STRICTLY PERSONAL

25 November 1986

I passed your personal note about space policy to the Prime Minister. She has asked me to say that she was grateful for it, has read it with interest and will reflect on it between now and the E(A) discussion. I have told her that you would still like to have a word if possible. She does not see any prospect of this at present, but you may find it possible to catch her in the House one evening.

(C. D. POWELL)

Geoffrey Pattie, Esq., M.P.

STRICTLY PERSONAL

PERSONAL

PRIME MINISTER

SPACE

Mr. Pattie has for some time been trying to set up a private meeting with you, to lobby for his ideas on space. At one stage, you mentioned the possibility of inviting him for a drink in Dulwich.

I have now persuaded him to put down his views in writing (and had them typed here in No.10). They are attached. Basically, he wants your support for a substantial increase in spending on Space - from £108 million in 1986/87 to £302 million in 1989/90 - when the issue comes to E(A).

I do beg you not to interrupt your Dulwich weekend with work. I suggest that I let Mr. Pattie know that you have received his paper, read it with interest and will reflect on it between now and the E(A) discussion.

Agree?

C.D.P.

Charles Powell
24 November 1986

JA2AGW

PERSONAL

From: Geoffrey Pattie, M.P.

House of Commons,
LONDON, SW1A 0AA.

24th November 86

Dear Charles,

Enclosed is my paper summarising the points I would have preferred to make to the Prime Minister in person about the Space Plan.

I would be grateful if you could forward the letter to her.

Yours sincerely,

Geoffrey Pattie

Dear Prime Minister

I have been hoping for some time to have an informal and private discussion with you about the Space Plan prepared by the British National Space Centre (BNSC) and about to go the rounds of Departments prior to being considered by E(A). I would still welcome such an opportunity very much but as time is now pressing I have put some thoughts down on paper.

Firstly, I am not attempting here to go into the details of the Plan - that can be done at E(A). It is the overall politics and our presentation that I am concerned with.

You have already indicated your sympathetic approach to British Space activity by approving in January 1985 the establishment of the BNSC and subsequently the appointment of its first Director General, and then chairing the E(A) at that time which enabled Britain to take a robust and positive line at the Rome Ministerial Conference of ESA Ministers.

I have to tell you that the establishment of the BNSC and the appointment of the highly respected Roy Gibson (ex director of ESA) as its first Director General have been widely welcomed not only by industry and academics in the UK but also in Europe - especially in Germany. The re-emergence of the UK as a confident partner in the European Space Agency in the last two years is welcomed as some counter to the potentially overwhelming ambitions of France.

I am always cautious about making comparisons between levels of expenditure in other countries and our own. Many other countries have economies which are stronger than ours and can therefore afford to spend more on areas such as space. Nonetheless the disparity between our current expenditure (at £108 million) and that of France (at nearly £500 million) is so great as to exceed comparisons of economic efficiency. The French Government is currently considering the level of its increase in Space activity and debating whether to increase its annual spend to £700 million or £900

million. However good the French are at running their affairs I cannot believe that they are seven or nine times better than we are.

In essence, the real significance of the Space Plan is political and strategic. Politically, we have emphasised the need for British companies to work with Government Departments on a joint venture fifty fifty funding basis and also to extend their collaborative endeavours with other European companies in a variety of supra national programmes. In the European context we have given practical leadership to the European programmes and we are still struggling to inflict some realism into the Commission's R&D plans.

In the UK our emphasis is on applications of technology and improving the speed and extent of technology absorption. The soon to be announced LINK programme is a classical example of what is needed - an acceleration of academic innovation into marketable products. Austin Bide's Report on the follow on to the Alvey programme takes the same line of emphasis on applications and developing user groups.

The trouble with a lot of advanced technology in political and presentational terms is that it is not easy for the lay person to understand. Space has an advantage in this regard in that some projects are comprehensible and even exciting. HOTOL the British space plane proposal is a very good example. I have been astonished by the great interest and even enthusiasm shown for HOTOL across a wide range of lay non specialists - men and women young and old. What appears to intrigue them is that this is a purely British invention and furthermore it is ahead of anything being offered in the free world. In other words HOTOL appeals to a sense of national pride and this is obviously important in political terms.

