ON SONIC BOOMS: PEOPLE VS PLANES

Time saved versus damage made

The "unrealistic" society in opposition to the supersonic transport referred to by Harvey H. Hubbard (PHYSICS TODAY, February, page 31) is the Citizen's League against the Sonic Boom. The address is 19 Appleton St., Cambridge, Mass. 02138. Hubbard's article will surely result in a flood of contributions being sent in.

"Superficial damage has been initiated in controlled tests only after repeated overpressures of about 5 grams/cm^2." If a typical boom is 1.5 grams/cm^2, an extrapolation of the probability curves in figure 8 shows that there is a 10^{-4} probability of exceeding this at a given ground station. In a city with a million housing units there will therefore be a hundred of them damaged—approximately one for every passenger on the plane, who will save less time than it takes to repair the damage produced. This is in addition to the discomfort, the disturbance of normal activity and the interruption of conversation or of thought of hundreds of thousands of individuals. What kind of systems analysis lends support to supersonic flight in anything but extreme national emergency?

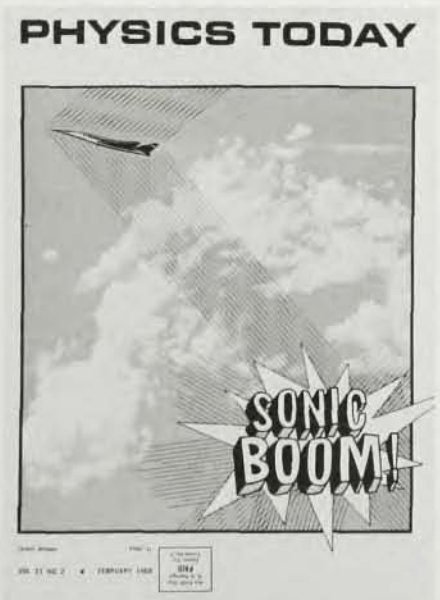
CYRIL STANLEY SMITH
Cambridge, Mass.

The SST and its sonic boom

Here are some comments that are stimulated by your February story "Sonic Booms." Many physicists realize that the sonic boom produced by a supersonic transport plane accompanies the plane throughout its supersonic flight path, and that a single flight of an SST across the US would boom 10 to 40 million people. And they realize that generation of a boom is unavoidable for any heavy object traveling in air at a speed exceeding the speed of sound.

What is often overlooked, however, is that most of the tests of acceptability of the boom have been carried out by engineers rather than by psychologists, psychiatrists, medical doctors, et al. If these latter had been in charge of the 1961 sonic-boom tests at St. Louis, the 1964 Oklahoma City tests, the 1965 Chicago tests or the 1966 Edwards Air Force Base tests, they would presumably have explored the most crucial circumstances, not the least crucial one. They would have chosen, as human subjects, not just young, healthy, wide-awake persons but also infants, aged persons, highly nervous people, people with heart conditions. They would have produced the booms at unexpected times, to get some idea of the startle effect on persons concentrating on delicate tasks and those completely relaxed and expecting no sudden bang. They would have produced some series of booms at night to find whether sleeping persons would be awakened again and again and whether this is acceptable to them.

They would have used extra-severe booms because it is well known that temperature and wind-speed variations in the atmosphere produce focusing effects so that about 1% of all booms



have twice the average intensity. (If a fleet of 150 SST's operated over the US daily, they would produce of the order of 5×10^9 man-booms per day; 1% of this number, or 5×10^7, is the estimated number of man-superbooms per day.)

The crucial question, in short, is this: Would the more intense booms be acceptable to the more vulnerable people?

WILLIAM A. SHURCLIFF
Director, Citizens League against the Sonic Boom

Making fun of real fears

What NASA writer Harvey H. Hubbard appears to say is that if we were not incompetent carpenters less meek than deer, then the sonic boom would not bother us. His article provided useful and enlightening technical information on the sonic boom. But what better way is there to arouse the suspicion of the populace as to the worth of science than to make callous fun of the real fears many people, physicists among them, hold for the future of our environment?

