TO STILL BOLDLY GO

BY IAN CRAWFORD

Manned spaceflight must not be stopped by the Columbia tragedy. It is good for science, business, culture and international politics

THIRTY YEARS AGO, on 14th December 1972, the last two human beings to visit the moon, Gene Cernan and Harrison Schmitt, left the lunar surface at the conclusion of the highly successful Apollo 17 mission. Thus ended one of the greatest episodes in technological and organisational achievement in human history, and one which has left an enduring scientific legacy in our understanding of the origin and evolution of the solar system. However, without the motor of superpower rivalry, and eclipsed by economic concerns and pressing social and environmental problems, the dream of a human future in space has been allowed to fade. Now, with the tragic loss of the *Columbia*, many people are wondering whether it was ever worth the cost. Given the evident risks, do we really need people in space?

As with all complex questions, there are several layers of possible answers to this. Let us start with the International Space Station (ISS)—which is completely dependent on the shuttle programme. Although Russian launch vehicles are capable of servicing the ISS in the short term, its continued construction relies on the heavy lift capabilities of the shuttle. However, the European and Japanese experimental modules, together with most of the solar power arrays, are still waiting on the ground. If the momentum behind this project is not to be lost, it is crucial that the remaining shuttles are cleared to fly again as soon as possible, and that urgent consideration is now given to the development of a safer, more reliable and cheaper successor. Maintaining this momentum is important not only because of the range of life and physical science experiments scheduled to be performed on the ISS but because of the role it is likely to play in the future exploration of the solar system.

Ian Crawford is a planetary scientist based at Birkbeck College, London

The ISS is helping to develop much of the scientific, technical and organisational expertise that will be required if and when a decision is made to once again send astronauts beyond earth's orbit—in particular to Mars. Travelling to Mars will only be possible once we have learned much more about the physiological and psychological effects of living in space for long periods of time, and the necessary research can only be performed on the ISS. With 15 contributing countries (sadly excluding Britain), the ISS is by far the most ambitious international collaborative space project yet attempted.

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There is a school of thought, widely aired since the *Columbia* accident, that *people* are not required in the exploration of space, and that robots could do it all for us. Indeed, this forms part of the British government's justification for not participating in the ISS, as explained by Lord Sainsbury, the science minister, in a speech to the Royal Society in October 2001: "We do not intend actively to participate in manned exploration of the solar system… we are not convinced that the benefits of human exploration go beyond the political and cultural into the scientific and commercial."

However, this ignores the clear scientific benefits that have resulted from human spaceflight. The hugely important scientific legacy of Apollo is the best example, but others include the repair of the Hubble space telescope by shuttle astronauts in 1993 (without which key astronomical discoveries made since would have been impossible), and the scientific experiments conducted in microgravity on US and Russian space stations over the years, up to and including the ISS. More worrying is the fact that this statement acknowledges the existence of "political and cultural" benefits, but implies that these cannot by themselves justify an investment in human spaceflight.

Few scientists would disagree that robotic probes are the proper instruments for the initial reconnaissance of the solar system, and that they have proved highly successful in this role. The question really is how to follow through—how best to maximise scientific knowledge once the initial reconnaissance is complete. Here, human flexibility—to undertake investigations ranging from research in microgravity, to geological and biological fieldwork on planetary surfaces—becomes vital. As the leading US space scientist Paul Spudis has put it: "although robots could play a significant role in gathering data, conducting science in space will require scientists."

Mike Malin and Ken Edgett, lead scientists for the camera system on Nasa's Mars Global Surveyor spacecraft, and pioneers in the robotic reconnaissance of Mars, agree: "We are constantly aggravated by the fact that all the questions we have about Mars could be answered… if we could just walk around on the planet for a few days… It's unusual to hear people like us argue for manned space exploration. But for about two years now we have

been absolutely convinced that we're going to have to send people there."

