

Steven Wallace on the Columbia tragedy

Hydrogen afterburners

Two insider views

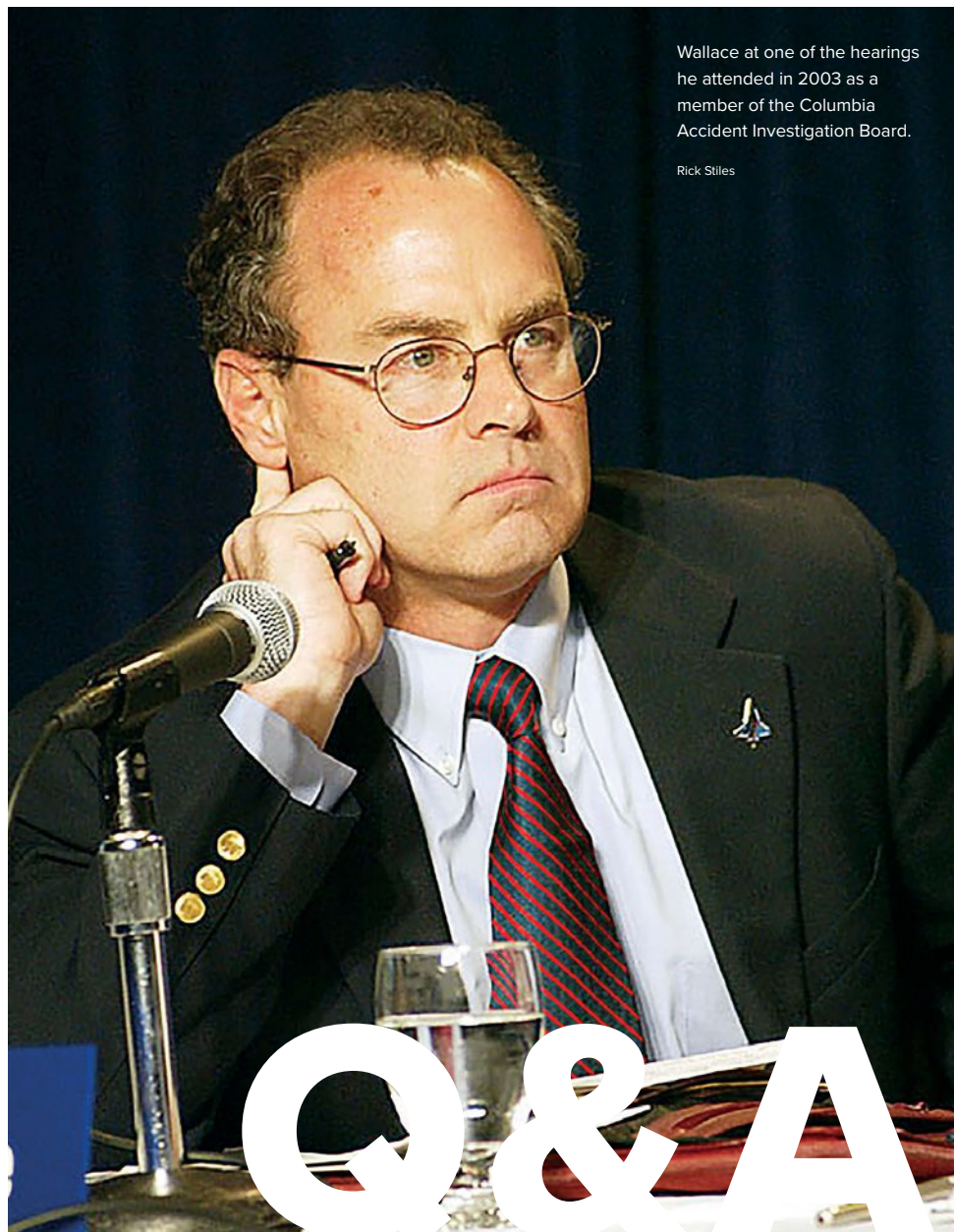
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The comet question

Are we giving these cosmic transients the attention they deserve in planetary defense?

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Wallace at one of the hearings he attended in 2003 as a member of the Columbia Accident Investigation Board.

