A ‘Sonic Attack’ on Diplomats in Cuba? These Scientists Doubt It

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By Carl Zimmer

A scientific enigma lies at the heart of a strange confrontation between the United States and Cuba.

According to the State Department, nearly two dozen diplomats at the American Embassy in Havana have been stricken with a variety of mysterious medical symptoms, including hearing loss and cognitive difficulties.

After concluding that staffers were the victims of a stealth attack, the department [withdrew nonessential personnel from Havana](https://www.nytimes.com/2017/08/24/us/politics/health-attack-us-embassy-havana.html) and issued an advisory urging Americans not to visit. On Tuesday, the Trump administration [expelled 15 Cuban diplomats](https://nyti.ms/2yGeISn) from the United States.

The State Department has not provided further details about the medical condition of the affected staffers. But government officials have suggested anonymously that the diplomats may have been [assaulted with some sort of sonic weapon](https://www.nytimes.com/2017/08/10/world/americas/mysterious-health-issues-drove-us-diplomats-from-cuba.html).

Experts in acoustics, however, say that’s a theory more appropriate to a James Bond movie.

Sound can cause discomfort and even serious harm, and researchers have explored the idea of sonic weaponry for years. But scientists doubt a hidden ultrasound weapon can explain what happened in Cuba.

“I’d say it’s fairly implausible,” said Jürgen Altmann, a physicist at the Technische Universität Dortmund in Germany and an expert on acoustics.

For decades, military researchers tried to transform sound into a nonlethal weapon that could stop enemy soldiers in their tracks.

“Why go in there with batons and guns when you can go in with something simple, like a sound generator?” said Dr. Geoffrey S. F. Ling, a neurologist at Johns Hopkins University and the former director of the Biological Technologies Office of the federal Defense Advanced Research Projects Agency.

The Pentagon funded development of loudspeakers to deliver long-range blasts of sound. The Navy uses them to ward off pirates, while the Army deploys them at checkpoints. In recent years, police have used so-called long range acoustic devices to break up crowds like those at [the protests in Ferguson, Mo](http://www.popularmechanics.com/military/weapons/a11139/real-military-uses-for-all-that-ferguson-police-gear-17105149/).

But these weapons work because they are insufferably loud, and if one were used against diplomats in Cuba, there would be no mystery about it. So speculation has swirled around another possibility: a device producing a sound outside the range of human hearing.

One possibility is infrasound — low-frequency sound that cannot be heard by humans. A report by the National Institute of Environmental Health Sciences in 2002 noted that the military [had tried to weaponize infrasound](https://ntp.niehs.nih.gov/ntp/htdocs/chem_background/exsumpdf/infrasound_508.pdf) but had not succeeded because it was hard to focus the wavelengths.

The primary effect of infrasound on humans “appears to be annoyance,” the report concluded.

Ultrasound is the more likely possibility. At frequencies higher than 20,000 hertz, beyond human hearing, ultrasound can damage tissue if produced with enough power.

Doctors use focused blasts of ultrasound to smash kidney stones. Decades ago, researchers created intensely powerful ultrasound beams in laboratories that [can kill a mouse at close range](http://asa.scitation.org/doi/abs/10.1121/1.1916916).

Less powerful ultrasound beams don’t cause injuries and have a variety of medical uses, including commonplace medical scans. But there’s anecdotal evidence that at certain intensities, they can make people very uncomfortable.

Steven L. Garrett, who taught acoustics at Penn State University before retiring last year, used to demonstrate ultrasound beams to his students. Often he would get nauseous and develop a headache; eventually he took to wearing protective gear.

“We didn’t use them any more unless we not only had earplugs in our ears, but earmuffs over the earplugs,” he said.

Unfortunately, anecdotes like this make up most of what scientists know about the health effects of ultrasound. “The data is very slim,” said Timothy Leighton, a professor of ultrasonics and underwater acoustics at Southampton University.

It’s difficult to get people who report symptoms to volunteer for the studies, he said. And while the military, too, has investigated weapons based on sound beyond the audible spectrum, they dropped major research projects in the 1990s.

Even if another player has succeeded in developing an ultrasonic weapon, researchers said, the laws of physics make it unlikely that the device could harm diplomats from afar.

“Ultrasound cannot travel a long distance,” said Jun Qin, an acoustic engineer at Southern Illinois University. The further the sound goes, the weaker it gets. And, noted Dr. Garrett, humidity in a place like Havana would weaken it still more.

Moreover, a beam of ultrasound will mostly bounce off the exterior of a building. What little sound got through would be of a lower, less harmful frequency.

One way to overcome these hurdles would be to use a bigger weapon. But a massive vehicle topped with a giant sound cannon in front of diplomatic houses would probably not go unnoticed.

“If you’re talking about a ray-gun rifle knocking out someone with ultrasound they can’t hear at a hundred meters — that’s not going to happen,” said Dr. Leighton.

An ultrasound-emitting device planted inside a building, on the other hand, might be close and powerful enough to cause harm to occupants. But even an interior wall would block its waves.