The ~~go~~/no-~~go~~ decision on HOTOL will not be needed before 1991 (which puts it barely in the next Parliament never mind this one) but if the project is to continue in the meantime

with ESA support it will have to be coming from a country which has a viable space programme and not from a country which has decided to come out of space.

Politically therefore, if E(A) decides not to approve the Space Plan at roughly the proposed expenditure levels then the consequences will be a gradual withdrawal by the UK from the European Space effort. This would not happen overnight but it would have to be announced because the Space Plan will have to be published together with the HMGs reaction to it. A decision to run down still further our already very modest effort would run totally counter to our policies in Europe, our industrial and high technology policies eg LINK in the UK, and as far as HOTOL would be concerned would be the latest example of Britain once again losing her nerve after the invention had been hers. I find that members of the public seem almost resigned to this happening with HOTOL. Only our competitors and would be partners are incredulous.

In strategic terms I do think we need to consider the implications for our military capabilities if our civil capacity is gradually run down. We will the become entirely dependant on the Americans and I wonder if this is what you want. MOD tend to say that they can manage and that they are indifferent on the question of UK capability. They have however been proved wrong in the past when in 1976-7 they took this line and then came along with a new proposal for a range of SKYNET satellites and they were very relieved to find a UK industry - sustained by civil projects - in existence to build the satellites for them.

Discussion at E(A) will centre as ever on money. The 86/7 spend on Space is £108 million and the Plan envisages increases up to £302 million in 1989-90. There is no denying that in percentage terms the increase is very significant indeed but the Plan argues that we have been underspending for some time and that ESA is about to increase its activities and the question is whether or not we have the self confidence to stay with the team.

In MISC 110 and the discussions about LINK the MOD have rightly been in the firing line, as they will be again on Alvey II and as they should be in terms of Space. I am making no criticisms of any of our colleagues but after 5½ years in MOD no-one in your Government understands more about the entrails of that Department than I do. I know how and why they commit forward their R&D programmes in order to absorb all unallocated moneys, thereby putting any Minister in the position of having no surplus funds for manoeuvre. It is probably better if I develop this point in person.

I feel very strongly that it would be a tragic error if we did not have the confidence to chart a way forward in advanced technologies into the next century all for the lack of a sum which is less each year than the MOD equipment underspend.

Annex A is an unsolicited paper from Chatham House and Annex B a paper from (of all people) the Adam Smith Institute.

Yours ever,

Geoffrey.

From: Geoffrey Pattie, M.P.

House of Commons,
LONDON, SW1A 0AA.

21st November 1986

Dear Prime Minister,

I have been hoping for some time to have an informal & private discussion with you about the Space Plan prepared by the British National Space Centre (BNSC) & about to go the rounds of Departments prior to being considered by E(A). I would still welcome such an opportunity very much but as time is now pressing I have put some thoughts down on paper.

Firstly, I am not attempting here to go into the details of the Plan - that can be done at E(A). It is the overall politics & our presentation that I am concerned with.

You have already indicated your sympathetic approach to British Space activity by approving in January 1985 the establishment of the BNSC & subsequently the appointment of its first Director General, and then chairing the E(A) at that time which enabled Britain to take a

robust & positive line at the Rome Ministerial Conference of ESA Ministers.

I have to tell you that the establishment of the BNSC & the appointment of the highly respected Roy Gibson (ex director of ESA) as its first Director General have been widely welcomed not only by industry & academia in the UK but also in Europe - especially in Germany. The re-emergence of the UK as a confident partner in the European Space Agency in the last two years is welcomed as some counter to the potentially overbearing ambitions of France.

I am always cautious about making comparisons between levels of expenditure in other countries & our own. Many other countries have economies which are stronger than ours & can therefore afford to spend more on areas such as space. Nonetheless the disparity between our current expenditure (at £108 million) & that of France (at nearly £500 million) is so great as to exceed comparisons of economic efficiency. The French Government is currently considering the level of its increase in Space activity & debating whether to increase its annual spend to £700 million or £900 million. However good the French are at running their affairs I cannot believe that they are seven or nine times better than we are.

From: Geoffrey Pattie, M.P.

