

The Starship as an Exercise in Part 1 - The Political

If the hypotheses we have here laid down are dismissed as Utopian, that does not mean that they are unnecessary or impractical. For we are so often the prisoners of our old traditions that we do not recognise our presence in a new world. [1;p661]

Political preconditions to large-scale space development and colonisation, and thus ultimately to interstellar travel, are identified. It is argued that only the establishment of a federal world government will fully satisfy these conditions.

Introduction

The title of the present paper paraphrases that chosen by Parkinson for his 1974 paper, *The Starship as an Exercise in Economics* [2], in which he considered the economic implications of interstellar travel. Economics cannot be divorced from politics, however, and we shall argue here that far-reaching political issues are implicit in any discussion of interstellar travel, for both economic and other reasons.

A perusal of the different suggestions for rapid interstellar space flight [3-8] shows that they all necessitate large-scale construction activities in space. Not only must the interstellar vehicles themselves be built in space, but their ultimate sources of energy (hydrogen and helium isotopes for fusion rockets, sunlight for both antimatter production and laser power) must also be collected there.

Thus, any form of rapid interstellar travel will require the existence of a substantial space infrastructure. This will involve:

- The development of efficient methods of transportation between the surface of the Earth and near-earth orbit (e.g. HOTOL-type spaceplanes and advanced heavy-lift launch vehicles);
- The ability to build large and complicated structures in space (e.g. space stations, space factories, solar arrays, lunar and planetary outposts);
- The ability to tap large quantities of solar energy;
- The extraction of extraterrestrial raw materials (especially from the Moon and from asteroids);
- The capability of transporting these materials around the inner solar system; and
- The ability to process these materials in space.

As it is unlikely that any society will develop this infrastructure solely for the benefit of interstellar exploration, only a space-based civilisation, using the economic potential of the solar system for its own domestic purposes, will be able to afford rapid interstellar space flight [2].

The Political Preconditions

Given that an advanced interplanetary civilisation is a prerequisite to interstellar travel, the political questions concern the changes in human organisation that will be necessary before such a society can develop. At least four important preconditions, which involve essentially political issues, may be identified.

Survival

Technological society must continue to exist. If there is no advanced technology then there will be no space infrastructure and thus no starships. The foremost political precondition for all future technological developments is that the world must be organised so as to preserve its scientific and technological base.

Geopolitical Stability

The timescale involved in developing an advanced space infrastructure will be such that governments undertaking it must be free to sustain major projects for many decades, and perhaps centuries. The organisation of today's world is not conducive to such long-term planning as governments are constantly distracted by a host of domestic and foreign policy issues. If space is to occupy governments to the same extent that they are currently occupied by (say) foreign affairs, these other distractions must somehow be made less urgent.

Resource Availability

Technological society must not only enjoy long-term stability, but must have sufficient intellectual and material resources to devote to the development of a space-based infrastructure. Until extraterrestrial materials can make a significant contribution, material resources must be provided by some combination of global economic growth and a diversion of resources from other sectors of the world economy.

Moral Justification

There are many social, economic and environmental problems in desperate need of attention. If significant resources are to be assigned to space

development, rather than to other deserving projects, it will not only be necessary to expound its long-term value but also to demonstrate that it is not incompatible with the solution of these other problems. Unless this can be achieved, any proposal to divert large sums of money into outer space will not be politically attractive.

World Government

In a previous article [9], I argued that the establishment of a world space agency would go a long way towards the creation of a political environment within which the steady development of a space-based infrastructure could proceed. However, although an ambitious international space programme would provide an excellent foundation for the development of a space-based society, this proposal fails to address the other political issues identified above. Thus, it seems that if a major world space programme is to be successfully sustained, it must be underpinned by far wider geopolitical reforms, and I shall argue here that the logic points in the direction of some kind of planetary government.