Rick Stiles

STEVEN WALLACE

POSITIONS: Since 2008, an aviation consultant specializing in product safety reviews for companies; 2000-2008, director of FAA's Office of Accident Investigation that assists the U.S. National Transportation Safety Board; February 2003-August 2003, member of the Columbia Accident Investigation Board, CAIB, that made a series of recommendations to NASA. These were divided into actions to be completed before the space shuttles resumed flying and long-term changes the agency should make; 1991-2000, FAA senior representative at the U.S. embassy in Rome, where he was the liaison to 20-plus European countries in matters including accident investigations involving U.S. aircraft; 1984-1991, manager of FAA transport standards staff in the Seattle regional office, overseeing engineers, pilots and technical writers who developed certification requirements for transport category aircraft; 1976-1984, legal adviser to FAA's New York and Seattle regional offices.

NOTABLE: Wrote the executive summary of the CAIB report and oversaw the part of the investigation that probed NASA's decision not to further analyze the suspected foam damage to the orbiter. Dual citizen of the U.S. and Ireland. Has a commercial pilot license and has flown a variety of planes. He owns a Sling TSi, a four-seat South African aircraft he built from a kit.

AGE: 74 on Feb. 1

RESIDES: Vashon, Washington, near Seattle

EDUCATION: Bachelor of Science in psychology, Springfield College in Massachusetts, 1971; juris doctorate, St. John's University School of Law in New York, 1975.

Lessons from Columbia

Steven Wallace, like many in the safety of flight business, remembers exactly where he was when he heard that the space shuttle Columbia broke apart 20,000 feet over Texas, killing the seven aboard: It was Saturday and his birthday, so he was playing tennis. Over the next seven months, Wallace would help determine the cause of the tragedy as a member of the 13-person Columbia Accident Investigation Board appointed by NASA. In its 248-page report, the CAIB (pronounced "cabe") concluded that the orbiter was ripped apart when hot atmospheric gases penetrated a hole in the left wing, created by foam that fell from the external tank during launch. The CAIB determined that NASA's culture had also contributed to Columbia's demise by pushing ahead with a rigorous launch schedule to complete initial construction of the International Space Station and dismissing frequent foam strikes as "an acceptable risk." As the 20th anniversary of Columbia approached, I reached Wallace via Zoom to discuss the report's creation and whether its findings still ring true for NASA as it attempts to return humans to the moon under the Artemis program. — *Cat Hofacker*

Q: Where were you on Feb. 1, 2003?

A: I was playing tennis at an indoor tennis club in McLean [Virginia], where I played several times a week, and I got a phone call from my wife telling me that they lost communication with the space shuttle Columbia. Well, if you lose communication with it, it's because it's gone, except for temporary interruptions. We later learned that in mission control in Houston, a flight controller had told Leroy Cain, who was the asset and entry flight director in charge of the flight at that point, that they were starting to see a few things that looked wrong. Just a very few, and [controllers] did not realize this shuttle had crashed until it was shown on television, and then they saw the three streaks of the main engines going across the sky. The TV people couldn't figure out what it was. This is just over Dallas. Once I got the call, I talked to the FAA administrator and the head of safety for the FAA, who I directly reported to. They did not know that I was predesignated on a NASA plan, because the director of accident investigation was on NASA's contingency plan.

Wallace means that, in his role as director of FAA's Office of Accident Investigation, he was predesignated to serve on the International Space Station and Space Shuttle Mishap Interagency Investigations Board, the group of high-ranking officials who, in the event of a shuttle crash or similar "serious mishaps," would convene. Renamed the CAIB, this board chaired by retired U.S. Navy Adm. Hal Gehman originally consisted of officials from the Defense Department, Department of Transportation and NASA. Gehman later requested that NASA Administrator Sean O'Keefe appoint five additional members who were not government employees, including former astronaut Sally Ride. — CH

So I explained to them that I had this role but I didn't know what was going to happen. Fred Gregory [the deputy administrator of NASA] called me that day or the next day and told me to get on a plane. We made a few stops to pick up a few other CAIB members, including Adm. Gehman. We went initially down to Barksdale Air Force Base [in Louisiana]. That's where they were collecting the debris, but we then quickly moved to Houston.

Q: Did the CAIB realize at that point that your investigation might have to go beyond the physical cause of the accident and examine NASA's culture, as the Rogers Commission did?

A: Not at that point. On the plane ride, Adm. Gehman was sort of drawing us out about our approach — things like are witnesses going to have confidentiality. We can do that, and the military does that [in its investigations], and the civilians don't do that. But what you're describing is very much the key part of the direction of the investigation, and Gehman really took the lead on that. NTSB [U.S. National Transportation Safety Board] people have a saying that when you find the human error, that's not the end of the investigation; that's the beginning of the investigation. What is the true root cause? The root cause is the thing that you have to change so it doesn't happen again. Gehman was very much thinking in those terms, I think, from day one.

