

East Coast Mystery Booms: Mystery Gone But Booms Linger On

The ominous, window-shaking "explosions" heard along the East Coast last winter prompted an official government report on the phenomenon, but some scientists continued to raise questions even after the report's release (*Science*, 31 March 1978, p. 1416). Were the "explosions" simply sonic booms from routine military maneuvers transmitted unusual distances during exceptional weather conditions, as the official report suggested, or was there more to it? Did Concorde, the supersonic transport, cause booms along the U.S. East Coast (in addition to those it caused in Nova Scotia)? Could some have been natural phenomena, perhaps associated with earthquakes?

A year after the public reported the first booms, the official explanation of the loudest booms has gained considerable ground at the expense of some of the more exotic theories. An explanation for some of the less intimidating rumbles, which have been reported since last winter, has also been discovered. Booms heard around Boston and southeastern New England this summer do originate, the Federal Aviation Administration (FAA) concedes, from Concorde. All in all, there is much less room left for any mystery.

Although not as loud as the winter booms elsewhere, the New England booms did not escape public notice. Edward Chiburis, a seismologist at Weston Observatory, received 10 to 50 calls a week from people in the Boston area, Nantucket, Long Island, and southern Connecticut, all wondering what the rumbles were about. Chiburis described the sounds he heard as a rapid series of muffled booms or rumbles, "like a bass drum at about 200 meters." He heard the rumbles almost every morning at about 8:20 for 2 weeks.

The public also called the FAA about the booms. Between mid-July and mid-August, the FAA received 390 calls about booms that seemed to be related to inbound Concorde flights to New York. These reports convinced the FAA that the low rumbles heard around southern New England were Concorde booms reflected from high in the stratosphere when the plane was still 120 to 240 kilometers away. This was possible because the shock wave created by Concorde during supersonic flight not only projects downward, where the "primary" boom is heard in the vicinity of the plane, but

also upward. Some of this upward-directed sound can be bent back down toward a distant spot on the ground by sharp changes in air temperature in the stratosphere. Residents of southwestern England are also familiar with this "secondary boom" phenomenon, which has been noticeable there since Concorde runs began; at present no practical way to eliminate secondary booms has been found.

The FAA does not consider secondary booms to be a problem in operating the Concorde. In fact, it has pronounced a secondary boom to be something other than a sonic boom. According to the preamble of final FAA sonic boom rules issued last June, the low intensity and unalarming nature of a secondary boom exempt it from consideration under sonic boom regulations. Jeremy Stone, of the Federation of American Scientists, maintains that a conflict exists between such an interpretation and the vague existing rules, which require that no measurable sonic boom of any sort affect the surface. Thus, although a prominent antiboom activist terms the Boston booms "trivial" and of no concern, the federal government may still have some difficulties in defining sonic booms.

Arizona Booms

The subdued booms reported in New England and elsewhere since last winter are but whispers compared with the "explosions" of last winter. However, it now appears that secondary booms and other sounds were caught up in a "boom flap" precipitated by exceptionally strong booms at a few places along the Atlantic seaboard. Since the release last March of the official report prepared by the Naval Research Laboratory (NRL), additional evidence supporting the role of unusual weather in producing strong booms has come from Arizona.

In April of 1975, a salvo of booms struck Tucson. Like those on the East Coast, these booms seemed mysterious and attracted considerable public attention. Their being sonic booms seemed unlikely at first because the nearest supersonic aircraft were more than 100 kilometers away, well beyond the usual range of sonic booms. But Richard Wood, a meteorologist at the U.S. Weather Service's Tucson office, concluded that the booms coincided with the presence of an unusually swift jet stream blowing from the direction of the super-

sonic aircraft. The push of the 250-kilometer-per-hour winds and possibly the bending effect of vertical temperature changes associated with a strong jet stream apparently focused the booms into Tucson.

According to Wood's analysis, the situation near Charleston, South Carolina, when booms were heard resembled that during the Tucson episodes. Wood found that, when jet stream winds in excess of 200 kilometers per hour coincided with military flight operations, the maximum number of reports were made. Wood cited, among others, a 4-day period of Saturday through Tuesday. Although the jet stream was particularly swift throughout the period, residents reported booms only on Tuesday, apparently because supersonic aircraft did not operate on Saturday, Sunday, or Monday (a holiday that week).

At least one of the more exotic theories for the East Coast mystery booms has been dropped in favor of NRL's and Wood's explanation. Last spring, Jeremy Stone and Richard Garwin, a physicist with IBM, speculated that, if a suggestive correlation between South Carolina booms and Concorde departures from England held up, then perhaps the booms were transmitted over the nearly 6000 kilometers in between by way of the thermosphere (the region above a height of 80 kilometers). Garwin now believes that, as a result of further studies by himself, a Department of Defense study group, and NRL, the theory is untenable because too much of the boom's energy would be dissipated before it even reached the thermosphere.

The case for a natural source for at least some booms continues to be argued by Sandra Claflin-Chalton and Gordon J. MacDonald. They report in a recent study published by the MITRE Corporation that only 413 of the 594 boom events reported last winter and spring could be associated with known supersonic aircraft operations. They conclude that many of the remaining 181 events have a natural origin, perhaps associated with movement within the earth's crust.

Most observers now feel more comfortable with the NRL explanation of unusual weather for all the booms. Further study of last winter's flap is unlikely unless the booms return. The Navy has begun issuing advisories during exceptional weather conditions to avoid such a recurrence.—RICHARD A. KERR