The creation of a world government would be a very major change in the organisation of human affairs on this planet, and one that certainly will not be made merely to assist in the development and colonisation of outer space. Indeed, all the principal arguments for world government recognised by political thinkers (e.g. Saint-Pierre (1713; popularised by Rousseau [10]), Paine [11], Kant [12], Kerr [13], Laski [1], Wells [14,15], Russell [16,17]), are based on the need to prevent military conflict and divert military resources to more productive ends. These arguments are even more cogent today, as the world becomes aware of pressing social, economic, and environmental problems that can only be effectively managed at a global level (e.g. Brandt [18]). However, even if a world government is established principally for other reasons, we shall argue that it would also greatly facilitate the large-scale development of the solar system, and thereby pave the way for interstellar travel.

We need not be concerned here with the precise institutional form of a world government except to say that we should have in mind a federal structure, within which the presently extant nation-states cede responsibility for global affairs to a higher level. We now consider how this would satisfy the remaining political prerequisites for long-term space development.

World Government

Preconditions

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Survival

Although there are possible natural hazards to the future of human civilisation, the most pressing dangers are of our own making, and arise primarily from the belligerent competition of nation-states. Ever since the invention of nuclear weapons this competition has carried the implicit risk of annihilation. This risk now seems lower than formerly, but it is still present, and as long as international relations remain anarchic, with each nation-state acting as judge in its own cause, the long-term future of civilisation cannot be guaranteed in a nuclear age. As the maintenance of an advanced technical civilisation is a prerequisite to the establishment of a space-based society, good prospects for the latter can be secured only by ending the anarchy that currently exists between nation-states. The only way to end anarchy, almost by definition, is to replace it by government, in this case, by world government.

Although a nuclear balance of power has kept the peace for almost fifty years the problem is that, in the present context (and ignoring all other human and moral arguments), we have to guarantee peace for at least as long as a space-based society would take to become fully self-sufficient, almost certainly several centuries. Two hundred years ago Immanuel Kant [19] concluded that

"an enduring universal peace brought about by a so-called balance of power... is a mere figment of the imagination, like Swift's house, whose architect built it so perfectly in accord with all the laws of equilibrium, that as soon as a sparrow lit upon it, it fell in."

The number of times that power balances have failed since Kant's time give no great confidence in their efficacy.

Kant came to the conclusion that the problem lay with the existence of sovereign nation-states. In his essay "To Perpetual Peace" published in 1795 [12], he drew attention to the fact that "the existence of many *separate*, independent, adjoining nations ... is in itself a state of war" (Kant's italics), and, to avoid this unhappy situation, "the right of nations shall be based on a federation of free states" within which "men and nations stand in mutually influential relations as citizens of a universal nation of men".

Following Kant, it is argued here that the evolution of a world government is necessary in order to guarantee the survival of a technological civilisation on Planet Earth.

Geopolitical Stability

Institutional arrangements made to keep the peace between independent nation-states (e.g. a balance of power, 'collective security', multilateral treaties, etc) will, as Kant pointed out, always be potentially unstable. Even if these arrangements are in principle able to keep the self-destruction of civilisation at bay indefinitely, governments will still have to devote a considerable fraction of their energies to being continually on guard against instabilities and taking corrective action when appropriate.

This situation has existed for the past fifty years, and, although a nuclear war has been avoided, governments have been so preoccupied with foreign policy and defence-related issues that they have had little time or energy to consider anything else. If the world view of individual politicians, and of the public at large, is dominated by a concern for military security, it will be very difficult to get a project such as the colonisation of outer space onto the political agenda.

The single most important political development that could alleviate this situation would be the implementation of a system of international law which guaranteed peace and security without the inherent risk of war. The reliability of any such system would be inversely proportional to the degree of sovereignty retained by the nation-states. A federal world government would provide the most satisfactory solution, as it would be free from present preoccupations with national security, and would be able to concentrate its energies on long-term global projects (including long-term space projects).