A smaller emitter placed even more closely, perhaps in someone’s pillow, might do the trick, said Dr. Qin. But it’s hard to believe such a device could escape attention. In theory, a building could be packed with small emitters; however, experts called it unlikely.

And while ultrasound can cause many of the symptoms reported, there’s no evidence that it can cause mild brain injury.

“I know of no acoustic effect that can cause concussion symptoms,” Dr. Altmann said. “Sound going through the air cannot shake your head.”

For all of these reasons, experts said, ultrasound weapons should not top the list of possible explanations for the hearing loss and headaches and other symptoms said to have been observed in diplomats.

“I believe those people got something that hurt them,” said Dr. Qin. “But it could be something in the environment.” The possibilities include toxins, or bacterial or viral infections, that can damage hearing.

Dr. Leighton said contagious anxiety or another psychogenic contributor couldn’t be ruled out. “If you make people anxious that they’re under attack from an ultrasonic weapon, those are the symptoms you’ll get,” he said.

Sorting through all those possibilities will be difficult now.

If a mysterious high-tech ultrasound weapon were used, it ought to have been easy to get the evidence while the attack was underway, Dr. Garrett said. Cellphone microphones are often sensitive to ultrasonic sound, he noted, and commonly available iPhone apps could have revealed it.

Investigators now are left to examine diplomats for telltale physical damage, like damaged eardrums.

“I think they missed their chance” to find the cause, he said. “It should be a piece of cake.”

What’s a Science Reporter to Do When Sound Evidence Isn’t Sound?

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By Carl Zimmer

On Tuesday, Michael Mason, my editor on the science desk, shot me an email. Would I consider writing an article about “this sonic ‘attack’ business”?

I knew exactly what he was talking about. I had been vaguely puzzled about this business for months.

Earlier this year, my colleagues at The New York Times started to report on a medical mystery that has turned into an international standoff. American diplomats in Cuba have fallen ill with a variety of perplexing symptoms, including — reportedly — some that might denote mild brain injury. The United States government has claimed foul play and accuses Cuba of, at the very least, not protecting the diplomats.

No one was publicly saying what caused the symptoms. But again and again, I would see suggestions that the diplomats were being attacked with a sonic weapon. A sound rifle, perhaps.

When the United States escalated the dispute by [expelling 15 Cuban diplomats](https://www.nytimes.com/2017/10/03/world/americas/us-cuba-diplomats.html) on Tuesday, Michael decided he wanted to learn more about this strange idea. I decided to try to find something out — not as a political reporter but as a science writer. [My article](https://www.nytimes.com/2017/10/05/science/cuba-sonic-weapon.html) was published on Thursday.

I have been contributing articles about science to The Times [since 2004](https://goo.gl/rhGsYK). For the past four years I’ve written a weekly column called [Matter](https://www.nytimes.com/column/matter). I usually base my ideas on scientific research that has matured far enough that it is beginning to get published in peer-reviewed journals. The biggest challenge in writing these is that there’s so much data to learn about, to mull and to transform into a narrative that will be compelling to nonexperts.

I knew that an article on sonic weapons would be very different from the ones I usually write. Consulting with Gardiner Harris, who covers international diplomacy for The Times and has written several articles about this case, I learned there was not even an official medical report.

I decided to try to draw some boundary lines for all the speculation swirling around the story. Is the idea of a sonic attack plausible, based on what scientists know about sound and the human body?

I wound up perusing a massive 2009 book called “ ‘Non-Lethal’ Weapons,” with a chapter summarizing research on using sound to incapacitate people at a distance.

But there’s less than meets the eye. There’s a lot of wild rumor about secret weapons that can make brains explode or make people think there’s a voice inside their head. And while medical researchers have studied the effects of sound for decades, they’ve done so sporadically, leaving us with a very patchy understanding.

So I hit the phone. I didn’t want to talk with just anyone — I looked for people with lots of experience in research that had direct bearing on this question. I started with Timothy Leighton, whose job title at Southampton University is, literally, professor of ultrasonics and underwater acoustics. Better yet, Dr. Leighton has published the only thorough recent scientific review of the effects of environmental ultrasound that I’m aware of.

When I interviewed Dr. Leighton and others, I made clear I didn’t expect them to solve this mystery; I just wanted them to reconcile the question with what we know through science. Everyone I spoke with had been following the news, too, so in each interview we hit the ground running.

Spoiler alert: The consensus was that it was extremely unlikely the diplomats were the victims of a sonic weapon. It would be necessary to rule out less exotic possibilities before taking that one seriously. The notion has ricocheted like mad around the press, making it possible for readers to assume that it has been generally accepted by experts. But it most certainly has not. I’ll be curious to see if articles like mine can put the brakes on the speculation.

If the United States government ever does release the results of a detailed investigation, I would love to report on the case again. But, as the retired acoustics professor Steven L. Garrett pointed out, the chance to easily prove that a sonic weapon was involved — using a cellphone microphone — is long past. I may never get to write that follow-up.