applicable law, actual and potential, is in order.

**AIRPORT AND AIRCRAFT NOISE**

*Private Remedies*

Of the many legal questions presented by aircraft and airports, ambient noise has been most discussed and most litigated. Legal literature abounds in cases and articles forming an impressive array of precedents for any litigation which may now arise.\(^6\)

The noise problems of the supersonic transport fall naturally into two distinct categories. One is the noise ordinarily associated with jet aircraft (the roar of the exhaust and the whine of the compressor), the other is the sonic boom or shock wave. They are quite different.

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The courts have heretofore allowed suits for airport and aircraft noise on three different theories: trespass, nuisance and a "taking" of the plaintiff's property. The actions have appeared as petitions to enjoin the sound-source and as suits for damage caused by the sound.

Classically, trespass is a physical invasion of another's possessory interest in property. Airport noise involving the take-off and landing of aircraft may reach a neighbor merely because of horizontal proximity. It is difficult to visualize such lateral propagation of sound waves as a physical invasion of a possessory interest in real property. In-flight engine noise may reach people on the ground when aircraft engage in overflight or in nearby lateral flight. The trespass cases have ordinarily involved noise from overflight and the plaintiffs have usually relied on the maxim "cujus est solum ejus est usque ad coelum," the owner of the land owns the airspace to the sky above.

The validity of the theory of trespass has been seriously impugned by United States v. Causby and section 104 of the Federal Aviation Act of 1958. In Causby, the Supreme Court said:

It is ancient doctrine that at common law ownership of the land extended to the periphery of the universe—Cujus est solum ejus est usque ad coelum. But that doctrine has no place in the modern world. The air is a public highway, as Congress has declared. Were that not true, every transcontinental flight would subject the operator to countless trespass suits. Common sense revolts at the idea.

This is a formal holding endorsing the same view earlier expressed by Mr. Justice Jackson in a concurring opinion.

Today the landowner no more possesses a vertical control of all the air above him than a shore owner possesses horizontal control of all the sea before him. The air is too precious as an open highway to permit it to be "owned" to the exclusion or embarrassment of air navigation by surface landlords who could put it to little real use.

Since 1958, congressional policy in this matter has existed in statutory form. The Federal Aviation Act recognizes that every citizen of the United States has "a public right of freedom of transit

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53 McPheeters v. Loomis, 125 Conn. 526, —, 7 A.2d 437, 440 (1939).
55 328 U.S. 256 (1946).
57 328 U.S. at 260-61 (footnote omitted).
through the navigable airspace of the United States.\textsuperscript{59} Navigable airspace is defined as "airspace above the minimum altitudes of flight prescribed by regulations issued under this chapter, and shall include airspace needed to insure safety in take-off and landing of aircraft."\textsuperscript{60}

It seems reasonably clear that trespass to airspace can be maintained only if there is flight, in the airspace immediately above the land, interfering unreasonably with the landowner's use and enjoyment of his property.\textsuperscript{61} Supersonic aircraft will not offend in these respects any more, or any less, than other jet aircraft. In take-off and landing operations, the supersonic aircraft will operate at subsonic speeds and will be operationally indistinguishable from other jets. Since it will fly at a much higher altitude, its "ordinary" in-flight engine noises will be even less discernible than that of other jets. The SST will not trespass physically nor through its engine noise anymore than jets in current operation.

Another avenue of potential recovery in aircraft noise suits is the theory of nuisance.\textsuperscript{62} The basis for the action is that the defendant has interfered with the plaintiff's use and enjoyment of his property and that the plaintiff ought, therefore, to be compensated. It should be noted here that most of the noise suits are predicated on more than one theory, e.g., trespass and nuisance; and that plaintiffs usually seek injunctive relief or, alternatively, money damages. However, no case has been found where a court has enjoined the operation of a publicly owned and publicly operated airport.\textsuperscript{63}

Here, as in other nuisance cases, the court weighs the plaintiff's interest in the quiet enjoyment of his property against the interests of the defendant and the general public in the airport and in air transportation. Another factor entering the case at this point is that public airports are very often operated under statutory authority. Normally, it is also true that commercial airliners using the facility are licensed to operate by appropriate government authority. In this situation the courts usually find that the nuisance, if there be one, has been "legalized." This means simply that conduct which constitutes a nuisance has been excepted from that invidious category and has been made lawful by legislative fiat. Activities which result in a legalized nuisance in the sense just described are no

\textsuperscript{60} Id. § 1301(24).
\textsuperscript{63} Id.
longer actionable under the nuisance theory. While the application
of this doctrine varies from state to state, it has been followed quite
frequently when the issue has been raised.\textsuperscript{64}

The nuisance theory has had little success in noise cases in-
volving both propeller and ordinary jet aircraft and public airports
servicing such aircraft. It seems unlikely that the theory will be
more successful when applied to subsonic operations of the SST.

Airport and aircraft noise litigation has most frequently been
based on a theory of unconstitutional "taking." The plaintiff usually
alleges that the airport owner has taken (inversely condemned) the
plaintiff's property by causing noisy flights to be made over it. The
fifth and fourteenth amendments, and similar state constitutional
provisions, then require that the plaintiff be fairly compensated for
his loss.

In \textit{United States v. Causby},\textsuperscript{65} the Supreme Court stated:
"Flights over private land are not a taking, unless they are so low
and so frequent as to be a direct and immediate interference with
the enjoyment and use of the land."\textsuperscript{66} In that case, overflights con-
stituted a taking because altitude and frequency were such that some
150 frightened chickens had killed themselves by flying into the
walls, thus destroying "the use of the property as a commercial
chicken farm."\textsuperscript{67}

In \textit{Griggs v. Allegheny County},\textsuperscript{68} sixteen years later, the Su-
preme Court again found a taking of the plaintiffs' property where
flights over their country home at heights of thirty to three hundred
feet were "regular and almost continuous"\textsuperscript{69} and had made the home
"undesirable and unbearable for their residential use."\textsuperscript{70}

It is important to note that in both cases low, frequent over-
flights were proved, or alleged without contradiction. In both cases
the occupants abandoned their property because of the overflights;
and in both cases the Supreme Court made it clear that a taking
resulted because the plaintiffs' properties were rendered unfit for the

\textsuperscript{64} O.S.T. REPORT at 125; see, e.g., Richards v. Washington Terminal Co., 233
U.S. 546 (1914).

\textsuperscript{65} 328 U.S. 256 (1946).

\textsuperscript{66} Id. at 266.

\textsuperscript{67} Id. at 259.

\textsuperscript{68} 369 U.S. 84 (1962).

\textsuperscript{69} Id. at 87.

\textsuperscript{70} Id.; but see Batten v. United States, 306 F.2d 580 (10th Cir. 1962), cert.
County in Perspective: Thirty Years of Supreme Court Expropriation Law}, 1962
\textit{THE SUPREME COURT REVIEW} 63.
uses to which they were being put. The cases illustrate the decreasing emphasis placed on physical taking by the courts. This probably results from a recognition that property interests are in fact a conglomerate of intangibles, e.g. rights, privileges and powers with respect to an object.\(^{71}\)

Decisions on the “taking” theory may also arise in state courts since every state constitution requires compensation for the taking of a person’s property. The state constitutional provisions show minor deviations in language, but where the issue has arisen, the state courts have held that a “taking” in the constitutional sense occurs only when the plaintiff has been substantially deprived of the use of his property. The language of *Thornburg v. Port of Portland*\(^{72}\) is apt and typical.