Resource Allocation: Turning Swords Into Spaceships

The development of a space-based infrastructure will require a large-scale investment of intellectual, material and financial resources, and international cooperation will certainly be required in order to achieve an acceptable sharing of the burden [9]. However, international cooperation will not, by itself, create these resources, which must still be found from within the world economy. In the shorter term, this will necessitate a diversion of resources from other areas of economic activity. Given all the other demands on the world economy, there seems only one area that could be cut back to yield sufficient resources for space development, and that is the military sector. There are at least four reasons why the military sector is the



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The Moon in orbit about the Earth taken from the Galileo spacecraft on December 16, 1992.

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obvious source of resources for space development:

- ❑ Very considerable resources are devoted to it. In 1990, the world spent approximately a thousand billion (10^{12}) dollars on weapons [20]. The Economist [21] has estimated that in 1985 the World's gross domestic product (GDP) amounted to US\$ 12.8×10^{12} which (adopting the average (nominal) GDP growth rates of the OECD countries [22]) implies a 1990 value of about US\$ 18×10^{12} . Thus, the arms budget presently accounts for about 6% of the world's GDP.
- ❑ This vast expenditure is essentially unproductive. Six percent of the gross world product might be draining into a black hole for all the good it does the global economy. A transfer of these resources to space projects (which, at worst, could not be less productive) would not adversely affect global society.
- ❑ Many aerospace companies producing high-technology weapons would be the very companies needed to develop a space infrastructure. A switch from one to the other would have only a minor impact on the industry, and on the local economies it sustains.
- ❑ Many of the world's scientific and

technical personnel are presently tied up in military research and development. By its very nature, the development of a space infrastructure will be a high-technology enterprise, which will require a large number of highly trained people. As in the case of material resources, there is probably no other sector of the world economy from which they could be taken without adverse social and economic consequences.

These arguments imply that, if the world is to afford an ambitious programme of space development, it will have to disarm. However, the degree to which disarmament will be politically acceptable will depend on the ability of international institutions to guarantee peace and security. There are doubtless a number of possible half measures, but the most secure international framework, and thus the greatest possibilities for disarmament, would be provided by the inauguration of an era of world government.

Moral Justification

That there is potentially a moral dilemma cannot be doubted. Our society is faced with a large number of other problems, and many will question the diversion of resources into outer space when so much still remains to be done on Earth. There is a

school of thought in the space community which holds that space development cannot wait until all Earth's social problems have been solved. However, this argument not only turns a blind eye to substantive moral issues, but ignores the *political* point that governments will not win support by pursuing a policy which neglects problems which the majority of people consider more important than the development of outer space.

There do exist both short and long term economic justifications for space development (to be discussed in Part 2) which are not without moral implications, but these are unlikely to win this particular argument alone. It will therefore be both politically and morally necessary to ensure that space development proceeds simultaneously with efforts to improve the human condition on Earth. Further, I suggest that the resources for both sets of programmes will, in large measure, have to come from what is now the military sector of the world economy. If these arguments are accepted, there are at least two reasons why they imply the need for a world government. Firstly, governments will not disarm until the anarchic situation between nation-states is replaced by one of international law and order. Secondly, many of the social problems which need to be addressed are global problems, in need of global solutions; if they are to be tackled seriously it will be neces-

sary to organise remedial measures on a world-wide scale, and to remove the political obstacles to their solution which arise from present assumptions of national sovereignty. Both conditions would be satisfied best within the institutional framework of a federal world government.

Conclusion

We have argued that world government is a prerequisite to solar system colonisation, and thus to interstellar travel, because it offers the surest way of satisfying the political conditions that must be met before human society will be ready for such an undertaking. These arguments largely revolve around the provision of resources for space infrastructure, and we have argued that, given a stable geopolitical environment, these could be provided by a transfer of resources from what is at present the military sector of the world economy. However, a world government will also need to draw on savings made in this sector in order to finance much needed improvements on Earth itself. Given these competing claims, it is necessary to consider why a world government should divert any resources to a world space programme. We will discuss this aspect of the problem in Part 2 in a forthcoming issue.