SST research and the sonic boom are good examples of the way in which science, technology and human values are inextricably linked. Fluid and structural mechanics and the psychology of perception are scientific disciplines. However, the social and economic decisions that must be made before the future of the SST is decided fall into the domain of human values and politics. Insofar as Hubbard stuck to the scientific, there can be little controversy. But since he transgressed into the field of human values, I believe that the "other side" should be given equal space to reply.

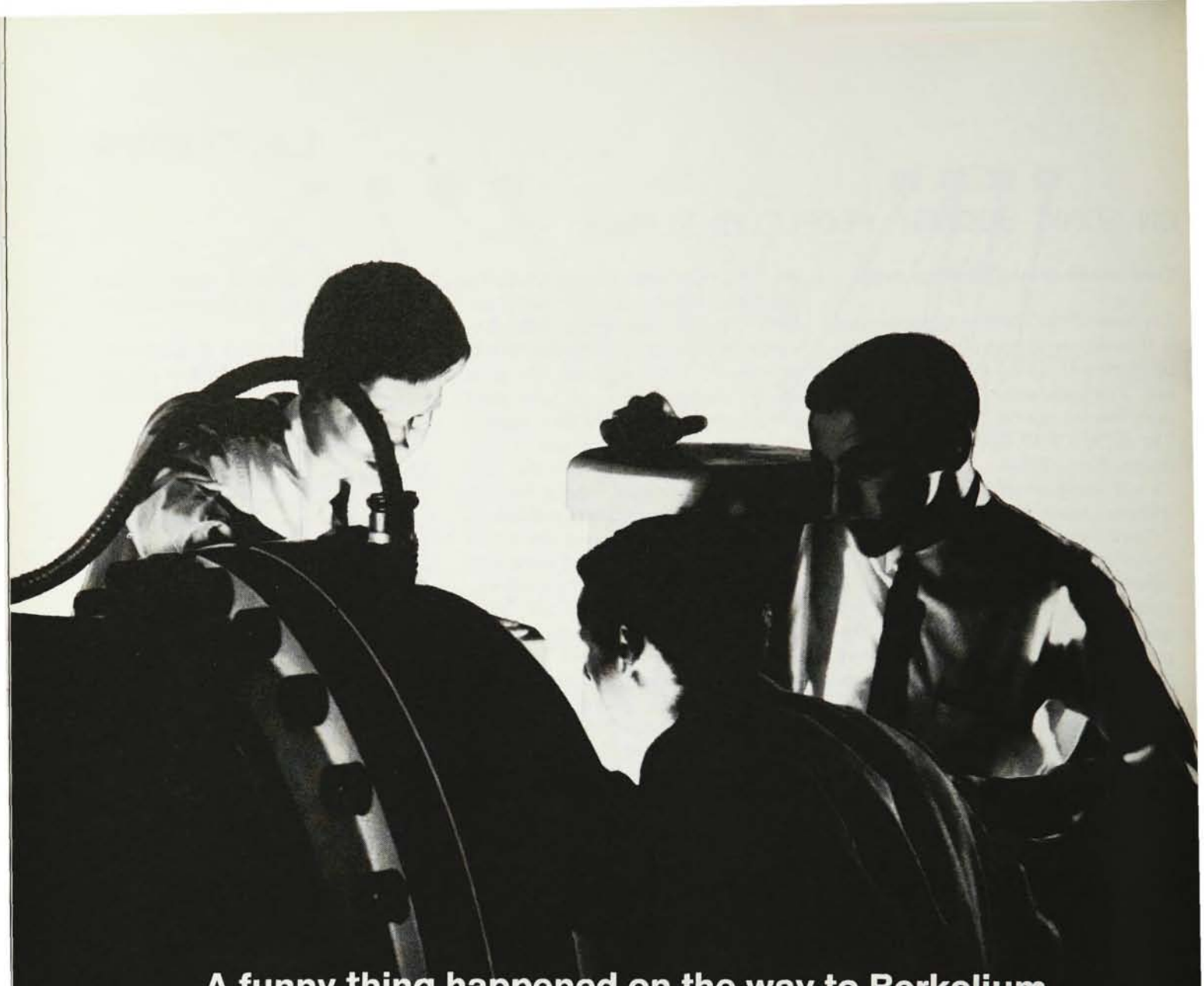
ROSS HOLMSTROM
Waltham, Mass.

