Viewpoints

The Current and Future Utility of Air and Space Power

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This article addresses its topic in four parts. First, it shows from past experience how difficult predicting the future is, and assesses whether the UK's recent National Security Strategy and Strategic Defence and Security Review take adequate account of this unpredictability. Second, it discusses the key characteristics of air and space power relative to land and naval power, by boiling the essential differences down to just four basic factors, and assessing the implications for the aerospace contribution to joint campaigns. Third, it examines the very difficult trade-off between the flexibility of aerospace capabilities (in terms of geographical application, operational utility across the spectrum of conflict, and adaptability of effects) and the high costs and lead times which such flexibility normally requires. Finally, it analyses the human dimension of air and space power, by assessing how advances in simulation, UAV technology and computer networking are changing the roles of human operators, and what this means for the future of aerospace power as a distinctive specialism within military power as a whole.

Introduction

Articles on contemporary defence issues have a very short shelf life, before they are overtaken by events. I am reminded of a book chapter which I wrote in 2001 about the future of air power, which was not published until six months later, by which time the September 11th attacks had transformed the strategic landscape.[1] In such frustrating circumstances, it is very tempting to leave current affairs to journalists and to seek refuge in the relative certainties of the past, and it is no accident that my own two most recent books have focused on the very different field of ancient Greek and Roman warfare![2] However, it is still worthwhile to seek more enduring insights than are contained in the latest headlines, and aerospace power now has a sufficiently long history that one may identify fundamental patterns and characteristics which seem likely to persist in some form, whatever surprises the future may hold. Although I am writing this article in the immediate aftermath of the UK's long-awaited *Strategic Defence and Security Review* (SDSR), I will resist the temptation to dwell on the detailed outcomes of that review, and I will focus instead on broader and more enduring considerations which seem likely to determine the current and future utility of air and space power.[3]

I will structure my remarks under four headings. First, I will build on

the points I have just made by discussing the sheer difficulty of 'Predicting the Future', and the implications this has for policy formulation. Second, I will assess what is really distinctive about 'Air and Space Power', and hence what its continuing contribution is likely to be within military power as a whole. Third, I will examine the common suggestion that 'flexibility' is a key aerospace attribute by addressing 'The Benefits and Costs of Flexibility'. Finally, I will discuss 'The Human Dimension', which remains all-important even though air and space power is so intrinsically bound up with technology. As British airmen and airwomen adapt to bruising force reductions and draw breath after an often bitter struggle for survival over the past few years, I hope that this article will help to refocus attention away from battles over particular systems and facilities and back towards the overall contribution and successful application of aerospace power as an integral element of the UK's security policy.[4]

Predicting the Future

Attempts to foresee what might happen in the months and years ahead are routinely prefaced by disclaimers about the enormous uncertainties inherent in such an enterprise, and a common joke is that, 'Predictions are very difficult, especially about the future!'. This joke actually captures an important truth, since I would argue that the best way to look when trying to predict the future is not forward at all, but rather backwards into the past. This is for three principal reasons. First (as I discuss in my next book, *Simulating War*), the past offers a rich tapestry of experience about how conflicts can actually unfold, whereas theoretical speculations about possible future clashes like the one now simmering over Iranian nuclear activities inevitably tend to be dominated by technical military considerations such as targets, ranges and air routes rather than by less quantifiable human aspects.[5] Not until a conflict is actually under way does this broader dimension become fully apparent (as happened in both Iraq and Afghanistan), so vicarious understanding of past conflict dynamics is a key way of preparing ourselves for the inevitable shock and surprise. Bismarck put it very well when he remarked that, 'Fools say that they learn by experience. I prefer to profit by others' experience'.

The second invaluable contribution of historical awareness is that it reminds us of the sheer complexity of warfare, and shows how apparent patterns and trends can reverse themselves with alarming frequency. The history of the Arab-Israeli conflict over the past fifty years is a particularly telling illustration. In the wake of the 1967 Six Day war, it looked as though Israeli air and armoured forces enjoyed complete dominance over their more numerous Arab opponents, but in the Yom Kippur war of 1973 these forces received a very bloody nose at the hands of Arab missile defences. Just a few years later there was another stark reversal as the Osirak raid of 1981 and the incredibly one-sided air and air defence battle over Lebanon in 1982 suggested that Israeli air power was more dominant than ever, but very quickly the picture changed yet again as guerrilla tactics first in Lebanon and then in the successive

Palestinian intifadas altered the rules and inflicted severe setbacks despite Israel's apparently unchallenged conventional superiority.[6] In 2006, the IDF proved shockingly unable to assert its dominance even in a fairly 'conventional' war with Hizbollah in Lebanon, but more recently the conflict in Gaza and the long-range IAF strikes against a Syrian nuclear cache and an arms convoy in Sudan have shown that the Israeli military is still very much a force to be reckoned with.[7] Clearly, any assumption that recent experience is a reliable guide to what we can expect in the future is shaky to say the least.