(In Part 2 of this article Dr I.A. Crawford will discuss the subject of 'A World Space Programme')

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The Starship as an Exercise in Part 2 - A World

In Part 1 of this article* we argued that a federal world government is a prerequisite to solar system colonisation, and thus to interstellar travel, as it would offer the surest way of satisfying the political conditions that must be met before human society will be ready for such an undertaking. Here we conclude these arguments by considering why a world government would wish to support a world space programme.

Why a World Space Programme

There are at least four compelling arguments for an ambitious space programme within the context of a federal world government:

Support for High-Technology Industries

A world government would inherit a large number of high-technology aerospace companies, whose business is at present dominated by the production of weapons. These companies directly employ over a million people in the US alone [1], and many millions more depend on them indirectly. A world government with little demand for military products may find it politically necessary to offer these companies alternative business. An ambitious space programme is the obvious alternative because the technologies involved are similar and many of the companies hardest hit by disarmament already have a significant interest in the development of space hardware [2,3]. For example, the world's four largest arms producing companies in 1989 were, in order of decreasing arms sales [4], McDonnell Douglas, General Dynamics, Lockheed, and British Aerospace; all four are predominantly aerospace companies, and all four would find a switch from arms to space relatively painless. In 1989 Lockheed and McDonnell Douglas were, after Rockwell International (itself arms producer number 10), the second and third leading NASA contractors [5].

Even if a world government found it politically and economically possible to let these industries wind down, there are other reasons why this would be highly undesirable. The fact is that these companies represent an enormous pool of high-technology expertise, relevant to many other areas of the world economy, which would be at least as important to a future world government as it is to national governments today.

The Cosmic Perspective and Global Solidarity

A federal world government is desirable primarily as an institutional framework within which many of our

most pressing problems can be satisfactorily addressed. However, in spite of the obvious urgency of this task, considerable nationalistic opposition can be expected and, even if federation is successfully achieved, the danger of disintegration will be present for some time. Anderson [6] referred to nations as essentially 'imagined' political communities, "imagined" because the members of even the smallest nation will never know most of their fellow members ... yet in the minds of each lives the image of their communion". This point was taken up by Hobsbaum [7], who pointed out that, throughout history, states have had "every reason to reinforce ... the sentiments and symbols of 'imagined community' wherever and however they originated". Thus we see that a world government will want to encourage new, *global*, visions of humanity to supplant politically divisive, nationalistic ones.

One way of achieving this will be through global cooperative projects with which widely separated people can identify. A world government could initiate many worthwhile developmental projects which would fulfil this role to some extent. However, from the point of view of enhancing global solidarity, it is important that some of these cooperative projects possess sufficient intrinsic excitement to catch the imagination of the majority of human beings everywhere. The exploration of space is an obvious candidate for such a programme. It has a unique advantage through its ability to add a *cosmic* dimension to the world view of ordinary men and women. The image of Earth's place in the cosmos provides powerful testimony to the unity of humanity, and thus carries a potent, if implicit, argument for the political unification of human societies. At present, only a tiny fraction of human beings appear to have incorporated this perspective into their personal philosophies, but a high-profile global space programme could stimulate many others to do so, thereby playing a significant role in building a sense of global community.

A Moral Equivalent of War?