House of Commons,
LONDON, SW1A 0AA.

2

In essence, the real significance of the Space Plan is political & strategic. Politically, we have emphasised the need for British companies to work with Government Departments on a joint venture fifty fifty funding basis & also to extend their collaborative endeavours with other European companies in a variety of supra national programmes. In the European context we have given practical leadership to the Eureka programme & we are still struggling to inject some realism into the Commission's R & D plans.

In the UK our emphasis is on application of technology & improving the speed & extent of technology absorption. The soon to be announced HIVE programme is a classical example of what is needed - an acceleration of academic innovation into marketable products. Austin Bide's Report on the follow on to the Alvey programme takes the same line of emphasis on applications & developing user groups.

The trouble with a lot of advanced technology in political & parliamentary terms is that it is not easy for the lay person to understand. Space has an

advantage is this regard is that some projects are comprehensible & even exciting. HOTOL the British space plane proposal is a very good example. I have been astonished by the great interest & even enthusiasm shown for Hotol across a wide range of lay non specialists - men & women young and old. What appears to intrigue them is that this is a purely British invention & furthermore it is ahead of anything being offered in the free world. In other words HOTOL appeals to a sense of national pride & this is obviously important in political terms.

The Go/No-Go decision on Hotol will not be needed before 1991 (which puts it barely in the next Parliament never mind this one) but if the project is to continue in the meantime with ESA support it will have to be coming from a country which has a viable space programme & not from a country which has decided to come out of space.

Politically therefore, if E(A) decides not to approve the Space Plan at roughly the proposed expenditure levels then the consequences will be a gradual withdrawal by the UK from the European Space effort. This would not happen overnight but it would have to be announced because the Space Plan will have to be published together with the HMG reaction to it. A decision to run down still further an already very modest effort would run totally counter to

From: Geoffrey Pattie, M.P.

House of Commons,
LONDON, SW1A 0AA.

3

our policies - Europe, our industrial & high technology policies eg HMX & the UK, & as far as Hotol would be concerned would be the latest example of Britain once again losing her nerve after the invention had been hers. I find that members of the public seem almost resigned to this happening with Hotol. Only are competitors & would be partners are incredulous.

In strategic terms I do think we need to consider the implications for our military capabilities if our civil capacity is gradually run down. We will then become entirely dependant on the Americans & I wonder if this is what you want. MoD tend to say that they can manage & that they are indifferent on the question of UK capability. They have however been proved wrong in the past when in 1976-7 they took this line & then came along with a new proposal for a range of SKYNET satellites & they were very reluctant to find a UK industry sustained by civil projects - in existence to build the satellites for them.

Discussion at (A) will centre as ever on money. The 86/7 spend on Space is £108 million & the Plan envisages increases up to £302 million in 1989-90. There is

no denying that in percentage terms the increase is very significant indeed but the Plan argues that we have been underspending for some time and that ESA is about to increase its activities and the question is whether or not we have the self confidence to stay with the team.

I Misc 110 and the discussions about LINK the MOD have rightly been in the firing line, as they will be again in Annex II and as they should be in terms of Space. I am making no criticism of any of our colleagues but after 5½ years in MOD none is [illegible] Government understands more about the entrails of that Department than I do. I know how and why they commit forward their R&D programmes in order to absorb all unallocated money, thereby putting any Minister in the position of having no surplus funds for manoeuvre. It is probably better if I develop this point in person.

I feel very strongly that it would be a tragic error if we did not have the confidence to chart a way forward in advanced technologies into the next century all for the lack of a sum which is less each year than the MOD equipment underspend.

Annex A is an unsolicited paper from Chatham House and Annex B a paper from (of all people) the Adam Smith Institute.

Yours ever

Geoffrey

GEORGE BROCK OP-ED

ANNEX A

BRITAIN IN SPACE

by Admiral Sir James Eberle, Director,
Royal Institute of International Affairs

Government Ministers will shortly be asked to consider the future shape of the British space programme. That future is not simply a matter of what makes sense for Britain. The space business is inherently international; the development of space technologies depends on international collaboration; and the regulation of the use of space, both military and civil, depends on international agreement. A decision will soon be required as to whether Europe will accept President Reagan's invitation to cooperate in designing and building, together with Japan and Canada, a space station for the 1990s. For these reasons the Royal Institute of International Affairs is currently undertaking an investigation of the international dimension to British space policy; and with sister institutes in other European countries is conducting a joint study on the future of European space policy. Over 80% of the government funded investment in civil space is at the moment spent through the European Space Agency.

