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NEWS AND COMMENT

East Coast Mystery Booms: A Scientific Suspense Tale

Since last December, the public, government officials, and some very distinguished scientists have been baffled by a series of booming noises heard off the East Coast of North America, mostly in southern Nova Scotia, New Jersey, and Charleston, South Carolina. Like any mystery, the boom incidents have attracted their share of nuts and spooks—the nuts include those who write the government about them, giving a return address of "Planet Jupiter"; the spooks seem to include representatives of the Central Intelligence Agency, who quietly have been inquiring around Washington about the possible cause of it all.

And then there are the scientists. Competing scientific views of the cause, or causes, of the booms came into the open recently when (i) two prominent scientists, who apparently believe that the booms could be precursors of an East Coast earthquake, considered giving a press conference but decided not to do so and, (ii) conflicting explanations were put forward at press conferences given first by the government's Naval Research Laboratory (NRL) and then by the Washington-based Federation of American Scientists (FAS).

On 3 March, the NRL announced that offshore military aircraft traveling at supersonic speeds for brief periods were probably responsible for the booms. Several days later, FAS director Jeremy J. Stone postulated a new phenomenon—namely that shock waves from the Concorde supersonic transport, which tripled its number of transatlantic flights just when the boom reports began, are transmitted at great speeds through the upper atmosphere and causing the booms. In the midst of all this, as these scientific sleuths have been crisscrossing each other on the scent of the mystery, presidential science adviser Frank Press seems to have been serving as an informal traffic cop.

As far as is known, the booms do not harm people or property. People simply report having heard a loud, sharp detonation, often when they are indoors. Most scientists who have looked over the boom reports agree that what is being heard is not direct sound but infrasound—the noise of the overpressure of a shock wave hitting a structure, such as a building. In most cases, instruments recording the events indicate that the shock wave is airborne and is not accompanied by seismic activity.

Apart from the recent spate of reliably reported East Coast booms, booming is a historical phenomenon. For hundreds of years sailors in the North Atlantic have heard booming noises and considered them harbingers of good weather; near Lake Seneca, New York, booms, known as the "Seneca guns," have been heard since historical times.

No single theory of their origin has been completely accepted by scientists, although such booms have been a subject of considerable interest. But those who operate sensitive acoustical instruments say the new series of East Coast booms is different. After a highly unusual boom in the Palisades region of New York on 2 December, other soundings from New Jersey, Charleston, New York, and New England were reported. In late December, science adviser Press asked the Department of Defense to look into their possible cause, and, in January, as the reports continued, the NRL began its 2-month investigation of the citizen reports.

The mystery booms also interested Thomas Gold, professor of astronomy at Cornell University, who is well known for his work on pulsars, and Gordon J. F. MacDonald, a prominent geophysicist who is, at present, a consultant to the Mitre Corporation.

Gold, who has been interested in methane as an indication of tectonic activity in the earth, and in the possibility that explosions of leaked, airborne methane are the cause of historical booms such as the "Seneca Guns," apparently was postulating that the East Coast booms were linked to methane explosions. Several associates of Gold's say that he thought that the East Coast Booms could presage a major quake in the area. Gold would not comment directly to *Science* on his earthquake hypothesis, but he did note that Charleston had suffered a major earthquake in 1886 after booming noises were reported in the region.

An associate of Gold's at Cornell, astronomer Carl Sagan, apparently put Gold and MacDonald in touch with FAS director Stone. Stone told *Science* that Gold and MacDonald were interested in publicizing their view of the booms and that, among other things, they talked of holding a press conference to warn of the boom-methane-earthquake possibility.

Stone says this aroused his interest in the booms and in particular correlations between Concorde flights and booms reported in Nova Scotia by an amateur group lead by a housewife named Hattie Perry. By late February, Stone was more and more convinced that Concorde was the cause, but the earthquake precursor theory was also still alive.

Meanwhile, the Naval Laboratory's

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60-day investigation, which looked at causes for the booms ranging from ship disasters to meteorites, was winding up. On 3 March, NRL officials told Press that, in their opinion, the booms were caused by military aircraft flying at around 35,000 feet (10,500 meters) for brief periods of supersonic flight. Press heard the NRL conclusions in the morning, and surprised the Navy scientists by asking that their report be released at a news conference that afternoon. Whether the haste was meant to diffuse the impact of a possible Gold-MacDonald earthquake warning is not clear.

A little later, Stone concluded that the turning, acceleration, and deceleration of the high-flying Concorde was responsible for the Nova Scotia booms and some of those reported in the New Jersey area. As for Charleston, where the booms seemed to be occurring regularly before Concorde landings in the United States, Stone and IBM scientist Richard Garwin postulated an unusual new mechanism by which the shock wave from the plane could travel faster than the plane's ground speed and be bent back to earth farther along the plane's route. Stone briefed Frank Press on 10 March and offered to withhold public release of his theory to accommodate Press's schedule. Press then arranged for a second briefing, to the Secretary of Transportation, to be held 2 days later, before the FAS would go on record saying that the cause of the booms was the Concorde. At Press's request, the NRL is reviewing the FAS findings. And the FAS has asked British Airways and Air France, the two airlines that fly Concordes into the United States, to freeze Concorde routes so that systematic observation can determine whether the planes are causing the booms. MacDonald told *Science* that he feels there is a need for more systematic measurement, so that scientists can make a more thorough study of the entire problem.