The third, and perhaps the most sobering, way in which looking backwards can enlighten our efforts to predict the future is by reminding us of how blinkered and flawed our similar predictions have been in the past. Just over 20 years ago, I edited a full-length book on *The Future of UK Air Power*, and re-reading that book today is a very salutary endeavour as we try to peer forward a similar distance into our own future.[8] As I said when addressing this same topic in the *RUSI Journal* a year ago, 'Who in 1988, after years of Cold War confrontation, would have dared to suggest that British aircrew would spend almost all of the next two decades engaged in active combat operations over Iraq, or that a bloody and frustrating counter-insurgency campaign would still be being waged in Afghanistan in the first decade of the twenty-first century, but with the NATO alliance as the protagonist rather than the USSR?'.[9] Our lamentable failure to foresee in advance such seminal events as the end of the Cold War, Saddam Hussein's invasion of Kuwait, renewed ethnic strife in the Balkans, the September 11th attacks, the continuing insurgencies in Iraq and Afghanistan, or the recent disastrous financial crash should make us very humble indeed in our efforts to predict how the world might look in 2030 and beyond. Nicholas Taleb's 2007 book *The Black Swan* suggests that the world is so complex that any kind of prediction is a mug's game, and recent 'left-field' shocks such as the BP oil spill and the tragically early death of Air Chief Marshal Sir Chris Moran are a terrible illustration of the force of his remarks.[10] One can quite understand why Macmillan reportedly identified as the biggest challenge of his premiership the single word, 'Events'.[11]

Judgements about what kind of conflicts the future might hold became a very live political issue during the recent defence review process, because of their direct implications for the kind of forces which Britain most needed to maintain. Future Chief of the Defence Staff General Sir David Richards made an especially bold and challenging speech at the International Institute for Strategic Studies in January 2010, in which he argued that, 'We have traditionally viewed state-on-state conflict through the prism of putative tank battles on the German plains or deep strike air attacks against strategic sites. While these are still possibilities, they are increasingly unlikely – certainly at any scale... State-on state warfare is happening and will continue to happen but some are failing to see how. These wars are not being fought by a conventional invasion of uniformed troops, ready to be repulsed by heavy armour or

ships, but through a combination of economic, cyber and proxy actions. Modern state-on-state warfare looks remarkably like irregular conflict'. General Richards went on to argue that, 'Hypothetical situations have been outlined to demonstrate this is not so. One such is a possible attack on Middle Eastern nuclear sites. They don't. While an initial attack may be conventional, lessons from Afghanistan, Iraq, Lebanon and other places have shown us that the response would most likely include the sponsoring of proxies and terrorists wherever they could be found. Nations will do their utmost to bleed their enemies' morale for the lowest economic, political and military cost as we have come to expect from non-State actors'.[12]

Only time will tell whether General Richards' very clear prediction is borne out by events. It certainly fits closely with recent experience, but as I have just shown, recent experience is a very weak reed on which to rely, and confident assertions about what the future holds are often proved to be disastrously misplaced. I cannot help citing what another very clever soldier, General (now Lord) Charles Guthrie, predicted in his contribution to my own 1988 book. General Guthrie began his chapter on 'The Future of Battlefield Air Support' with a ringing assertion that, 'After the year 2000, much on the Central Front will be similar to today. The conventional threat facing the Allied ground forces will be from mass: superior numbers of tanks and helicopters, supported by guns, rockets and aircraft, whose aim would be to roll over NATO forces and their reserves as quickly as they could'.[13] In the event, of course, the Central Front, the Warsaw Pact and the USSR itself all disappeared just a few years after these words were written, and the strategic environment which had seemed so predictable underwent a revolutionary upheaval. Without similar hindsight, it is impossible as yet to confirm or refute General Richards' more recent vision, but past experience clearly shows how wrong our images of the future tend to be, and the more certain that people are of what the future holds, the more worried and critical a response they should receive.

