

## The moon as a stepping stone for a spacefaring civilization

K. Multhaup

Westfälische Wilhelms-Universität, Institut für Planetologie, Germany  
(multhaup@uni-muenster.de / Fax: +49-251-83-36301)

### After *Columbia*

In early 2004, U.S. president George Bush introduced the Vision for Space Exploration (VSE). Conceived in the aftermath of the *Columbia* tragedy, it called for NASA to first return astronauts to the moon by 2020 and then send crews to Mars and beyond thereafter. Bush's plan has once again enlivened the long-lasting discussion of manned spaceflight vs. robotic exploration. Also, the plan to use the moon as a stepping stone has come under scrutiny and is being debated. Alternate approaches minimizing or deleting manned lunar exploration in the frame of the VSE were proposed.



Fig. 1 A composite manned spacecraft departing Earth orbit en route to the moon. Image: NASA.

In order to assess the value of us going back to the moon, it is necessary to debate without bias the meaning of human spaceflight in general and to discuss the role of science in future efforts.

### Lunar disenchantment

Within the scientific community, manned exploration programs are put into question time and again. It is demanded that in light of supposedly immense costs any endeavour concerning this matter shall be justified by an indisputable scientific return — and in current debates, scientific value is not recognized in such a way that funding appears well-invested. It is lamented that funds are drawn from what is considered real science.

In the past, robotic exploration has opened our eyes to the many wonders of the solar system. Through the eyes of *Cassini*, *Mars Express*, and other successful spacecraft, we have seen exotic landscapes—yet on second sight, some appeared all too familiar. *BepiColombo* will fly to Mercury to unravel its mysteries and the Jovian system may receive a new

earthly visitor in the not too distant future. By means of machines like *Spirit* and *Opportunity*, we have roamed the surfaces of Mars—without actually ever setting foot there. Therefore, the question is often asked, “Why send crews?”



Fig. 2 The upcoming Lunar Reconnaissance Orbiter (LRO) as it circles the moon. Robotic spacecraft deliver science for a fraction of the costs of manned exploration. Is this reason enough to question the presence of man in space? Image: NASA.

But even among those who basically support the concept of manned exploration, the decision to use the moon as our next destination and stepping stone is challenged. It is feared by some that manned lunar exploration in particular will bog down the space program for decades to come and eventually inhibit human exploration of Mars.

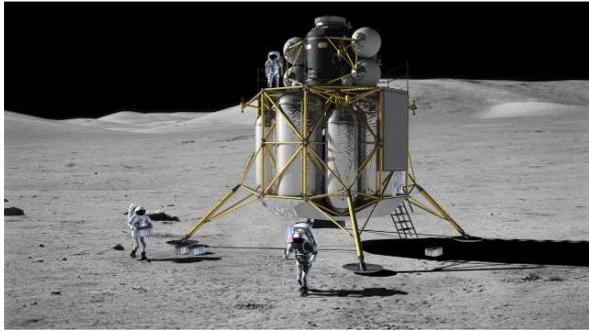
### Refutation of arguments

Both science and exploration have their roots in the human desire to evolve and expand. But if the virtue of human spaceflight is assessed in view of scientific return only, then the question must also be allowed what purpose planetary science has. What do we, the community of planetary scientists, do to benefit mankind?

I see two tiers in planetary science. One of them—the well established approach—is to learn about the planets in order to understand our own homeworld and the place that it takes in the solar system. A great many basic questions from this research theme can be answered by theorizing, by observing from the ground, and by sending unmanned spacecraft. But robots can only do so much ...

In this tier, human spaceflight admittedly is not required, but more than acutely helpful. A geologist

walking around on the surface of Mars will possibly learn more about the planet in a day's work than an automated rover slowly crawling from rock to rock in a couple of years. Nonetheless, the billions and billions of dollars that are required to conduct such programs can hardly be justified exclusively by science. Technology will evolve and the quality and quantity of science return from robotic missions will increase.



**Fig. 3** The proposed *Altair* lander sitting on the surface of the moon. It will enable astronauts to pick up where Harrison Schmitt—the first (and to date last) geologist to walk on the moon—left off in 1972. Image: NASA.

In the second tier though, the focus of science shifts away from basic understanding. We shall apply our scientific knowledge and use it to settle on other worlds. Why? Simply because we are an exploratory species! Human exploration of the solar system does not need to be justified by science. This misjudgement is with us ever since we first discussed the true value of Apollo. The concept of man in space is of paramount importance in itself.

Not many will adapt this view. But there is more. Carl Sagan wrote: "... every surviving civilization is obliged to become spacefaring—not because of exploratory or romantic zeal, but for the most practical reason imaginable: staying alive." In this context, understanding how the planets, moons and asteroids work will be a key to becoming true solar system dwellers and protect our well-being against self-imposed threats or cosmic catastrophes.

### **The moon as a stepping stone**

Maybe the timing of the Apollo program was a mistake. We took the second step well before the first. The first step should have been establishing ourselves in low Earth orbit. Now we are in the process of doing so—although the sheer impact of our early "giant leap" has made it difficult for NASA over the years to sell less ambitious programs to the various administrations of the U.S. and to the public. Or to the scientific community.

Of course, the shuttle and ISS programs do not serve exploration *per se*. "That's not exploration; that's like driving a bus over the same highway two hundred miles," the above cited Sagan also said. But through

the shuttle and the station that we built using it, we are learning how to live and work in space.



**Fig. 4** Today's astronauts are living and working in low Earth orbit. Image: NASA.

Now, we are ready for the second step. While we could also go to Mars without setting foot on the moon again, we ought to follow an expedient sequence of steps that will allow us to evolve and stage a sound exploration program. The new Constellation program hopefully will do what Apollo could not achieve.

Yes, returning man to the moon will be expensive. It will cost money and time. So will expeditions to Mars. But do we really wish to discuss the price tag of destiny in space? Or survival?



**Fig. 5** Footprint in the lunar surface. Are we ready to accept the inheritance of Apollo? Image: NASA.

### **Closure**

Manned exploration will both push frontiers and expand knowledge, just as science will enable us to understand the nature of these frontiers. The human future in space will be built on these foundations.

While the moon in itself will be a rewarding destination to concentrate our upcoming exploration efforts on, it will also serve as an excellent technological testbed for our further steps out—maybe to Mars or to the asteroids.