The idea that must be expressed to the jury is that before the plaintiff may recover for a taking of his property he must show by the necessary proof that the activities of the government are unreasonably interfering with his use of his property, and in so substantial a way as to deprive him of the practical enjoyment of his land.\(^{73}\)

As previously indicated, the taking cases have usually dealt with low and frequent overflights and the emphasis in the judicial opinions has been on the fact that such overflying has made the plaintiff’s property uninhabitable and unusable. In this context, the *Thornburg* opinion deserves closer scrutiny since the court there held that a noise-nuisance can amount to a taking without overflights.\(^{74}\)

In *Thornburg*, the Supreme Court of Oregon held, in a very close decision (4-3), that evidence of frequent nearby lateral flights had been erroneously excluded by the trial judge. The court said that a nuisance may constitute a taking whenever “a possessor is in fact ousted from the enjoyment of his land.”\(^{75}\)

The court explained that if the noise problem were treated as a nuisance rather than a trespass, the jury could balance the harm to the plaintiff’s interest against the community benefits flowing from the operation of the airport.\(^{76}\) Thus the court’s ruling liberalizes the introduction of evidence for both plaintiff and defendant.

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\(^{71}\) Dunham, *supra* note 70, at 82.


\(^{73}\) *Id.* at 104, 376 P.2d at 110.

\(^{74}\) *Id.* at 106-07, 376 P.2d at 107. However, a review of earlier cases demonstrates that, in the last decade, damages have been awarded in only two cases where the overflights were at a height greater than 200 feet. *O.S.T. Report* at 127.

\(^{75}\) 233 Ore. at 105, 376 P.2d at 105.

\(^{76}\) *Id.* at 107, 376 P.2d at 107.
This seems certain to focus the jury’s attention on the public interest more sharply than would be usual in a "taking" case. It is significant to note that the jury awarded no damages to the plaintiffs on remand.\textsuperscript{77}

The dissenters vigorously pointed out that the court’s opinion erased the distinction between trespass and nuisance,\textsuperscript{78} and that the abrogation of this distinction was for the legislature rather than the court.\textsuperscript{79} They stated that the majority holding that evidence of lateral flights was admissible evidence in an action for taking was without precedent. The dissent concluded that the plaintiffs could have sued in nuisance for damages, but having elected to sue on the theory of a "taking" of their property, plaintiffs were bound by the eminently correct decision of the trial court.\textsuperscript{80} They did agree with the majority that the plaintiffs must show a substantial interference with their property rights in order to obtain relief under any theory.\textsuperscript{81}

Twenty-one states have so-called "damaging" provisions in their constitutions designed to compensate private parties for injuries to property not amounting to a taking.\textsuperscript{82} The Washington constitutional damaging provision\textsuperscript{83} has been established as the basis for a decision of great significance to the aviation industry. In \textit{Martin v. Port of Seattle},\textsuperscript{84} 196 plaintiffs living within sixteen blocks of the Seattle-Tacoma Airport brought suit against the Port of Seattle as owner-operator of the airport. The plaintiffs alleged "taking" in the constitutional sense by reason of noise from frequent low overflights and also "damaging" within the terms of the Washington Constitution.

The only issue originally tried before the judge was liability—damages being reserved for subsequent jury trials. The trial judge held the Port liable to all plaintiffs without distinguishing the varying degrees in which the defendant had interfered with the plaintiffs' use of their respective properties. In a soaring flight of judicial interpretation he said that in \textit{Causby} and \textit{Griggs}:

\textit{[T]he United States Supreme Court has held that it is contrary to the provisions of the fourteenth amendment for any government operating

\begin{footnotesize}
\textsuperscript{77} O.S.T. \textit{Report} at 127.
\textsuperscript{78} 233 Ore. at —, 376 P.2d at 113-16.
\textsuperscript{79} \textit{Id.} at —, 376 P.2d at 116.
\textsuperscript{80} \textit{Id.} at —, 376 P.2d at 116-17.
\textsuperscript{81} \textit{Id.} at —, 376 P.2d at 115.
\textsuperscript{82} LEGISLATIVE DRAFTING RESEARCH FUND OF COLUMBIA UNIVERSITY, INDEX DIGEST OF STATE CONSTITUTIONS 464 (2d ed. 1959).
\textsuperscript{83} "No private property shall be taken or damaged for public or private use without just compensation having been first made, or paid into court for the owner . . . ." WASH. \textit{CONST.} art. 1, § 16 (amendment 9) (emphasis added).
\end{footnotesize}
an airfield to not condemn and pay for reasonable use of air space adjacent to airports.\textsuperscript{85}

The Supreme Court of Washington heard the appeal \textit{en banc}. In an opinion which ignored the lower court’s clearly erroneous interpretation of \textit{Causby} and \textit{Griggs}, the supreme court affirmed the decision below. Placing heavy reliance on the constitutional damaging clause, it held that the owner-operator was liable for all damage suffered by any of the plaintiffs from aircraft operations. Damage was defined as a depreciation in the market value of plaintiffs’ real estate resulting from the operation of jet aircraft.\textsuperscript{86}

This is a far cry from the substantial interference with the plaintiffs’ property required in the “taking” cases and, in fact, the Washington Supreme Court expressly rejected substantial interference as an injury criterion in this case.\textsuperscript{87} The court seemed to feel that inverse condemnation and direct condemnation were subject to evaluation with the same measures.\textsuperscript{88} Since in direct condemnation the state must pay whatever damages are assessed regardless of the extent of the injury or the substantiality of the defendant’s interference, the same yardstick should be applied to inverse condemnation by constitutional “taking” or “damaging.” Here, therefore, minor damage may be recoverable.

However, the court’s reasoning ignores the fact that inverse and direct condemnation, as the labels imply, present different sides of the same coin. In direct condemnation, a public body has made a deliberate, formal decision that the plaintiff’s property is necessary for a public use. In inverse condemnation, the public body has either made no decision at all with respect to plaintiff’s property, or it has decided that it is not needed for a public use. When inverse condemnation occurs, the court forces the public body to reverse its former decision, or to come to an entirely new decision and to expend tax money for the plaintiff’s property.\textsuperscript{89} Law and logic do not demand that both kinds of condemnation be treated alike. It would not seem to be unfair to require that the party seeking inverse condemnation prove substantial interference by the condemnor with his use and enjoyment of his property.

Although it seems that Washington “taking” cases will still

\textsuperscript{85} Martin v. Port of Seattle, Civ. No. 560219 (King County Super. Ct., Wash., Oct. 5, 1962).
\textsuperscript{86} Martin v. Port of Seattle, 64 Wash. 2d 309, —, 391 P.2d 540, 547 (1964); see O.S.T. REPORT at 129.
\textsuperscript{87} 64 Wash. 2d at —, 391 P.2d at 546; see O.S.T. REPORT at 129.
\textsuperscript{88} 64 Wash. 2d at —, 391 P.2d at 547; see O.S.T. REPORT at 129.
\textsuperscript{89} See Van Alstyne, \textit{Modernizing Inverse Condemnation: A Legislative Prospectus}, 8 \textit{Santa Clara Law.} 1 (1967).
follow the general rule that substantial interference with property is required, 90 Martin continues to stand for an easier rule in constitutional damaging cases. The decision is an economically important one to airport operators.

Municipal Ordinances

Thus far this discussion has been limited to the forms of relief theoretically available to private parties who claim injury from airport and aircraft noise. However, municipalities have also sought to abate such noise by enacting appropriate legislation 91 in the interest of the peace and quiet of their citizens. These ordinances have in turn provoked airport operators and airlines into affirmative countermeasures. The ordinances and the cases merit close scrutiny.