The British Government as a whole has now produced its own rather more nuanced visions of future security challenges, as in the detailed and thoughtful efforts by the Development, Concepts and Doctrine Centre (DCDC) to predict the *Future Character of Conflict and Global Strategic Trends out to 2040*.[14] These have fed into the latest edition of the *National Security Strategy*, which ranks future threats into three tiers of priority. In the highest tier come four sets of risks – terrorism, cyber attack, natural disasters, and an international crisis between states.[15] The thrust of the document is very different from the Cold War emphasis on a single overriding threat from the Warsaw Pact, and also from the 1998 *Strategic Defence Review* with its focus on 'discretionary' intervention operations overseas.[16] The new strategy is much more focused on mitigating direct threats to the UK from a wide range of potential challenges, on the grounds that, 'Britain today is both more secure and more vulnerable than in most of her long history. More secure, in the sense that we do not currently face, as we have so often in our past, a

conventional threat of attack on our territory by a hostile power. But more vulnerable, because we are one of the most open societies, in a world that is more networked than ever before.'[17] However, intervention operations to tackle these globalised challenges at their source remain a key *leitmotif* of the new strategy, as is clearly illustrated in the SDSR, which assumes that Britain needs to be capable of conducting one enduring stabilisation operation with up to 6,500 personnel, as well as two non-enduring intervention operations with up to 3,000 personnel between them.[18]

This Defence Planning Assumption shows how the continuing conflict in Afghanistan inevitably exerts a massive influence over our thinking about future defence needs. The unforeseen occurrence of the Falklands and first Gulf wars made it politically difficult to carry through some of the force adjustments planned in the defence reviews conducted a few months earlier in 1981 and 1990, but this is nothing compared to the political untouchability of forces needed for the ongoing Afghan conflict, whatever hypothetical arguments may be made about how strategic needs may change in the future.[19] The very longevity of recent military commitments in the Balkans, Iraq and Afghanistan is a major factor in its own right, and suggests that (barring ignominious withdrawal) it is much harder to get out of modern conflicts than to get into them.[20] Air power is just as affected as surface power by this 'stickiness' of commitments (which is awfully reminiscent of Brer Rabbit's famous duel with the 'Tar Baby'), and since client regimes will continue to depend on air support even after Western ground forces have been withdrawn, the precedent of US air support for South Vietnam in the Nixon and Ford eras may become highly relevant.[21]

It is all too easy to become fixated on actual current challenges rather than more serious potential ones, so a welcome feature of the *National Security Strategy* is its explicit and detailed articulation of the principle that risks must be prioritised according to the product of their likelihood and relative impact – hence, even a low risk of chemical, biological or nuclear attack or of renewed conflict with Russia or China is a very serious concern because of the gravity of the potential consequences.[22] During the Cold War, I am glad that the UK deterred a Warsaw Pact attack on NATO while failing to deter an Argentinean attack on the Falkands, rather than *vice versa*! The new strategy acknowledges that deterrence is still a key function of military forces, and that certain capabilities may serve a very valuable deterrent purpose even if they are not routinely used in anger.[23] However, there is also the opposite mechanism of a 'self-fulfilling prophecy', in which specialising in a particular form of warfare may make it hard to avoid taking a lead in tackling such conflicts should the need arise. Britain has traditionally seen itself as good at counter-insurgency operations based on experience in Malaya and Northern Ireland, but its recent involvement in Iraq and Afghanistan has been much more traumatic, and it is by no means clear that the UK will want to focus on further such operations in the future, as General Richards' vision seems to imply.[24]

Even if Britain does find itself fighting more such irregular conflicts, a further key point is that 'asymmetry' cuts both ways. Not only are today's 'hybrid' wars ones in which adversaries are very willing to engage in intense stand-up fights (as recent experience in Lebanon and Afghanistan shows) if we do not maintain clear 'escalation dominance', but allowing the enemy to shape the nature of the fighting is a sure route to defeat, and we must be prepared to seize the initiative and fight wars on our own terms, especially by employing our distinctive advantages in aerospace power.[25]