In 1910 the philosopher and psychologist William James published his famous discussion on the need for

human societies to find a 'moral equivalent of war' [8]. Although a pacifist, James was concerned that pacifism *per se* was unable to provide substitutes for the ideals of heroism, glory, adventure etc., which (arguably) provide powerful psychological attractions to war for many people. James realised that the problem does not lie solely, or even mainly, in the minds of fighting men, but also in the collective psyche of public opinion. He therefore argued that it is desirable to find an alternative to war that would satisfy many of the psychological needs for which militarism appears to cater, but which would avoid its obvious disadvantages. This view was reiterated by Russell [9; p.65] when he wrote 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 exploration and colonisation of outer space, starting with the Moon but moving inexorably through the solar system towards the stars, would constitute a grand, *non-destructive*, human adventure, which may largely satisfy these criteria. By providing the world with a plausible 'moral equivalent of war', a substantial space programme could be of considerable social value to a world government. Even if a point is eventually reached when war becomes unthinkable, a world government may nevertheless find it desirable to provide an increasingly well-off human population with a sense of purpose and adventure. As space is to all intents and purposes infinite, its exploration and development may provide a safety valve for human energies into the indefinite future. At the very least, it would enable us to avoid the stagnation at the 'end of history' which Fukuyama [10,11] has recently argued to be the ultimate fate of a peaceful democratic world.

Extraterrestrial Resources

The major economic tasks facing a world government will involve the re-organisation of the world economy along the lines of sustainable development, and the promotion of acceptable standards of living in Earth's poorer regions. These tasks will require significant investment of global resources, and will limit the extent to which less urgent projects are considered justifiable. Nevertheless, there are persuasive economic reasons why a world government may wish to main-

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tain a steady investment in space infrastructure, even while tackling these other problems. These arguments are centred on the possible future requirements of the world economy for extra-terrestrial resources.

The realisation that the Earth's natural resources are finite has been going for several decades and now overshadows most speculations on the future of human civilisation. Indeed, Meadows *et al* [12; p.126] went so far as to state that "...under the assumption of no major change in the present [world economic] system, population and industrial growth will certainly stop within the next century, at the latest". This is an extreme conclusion, and the simplistic economic model upon which it was based has been much criticised. However, insofar as the Earth is a finite system, the conclusion (although not the timescale) is probably sound. Genuine 'limits to growth' will one day confront human civilisation unless there is a major change in the global economic system. As the management of the world economy will be one of the primary functions of any future world government, this problem may be expected to have a high priority in its thinking.

While there is much that can be done to postpone the onset of a resource-starvation crisis beyond the timeframe envisaged by Meadows *et al* (e.g. greatly increased energy efficiency, development of renewable energy sources, large scale recycling, and development of an 'industrial ecology', [13]), these measures will not, by themselves, eliminate the ultimate threat of economic stagnation and decline. Thus, in addition to encouraging the implementation of these shorter term policies, a responsible world government would be forced to identify longer term solutions. As pointed out by Martin [14] and Schultz [15], there is only one obvious way out of this dilemma, namely the utilisation of extraterrestrial resources. As the resources of the solar system are, to all intents and purposes, infinitely greater than those of Earth alone, the industrialisation of the solar system has the potential to solve the 'limits to growth' problem by opening a previously closed planetary economy to unlimited supplies of external raw materials.

It is probable that, given proper management [13,16], the world economy will be able to operate successfully without recourse to extraterrestrial resources for several centuries. However, if a transition to extraterrestrial resources is to occur smoothly, signifi-

cant infrastructural investment will be needed well in advance. A responsible world government would thus view the development of a space infrastructure as a worthwhile, and perhaps essential, investment in the future of the world economy.

Financing a World Space Programme

We argued in Part 1 that the only logical means of financing a programme of space infrastructural development would be to transfer resources from what is now the military sector of the world economy, and that only a world government could accomplish this.

The world's present military expenditure of \$10¹² pa amounts to approximately 6% of its GDP. Given that a world government will find it politically and morally imperative to spend much of this 'peace dividend' on other projects, but may regard a space programme to be worth some fraction of it, 1% of world GDP may be a realistic figure for the latter. This is one sixth of present-day military spending, or about \$180 billion per year at today's prices. It is over twelve times NASA's 1991 budget of \$14 billion, or somewhat over half the US military budget of \$300 billion [4]. In the longer term, this value of 1% of GDP will increase as a result of economic growth.