Q: In the early days of the investigation where the CAIB was gathering information, how did you decide which member would oversee which part of the investigation?

A: We did that fairly quickly. We broke into four or five groups, and mine was the on-orbit group and the decision making that was done around that. One key aspect of that was the Linda Ham interview, which was done primarily by an investigator that I brought in from FAA.

"NTSB people have a saying that when you find the human error, that's not the end of the investigation; that's the beginning of the investigation."



▲ This photograph of debris from the Columbia orbiter was taken by a cardiologist in Tyler, Texas. The orbiter began disintegrating as it flew across the southern United States, shedding thousands of pieces of debris that would later be collected by NASA, the U.S. Forest Service and volunteers.

AP Photo/Dr. Scott Lieberman

NASA's Linda Ham led the mission management team for the Columbia flight, the group of managers from various parts of the shuttle program whose role was to resolve any problems that arose before or after a launch. — CH

I brought in three people from the FAA and a couple from NTSB to just help my team, and the FAA guys did a very good job in drilling down to that story about how Linda Ham and other managers really suppressed open communications.

Wallace is referring to NASA's handling of requests by engineers to obtain U.S. spy satellite imagery of Columbia on orbit to see if pieces of insulating foam seen striking the orbiter's left wing in launch footage had damaged the wing and, if so, how severely. According to the CAIB, Ham told colleagues she couldn't identify who made the request, so she told the Defense Department liaison that "I don't think we need to pursue this." In a NASA press conference held shortly before release of the CAIB report, Ham at times fought back tears and said: "We were all trying to do the right thing. All along, we were basing our decisions on the best information that we had at the time," according to media reports. — CH

The CAIB members in my group were Sally Ride and Maj. Gen. Kenneth Hess of the Air Force Safety Center. The entire CAIB met every morning. If Gehman wasn't there, I usually ran the meetings, and we'd just have a collegial discussion, but there are often 100 people in the room including the support staff. I will tell you briefly that the NTSB did not agree to be part of the NASA contingency plan. I have a huge respect for that agency, but they really run investigations and are not normally in a good position to participate in investigations that they are not in charge of, because being independent from other agencies is hugely important to them. And so they don't want to put their signature on something that isn't theirs. So they came to the investigation, a lot of them, including the most senior aviation people, but they weren't on the board, and they were so cautious about what they would do and what they would say. But some of them did working-level stuff. One NTSB staffer, he actually laid out the wreckage in the hangar [at NASA's Kennedy Space Center] and his name is Clint Crookshanks. They knew how to do that, and he led that extremely well.

Q: It's very sobering that in addition to the physical cause of the foam, the report concludes that the root cause was NASA's "normalization of deviance" about the frequency of the foam strikes. The CAIB traces that at least in part to how the shuttle fit into the overall U.S. space program.

A: Exactly. That's where I would have started this discussion. You know my birthday; I was 8 when Sputnik went up in 1957. That was the heart of the Cold War. We had drills in my grade school. I came home with literature



“The best rocket scientists in the world, and NASA lost two shuttles in 135 flights. If you lost 1 in 67 commercial [airline] flights in the U.S., that’d be the end of that industry.”

about how to build a bomb shelter, and as a child, I was afraid of that. It was a few years later when President Kennedy said we’re going to put a man on the moon in a decade. Well, that was a vision and a very bold vision, and when we started the very first space shots — I was probably in seventh grade when Alan Shephard just went up and back, like these space tourists are doing now — everything in school would stop. We didn’t have television coverage. We’d be listening on the PA system. It was a huge deal.

Q: And when the Nixon administration canceled Apollo and gave the go-ahead to develop the shuttle, the U.S. lost that big vision?

A: Right. So where are we now? Well, we have this Artemis mission. We say we’re going back to the moon. What has changed is that they didn’t know that there was all this water on the moon, and now they know

there’s water. So now they want to go see if we can establish a permanent presence there, and maybe survive long term or turn water into hydrogen and oxygen. I’m still not clear what the nation’s appetite for human spaceflight is. I don’t know that people are that interested in it. There isn’t that Cold War urgency about it. And are we really going to be putting lives at risk? Spaceflight is very dangerous, and for what long-term purpose, I don’t know. They talk about the moon being a potential stepping stone to Mars. I’m not arguing with that, but I’m not sure how much risk the nation is willing to accept.

