Testimony
of

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The United States may have a long-term future in human space flight. For the near term, however, human space flight should be suspended, or at least drastically curtailed. If the shuttle flies at all, it should fly unmanned, or at worst with a minimal crew. The space station should be mothballed or converted to a space platform, a research facility to be visited periodically for refueling, maintenance, and changing experiments. The upcoming mission to refurbish the space telescope should be canceled or flown only by the astronauts actually conducting the repairs; for the foreseeable future all orbiting scientific instruments should be designed to function untended and be launched on expendable launch vehicles to their optimal orbit.

The problem, of course, is the shuttle. Humans may one day fly to Mars and beyond, but not on the shuttle. While it is a technological marvel, it is also the world's most expensive, least robust, and most deadly launch vehicle. On average, one astronaut dies for every eight flights. I do not know of any transportation system, not even an experimental system, approved to operate with such a record. After the *Challenger* disaster, the Rogers Commission and every other body that studied the accident gave NASA the same advice. First, do not rely on the shuttle as the mainstay of the space program; it is too expensive and too fragile to ever fill that role. Second, begin at once to develop a replacement vehicle. Sixteen years later, the *Columbia* disaster found NASA massively dependent on the shuttle with no replacement vehicle in sight. The shuttle has never been and never will be the launch vehicle that NASA wants it to be, yet the agency appears determined to return to business as usual.

At least for the short term, we do not need the shuttle and we do not need people in space. Anything we want to do in space, we can do more cheaply, more effectively, and more safely with automated spacecraft monitored and controlled from Earth. The reason is simple. Whenever people are put on a spacecraft, its mission changes. Instead of exploration or science or communication or weather, the mission of the spacecraft becomes life

support and returning the crew alive. This limits where the spacecraft can go, how much equipment it can carry, how long it can stay, and what risks it can take in pursuit of its mission. The net impact of people on a spacecraft is to greatly limit its range and capabilities without adding any value that can begin to compensate for these drawbacks. A rough rule of thumb, first introduced by NASA Associate Administrator George Low in the Apollo program, is that putting people on a spacecraft multiplies tenfold the cost of the undertaking.

For more than forty years, NASA has been sending humans and machines into space. It has spent about two-thirds of its funds on human spaceflight, about one-third on automated spacecraft. The most important returns, after Apollo, have come from the machines--the space probes, the scientific satellites, the communications, geodesy, and weather satellites. The return on manned spaceflight has been mostly psychological, a kind of public entertainment based on flying the astronauts as an end in itself. NASA used to call this "the next logical step," envisioning a succession of manned projects culminating in a human mission to Mars. Now NASA simply says that it has achieved a "permanent human presence in space." It has not made clear what the people are to do there, other than take their own pulse in an endless round of experiments to understand the physiological risks of flying to Mars and back.

Before we can fly to Mars, we must first master flight to low-Earth orbit (LEO). Indeed, if we were to commit tomorrow to a human mission to Mars, it would still cost more to get to LEO than it would to get at all the rest of the way to Mars and back. This is the real obstacle to our future in space. It is the obstacle that the shuttle was supposed to overcome. After thirty years and tens of billions of dollars, it is clear that the shuttle will never be the vehicle NASA promised. We must recognize that reality, scrap or severely curtail shuttle operations, and get on with the challenging but promising business of building the launch vehicle or vehicles we need.

This can be done with no increase in NASA's budget. The money saved by stopping or limiting shuttle operations and by moth-balling or converting the space station will free up enough funds annually to do what the Rogers Commission told NASA to do seventeen years ago. Of course, additional funding might accelerate the process, but this is not a race, like Apollo was. It is a simple, straight-forward research and development program committed to the long-term development of our access to space. It may take five to ten years to develop a space plane to shuttle astronauts to LEO. It will probably take ten to twenty years to develop a vehicle that will provide truly reliable and economical launch to LEO. There is no reason to believe that the public will lose interest in space

if there are no astronauts in orbit. Manned spaceflight shut down through much of the 1970s while we developed the shuttle. Neither Congress nor the public abandoned NASA or the space program in that time. Indeed, a serious research and development program might actually increase public interest. The shuttle now captures public attention only when it flies celebrities or fails catastrophically.

Another way to restore public interest in the space program during a sustained period of launch vehicle development is to divert some of the savings from shuttle and space station operations to unmanned spaceflight. The international fleet of automated spacecraft currently on its way to Mars holds out far more promise of exciting discovery than does one more astronaut running a treadmill in LEO. Space science has been repeatedly taxed over the years to staunch the budget hemorrhaging in the shuttle program. Many worthy projects await funding.