Air and Space Power

The recent fourth edition of *British Air and Space Power Doctrine* (AP 3000) lists various strength and limitations of air and space power in turn.[26] In an article a year ago on the Strategic Impact of Unmanned Air Vehicles (UAVs), I decided to start off by going back to basics and distilling the fundamental distinctive characteristics of air and space platforms down to just three strengths and one weakness which the two forms of power share due to their common attribute of 'flight', and from which other consequent characteristics flow.[27] The first basic strength of air and space power is **perspective**, since the height which flight makes possible allows direct lines of sight over a very wide area (extending to a third of the Earth's surface for a satellite 36,000 km up in geosynchronous orbit). The second fundamental advantage of aerospace vehicles is **speed**, since the lower frictional resistance of the air enables air platforms to attain speeds around an order of magnitude higher than their land or naval counterparts, while in space the virtual absence of atmospheric resistance allows vehicles to move at least an order of magnitude faster still (28,000 km per hour for satellites in low earth orbit). The third inherent strength of air and space power is **overflight**, since aerospace platforms can move freely in three dimensions rather than being confined to the land or sea or constrained by terrain obstacles to follow specific linear routes, making it much harder than with surface forces for an adversary to block their progress. The one big offsetting weakness of aerospace vehicles is **energy needs**, since overcoming gravity without resting on land or water requires large energy expenditure per unit of payload, either constantly (to maintain the necessary airflow over wings or rotor blades) or in the initial surge to give missiles or satellites the enormous height and speed required for sub-orbital or orbital flight.[28] Compounding this weakness is the fact that the fuel needed to provide the energy is itself heavy, and thereby creates a vicious circle of escalating energy needs.

From the three basic strengths of air and space power flow several consequent advantages. In particular, the combination of speed and overflight gives aerospace vehicles the reach to cover large distances and the penetration to fly deep over enemy territory. Air vehicles also have the agility to reach a crisis point quickly and to be re-tasked anywhere across a wide area, while spacecraft, though lacking in agility because of the vast energy costs of changing an established orbit, have the persistence to remain in flight for years on end due to the lack of

frictional resistance. An interesting alternative capability may be offered in future by long endurance airships or solar powered UAVs such as Zephyr, which sacrifice speed in order to minimise energy needs and maximise persistence, hence allowing a more constant and focused air presence over a given area than low orbit satellites are able to provide as they flash across the heavens.[29] More traditional air vehicles suffer from a greater degree of impermanence and base dependence because of the need for constant replenishment of their fuel and ammunition (though these limitations have been eased significantly in recent decades by the advent of air-to-air refuelling techniques). Meanwhile, all aerospace vehicles are afflicted by cost and fragility, due to the advanced technology which flight requires and the difficulty of providing protective armour because of the excess weight it would involve.

By the 1990s, advances in micro-electronics were offsetting these inherent weaknesses of aerospace power, by giving Western air forces the network capabilities to take full advantage of aerospace surveillance, the electronic countermeasures needed to overcome enemy air defences, and the precision attack capabilities needed to increase the efficiency of their bomb loads by at least an order of magnitude.[30] In 1991, the US-led coalition overwhelmed Iraqi air and surface forces in an aerospace-led 'blitzkrieg' which mirrored on a larger scale the one-sided triumph which the Israelis had initially achieved in Lebanon a decade earlier.[31] US air theorist Colonel John Warden proclaimed that, 'The world has just witnessed a new kind of warfare – hyperwar. It has seen air power become dominant. It has seen unequivocally how defenseless a state becomes when it loses control of the air over its territories and forces. It has seen the awesome power of the air offensive – and the near impossibility of defending against it... We have moved from the age of the horse and the sail through the age of the battleship and the tank to the age of the airplane'.[32] Operation Deliberate Force in Bosnia in 1995 seemed to confirm the potential of aerial coercion, and the success of the similar air campaign during the Kosovo crisis in 1999 prompted even the sceptical John Keegan to admit that, 'A war can be won by air power alone'.[33] When the Taliban regime in Afghanistan was overthrown in 2001 by a combination of precision air power and special forces and local allies on the ground, this appeared to endorse once again the dominance of Western aerospace capability.[34]