What then are the factors which British ministers should take into account in reaching their decision? Our European friends say that we, the British, need to take an imaginative leap forward. Space technology is important and will become more important. Direct and indirect applications will, in the longer term, have a profound effect upon our economies, our cultures and our security. There is already fierce

intercontinental competiton to develop and market space launch capabilities, particularly in the light of the US space shuttle disaster, not only in the US, the USSR and Europe, but strikingly now from Japan and China. No individual European country has the resources or the capabilities to keep up in the space race. Only through collective effort has Western Europe a chance of making a significant impact. An active space policy is a necessary attribute of a country or group of countries which aspires to serious international influence. So the argument runs.

The difficulty is that this is not the way in which space policy has typically and historically been viewed in Britain. Space activities have been seen as the purview of the military superpowers, with British interests being pursued peripherally by a small number of enthusiastic scientists and a few industrialists; and intermittently by defence experts. The commercial success of some of our major aerospace companies in the manufacture of communication satellites has received scant attention. In terms of public policy and public expenditure space has had no special 'clout' in competing with many other claimants for attention and investment. Decisions have often depended on narrow and short term 'on balance' arguments. Thus we have avoided a choice of whether to 'get into' space, or to 'get out of' space, by continuing to dabble in the space business without showing any significant Government commitment to it. If we, the British, continue in this over-cautious vein, our European friends tell us, we risk becoming the 'also rans', users of space technology not producers, with little influence in

determining future patterns of international collaboration, and dependent on the priorities of our partners, both in Europe and across the Atlantic.

In January this year the Government took a small but most welcome step forward in establishing the British National Space Centre to provide a focus for coordinating British space activities. Instead of relying on the sum of the separate interests of individual government departments, BNSC was charged with producing a coherent overview in consultation with widening interests in space of British Industry and the universities. The aims were to ensure both that civil space activities are looked at in the round and - crucially - their integration with the needs of the military space programme. We also need to review the balance between our national space effort and our international commitments. Roy Gibson, the Director of BNSC, and his colleagues have worked hard to produce a coherent strategy upon which the Government can base a space policy.

We need to be clear that the future of the British space programme now rests on a strategic choice. It is a strategic choice with major implications, both military and civilian. The pace of technical change will not readily allow us to continue dabbling and to have another look in five years' time. The economic and technological drive of other Governments' space programmes will not pause while we have second or third thoughts. Crucial European and international negotiations will take place in 1987. We the British must assess our future space programme in relation

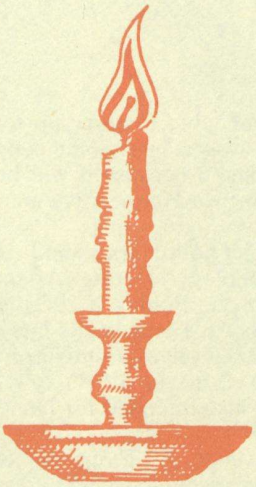
to the likely important impact of space upon international relations, and as the future 'cutting edge' of technology; and not just on the narrow criteria of the current state of the art and the costs of the investment.

We cannot proceed alone. We thus have to be clear about our preferred partners for collaboration. On the civilian side our small contribution has been firmly in the European Space Agency's basket. This needs to be reinforced. On the military side we have favoured a mix of national, Anglo-American and NATO programmes. However, our leading European partners, especially the French and Germans, are now actively discussing the development of both military and civil applications of space on a joint European basis. We need to join them.

ANNEX B

ADAM SMITH INSTITUTE

Enlightenment



BRITAIN'S FUTURE IN SPACE

PETER YOUNG

Britain was once among the leaders in aerospace technology. Our loss of that position is a symbol of the malaise which overtook this nation in the last decades, a malaise from which we are only now recovering. A reassertion of British leadership in aerospace would underline this recovery and give new confidence to the nation.