At least four municipalities in the United States have enacted ordinances designed to suppress airport and aircraft noise. Some approach the problem by regulating the altitude at which aircraft may fly over the city or town. 92 Some prescribe permissible noise levels at varying distances from the runways, such levels usually being expressed in decibels (db) or perceived noise decibels (PNdb). 93 The ordinances vary greatly in complexity and only one, the simplest of the lot, is specifically directed at supersonic transport and the sonic boom. 94 Fines are the normal penalty, although imprisonment is a possibility under one ordinance. 95 One airport operator has joined the fray by setting maximum noise levels as operating conditions at its airport. 96 Another has passed an anti-noise resolution which has a strongly hortatory tone. 97

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91 In the past, airport zoning ordinances have sought to impose height and use restrictions on adjoining landowners for the benefit of airport operators. See Seago, The Airport Noise Problem and Airport Zoning, 28 Mo. L. Rev. 120 (1968); Note, The Validity of Airport Zoning Ordinances, 1965 DUKE L.J. 792; Comment, Airport Approach Zoning: Ad Coelum Rejuvenated, 12 U.C.L.A. L. REV. 1451 (1965). The ordinances discussed in these pages, however, seek to enforce noise suppression at the airport site for the benefit of the neighbors.
92 E.g., Audubon Park, Ky., Ordinance 4, § 1 (Series 1967), Nov. 20, 1967. "It shall be unlawful for any person . . . or business entity to fly, operate, or in any manner participate or engage in the flight or operation of any aircraft over the . . . City at a height of less than seven hundred and fifty (750) feet."
93 E.g., Park Ridge, Ill., Ordinance 64-2, § 2(c), Jan. 7, 1964. "A noise heard, measured, registered and recorded . . . more than 87 decibels in intensity shall be and is hereby declared to be an unusually loud noise and is prohibited, provided however, that if the said noise is made or created by an aircraft in flight over . . . an airport runway extension, such noise so heard . . . of more than 95 decibels in intensity shall be . . . declared to be an unusually loud noise and is prohibited."
94 Santa Barbara, Cal., Ordinance 3246, Sept. 26, 1967.
96 See Port of New York Authority regulation in 1967 COMM. PRINT at 104.
97 Board of Airport Commissioners, City of Los Angeles, Resolution 2059, Sept. 25, 1963.
Airport and airline operators have sought the aid of the courts to prevent enforcement of altitude and anti-noise ordinances. The two types of ordinances are aimed at the same thing: noise. By setting a "floor" below which aircraft cannot fly over the municipal limits, the altitude ordinance alleviates the noise distress of the people below. Similarly, by setting maximum noise levels, the other ordinances effectively set the altitudes at which airplanes can approach the airport. Important and illustrative cases are: Allegheny Airlines v. Village of Cedarhurst; American Airlines v. City of Audubon Park; and American Airlines v. Town of Hempstead.

In the Cedarhurst case, the airlines sought to enjoin enforcement of the ordinance which prohibited overflight at an altitude of less than 1000 feet. After extended litigation, the petitioner prevailed and the village was denied the right to enforce its ordinance.

In Audubon Park, a federal district court permanently enjoined the enforcement of a 750 foot minimum altitude ordinance enacted by a suburb of Louisville, Kentucky.

The anti-noise ordinance in the Hempstead case involved New York City's John F. Kennedy International Airport, perhaps the largest and busiest airport in the nation and certainly one of the most important. The plaintiffs were nine major certificated United States air carriers, the Port of New York Authority (operator of Kennedy Airport), the Air Lines Pilots Association, International, its president, and three other pilots as representatives of their class. The defendants were Hempstead and seven of its officials in their official capacities. The Administrator of the FAA intervened and supported the plaintiffs' motions for a preliminary injunction.

The great importance of the airport and the large number of people affected by its noise presented a hard case. As the Court of Appeals was to say later:

The Town of Hempstead, primarily residential, is the largest town in New York State, with an estimated population in 1963 of nearly 806,000. It lies to the east of John F. Kennedy International Airport ("JFK"), and it is estimated that 150,000 people live in its incorporated villages which lie within three miles of the Airport. These people share with many others ... a severe aircraft noise problem ...
... The District Court found that: "There is credible evidence that the noise of an aircraft overflight in Hempstead is frequently intense enough to interrupt sleep, conversation and the conduct of religious services, and to submerge for the duration of the maximum noise part of the overflight the sound of radio, phonograph and television. . . ."

"There is credible evidence that the noise of an aircraft overflight in Hempstead is frequently intense enough to interrupt classroom activities in schools and to be a source of discomfort to the ill and distraction to the well. . . ."

"It is a fair inference . . . that airplane noise is a factor of moment affecting the decisions of people to acquire or dispose of interests in real property in the areas within the Town affected by the sound of airplane overflights. . . ."

Nevertheless, the federal district court granted the petitioners' request for an injunction. The district judge concluded that the ordinance unconstitutionally burdened interstate commerce, that it operated in an area pre-empted by federal legislation and regulations, and, that it was in direct conflict with applicable federal regulations.

The court of appeals affirmed on the ground that the Hempstead ordinance was in direct conflict with applicable federal regulations controlling the patterns and procedures of aircraft flying in and out of Kennedy Airport. The ordinance and the regulations were in direct conflict because "compliance with the noise ordinance would require alterations in the flight patterns and procedures established by federal regulations." The court did not consider the question of the burdening of interstate commerce and of federal pre-emption, although it seems likely that it would have decided affirmatively on both issues. It did hold that the Cedarhurst case was "square precedent for holding the Hempstead ordinance invalid," and it distinguished a California case which had reached a similar conclusion on the "conflict" rationale, but had declined to accept "pre-emption."

The three grounds advanced by the district court are those

105 398 F.2d 369, 370 (2d Cir. 1968).
107 Id. at 233.
108 Id. at 232.
109 398 F.2d at 373-74 (2d Cir. 1968).
110 Id. at 375.
111 Id. at 376 n.4.
112 Id. at 375.
113 Id. at 372.
frequently urged by commentators on this aspect of "noise" litigation. These grounds have been successful notwithstanding the fact that the ordinances were phrased in terms of specific prohibitions against noise or limitations on altitude. Both are invalid when they conflict directly with federal regulations on flight, and such conflict appears inevitable whenever an airport is adjacent to the limits of a town or city.

Municipal ordinances having failed to control the airport noise problem, airport operators attempted some novel solutions. The Port of New York Authority operates the John F. Kennedy International Airport and considers itself to be the landlord of the airlines using that facility. In its capacity as landlord-lessee it has set certain "lease conditions" which the lessee-airlines must meet. One such condition is that the noise-level of aircraft takeoffs must not exceed 112 PNdb at certain specified distances from the borders of the airport. With considerable grumbling the airlines have met the Port Authority's conditions.115

This effort at enforced noise suppression has placed the Port Authority in a peculiar legal posture. In the Hempstead case, the Port Authority joined the airlines as plaintiffs and urged with them that Hempstead's ordinance was in direct conflict with federal regulations and attempted to operate in an area pre-empted by the Federal Government. As operator of Kennedy Airport, however, it enforces its own regulation which does affect flight patterns and procedures at the airport. The Port Authority maintains that its regulation is an expression of the common-law right of property ownership and control and thus can exist side-by-side with federal laws and regulations.116 The Port Authority's regulation has only been tested once and it has been upheld, at least at the district court level.117 If the Port Authority's position is a valid one, local governments may not need to resort to "police power" to impose maximum noise limits. Municipal airport departments may achieve the same end by setting appropriate conditions in the airport lease-contract.

A resolution of the Los Angeles Board of Airport Commissioners recites the Board's recognition that the supersonic transport is being developed and is likely to be used.118 The Board then indicates its awareness of "the serious noise and community relations problems" caused by subsonic jets and does "urge and request" that the deci-

115 See 1967 COMM. PRINT at 60-64.
116 Id. at 65-68.
118 Los Angeles, Cal., Resolution 2059, Sept. 25, 1963.
sion makers involved in SST development arrange matters so that supersonic aircraft will be able to: operate from existing and presently planned airports, produce noise levels in the airport environment compatible with the comfort, health and welfare of all persons in that area, and accept noise suppression devices during ground maintenance operations.