Beyond the scientific benefits, there are several economic benefits resulting from large space programmes. One of the biggest is the support they offer to aerospace industries. These industries are vital to the economy (directly employing well over half a million people in the US, and over 100,000 in Britain, with many more in supporting industries), and when not engaged in building spacecraft they are usually making weapons. For both political and ethical reasons—"arms into spaceships"— it is desirable to identify non-military activities for these industries. For example, if Britain had not opted out of the ISS, British Aerospace (now BAE Systems) could be devoting more of its business to building space station components rather than selling weapons abroad.

In the longer term, we should also bear in mind the possibility that the future wellbeing of the world economy may come to depend on access to the material and energy resources of the solar system. It is premature to assert that this will ever become necessary, but within a century or so the world may have to support a population of at least ten billion people, all aspiring to a higher standard of living. The development of space could open a previously closed planetary economy to an unlimited supply of external resources.

However, the most important reasons for going into space may not be scientific or economic at all, but rather political and cultural—the benefits acknowledged but dismissed by Sainsbury. Space exploration provides a natural focus for international co-operation. In trying to build a stable geopolitical environment on Earth, it must be desirable to increase the range and depth of international collaborative projects. Human space exploration is an ideal candidate for enhancing a sense of international solidarity as it is highly visible to the global public. The collaboration of 15 nation states in the construction and operation of the ISS provides a model which could be extended to human activities on both the moon and Mars. Such high-profile space activity would also provide a stimulus for scientific and technical education, which must be of value to any "knowledge-based" society.

More fundamentally, a sense of purpose and achievement is important for the wellbeing of any civilisation, and space exploration may be one of the few such options open to us. That societies and individuals need something like this, even if most people can only participate vicariously, has been noted by several thinkers over the years. In 1910 William James famously drew attention to the desirability of identifying what he termed "a moral equivalent of war," and in 1952 Bertrand Russell thought that "if the world is ever to have peace, it must find ways of combining peace with the possibility of adventures that are not destructive." The human exploration of space would constitute a grand, non-destructive, human adventure which may help fulfil this psychological requirement.

A vibrant culture also needs sources of intellectual stimuli. In his celebrated 1989 essay *The End of History*, Francis Fukuyama painted a bleak picture of a global future lacking cultural and intellectual stimulation:

"The end of history will be a very sad time… daring, courage, imagination and idealism will be replaced by economic calculation, the endless solving of technical problems, environmental concerns, and the satisfaction of sophisticated consumer demands. In the post-historical period there will be neither art nor philosophy, just the perpetual caretaking of the museum of human history."

Some of the trends he identified are readily apparent, but the expansion of humanity into space could help mitigate the stagnation he predicted.

Of course, human space exploration is expensive, and the world has many other pressing economic and social problems. But even the costs should be kept in perspective—the whole Apollo project cost only about one seventh as much as the Vietnam war. The total cost of the ISS , over the 30-year period of construction and operation, is likely to be about $100 billion, and expeditions to the moon or Mars might cost several times this. But $100 billion over 30 years is only $3 billion a year, or roughly 1 per cent of the current US military budget ($306 billion in 2001, and set to rise sharply).

Given that future large-scale space activities are likely to be international in character, and that encouraging international co-operation is in any case one of the pre-eminent benefits of such activities, there is no reason why all this should be left to America alone. The EU has a GDP almost as large as the US, so can well afford to be an equal partner in the ISS, and the more exciting missions which may follow. Europe also has a well-developed aerospace industry able to contribute to, and benefit from, such participation. Within Europe, Britain should pull its weight and finally join the European Space Agency (ESA) human spaceflight programme. The ESA already has ambitious plans for post-ISS activities, and in January 2002 initiated the "Aurora" programme—a long-term plan for the exploration of the solar system, with the aim of sending people to Mars by 2030. Aurora is currently one year into an initial three-year study phase, after which ESA members must decide whether or not to participate in the full programme. For all the reasons given above, I think that we should do so.

Developing a global, human space programme, with an aim of sending astronauts back to the moon and on to Mars, is a noble vision for the 21st century, the realisation of which stands to confer great scientific, economic, and cultural benefits on our world. It would also be the best possible way of ensuring that those who have so tragically died in the exploration of space have not done so in vain. ■