Our aerospace industry is no longer largely nationalized. The freedom brought by privatization has lead to impressive results at British Aerospace and a new drive for innovation and success. Rolls Royce, the aero engine manufacturer, will soon join British Aerospace in the private sector. Britain is improving her space technology, and is the third largest producer of communications satellites, the major growth area of the field.

A possibility has been created for Britain to seize the lead in aerospace technology. By remarkable innovation Britain could leap ahead of its competitors and establish a new generation of spacecraft to dominate the aerospace industry of the coming century. This achievement would also have major implications for the defence of the nation, as technological changes are moving the front line of defence into space. Britain's hopes of such a dramatic breakthrough rest with one project: HOTOL.

What is HOTOL?

HOTOL stands for horizontal take-off and landing vehicle. It is the British design for an aerospace plane, able to use runways like an ordinary plane but also to achieve low earth orbit. Such an aircraft is hypersonic, travelling at many times the speed of sound. If developed it would truly constitute a new generation of plane, superior to both conventional rockets such as the French Ariane and also to partially reusable space vehicles such the American Space Shuttle.

The advantages of such an aerospace plane are immense. The cost of launching satellites would drop to one-fifth of present costs for low orbit, and at least halved for geostationary orbit. This would enable Britain to compete for 75% of the immensely lucrative satellite market. Furthermore the plane could take on a passenger role in later configurations, able to take passengers into earth orbit, or to fly from London to Sydney in an hour.

The Technical Breakthrough

Efforts to design single vehicle aerospace planes have been severely hampered by technical difficulties associated with the engines required for the task. Flying at very high speeds through both the earth's atmosphere and space creates many problems. The most difficult is that of producing an engine which is able to combine the functions of air breathing engine and rocket motor.

A conventional aircraft burns oxygen from the atmosphere, whereas a rocket burns only its own fuel and must carry its own oxidant on board. Thus conventional rockets, and partially reusable vehicles such as the Space Shuttle, discard boosters and fuel tanks on their journey into space. The weight of fuel makes takeoff in the manner of a normal passenger aircraft impossible. Vertical take-off is required, with all of the costly launch facilities which this implies.

HOTOL overcomes this problem by a revolutionary breakthrough in engine technology by scientists and engineers at Rolls Royce. They have created a novel propulsion system - Swallow - which combines air breathing and rocket propulsion, reducing greatly the amount of liquid fuel which has to be carried. Thus HOTOL will be able to achieve orbit in a single stage and be entirely reusable. At low altitude HOTOL will burn atmospheric oxygen, mixed with liquid hydrogen from an on-board tank. Once beyond the atmosphere, it will switch to liquid oxygen and liquid hydrogen.

The Competition

After the Challenger shuttle disaster and several failures of the mostly French Ariane rocket, satellite launching is in a state of disarray. Some American companies have even been reduced to sending their satellites aloft on Chinese rockets. Nevertheless these problems will be overcome, and probably quite soon.

Europe's launcher, Ariane, is currently quite competitive with the USA's Space Shuttle at launching satellites into geostationary orbit, (one in which a satellite appears to be in a constant position over one point on the earth's surface, about 22,500 miles up). However, shuttle launch costs could drop by up to 50%, either if the Americans built a second-generation shuttle or managed to launch the current shuttles twice as often.

In such circumstances Ariane would be uncompetitive, and the US, after a time, would be able to charge high monopoly prices for launches. Indeed the US has already announced its intention to drop the cost of their launches by at least a third after the introduction of a second-generation shuttle in around 2005.

The French response is to go ahead with the next version of the Ariane launcher, Ariane 5, which will be somewhat more economical than its predecessor because it will be

larger, able to carry up to three satellites, and has fewer fall-away stages. Some people suggest that the French favor Ariane 5 because it will be large enough for them to put their own Hermes five-man mini-shuttle on top of it.

In fact both Hermes and Ariane are largely based on 1960s technology. Hermes/Ariane5 are not markedly different from the Boeing X-20/Titan combination proposed by the U.S. Air Force in the late fifties and cancelled in 1963. In West Germany a similar project to Hermes is being planned by Messerschmidt-Bulkow-Blohm and Erno. Called Horus, it is also intended for launch aboard Ariane 5.