The Board further resolves that it will place restrictions on supersonic transport operations at the Los Angeles International Airport unless certain sound levels are achieved in the aircraft design. These sound levels are then expressed in terms of perceived noise decibels (112-120 PNdb), at specified distances from the runway. Since the noise standard of the Port Authority of New York is 112 PNdb it can be seen that the Los Angeles Airport Commissioners really do mean to limit supersonic jets to noise levels no greater than those produced by subsonic jets.

Two other ordinances have not yet been the subject of reported judicial decisions. Park Ridge, Illinois, a neighbor to Chicago’s busy O’Hare International Airport, has passed a noise abatement ordinance essentially similar to the Hempstead ordinance. It is likely that federal courts in Illinois would deny enforcement to the Park Ridge ordinance for the same reason that the Second Circuit struck down the Hempstead ordinance, i.e., direct conflict with federal regulations controlling flight. It is possible, of course, that in such a test the Illinois federal courts might go further and find that the ordinance is an undue burden on interstate commerce or that the federal government has pre-empted the field. It seems extremely unlikely that the court would find the ordinance to be a proper exercise of police power by the Park Ridge City Council.

The City of Santa Barbara, California, has taken still another tack by enacting an ordinance directed squarely at the supersonic transport. The ordinance is unique in that it deals only with SST overflight. Santa Barbara does not now have a busy international airport accommodating hundreds of jet flights daily and it is not likely in the foreseeable future to be a point of origin and termination for supersonic flights. Nonetheless, the city council has ordained:

Section 1. That flights of manned and piloted aircraft over and in the vicinity of the City of Santa Barbara so as to cause loud, sudden and intense “sonic booms” in the City constitute a public nuisance.

Section 2. That it is hereby declared to be unlawful to pilot any aircraft over and in the vicinity of the City of Santa Barbara at super-

120 Santa Barbara, Cal., Ordinance 3246, Sept. 26, 1967.
sonic speeds so as to cause loud, sudden and intense "sonic boom" impacts in the City of Santa Barbara.\textsuperscript{121}

The councilman who introduced the ordinance concedes that "it is an extension of the police power into areas where it has not been used before, and we are aware that we are pioneering and making new law in a new field."\textsuperscript{122}

Meanwhile, the federal government has acted to tighten its control over airport and aircraft noise by amending the Federal Aviation Act of 1958.\textsuperscript{123} The amendment provides that the FAA prescribe standards, rules and regulations for the measurement and abatement of aircraft noise and sonic boom and that the Administrator apply such standards, rules and regulations in issuing, amending, suspending, or revoking any certificates authorized by the act.\textsuperscript{124} These include certificates of public convenience and necessity,\textsuperscript{125} airman certificates,\textsuperscript{126} aircraft certificates\textsuperscript{127} and air carrier operating certificates.\textsuperscript{128}

The amendment would seem to strengthen the Cedarhurst and Hempstead decisions and to extend federal control to sonic booms as well as ordinary airport and aircraft noises. It further reinforces the web of federal regulation in this area and makes it less likely that a loophole can be found for a legitimate exercise of local police power.

THE SONIC BOOM

Nature and Effects

The peculiar roar and whine of subsonic jet aircraft are products of the engines and compressors. They are significant only at airports and where jets are flying nearby at low altitudes. Those who are at substantial distances, a mile or two, from an airport usually do not hear this noise. Those who observe high flying jets hear the engine sounds only as a distant drone, if at all.

Supersonic jets will cruise out of sight and out of hearing so far as engine sounds are concerned. While in flight, however, they

\textsuperscript{121} Id.
\textsuperscript{122} Address by Councilman Kemp, Santa Barbara, Cal., City Council, Nov. 19, 1967.
\textsuperscript{123} See p. 194 supra.
\textsuperscript{124} 49 U.S.C.A. § 1431(a) (Supp. 1968).
\textsuperscript{125} 49 U.S.C. § 1371 (1964).
\textsuperscript{126} Id. § 1422.
\textsuperscript{127} Id. § 1423.
\textsuperscript{128} Id. § 1424.
may, and often will, produce an abrupt clap of sound known as the "sonic boom." The term sonic boom is a description, not a definition. This sound comes not from the engines, but from the compression of the air as the body of the airplane passes through it at extremely high speeds. The surface of the aircraft pushes into the air mass, compresses it and forces it ahead as a fast moving wave front which continues as long as the aircraft is traveling at supersonic speeds. Thus, the sonic boom is not a phenomenon which occurs only when an airplane goes through the sound barrier.

The speeding shock wave will subject anything it strikes to an instantaneous increase in surface pressure. The normal atmospheric pressure on the earth's surface at sea level is approximately 15 pounds per square inch (2,000 plus pounds per square foot). The increase above this pressure caused by the shock wave is referred to as the "overpressure" and when measured in pounds per square foot (psf), it becomes a convenient index of the magnitude of the shock wave. When the shock wave strikes the ground or something upon it, the sensation of a bang is created. It has been described "as the footprint on the ground of a supersonic airplane in steady flight."

The force with which the SST's footprint strikes the ground depends upon the size, shape, mass, and speed of the aircraft, as well as the altitude of its flight. The bigger, heavier, faster and lower the airplane, the stronger its shock wave will be. Ideally, the SST should be pencil-slim, as light as possible and capable of traveling at very high altitudes where the great distance to the ground permits the shock wave to dissipate before it strikes.

The proposed Boeing SST is a very large airplane. It will measure about 300 feet in length and weigh in excess of 300 tons. It will cruise at an altitude of 60,000-70,000 feet at a speed of Mach 2.7 (2.7 times the speed of sound or 1800 miles per hour). The British-French Concorde is much smaller and the Russian transport, smaller still. Both of the latter have begun flight tests at subsonic speeds and thus far have apparently met expectations.

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133 Russian TU-144 330,000 100-130 180
  British-French Concorde 385,800 132 193
  Boeing SST proto 750,000 299 280
Experts all agree that the Boeing SST will create a very substantial shock wave, but that is about as far as agreement goes. The magnitude of the wave and the amount of damage it will cause is open to speculation, and speculation there has been! It is fair to say that much of this "guesswork" has been grim and that the prognosis for the SST has often been painted in gloomy shades.  

Extensive sonic boom tests have been conducted in various parts of the country seeking to determine when "overpressures" become damaging and when the boom becomes too annoying for society to accept. The longest and most completely supervised test was held over Oklahoma City in 1964.

This test involved eight flights per day, every day for six months, between 7:00 a.m. and 1:20 p.m. along a designated path, southwest to northeast above Oklahoma City. Twelve hundred and fifty-three flights were made. Forty miles of each 100-mile flight was at supersonic speeds, and the flights were designed to create overpressures ranging from 1.5 psf to 2.0 psf and back to 1.3 psf in the final weeks of the test. For the first half of the test, F-104 fighters were used and for the second half F-101 fighters, both much lighter and smaller than the proposed Boeing SST.

A total of 12,588 complaints (including 2234 repeat calls) were received at the FAA complaint center. Taking into consideration the total population of the study area and the 178 days of boom runs, there were a total of 752,000,000 boom exposures (1253 flights times 600,000 population). This is an average of one complaint for every 63,000 boom exposures.

Of the 12,588 complaints, 8335 alleged damage to property and a total of 2170 formal damage claims were filed with the government. Most of these (1732) were denied and those approved by the end of the test averaged $52.81 per claim. A majority of the claims involved damage to plaster and glass. It should be noted that the FAA asserted that no damage had occurred in any of the test houses it maintained under and adjacent to the flight path. About one-

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Specifications, 90 Aviation Week and Space Technology, Mar. 10, 1969, at 145, 180, 149.