However, a less flattering image of air power was also developing, and this image has assumed greater prominence in recent years. Already during the Kosovo campaign and Operation Enduring Freedom, there were concerns about the ability of air power to find and destroy enemy ground forces taking advantage of terrain cover, and these concerns came to a head after the Lebanon war in 2006 when the IAF proved signally unable to stop the rain of short range rockets launched by Hizbollah.[35] Still more significant was the revival of air power's image as an indiscriminate and politically counterproductive weapon, as even precision air power routinely inflicted numerous civilian casualties through 'collateral damage' and poor target

intelligence.[36] General McChrystal in Afghanistan told his officers in June 2009 that, 'Air power contains the seeds of our own destruction if we do not use it responsibly', and three months later, Prime Minister Gordon Brown said that, 'what separates successful counter-insurgency from unsuccessful counter-insurgency is that it is won on the ground and not in the air'.[37] General Richards has frequently echoed these thoughts on the limited utility of air power, as in his IISS speech in January when he argued that, 'Hi-tech weapons platforms are not a good way to help stabilise tottering states – nor might their cost leave us any money to help in any other way – any more than they impress opponents with weapons costing a fraction. We must get this balance right'. He went on to explain that, 'We need to right the balance in favour of unglamorous technology: protected transport, communications and intelligence; technology that allows the Armed Forces to get closer to the people and that gets an understanding of the battlefield directly to the commanders. The technology that puts the influencers in touch with those they seek to influence'.[38]

The truth is, of course, that these opposing images of aerospace power as a dominant independent presence and as a costly liability are both deeply flawed. Thoughtful commentators have long recognised that the utility of air power varies hugely with factors such as the geographical and political context of each specific conflict, as in Air Vice Marshal Tony Mason's notion of an 'Air Power Pendulum'.[39] Sometimes air power will play a leading role within the overall joint effort, while at other times it will play a more supporting part.[40] The recent controversy over the utility of air power has focused on air bombardment of surface targets, which in fact constitutes only one aspect of the multi-dimensional contribution which aerospace power as a whole makes to modern military operations. Nobody disputes that air transport and aerial surveillance and intelligence-gathering play an invaluable role in all conflicts, or that satellites have transformed everything from navigation and communications to reconnaissance and targeting. Control of the air and suppression of enemy surface-to-air and missile capabilities are more easily taken for granted during counter-insurgency campaigns like those in Iraq and Afghanistan, but one need only look back to British experience in the Falklands, Soviet experience against the Mujahideen, and Israeli experience against Hizbollah and Hamas to recognise the damage which can occur when opponents are able to use or contest the airspace over the theatre of conflict, even to a limited extent.[41] The reality is that aerospace power forms an increasingly integrated and indispensable element within military power in general, and that there is no question of British or other Western surface forces deploying or operating effectively without a very prominent air and space component to provide the crucial edge over less fortunate adversaries.

The Benefits and Costs of Flexibility

Two years ago, I took the risk of suggesting in a Staff College lecture

that aerospace power, while undoubtedly flexible, was not *uniquely* flexible compared to surface forces, as air power advocates sometimes tend to claim.[42] Flexibility has since become the central issue in debates over the future of air power, and Air Chief Marshal Sir Stephen Dalton laid great stress on this aspect in his own address to the International Institute for Strategic Studies in February, arguing that fast jets such as Tornado have proved their flexibility over the past two decades and offer a better way forward than 'to go down the route of low capability, niche specialisation, optimising our force structure purely for the war we're fighting now'. In Sir Stephen's words, 'real flexibility will be provided by a sensible capability-mix, giving us the combat power we need now in Afghanistan, but future-proofed – as far as possible – by adaptability and judged by consideration of through-life capability and cost-effectiveness, not simply the spot purchase price'.[43] This builds on the 2006 RAF strategy, which focuses on achieving 'An agile, adaptable and capable Air Force that, person for person, is second to none, and that makes a decisive air power contribution in support of the UK defence mission'.[44] The recent SDSR asserts similarly that capabilities must be 'flexible and adaptable, to respond to unexpected threats and rapid changes in adversaries' behaviour'.[45] Flexibility is clearly highly desirable, but it has costs as well as benefits, and achieving the best balance in the face of the current appalling resource pressures is the most difficult single challenge facing defence planners.

The essence of flexibility is that it allows a given military capability to handle multiple challenges, instead of requiring separate capabilities to deal with each one. Flexibility is an inherently multi-dimensional concept, and I will now discuss three of these dimensions in turn. The first is **geographical flexibility**, which involves being able to operate in diverse locations and to move swiftly between them. As I pointed out in the previous section, this is where aerospace power really shines because of its twin characteristics of speed and overflight. Satellites provide intrinsic global coverage, while aircraft (especially fast jets) have the responsiveness to reach a given crisis point rapidly, regardless of the surface terrain, and then to be re-tasked elsewhere just as quickly over a very wide area. Range and basing matter just as much as speed in underpinning this responsiveness.[46] The more deployable a given air capability is to bare bases, the more that transit times can be reduced during operations in a given region, while the longer the range of an asset, the wider the area it can cover from a given base. Sea-basing of air assets offers valuable flexibility in the positioning of bases at optimum points across two-thirds of the Earth's surface, and it also helps to evade political sensitivities and base-loading constraints affecting nearby land airfields. If geographical flexibility were the only aspect which mattered, then aerospace power would indeed be a uniquely flexible form of military might.