However, if Europe wishes to remain in the forefront of space technology and to retain launch vehicle capacity, then something entirely new is required. Rather than attempting to update 1960s technology, a break with the past and a new concept will be necessary. This is what Britain's HOTOL provides.

The importance of a leap forward in technology has not been lost on the Americans. President Reagan has announced a research programme to develop a 'National Aerospace Plane' (NASP), which he dubbed the 'Orient Express', capable of flying from New York to Tokyo in 2 hours. The President used the concept as a means of exciting the American people to the future both of the U.S. space programme and America itself. The U.S. Defense Department has stated:

"If the new research program is successful in demonstrating the necessary new technologies, an entirely new family of aerospace vehicles will be possible, able to cruise within the upper atmosphere at hypersonic speeds, or ascend directly into orbit...

"As a space launch vehicle operating from conventional runways, the fully reusable and single state aspects of the NASP are believed to produce very large reductions in the cost of placing payloads in orbit."

The Department of Defense and the National Aeronautics and Space Administration have awarded seven contracts to US aerospace and engine companies, worth about $500 million over a 42-month period for what they term "key technology validation." Despite the heavy funding, the NASP programme is in its earliest exploratory phase, with no clear conclusions as to the design of vehicle that will result. No technology breakthrough such as that made by Rolls Royce has yet been achieved.

How HOTOL Will Operate

HOTOL will take off from a conventional runway around 3000 metres long. Its undercarriage will be left behind on the runway. This is because the plane weighs five times more on take-off than on landing, owing to the weight of the fuel and the payload. It makes no sense to carry the strong and heavy undercarriage into flight. Instead a small conventional undercarriage will extend from the underside of the spacecraft on the final approach to landing.

A high take-off speed of 290 knots is achieved and HOTOL climbs at an angle of 24 degrees, reaching supersonic speed after just two minutes, and continuing to accelerate. After 4.5 minutes it clears the airlanes used by commercial airliners (12 kilometres), and after nine minutes reaches a speed of Mach 5 and a height of 26 kilometres. The fuel burned up to this point is about 18% of take-off mass, as opposed to about 50% for a vertical take-off vehicle. Such remarkable fuel economy is due to the engine's ability to burn atmospheric oxygen during the climb.

When HOTOL reaches the higher altitudes where the atmosphere is too rarefied to feed its air breathing rocket engine, it switches to a combination of on-board liquid oxygen and hydrogen for propulsion, and climbs on a higher rocket-like trajectory. When it reaches orbital velocity, (8 kilometres per second), at an altitude of 90 kilometres its main engine is switched off and it coasts to an operating altitude of 300 kilometres.

Most of HOTOL's forward fuselage is occupied by the large liquid hydrogen tank. At the rear is situated the liquid oxygen tank. Because the propellants are consumed at different quantities at different times, HOTOL's centre of gravity shifts during the flight; first backward as the hydrogen is consumed, then forward again as the oxygen is used at a greater rate. Small 'canard' fins on HOTOL's long nose enable HOTOLB to balance effectively, coping with centre of gravity shifts of up to 5 metres compared with the maximum 18 inches which the US Shuttle can withstand.

Large V-shaped wings extend from the rear half of the space plane, looking similar to those of Concorde. In fact the entire vehicle is influenced by the experience which was gained by British Aerospace in developing Concorde.

HOTOL is protected from the extreme heat generated on re-entry by a high temperature metal alloy skin. Because it has a larger wing area and lower mass than the Space Shuttle it can re-enter more gradually rather like a high altitude glider, keeping temperatures lower and avoiding the necessity for delicate tiles or more complicated heat shields.

HOTOL is intended initially to fly unmanned. It will be computer-controlled in flight and directed from earth. There is already much experience with pilotless research aircraft, target drones, and autopilot landings by commercial airliners in bad weather conditions. For later missions a manned module will be fitted into the cargo bay. This will be designed to carry mission specialists for such work as refueling space platforms, or other tasks that require human supervision.

HOTOL could also be used as an intercontinental passenger transport, able to carry around 60 passengers on long flights in very short times, (London to Sydney in 67 minutes). A detachable passenger module would be inserted in the space normally used for the payload bay.