Q: There is a line in the report about how NASA was an agency “straining to do too much with too little” budget. Is that still true today?

A: I don’t have enough intimate knowledge of what the projected costs are and what the budget is. I would

▲ As search and recovery teams located debris from the space shuttle Columbia in East Texas and elsewhere in the southern United States, the pieces were shipped to a hangar at NASA’s Kennedy Space Center in Florida for sorting. When this photo was taken in May 2003, some 82,000 pieces of debris had been located, with 753 of them identified as being part of the left wing.

NASA



▲ This picture of the STS-107 crew posing for the traditional in-flight portrait was on a roll of unprocessed film recovered from the orbiter debris.

NASA

just leave it with the fact that I'm not sure that the country as a whole has passion to get to the moon like what they did [in the Apollo years]. I do want to make one point about the risks of spaceflight, given that people are talking about tourism. I love the fact that this country allows people to take risks, and we are at some level an exploring species. But the space shuttle flew 135 times, and they lost two — one going up and one going down. In both cases, compared to these up and down flights conducted by Blue Origin and Virgin Galactic, you have to get going at 17,000 miles an hour to get into orbit. Now you've got this kinetic energy, and you absorb it in reentry. The best rocket scientists in the world, and NASA lost two shuttles in 135 flights. If you lost 1 in 67 commercial [airline] flights in the U.S., that'd be the end of that industry. Now, I think today's commercial spacecraft are much safer, because the space shuttle was inherently complicated and dangerous — self-stabilizing capsules like SpaceX's Dragon are way simpler, way safer. But again, it's hugely risky. The laws of physics just make it that way. And so you have to say, "Why are we going into the orbit?"

Q: That comparison to the airline industry is frequently made, but as you say, spaceflight is inherently risky in a way few other activities are. Is it unfair to expect airline-level safety?

A: Perhaps. The space shuttle was designed and kind of built to be all things to all people. Substantial effort was made to make it look like an airplane and land like an airplane, which it did, and it had all these capabilities. It could go into a polar orbit from Vandenberg Air Force Base [in California, now named Vandenberg Space Force Base], which they never once did, and grab a spy satellite. And then it had to have a large cross-range capability when it came back [to

land]. But again, that capability was never used. And like an airplane, it carried the cargo and the crew in the same vessel. You will not see that anymore [in today's capsules]. There's no reason you'd want it. It's safer and easier to separate.

Q: The physical causes of the Challenger and Columbia tragedies are different, but both were linked to the schedule and budget pressure NASA was feeling, which the CAIB report laid out in great detail. What did it feel like when the board pieced that together?

A: The physical cause was pretty clear. The organizational stuff is more subtle, and it's something where you don't typically have a revelation. You just get an increasing sense of things like schedule pressure. But some of the stuff was not so subtle, like Linda Ham asking, "We can say there's not a safety of flight issue, right?" about the foam shedding. Managers suppressed these discussions. That became very apparent.

Wallace is referring, in part, to discussions during mission management team meetings that were recorded, transcribed and reviewed by the CAIB. In one meeting in which the foam strike to the wing was discussed, Ham said NASA "doesn't believe" that the foam penetrated the lower layers of the thermal protection tile, based on an analysis with Boeing software. Therefore, there was "no safety of flight kind of issue, it's more of a turnaround issue similar to what we've had on other flights." In its report, the CAIB alleged that pressure to maintain the schedule of the next schedule launch prompted managers to cut short these discussions." In a NASA press conference shortly before the CAIB report was issued, a sometimes tearful Ham said she "takes responsibility" and "none of us felt that the analysis was faulty," according to media reports. — CH

And they suppressed requests for the military to image Columbia on orbit. I remember I had to go get my top-secret clearance jacked up another level — to what's called sensitive compartmented information — to be able to know the resolution, capability of the spy satellites, and in fact, I don't think I ever actually learned what it was, but I didn't really need to. But if they had seen a substantial hole in the leading edge of the orbiter, they would have immediately known they could not reenter. We did the actual test, firing a projectile at some RCC [reinforced carbon carbon] tiles, and you could put your head through the hole that was made. And so the Columbia board looked at, "Could you have gotten another space shuttle up there?" And the answer was you might have been able



to keep them on orbit for a month, and you might have been able to get another orbiter up there to recover the crew. The other thing we looked at was, “Could the crew of the Columbia have gone out and made some crude repair that might have enabled them to get to subsonic flight, in which case they could jump out?” If they had concluded they had to do that rescue scenario, I mean, NASA is chock-full of brilliant, dedicated, fearless people, and you know they would have had all the astronauts beating the door down to fly the rescue mission.