Although 1% is a very small fraction of global GDP, it would constitute a much larger proportion of a federal world government's total expenditure. Typically, Western governments today have total incomes amounting to 30 or 40% of GDP [17]. However, a federal world government would be much less centralised than existing national governments and would be unlikely to have a comparable fraction of the world's GDP at its disposal. Assuming that it were able to take over the global military budget (presently about 6% of world GDP), and raise additional revenue through moderate fiscal measures (e.g. environmentally targeted taxes on raw material and energy consumption), an income of 10% of the global GDP may not be unreasonable. The proposed world space budget may then account for about 10% of world government expenditure (the remainder being devoted primarily to development projects on Earth itself). This is comparable to the fraction of governmental expenditure typically controlled by a major ministry within existing national governments, and suggests that space policy could become (relatively) as important to a future world



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The Moon in orbit about the Earth taken from the Galileo spacecraft on December 16, 1992.
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government as, say, foreign policy is to present-day national governments. This comparison is quite appropriate as space policy (pursued for economic and other reasons) is the only *external* policy that could concern a world government.

Although a detailed analysis of how fast infrastructural developments could proceed given this level of investment is not considered here, it is possible to get an intuitive grasp of what may potentially be achievable by comparing the costs of past and future space projects with the suggested world space budget of \$180 billion. At today's prices, the space shuttle development cost was in the region of 20 to 35 billion dollars [18,19]; the cost of space station Freedom is also projected to be about \$30 billion [20]; and the cost of the Space Exploration Initiative (which, in its more ambitious versions [21], would involve an expanded space station, the creation of a lunar outpost and the landing of people on Mars in the early decades of the next century) is estimated to be about \$500 billion [22]. These correspond to average annual expenditures of about \$3 billion per year for the shuttle and Freedom (assuming ten year programmes) and perhaps \$25 billion per year for the SEI (assuming a twenty-year programme).

Thus, a world space budget corre-

sponding to 1% of world GDP would be more than five times that required to develop the space shuttle, the space station, and the SEI simultaneously. Maintained consistently over many decades, this level of funding would be more than sufficient to establish the basic elements of space infrastructure discussed in the Introduction of Part 1.

Conclusion

In this article (Parts 1 and 2) we have identified a number of political preconditions to the large-scale development of the solar system and have argued that a federal world government will be required if these conditions are to be fully met. As the development of a significant industrial infrastructure in space will be essential before any attempt can be made at rapid interstellar travel, the creation of a world government is also a prerequisite to this longer term objective. I am well aware

that many will consider all this to be hopelessly utopian, and I therefore reiterate that we have here been concerned with identifying political preconditions. I have not claimed that these preconditions will necessarily be met, only that without them many of our most ambitious hopes for the future of humanity in space may never be realised.

In order to illustrate the importance of these political developments, consider the repercussions of the federal constitution drawn up at Philadelphia in 1787 for the thirteen (previously independent) North American states. That constitution also was not inevitable (and many Americans, jealous for the sovereignties of their separate states, were in fact opposed to it [23]), but we can now see that its adoption was a political precondition to all that the United States has subsequently accomplished. By placing the resources of an entire continent at the

disposal of a single government, the federal principle eventually enabled the United States to undertake projects utterly beyond the reach of small, European-style, nation-states. Quite literally, the federal constitution worked out at Philadelphia in 1787 was (among much else) a prerequisite to the landing of man on the Moon almost two centuries later.

The creation of a federal world government would extend this process to its logical conclusion. By raising the largest unit of political organisation from the continental to the planetary scale, it would create the conditions of geopolitical stability, disarmament, and economic growth required for (among other things) the financing of an ambitious world space programme. It is difficult to see how the inhabitants of a politically and economically fragmented planet could ever be in a comparably strong position from which to aim at the stars.

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