At the end of each orbital mission, the orbital manoeuvring system (OMS) is activated to slow the vehicle for re-entry, which occurs at about 70 kilometres altitude. HOTOL adopts a pronounced nose-up orientation for re-entry which reduces as the aircraft's speed is reduced. A hypersonic glide starts at about 26 km high, bringing HOTOL down to its final approach phase. HOTOL descends to the landing area at an angle of 16 degrees and touches down at a speed of 170 knots.

Flexibility

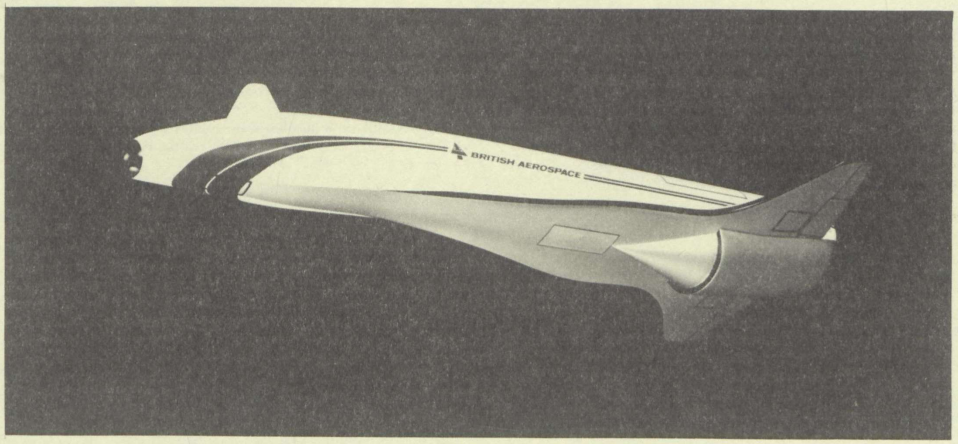
A major advantage of HOTOL is its flexibility. It can launch into low earth orbit from European airports. Should its mission call for an equatorial launch, for putting up satellites to climb into geostationary orbit, for example, HOTOL can be loaded at its base for a sub-orbital flight to an equatorial field. Once there, it can be refuelled for orbital flight.

HOTOL's rapid turnaround time - as little as 48 hours is aimed at - constitutes a major advance on existing launch systems. The use of conventional Concorde-length runways means that HOTOL's cargo can be loaded quite late, and that the preparation of it can take place close to the flight preparation point.

The Cost

The cost of the initial two-year investigation of the concept has been £3 million, with half of that sum coming from government and the other half split between British Aerospace and Rolls Royce. A second, more detailed, design study will cost roughly £75 million spread over three years. The cost of the whole project is put at some £4 billion, with test vehicles flying in the late 1990s, and the entry into service by the early 2000s.

Part of the cost of the second stage of research and development may well be contributed by the European Space Agency. HOTOL is not a direct competitor to the French Hermes mini-shuttle because the latter is not a launcher. Ariane 5 is a launcher, but is of an earlier generation. It is possible to argue that HOTOL might be a later successor to Ariane 5, and that European support for both projects might be justified. It is reasonable to expect that the European Space Agency (ESA) will contribute to the new three year study, on the basis that HOTOL could become a joint European project, with different countries having a stake in producing it.



A reasonable assumption might be that ESA could be asked to put up 65% of the three year R & D project, leaving between £25 and £30 million to be provided from Britain over a three year period. In return, Britain would participate in other joint ESA projects and contribute to them.

The Rationale

HOTOL represents a technological breakthrough which extends the range of options in several important fields. One factor which is of crucial importance is that HOTOL has been thought out with its market in mind. Instead of working to produce what is possible in new technology, the aim has been to produce a low-cost, flexible system designed for a market. HOTOL merits, and should be given, official support for the next stage of its development because of the possibilities it opens up in areas vital to Britain's future development.

DEFENCE

HOTOL has an important role to play in national defence. Firstly it is capable of launching military or reconnaissance satellites into low earth orbit. There is a multiplicity of communications, navigation and surveillance roles which will be required by the time it comes into service, and these are functions for which an independent capability would be preferred to buying space in the launch vehicles of other nations.