135 The Sonic Boom Comes Home, 2 Astronautics & Aeronautics, Sept. 1964, at 70, 71.

136 Id.

137 Id.

138 Id. at 72.
fourth of the exposed population found the boom unacceptable,\textsuperscript{139} even though "candid camera" films taken in downtown Oklahoma City at the height of the boom show no visible reaction of the citizens.\textsuperscript{140}

Tests conducted in other areas\textsuperscript{141} tend to support the results of the Oklahoma City tests, \textit{i.e.}, the pattern of complaints is the same in other localities. Upwards of twenty-five percent of the population describe the boom as intolerable, and the damage complaints usually concern minor property damage.\textsuperscript{142} The typical complaining citizen is annoyed by the noise, and he may be upset also by cracks in his plaster walls or by a broken window.

The original design target for the United States SST was an aircraft which would produce a maximum overpressure of 2.0 psf in climbing and 1.5 psf while cruising.\textsuperscript{143} Although there is some conflict of authority, it seems to be generally conceded that overpressures in the 1.5-2.0 psf range will not cause structural damage to sound buildings.\textsuperscript{144} In fact such overpressures would probably not crack plaster or break windows, if the plaster and windows had not previously been exposed to significant stress.\textsuperscript{145} In other words, if overpressures could be limited to 1.5-2.0 psf there would be very little property damage, and that only to property which had been weakened by prior conditions and circumstances.

However, even if the engineers were successful in designing and manufacturing such an aircraft there would be still another factor with which to contend. An aircraft properly designed and constructed to produce no more than 1.5-2.0 psf overpressure will inevitably exceed these limitations from time to time. This is because factors, other than design, operate to magnify the sonic boom, \textit{e.g.}, atmospheric conditions and maneuvering.\textsuperscript{146} About one-tenth of one

\textsuperscript{139} Beranek, \textit{Noise}, \textit{Scientific Am.}, Dec., 1966, at 66, 76.
\textsuperscript{140} \textit{The Sonic Boom Comes Home}, 2 \textit{Astronautics & Aeronautics}, Sept., 1964, at 70, 74.
\textsuperscript{143} Thompson & Parnell, \textit{Sonic Boom and the SST}, 39 \textit{Aircraft Engineering}, Mar., 1967, at 14, 15; D. Dwiggins, \textit{The SST: Here It Comes Ready Or Not} 131 (1968).
\textsuperscript{146} See Garrick, \textit{Atmospheric Effects on the Sonic Boom}, in \textit{Second Conference
The SST

percent of the time this magnification will double the intensity of the original boom, thus producing overpressures of 3.0-4.0 psf and perhaps higher.\textsuperscript{147} Although booms of ordinary strength probably will not cause ground damage, it is feared that the superbooms will.

The subject is not without controversy. It seems to be generally agreed that no personal injury will be done to anyone by a superboom.\textsuperscript{148} Although the startle effect might give someone a heart attack, so might the sudden acceleration of a motorcycle, an automobile backfire, or an “ordinary” sonic boom. The impact of the shock wave itself is not strong enough to do physical harm.

There is more uncertainty about the nature and extent of possible property damage from the superboom. Materials engineers stoutly maintain that various structural materials can withstand enormous shock wave pressures,\textsuperscript{149} but courts have entertained suits and juries have returned verdicts on testimony of indeterminate pressures.\textsuperscript{150} Even if allowance is made for the fact that judges and juries do not always capture all the intricacies of technical testimony, and that many of the claims are for structures weakened by age, the elements and stress, there remains a large grey zone clouding our understanding of property damage from shock wave.

The most thoroughly authenticated case of boom damage occurred before the SST had even reached the design stage.

In midafternoon of Aug. 5, 1959, the control tower at Ottawa airport gave clearance to the pilot of an F-104 jet fighter to make two low-level passes over the north-south runway. The first pass was uneventful. On the second pass the pilot made a slight left turn and pull-out before passing the end of the runway .... This runway is 1200 feet away from one of the faces of the terminal building, but the left heading brought the F-104 over the temporary control tower along a curved path over the terminal building. As the pilot applied additional

\textsuperscript{147} Baxter, \textit{The SST: From Watts to Harlem in Two Hours}, 21 STAN. L. REV. 1, 24-25 n.32 (1968).

\textsuperscript{148} A group of highly respected scientists has stated that “no damage to hearing is expected even for booms of 100 psf” and “no direct physiological damage is expected even for booms of 100 psf.” National Academy of Sciences, National Research Council, Report on Human Response to the Sonic Boom, Transmittal Letter (June, 1968); see also Kryter, \textit{Sonic Booms from Supersonic Transports}, 163 SCI. 359, 360 (1969).


power for his climb, the speed of the aircraft exceeded sonic speed. Reports vary as to the altitude of the aircraft, and opinions differ as to the sensitivity of the altimeter at its low altitude. It would appear that the altitude was about 500 feet above ground before pull-out.\textsuperscript{151}

The case is ideal for study purposes. There were numerous eyewitnesses. There is no doubt that the aircraft exceeded the speed of sound. The flight was low, directly over the affected building and the pilot engaged in the type of maneuvers now known to cause boom magnification. There was no other intervening proximate cause of damage to the building which was so new it was only ninety-eight percent completed.\textsuperscript{152}

The building was a modern concrete and steel structure with many windows and glass panels.\textsuperscript{153} Naturally a great deal of the glass was broken. Moreover the roof was ripped, the ceilings damaged, doorways dislodged, window frames wrenched, stucco cracked and torn loose, and various fixtures and appliances damaged. It does not appear, however, that the structural members of the building were weakened or the foundation undermined.\textsuperscript{154} The cost of repairing the damage was $300,000.\textsuperscript{155} There were no reported personal injuries.

The Ottawa experience clearly establishes that shock waves from aircraft moving at supersonic speeds can cause very serious property damage. The importance of this fact should not be played down. At the same time it should also be noted that the damage here was the result of a stunt and of pilot error. No one has any business flying at, or near, the speed of sound 500 feet above ground and in the immediate vicinity of buildings and people. In fact such flying at much slower speeds would usually be regarded as hazardous. No commercial airline would ever indulge in such conduct, and this sort of flying cannot be related in any meaningful way to the operation of a supersonic transport. The Ottawa incident is a useful warning of the potential severity of shock wave damage. It puts everyone on alert that supersonic speed is not to be trifled with, but such an incident is no more likely to occur after the SST is in general use than it was before. It is unrealistic to point to this unfortunate event as illustrative of the kind of damage that the commercial SST may cause.\textsuperscript{156}

\textsuperscript{151} Ramsay, \textit{Damage to Ottawa Air Terminal Building Produced by a Sonic Boom}, 4 MATERIALS RESEARCH & STANDARDS 612 (1964).
\textsuperscript{152} Id.
\textsuperscript{153} Id. at 613.
\textsuperscript{154} Id. at 615.
\textsuperscript{155} Id. at 616.
\textsuperscript{156} But see Baxter, \textit{The SST: From Watts to Harlem in Two Hours}, 21 STAN. L. REV. 1, 30 n.40 (1968). The overpressure at Ottawa may have exceeded 38 psf. D. DWIGGINS, \textit{The SST: Here It Comes Ready Or Not} 65 (1968).
The SST is intended to cruise one hundred twenty to one hundred forty times higher than the airplane involved in Ottawa. Since airlines do not court lawsuits, one may rest assured that the SSTs will be flown very carefully, with a minimum of maneuvering and sudden acceleration. There is a certain measure of comfort also in the fact that in the thousands of supersonic flights since 1959, including the 1253 Oklahoma City flights, no case of similarly severe property damage has been documented, and surely many super-booms have occurred in the millions upon millions of boom exposures since that time.