So, for the moment the prime suspects in the boom mystery are the military aircraft or Concordes. Both NRL and Stone dismiss the methane theory, and other natural causes, because the booms seem to come during working hours during the week. As one NRL spokesman quipped: "We decided that if it is nature, or God, causing these things he must be a civil servant working on Eastern Daylight Time." The Naval Research Laboratory has ruled out the Concorde as a cause of all the booms except those in Nova Scotia, because Air France's and British Airways' scheduled arrival and departure times did not correlate with booms, and because few booms were noted on Sundays, when the Concorde is flying.

While a few reported booms coincided with local, man-made related activities, such as TNT explosions, the only other likely explanation is the military aircraft that practice maneuvers regularly in blocks of airspace reserved for them up and down the coast. Although official logs of such maneuvers often do not record supersonic flights that coincide with the booms, pilots had said during interviews that they often make dashes and turns at supersonic speeds either without knowing it or without bothering to make an entry in the flight log. NRL has discovered several instances in which these flights correlate with the occurrence of booms in New England, Charleston, and even Florida. Stone, however, still dismisses the military aircraft theory, by and large, because military aircraft have been maneuvering off the coast "for 15 years," while the East Coast mystery booms seem to be a new phenomenon. The commonsensical reason that the Concorde is the most likely suspect, Stone says, is that the public reports of booming started in late November, shortly after the number of Concordes landing there increased.

Stone associates a directional change in the Concorde's flight path south of Nova Scotia—a turn that it must make to avoid dragging its sonic boom over land—to the booms reported by the citizen group in southern Nova Scotia. By using actual, instead of scheduled, departure and arrival times, and calculating when the Concorde made the turn, Stone says he finds very neat correlations between the time the shock wave left the aircraft and the time it should have hit southern Nova Scotia. Moreover, he says, multiple booms reported in Nova Scotia—which has the most precise, and extensive, set of boom data taken to date—could be accounted for by the fact that several shock waves converging on a single point would be given off as the Concorde turns. It is well established, Stone reports, that, when planes turn in supersonic flight they can cause a focused shock wave, or "superboom" that travels at the speed of sound and that can be heard hundreds of miles away. The best known, most studied shock wave effect of supersonic planes is the cone-shaped wave that moves with the plane, and intersects with the ground like a "carpet" that can extend 25 miles on either side of the plane's flight path.

Stone and Garwin account for some of the New Jersey booms, and many of the Charleston booms, by another kind of boom they call a "hyperboom." This hyperboom is created when the plane accelerates faster than the speed of sound and goes on traveling at those speeds. Because the plane is climbing at the same time, the shock wave is transmitted still higher, into the thermosphere 100 miles above the earth. The heat of the thermosphere, which is very intense, then bends the wave back down to earth, enabling a focused boom to hit the earth many thousands of miles away. Because the wave goes on traveling at its original speed, it will travel faster than the cruising speed of the plane, and arrive, thousands of miles away, before the plane lands, they say. Stone and Garwin's calculations, based on the neatly programmed flight of the Concorde, show that a shock wave leaving the plane as it accelerates off the coast of England, could arrive in Charleston, which is at that point directly on the plane's course, more than an hour before the plane itself would land in New York.

The hyperboom could turn out to have an adverse environmental impact, Stone and Garwin speculate, if the shock waves accelerate winds or cause "very large disturbances" in the thermosphere.

Stone notes that mysterious booms were heard in southwest England, and became known as the "bumps in the night" mystery, shortly after Concorde flights became routine there. Stone says a search of the literature revealed several instances of noises heard many, many miles away at very specific unexpected locations, such as when the noise of an Apollo space launch was reported far away in Florida, or even when the 100 cannon salutes fired in London on Queen Victoria's death were heard in Ireland.

"An interesting speculation that deserves further study" is the way Frank Press characterized the Stone theories to *Science*. But Press thinks the NRL work has much to recommend it, too. And NRL, for its part, is starting to find specific military aircraft that have flown supersonically in the region and time of specific booms. Meanwhile, the advocates of a natural explanation for the mystery are waiting to see how well man-related explanations hold up. Gold cautions: "We should leave open the question that some [booms] may be naturally caused. We can run a risk that we will sweep some potentially important, naturally caused booms under the SST carpet."

Thus, the mystery, which started last December with bafflement and a dearth of plausible explanations, now seems to have a plethora of them.

—DEBORAH SHAPLEY