Secondly, HOTOL can play an important part in the development of strategic defence. As the change is made from dependence only on nuclear deterrence to space defence systems, it is important that Britain is able to update its own military thinking, and has the technical means to participate in the change. HOTOL can provide the means for British assistance in the US-led Strategic Defence Initiative, and can enable us to ensure that a European extension of it can be deployed. It is designed to be able to dock with the space platforms currently in preparation.

Perhaps most important of all is that HOTOL provides the basis of an alternative weapons system in the event of the default of the Trident programme. Britain's entire nuclear deterrence relies on the Trident missile submarine programme, with British multiple warheads fitted to missiles bought from the United States. It is theoretically possible that Trident could fall victim to an arms reduction deal between the US and the USSR. Assurances from the current US President could not necessarily be guaranteed by any of his future successors. No major arms reduction package would be allowed by the Soviets to permit Trident sales to us, any more than the US could be expected to allow a deal which permitted Soviet sales to Bulgaria of their strategic missiles.

It is also possible that technological developments could lead to increased vulnerability of the Trident system. Because the system has a long lead time before it becomes operational, and because its declared useful lifetime is three decades, the possibility cannot be excluded that new methods of underwater detection will emerge to reduce its value, especially to a nation with so few of the submarines at sea at any one time.

HOTOL provides the basis of an alternative system. It could serve as an intercontinental bomber just as readily as a launch vehicle for satellites. It flies faster than ICBMs, which do not attain orbital velocity. Its cargo hold could contain multiple independently targeted warheads instead of commercial satellites. It has the ability to use conventional airstrips. It gives Britain the possibility of a flexible backup system to provide for deterrence in a European context.

Given the fact that the strategic perceptions of the USA may not always coincide with those of Europe, as well as the possibility that technological advance will weaken Trident, HOTOL provides a very important alternative recourse. Furthermore, it represents progress to the new space technology where military systems, both offensive and defensive, will probably be located. For strategic reasons alone, HOTOL is certainly a project which merits support at a level sufficient to maintain its progress. Fortunately there are non-military advantages which sustain the same view.

INDUSTRY AND COMMERCE

The record of governments at "picking winners" to back with money not available from the private sector is not a good one. It is a story of capital written off for expensive white elephants which fail commercially. There have been some successes, but many large scale failures. In general, the private sector stands back from projects whose success is unlikely. Too often public funds have achieved a technological advance which has not taken sufficient account of commercial realities. HOTOL is at least conceived in a commercial light to fill a market niche.

It is impossible to calculate industrial and commercial spin-offs from such a project, any more than one could have calculated the commercial impact of the US space programme. A possible parallel might be that of US aircraft makers who have made technological breakthroughs in pursuit of military needs, and then produced a range of highly successful civil airliners on the back of that basic research and development. In this sense, the 747 traces its origins back to the B-52.

For HOTOL it is likely that considerable private investment could be attracted, especially if the project were to involve European partners, and were to feature military participation. As stated, it is designed to bid for 75% of the market for future satellite launches. The possibility is there of the development of a whole generation of vehicles arising from the initial concept. From the first unmanned launcher could come both manned space vehicles and intercontinental hypersonic transports. Given the relatively low cost of sustaining the programme into the next stage of research and development, the arguments for preserving the option begin to look convincing.

MORALE

There is an aspect of HOTOL difficult to quantify. It is the effect it will have on national morale. The US space programme managed to capture the imagination of the public, and impart the confidence that America was moving forward in the vanguard of new fields of human endeavour. A similar effect could be achieved, at very much less cost, with HOTOL.

Britain has emerged from that long period of malaise and economic decline. HOTOL is the kind of project which could offer to people the promise of a nation at the leading edge of new technologies, moving confidently into the new century, and no longer looking back wistfully to glories long past. HOTOL offers the prospect of exciting new developments and new challenges. It offers a glimpse of the new Britain they want to believe will make its way in the coming world.

First published in the UK in 1986 by ASI (Research) Ltd., London SW1P 3DQ. (c) Adam Smith Institute, 1986

ISBN 0-906517-94-X