In addition to the property damage which might result from the sonic boom, opponents of the SST program are also concerned with the “annoyance” factor. How do people react to the boom? Overpressures below 1 psf seem to be generally tolerable, at 1.5 psf most people become annoyed and above 2.0 psf everyone is annoyed. At the outset of this article it was pointed out that noise tolerance is a highly subjective matter. It was shown also that in the several tests conducted over urban areas about twenty-five percent of the population regarded the boom as intolerable. The unemotional evidence of the photographic film, however, showed many of the complaining population going placidly about their daily business at the height of boom tests. Some accounts of the Oklahoma City tests indicate that response to the boom may be affected by greed, civic pride and other non-objective factors. The current plague of motorcycles which have now invaded our quietest suburbs indicates that we are willing to put up with terrible noise, if only it amuses our young—and a small minority of our young at that. This is not to argue that we should accept sonic booms and super-booms without a whimper. But, it does indicate that we are an extraordinarily tolerant people when it comes to environmental noise levels.

However, the attitude that we must tolerate sonic boom annoyance in the name of progress or a spirit of neighborly laissez-faire is unduly pessimistic as well as unrealistic. This state of affairs will simply not come to pass. It ignores practicalities. The first practicality is that no one has threatened to operate the SST over populated areas without carefully controlled preliminary trial flights. The second is that airlines depend for their existence on the goodwill of the majority of the public. They are not about to alienate a large

157 Hutchinson, Defining the Sonic-Boom Problem, 1 ASTRONAUTICS & AEROSPACE ENGINEERING, Dec. 1963, at 56, 57.
158 See note 139 supra and accompanying text.
159 See The Sonic Boom Comes Home, 2 ASTRONAUTICS & AERONAUTICS, Sept., 1964, at 70.
segment of their potential customers by unnecessarily assaulting their ears, offending their sensibilities and destroying their property.

The quasi-official position of the United States Government appears to be that there are no plans to operate the first generation SST on overland routes. This seems to be tacitly assumed by a broad spectrum of persons engaged in the aviation industry. Designers, engineers, builders and government personnel, all readily concede that no special design compromises have been made in the present SST to minimize the sonic boom.

Developing a long-range, financially sound program in the U.S. requires the first supersonic commercial airplane to be designed for high flight Mach numbers. The first plane must therefore incorporate structures and propulsion more advanced than those in operation.

The adoption of a much more ambitious program will probably pay off in the future; but it will also contribute to delaying further the availability of a first family of operational airplanes. It is extremely important, therefore, that the development program be carried on at an accelerated pace, without delays or indecision related to organizational problems, and without exaggerated emphasis on analyses of relative merits and economic effectiveness of present and future airplanes based on possible performance of first-generation SSTs. The past has shown that new systems once in operation rapidly improve much above initial expectations.

Speed then is the keynote for the first United States SST—speed and getting it off the ground! Style, economy and other "merits" are secondary and can safely be left to the second and succeeding generations. Even so, some authorities insist that, although the first-generation SST will be largely limited to overwater flights, it can still be an economic success. The possibilities of operating at subsonic speeds over densely populated areas, the use of supersonic corridors over sparsely populated areas and the interconnection of subsonic overland transports with supersonic overwater transports have not been fully explored.

The foregoing discussion of the damage situation and the "annoyance" factor may still justify some moderate pessimism. However, there is now much hopeful scientific evidence tending to

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160 "Our program is based on the assumption that you do not fly overland. On that assumption we make the clear cut and affirmative statement that you have got an economically viable airplane even if you are confined to overwater routes." Statement of General William F. McKee, Administrator, FAA. Hearings Before the House Subcomm. of the Comm. on Appropriations, 90th Cong., 1st Sess. 318 (1967).

"We have based our SST program decisions on the conservative assumption that this design is to be operated primarily over water." Statement of Major General Jewell C. Maxwell, Director, Supersonic Transport Development. Id. at 294.


prove that a great deal of the boom may soon be taken out of supersonic flight. Very recent studies have indicated that the ratio of the measured overpressure to the calculated overpressure is less than previously thought.\textsuperscript{163} In other words, the measured boom and the predicted boom have been brought into closer agreement. A greater number of samples, more accurate measurement and improved prediction techniques have combined to produce more reliable results. Significant diminution in superboom overpressures now appear to be within reasonable expectations.\textsuperscript{164} Configuration studies show that considerable boom reduction may also be achieved by design changes.\textsuperscript{165} It may well be, for instance, that overland routes could be served by a smaller, slimmer SST specifically designed for less boom, perhaps at the sacrifice of speed or some other factor. A prominent aeronautical engineer, Edwin L. Resler, has announced the development of a new supersonic jet design which will help to reduce the sonic boom produced by the SST.\textsuperscript{166} As has been shown earlier, careful flying will also help prevent the occurrence of sonic booms.

In this state of the art, it seems premature to anticipate disaster. True, the supersonic transport has a great potential for harm, but it also has a great potential for valuable service in the public interest. The present outlook for a cure of its more objectionable features is reasonably optimistic. Common-sense, the concern of our political leaders and the enlightened self-interest of the airlines join forces here to assure us that supersonic booms will not be thrust upon us willy-nilly. The United States SST seems to be following a rational developmental path and no strong reasons suggest that it be prevented from doing so. The vigilance necessary to prevent abuse is being exercised.

Domestic Law

Will the existent judicial precedents, statutes and ordinances apply to the phenomenon of the sonic boom? It seems safe to assume that whenever the noise produced by supersonic aircraft is similar

\textsuperscript{164} Id.
\textsuperscript{166} San Francisco Chronicle, June 28, 1968, at 44, col. 3.
to the noise produced by ordinary jets, the courts will reach for the old familiar precedents. Where, however, the noise is exclusively a product of supersonic flight (the sonic boom itself), precedents established for subsonic flight, although available, will not be as comforting, or as dispositive of the issue. In this situation, as well as in the determination of the applicability of the new ordinances and statutes specifically directed at sonic boom, there remains a very large area of legal uncertainty. Here, individual rights have not been formulated and the public interest has not been determined.

Despite the extensive sonic boom tests recounted in these pages and the many years of military flying at supersonic speeds to which United States residents have been exposed, the sonic boom has made comparatively few appearances in our case reports. These few cases are far from conclusive as the following discussion will demonstrate.

An early case was *Alexander v. Firemen's Insurance Company,*¹⁶⁷ which appeared in the Texas courts in 1958 and 1959. The plaintiff brought action against his insurers for damage to his warehouse allegedly caused by the flight of jet aircraft in the area where the building was located. The district court withdrew all issues from the jury and rendered judgment for the insurance company.¹⁶⁸ The plaintiff appealed.

The court of civil appeals held that the phrase "direct loss by . . . aircraft" in the insurance policy, fairly understood, included damage from sonic boom.¹⁶⁹ Since the damage was a covered risk, the plaintiff was entitled to take to the jury the question whether his loss had been proximately caused by a sonic boom. The court reversed and remanded the cause for new trial.¹⁷⁰ The opinion declared that the issue of coverage under the policy's "explosion" clause was not before the court, since no evidence had been adduced on that issue at trial. It affirmed that the trial court was correct in refusing to take judicial notice that a sonic boom was an explosion.¹⁷¹

On remand, the district court, after a jury trial, rendered judgment for the plaintiff in the sum of $2,750 and the insurer appealed. The court of civil appeals affirmed¹⁷² in an opinion written by the same judge who had written the opinion in the first appeal. The

¹⁶⁸ Id. at 753.
¹⁶⁹ Id. at 755.
¹⁷⁰ Id.
¹⁷¹ Id.
appellate tribunal found the evidence sufficient to sustain the judgment of the trial court.\textsuperscript{178}

The two opinions are strangely unsatisfactory. The facts indicate that the building was of frame and metal, well-built, without visible signs of deterioration and only two years old at the time of the "blast," which occurred in 1956.\textsuperscript{174} It is said that the building collapsed and was extensively damaged after "a terrific blast or sonic boom occurred over Hico."\textsuperscript{176} One opinion states that the plaintiff alleged that the force and pressure of the "air disturbance, created by the aircraft, unseated the girders beneath the building and capsized it."\textsuperscript{178} Yet, neither opinion mentions that any witness saw an airplane, much less estimated its altitude or speed. There is no description nor identification of any airplane in the opinions, and, absent access to the trial records, the matter is left to the reader's imagination. These appellate opinions thus lose much of their value as contributions to the development of sonic boom law.

