

## Arguments in favour of the space station

Sir — The Microgravity Advisory Committee (MAC) of the European Space Agency has read with interest your leading article and Briefing about the International Space Station (ISS)<sup>1</sup>.

The MAC appreciates your efforts to clarify aspects of the scientific research planned on board the ISS and the technical and 'political' motivation for such an important international programme, but both the article and Briefing seem to show a negative attitude towards the project.

In both the physical and life sciences, research on phenomena and processes at near-zero gravity levels cannot be done on Earth for sufficiently long periods. Moreover, the necessity to repeat experiments at a pace consistent with that of the on-ground research — considered a basic requirement — can be assured only on board space stations.

The conclusion of your leading article that "the [scientific] community has placed its negative scientific judgements of ISS on the record" sounds unfair because it is not well supported by evidence: although it is true for some scientific societies, it does not represent the general opinion of the scientific community as a whole.

First, of the many personal opinions given by scientists interviewed by *Nature*, few positive comments seem to have found their way into print.

Second, in the ELGRA Report on microgravity research in Europe (September 1995), a committee consisting of a Nobel prizewinner and leading scientists recognized that "low-gravity is a useful tool — in some cases a unique tool — for the study of a number of physical and physico-chemical phenomena which are important in science, engineering and technology.... If the space station becomes available, the scientific community will make the best possible use of it to perform experiments." But, when writing of a "broad consensus" about the expected weak impact of the research planned for the ISS, such a statement is valid only if objective methods are used to establish it.

The experiments are being, and will be, chosen on the basis of rigorous peer-review procedures clearly stated in each announcement of opportunity. The only criterion has been and will be scientific excellence, a point on which there does exist a broad international consensus. Cost is not among the points the peers are asked to evaluate, for good reason. As correctly stated, the costs of these experiments, after deducting the costs of the orbiting laboratory, are not basically different from

the corresponding experiments performed on Earth.

Research on gravity-related phenomena in life and physical sciences has, in the past 20 years, given important results despite the scarcity of flight opportunities: these include advances in the understanding of the stability and dynamics of liquid interfaces (liquid columns, Marangoni motions), of transport phenomena (diffusion, Soret effects, crystal growth), of many physiological processes (the treatises on respiratory physiology must be considerably revised in the wake of many flight results) and in cell biology.

The possibility of gaining exciting insights from the 'continuous' use of an orbiting laboratory represents a real 'quantum jump' in scientific development and a potent magnet to attract young researchers and top-level scientists, as has already happened in the past few years.

The ISS represents one of the most demanding and challenging efforts made in the field of international scientific and technical cooperation. Whatever the other reasons for this programme, the situation is much the same as for any project of similar size: it has an impact on every aspect of science and technology precisely because of its size and the intensive and multidisciplinary collaboration it requires.

No scientific endeavour can, from the start, predict what benefit it may eventually have: let great projects grow and answer the question posed by Benjamin Franklin: "Of what use is the baby you have in your arms, Madam?"

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Sir — Your discussion of the International Space Station<sup>1</sup> failed to draw attention to two of the most important arguments in favour of this ambitious project.

One is the development of new institutional arrangements needed for the management of complex international space projects. The quotation from John Logsdon (ref. 1, p. 734) that "in effect, an international space agency has been created for the station" may be overstating things at present, but there are strong reasons for believing that, if humanity is to have a significant future in space, a World Space Agency of some sort will be both necessary and desirable<sup>2</sup>. If experience with building and operating the ISS helps to develop the institutional foundations for a future world space programme, that alone will be one of its most important legacies.

The other main argument in favour of the ISS is the experience that it will provide in building large structures in space. As your

discussion highlighted, many scientists have grave doubts about the suggested scientific applications of the ISS itself. But considerable, if long-term, scientific advantages are likely to follow from an ability to construct large structures in Earth orbit and beyond (for example, large space telescopes, lunar and planetary outposts and, eventually, interstellar space probes<sup>3,4</sup>).

These arguments make sense, of course, only if one accepts that a significant human presence in space is a desirable future goal. Many in the scientific community do not accept this assumption, and the editorial pages of *Nature* have reflected this widespread scepticism. However, accepting that many of the arguments for an ambitious human space programme are social and political (reviewed in ref. 2) rather than narrowly scientific, it seems clear that science would be a major beneficiary. In which alternative future would we be likely to learn the most about the Universe and our place within it? And if we aspire to follow the latter course, it is not too soon to start laying the foundations for the technical and institutional infrastructure that will be required.

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Sir — International Space Station "Worry no. 4" (manpower) is not a worry! I consider it a positive sign that "many researchers admit they worry that the station will not live up to its potential". This is a measure of their eagerness to use the station to conduct unique research in the microgravity environment. One of your worries is, however, misstated in your Briefing<sup>1</sup>.

It implies incorrectly that insufficient crew time is available for research once construction is complete. It is true, and understandable, that crew time for research is limited during construction. But, when assembly is complete, the available crew time for research jumps to 160 hours per week, equivalent to four full-time crew members. Our best analyses show that this amount is not the constraining resource for the planned research.

The preservation and improvement of the research capability of the space station is a high priority of this programme.

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1. *Nature* 391, 721 & 732–737 (1998).

2. Crawford, I. A. *Space Policy* 11, 219–225 (1995).

3. Crawford, I. A. *Q. J. R. Astr. Soc.* 31, 377–400 (1990).

4. Mallove, E. & Matloff, G. *The Starflight Handbook* (Wiley, New York, 1989).