Sonic damage claims

Your article called "Sonic Booms" is highly inaccurate. On page 37 is a statement, "Well constructed buildings in good condition would not experience serious damage . . ." The writer ignores the facts.

On 17 Feb. 1967 a jury in federal court in Oklahoma City awarded me $10 000 for damages to my home during the 1964 sonic-boom tests in Oklahoma. This case was not appealed by the government. It was paid in full.

An additional eight of 105 cases



A funny thing happened on the way to Berkelium

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were chosen to serve as test cases. It was stipulated that the remaining 97 cases would be determined by the decision of the first eight. All eight were won and are being appealed by the government. The damage total for the first eight cases was slightly more than $18 000.

It was the contention of the FAA during the test program that only poorly constructed buildings could be affected by the booms. Actually this was all part of the "big sell" to lay the ground work for the Super Sonic Transport. Every possible trick was used to rig the results of the tests. These rigged results are still being doctored to meet the new selling program for the SST.

My home took from mid September of 1961 until 15 Jan. 1963 to build. It is built upon a pier and grade-beam foundation. The center load-bearing structure is steel. The foundation contains 4000-pound-test concrete, 184 yards of it. The sonic booms caused the bedrock beneath my home to shift along the geological fault, thus cracking my foundation and floors.

During May or June of this year Doubleday will publish a book by Don Dwiggins called *The SST—Here It Comes, Ready Or Not*. I suggest that the writer of your article might read that book.

BAILEY SMITH
Oklahoma City

Air-coupled seismic waves?

Effects of the sonic boom from supersonic aircraft are similar to those produced by blast waves that, because of atmospheric wind shears and temperature inversions, return to earth at long distances from the original source. In studying such phenomena it is often difficult to explain the effects produced in terms of the shock overpressure alone, and on occasions significant effects appear to be associated with seismic surface waves. It appears probable that surface waves of this magnitude would be possible only if they were coupled to the air shock wave. Seismic waves travelling in a layered medium, in which the seismic velocity increases with depth, form a dispersive chain of waves whose velocity of propagation depends on the frequency of the wave. If the seismic disturbance is generated by the loading of an air wave passing over the surface of the ground, the seismic wave with a frequency such that its velocity is the same as that of the advancing air wave will not dissipate in the direction of the wave but will, in fact, continue to absorb energy in a resonant manner and reach an unexpectedly large magnitude. Such air-coupled waves would appear to be a very likely phenomenon associated with sonic booms travelling over the surface of the ground at a constant speed. The acceleration record shown as part of figure 11 in Harvey Hubbards' article appears to be typical of that produced by air-coupled surface waves. The frequency content of sonic booms and the typical velocity of the shock front over the ground would appear to be close to ideal for the production of air-coupled waves. The geological structure of some regions in the path of supersonic transports may also lend itself to the production of this phenomenon. This effect may have been taken into account in considering the effects of the shock waves from supersonic aircraft, but I have not seen it discussed in the literature.

J. M. DEWEY
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Criteria for sonic booms

Your February editorial asks two questions: (1) ". . . if . . . if . . . why can we not show our neighbors that our methods are strong, *our criteria valid*, and our concerns interesting?" and (2): "If there is a relation between *science* and the human condition, how shall *we* demonstrate it?" (All italics mine.)

Answering question 2 first: It is arrogant, and solecistic, to switch from "physics" to "science" and assume that "we" the physicists speak for *all* science. Let physicists learn much much more of *other* branches of science, and show how *they* relate to human conditions.

Answers to question 1: To show neighbors that physics has valid criteria, you first have to have them and then demonstrate them. The article in this same issue on "Sonic Booms" by Harvey H. Hubbard demonstrates clearly the lack of such criteria. He says, "There are those who would ban the supersonic transport . . . others are taking a more realistic approach. . ."

Who would want Hubbard to ordain matters of human condition when he has clearly already made up his mind