On August 31, 1956, during an air show at Will Rogers Field in Oklahoma City, an Air Force pilot flew at supersonic speeds. The original plaintiff sued the United States Government and its insurer, Lloyds' of London, for $750 damage to his property from sonic boom. Three hundred others alleging damages of $25 to $4000 from the same source were allowed to intervene.\textsuperscript{177}

It developed at trial that Lloyds' had insured the United States against the hazards of the air show "and that the policy covered claims arising out of sound wave shock resulting from aircraft passing through the sonic barrier."\textsuperscript{178} The United States admitted a single low-level flight on August 31, 1956, causing glass breakage in the air terminal building at Will Rogers Field.\textsuperscript{179} There was judgment for the defendant insurers and the plaintiffs perfected an appeal.

The federal circuit court reversed and remanded for dismissal because of an improper joinder of parties.\textsuperscript{180} The impropriety lay in the fact that the cause of action against Lloyds' was on the contract of insurance, and the suit against the United States sounded in tort.\textsuperscript{181} For purposes of this analysis, the case has little precedential value.

\textsuperscript{173} Id. at 352.
\textsuperscript{174} Alexander v. Firemen's Ins. Co., 317 S.W.2d at 754.
\textsuperscript{175} Id.
\textsuperscript{176} Firemen's Ins. Co. v. Alexander, 328 S.W.2d at 351.
\textsuperscript{177} Lloyds' London v. Blair, 262 F.2d 211 (10th Cir. 1958).
\textsuperscript{178} Id. at 212.
\textsuperscript{179} Id.
\textsuperscript{180} Id. at 213-14.
\textsuperscript{181} Id.
In Coxsey v. Hallaby, 182 a federal district court refused to enjoin the 1964 Oklahoma City sonic boom tests. The court held that it had no jurisdiction in the matter since the test program was authorized by federal statute 183 and the United States had not consented to the suit. Moreover, the court stated that even if the matter had been within its jurisdiction, it would still enter judgment for the defendant since the plaintiffs had failed to establish irreparable injury, had an adequate remedy at law and thus had shown no right to equitable relief. 184

Since the action was brought while the tests were in progress, the opinion of the trial judge may be considered as a species of res gestae and thus has particular significance. He accepts without question, and without citation of authority, the results of prior government tests which "demonstrated that sonic booms of one hundred twenty psf did not have any adverse effect upon the health of persons on the ground and that no pain was experienced by human beings at less than forty pounds per square foot." 185 He then goes on to say that the test overpressures did not exceed 2.0 psf and that these sonic booms had no noticeable effect on the buildings equipped with instrumentation by the FAA. 186

The judge had serious reservations about the credibility and reliability of the testimony offered by the claimants and their supporters.

The emotions of all witnesses who testified on behalf of the plaintiffs were noticeably involved. Their extreme irritation indicated strongly that they were the type individuals who are easily irritated . . . . [T]hey and others objectioning to the continuation of the boom project were actuated, and their irritation increased by their belief that the government did not intend to make just compensation for any possible damage caused by the vibration created by the sonic booms. Emotionally stable and disinterested citizens were not upset nor unduly annoyed by the booms. Most did not notice them at all, as clearly shown by motion pictures placed in evidence. I think it proper to state that throughout the various hearings the conclusion was inescapable that the protests to the "booms" were being aggressively voiced by a very few persons, and that their protests were not representative of the attitude of the rank and file citizen. 187

It would be difficult to conceive of a more unsympathetic reaction to those who seek relief from sonic booms. If this feeling

183 Id. at 979; 49 U.S.C. § 1353(b) (1964).
184 231 F. Supp. at 980.
185 Id. at 979.
186 Id.
187 Id. at 980 (emphasis added).
should spread generally through the judiciary, it bodes ill for future claimants of injury from sonic booms.

Coxsey is perhaps not as atypical as its strong language might lead one to believe. The courts have in fact been quite unsympathetic. In a 1964 case in which the plaintiff had alleged personal injury and property damage (broken glass), the government's motion for summary judgment was granted on the ground that the supersonic program involving military aircraft fell within the discretionary function exemption of the Federal Tort Claims Act. A 1965 federal case then held that where there was no evidence of cracked or shattered glass in his building, the plaintiff's evidence was insufficient to establish a sonic boom, since glass breakage is the first damage to occur in instances of exposure to sonic booms.

Bennett v. United States decided that "physical invasion of . . . shock waves . . . do not constitute a taking of property as opposed to a mere nuisance and trespass." The plaintiff was, therefore, denied recovery under the Tucker Act. This is believed to be the only case in which a court has specifically held that there can be no taking by sonic boom.

In Dabney v. United States and Lorick v. United States, the courts held that the plaintiffs had not sustained their burdens of proof. In Dabney, the court found that the overpressure on the plaintiff's residence caused by the B-58s (1.26 psf), was not great enough to do any damage. According to this court, a B-58 must cause a 10 psf overpressure in order to injure property. The court also stated that a B-58 must fly supersonically at 6,000 feet altitude in order to exert an overpressure of 10 psf on the ground. In Lorick, the court held that the plaintiff had failed to show that defendant's aircraft exceeded the speed of sound. Thus, plaintiff had failed to prove that the defendant had caused any sonic booms.

For one reason or another, the plaintiffs in all of the foregoing sonic boom cases were denied recovery. However, prospective plain-

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189 Id. at 1005; 28 U.S.C. § 2680(a) (1964).
192 Id. at 630.
196 249 F. Supp. at 600.
197 Id. at 599.
198 267 F. Supp. at 100.
199 Id. at 102.
tiffs in suits to recover for sonic boom damage may find a small measure of encouragement in *Neher v. United States*. There, plaintiff was the owner of a sixty-five year old apartment building in St. Paul, Minnesota, situated eight to ten miles from the center line of an air corridor designated by the Air Force as the Minneapolis corridor. This corridor was about twenty nautical miles wide and from three to six hundred nautical miles long. From April 5, 1962 through August 6, 1962, B-58 Air Force planes made forty-one supersonic flights over the Minneapolis-St. Paul area. These flights were at Mach 2.0 and 30,000 to 50,000 feet altitude. Plaintiff specifically noted the occurrence of sonic booms over her property during that period. She and some of her tenants also noticed plaster cracks and broken windows at that time. Subsequently, squeaks developed in the floors and stairway.

The plaintiff's action for property damage was brought under both the Federal Tort Claims Act and the Tucker Act. A judgment was rendered for the plaintiff for $750 under the Federal Tort Claims Act, but no recovery was allowed under the Tucker Act since there can be no constitutional taking without physical invasion by low and frequent overflights.

The court found that the discretionary function exemption of the tort claims act had been waived by stipulation of counsel. This opened the way for a finding that designation of the populous Minneapolis-St. Paul area as an air corridor amounted to negligence where many less heavily populated areas were available for the purpose. The court felt that the defendant should have recognized that sonic booms of low strength constitute a risk to substandard structures even though such booms usually do not cause damage. The court had little trouble with causation despite the testimony of expert witnesses that the booms were not the cause of the damage. The court distinguished between legal cause and scientific cause and pointed out that liability attaches to legal cause which existed here.