Q: This was a very emotional, high-stakes investigation, and the board needed NASA's cooperation to get to the bottom of it. How did you go about asking NASA personnel the hard questions while maintaining good working relationships?

A: NASA is an organization that deserves a huge amount of respect, and they got a huge amount of respect from us. And so, yeah, sometimes in a particular interview, a particular question might be difficult or challenging, but for the most part, you went in there clearly conveying your respect. At the same time, we probed organizational flaws as early as we could, so it just seems to me like it worked out pretty well. There were 13 board members, but some of the individual investigators that we brought in were authorized to do the interviews, and if any of the board

members felt that someone was crossing a line somewhere, we would intervene. I just think that there was just an underlying respect that was apparent. I remember Gehman going into the astronaut office and telling them, “You’re the nation’s heroes.” His leadership was crucial.

Q: Adm. Gehman in particular went to great lengths to make sure the CAIB was independent. How aware were you and the other members of those struggles?

A: I wasn’t aware of every aspect of the meetings and the disagreements and the discussion about whether the report would be fully released to the public. I felt like Gehman was very open and shared a lot with us, but I don’t know what I don’t know. On the writing of the report, I remember we brought in a guy named Dennis Jenkins, who was a very prolific writer.

Jenkins is the author of the 2001 book “Space Shuttle: The History of the National Space Transportation System.” — CH

He was also really good at laying out the report logically, and he was really instrumental in that. When we were done writing the report, he had the

▲ Retired U.S. Navy Adm. Hal Gehman (center), chair of the Columbia Accident Investigation Board, makes opening remarks during a June 2003 hearing. Steven Wallace is on the left, and at right is Douglas Osheroff, a Nobel laureate physicist who was one of the members later added to the board.

Rick Stiles



“The physical cause was pretty clear. The organizational stuff is more subtle, and it’s something where you don’t typically have a revelation. You just get an increasing sense of things like schedule pressure.”

▲ Eighty-two seconds after the space shuttle Columbia lifted off from NASA’s Kennedy Space Center for the STS-107 mission, one of the pieces of foam that separated from the external tank struck the orbiter’s left wing. The Columbia Accident Investigation Board discovered such foam shedding was a frequent occurrence on shuttle flights, and NASA managers had come to consider this “an acceptable risk.”

Scott Andrews

report on one compact disc, and he got in his Gulfstream jet and flew to have it printed. While he was flying out there, we would call him up and say we had some edits here, and he would edit it. He’d asked the pilots, “How many pounds of reports can I put on this?” It was something like 1,500 or 3,000, so he brought back a Gulfstream jet full of reports, and those were the initial copies of it. We took them to the families of the astronauts, and Gehman took one to [NASA Administrator] Sean O’Keefe. Then we released it to reporters. We did this in the NTSB hearing room, which is right in L’Enfant Plaza [in Washington, D.C.]. We gathered all these reporters, and we gave them each a copy of the record, and we locked them in a room and said, “You can just read this for the next hour or two. Then we’ll have a public hearing and we will present it, and you’ll be able to ask us questions.”

Q: The CAIB concluded that NASA’s culture had to change if it was going to have the chance of running a successful spaceflight program. You

told reporters at the time you were pretty confident NASA could make that shift — has it?

A: I don’t have any inside track to NASA at this point, so I don’t know. And I don’t know if the Artemis program is well-funded enough. I remember when Vice President Mike Pence said we’re going back to the moon in 2024; I thought, “Yeah, that’s not a vision for human spaceflight. That’s a political statement.” It’s not a business issue, a vision for human spaceflight. You’ve got to get the country wound up and you have to fund it, and it’s expensive. So I was skeptical. But now NASA has launched Artemis I, and I think it’s good they’re utilizing commercial companies. At the time of the report, some people claimed that the CAIB had suggested this was a bad idea. We did not suggest that or have opposition to using commercial companies. But let’s consider the organizational things and substantial contributing factors to the Columbia accident. Could they happen again? I’m not in a business to say that, but NASA isn’t making all those decisions anymore. Sometimes they’re purchasing rides on private companies’ vehicles. That’s clearly different. ★