Those who sue commercial SSTs for sonic boom damage will

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201 *Id.* at 213.
202 *Id.* at 212.
203 *Id.* at 213.
208 *Id.* at 217.
209 *Id.* at 218.
210 *Id.* at 217-18.
not be hindered by a discretionary function exemption, but even then the outlook for recovery seems rather bleak. The Alexander cases discussed previously indicate the possibility of recovery under “aircraft damage” and “explosion” clauses of property insurance policies, but astute insurers will surely block this loophole if it still exists. Perhaps the insurance companies will develop new “sonic boom” coverage at appropriate rates. The Neher case indicates that some courts may be willing to find liability for sonic boom damage, although this is tenuous comfort since the issue there was exclusively one of governmental liability.

International Law

The scope of this paper does not permit an in-depth inquiry into the application of international law to the operation of commercial SSTs. It is apparent, however, that since the sonic boom may carpet an area fifty miles wide, off-shore supersonic flights by United States commercial SSTs may affect the nationals of foreign nations and their property. Similarly, foreign commercial SSTs may also cause damage while flying at supersonic speeds off the coast of the United States. In both instances, overflights will also present a risk of sonic boom damage to the territory below.

The sonic boom problem presented by commercial supersonic flight is novel and was not taken into consideration when the international air agreements now in force were negotiated, or when the various national air laws were enacted. However, there are general powers in many of these agreements and laws which might be invoked to restrict supersonic flight. For instance, the Chicago Convention of 1944, ratified by 75 nations including the United States, provides that a country may “restrict or prohibit” aircraft from flying over portions of its territory “for reasons of public safety.” The only limitations on this power are that each prohibition must be applied uniformly and that the prohibited areas must be “of reasonable extent and location so as not to interfere unnecessarily with air navigation.”

216 Id.
It is certainly conceivable that signatories to this agreement might regard supersonic flight over their territories, or within fifty miles of their borders, as a danger to their “public safety” within the meaning of the Chicago Convention. That issue, as well as the question of the reasonableness of any prohibitions and the uniformity of their application would create serious problems for those who wish to fly supersonic aircraft on international routes.

A number of existing foreign air laws prohibit “dangerous flying” and provide for the levy of fines, and imprisonment, against the pilot and the owner of the offending aircraft, whenever it is “flown in such a manner as to be the cause of unnecessary danger to any person or property on land or water.” It does not require strained interpretation to include supersonic flight within the general understanding of the quoted prohibition.

Many air laws also provide that an aircraft owner is absolutely liable for “material loss or damage ... caused to any person or property on land or water by ... an aircraft while in flight.” It would be difficult to contend that aircraft in supersonic flight should be exempted from the application of these provisions.

Most of the presently effective air laws regulate the altitude of flights over the territory for the safety of persons or property on land or water. In theory, at least, individual countries could set minimum altitudes for supersonic flights so high as to make such flights impractical or impossible.

In addition to all of the foregoing, a majority of the current air laws grant the appropriate administrative agencies a general power to make all rules necessary to prevent aircraft from “endangering other persons and property” and, in general, to insure safe flight of aircraft over their countries.

Enough has been said to indicate that the approaching age of supersonic air travel should be preceded by an international convention to settle the rules by which such travel will be controlled.

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217 Civil Aviation Act of Great Britain, 12 & 13 Geo. 6, c. 67, art. 10 (1949); see also Dept. of Industries and Labor, Indian Aircraft Rules, art. 21 (1937); Civil Aviation Act of New Zealand, N.Z. STAT. 1948, art. 6. 218 Civil Aviation Act of Great Britain, supra note 216, at art. 40; see also Brazilian Code of the Air, Decree-Law No. 483, art. 97 (1938); Air Code of the U.S.S.R., No. 14/1713, art. 78 (1935). 219 E.g., Civil Aeronautics Law of Japan, Law No. 231, art. 81 (1952); see also Aviation Law of Austria, art. 124 (1957). 220 E.g., Civil Aviation Act of Great Britain, supra note 216, at art. 8.
Summary

This inquiry shows that supersonic airplanes may bring about a change in the quantity of airport noise, but they are not likely to affect the quality of that noise. It seems unlikely that the SSTs will trigger radical reforms in the legal rules applicable to airport noise, because they simply will not make a radical physical change in such noise. The airport noise problem cries out for a cure without the SST, and the advent of that type of aircraft will not improve the situation, but it will not make it much worse either. Reform of "airport" law will not find its raison d'etre in the SST and reformers must seek their impetus elsewhere.

Somewhat more surprisingly perhaps, it seems that the sonic boom will be inexorably assimilated into existing law. Already, courts have refused to find that there can be a constitutional taking of property by the supersonic shock wave sweeping across the ground. Trespass and nuisance then seem fated to be the vehicles for property damage litigation involving a sonic boom. One would have thought that this phenomenon was sufficiently different from anything which preceded it to spur judicial minds to imaginative and inventive solutions. This has certainly not been the case and there is considerable doubt whether trespass will be considered an appropriate vehicle, particularly in cases where there is no over-flight but only lateral flight. This leaves the boom-suffering citizen with only one arrow in his legal quiver—nuisance. The paucity of legal remedies calls for intensive, careful analysis. A new injury demands a new remedy.

When confronted with the possibility of some injury to the public and the presently inadequate machinery for compensating such injury, the temptation to prevent the cause of harm from coming into existence is very strong. Stop the problem by stopping the SST is an easy and attractive rallying cry. It is also demonstrably unsatisfactory.

Three foreign countries are already engaged in manufacturing SSTs and presumably they are committed to using them. Are we prepared to bar British, French and Russian SSTs from flying to our airports or within 50 miles from our shores? Can we enforce such a bar within recognized principles of international law? Assuming we could, do we want to offend international comity by doing so?

National airlines in Canada and Mexico may decide to operate SSTs and be permitted to do so by national law. Are we prepared to tell these countries they cannot fly supersonically over their own territories because they will thus cause booms in several northern
states or in Texas? The adoption of this position by the United States is certain to cause ill-feeling with two friendly and peaceful neighbors.

Consideration should also be given to the effect the SST may have on our aircraft industry. A newsmagazine has recently stated that the future of the aeronautical industries of France and Great Britain rests in large measure on the success of the Concorde. The airplane is described as a gamble for enormous stakes.221 If the SST is of such marked importance to the aircraft industries of Great Britain and France, it surely also must be of some significance to the United States aircraft industry.

Outlawing the SST is not a sensible answer to the problems it presents. It would not guarantee complete protection from sonic booms; it might cause unfortunate stresses with friendly (and unfriendly) nations; and it would surely place our own aircraft manufacturers at a competitive disadvantage in world markets. It would exclude United States citizens and industries from most of the benefits of the SST without protecting them entirely from its harmful effects.

The SST is here. We must accept it and cope with it. We can best cope with it by continuing to do all the things we have already done to protect ourselves from aircraft noises and by doing these things more efficiently and effectively.

Zoning laws and practices must be gradually changed to provide for restriction of airport neighborhoods to industries not affected by loud noise. Where residential zoning in these areas is inescapable, an increased use must be made of air conditioning and sound-proofing in order to make these residences comfortably habitable. This area will not provide a quick solution, but the effort must nonetheless be made.

Research in SST designs must be continued; flight techniques must be improved and flight maneuvers must be rigidly controlled; adaptation of the airplane to its mission (land or sea) must become a fixed policy. All of these steps will decrease the number of booms and minimize those that do occur. This list is illustrative rather than exclusive and other alleviatory measures will certainly be developed.

A people intelligent enough to develop a supersonic airplane must surely be ingenious enough to render it acceptable. Research to this end must be intensified.