The second important dimension is **operational flexibility**, by which I mean the ability of forces to operate across the spectrum of

conflict, despite opponents' efforts to counter them. The fragility of aerospace platforms is a liability in this regard, especially for helicopters and UAVs, but this is offset for fast jets and satellites by the ability to exploit speed and height to stay out of reach of low technology threats such as guns while using electronic countermeasures to defeat high technology threats like surface-to-air missiles. The impermanence of air power is actually an advantage in terms of survivability, since air vehicles are vulnerable only when they appear over the conflict zone from the safety of distant bases, while surface forces (especially on land) have a more permanent presence in the combat zone and so need to be constantly on guard against enemy attack. The more detached and evanescent nature of aerospace power has real benefits also at lower levels of conflict, since satellites enjoy untrammelled overflights even in peacetime, and since it is more politically acceptable to employ air power in ambiguous situations than to deploy ground combat forces (as in the No-Fly Zones over Iraq before 2003 and the ongoing UAV operations over Pakistan).[47] Hence, at least for Western nations with their political sensitivities and their preponderance in electronic warfare, air and space power do currently provide rather greater operational flexibility than surface power.

The third key dimension is **flexibility of effect**. Air planners have put a lot of emphasis on this area in recent years, as in the evolution of multi-role platforms such as the F-15E, F-18 and JSF which can switch seamlessly between air-to-air and air-to-ground engagements, and as in the growing use of both fast jets and UAVs such as Predator as 'combat ISTAR' platforms which can conduct detailed surveillance and then use their own weapons to attack any targets which might be found.[48] A lot of thought has also gone into tailoring air effects through developing smaller and more precise munitions and through the use of 'non-kinetic' means such as fast fly-bys to intimidate those on the ground.[49] However, it is in this area where aerospace power is inevitably most limited compared to surface forces. If one leaves aside for a moment inherently joint activities such as transporting troops or supplies or providing networked communications, all that air and space platforms can really do to affect a situation on the ground or sea is to observe it from overhead or to threaten or carry out an armed attack. Only surface forces not detached from the situation by height and speed can conduct more subtle and discriminate interactions such as searching inside woods, buildings, caves or boats, conversing with people, taking prisoners and so on. In terms of flexibility of effect, air and space platforms are at a clear disadvantage compared to land and sea forces, and this is why I questioned the idea that aerospace power is uniquely flexible overall.

An equally serious problem is that the undoubted flexibility which air and space power currently enjoy in geographical and operational terms has three significant costs. First, there are frustrating trade-offs among some of the component elements of flexibility – for example, speed increases responsiveness and survivability but limits basing options, decreases endurance, and

makes it even more difficult to engage 'with' a particular situation on the surface. Second, making a given aerospace capability more flexible and capable (such as by building aircraft carriers to provide a sea-basing option) also makes the force cost even more to build and operate than it would otherwise have done, hence further reducing the number of platforms which can be afforded within a shrinking budget. Third, larger and so more capable and adaptable platforms also tend to have very long procurement lead times, as illustrated by the fact that Britain's current Typhoon and aircraft carrier programmes already featured heavily in the conference on the future of UK air power which led to my 1988 book![50] These problems interact to produce a classic vicious circle, with more and more of the defence budget being pre-committed on projects begun long ago, leaving very little scope to exploit new technological opportunities or to react to new strategic requirements, and so making it even more important that existing platforms be made as adaptable as possible so that they may be modified to cope with whatever unforeseen challenges the future may hold. The Typhoon programme illustrates the resulting dilemmas very well, since contractual commitments make it hard to save money by cancelling outstanding orders, and since turning what was originally conceived as a Cold War dogfighter into a flexible combat ISTAR platform involves significant extra expenditure in itself.[51] Similarly, the crippling contractual penalties for cancelling one of the two aircraft carriers have played a key role in the much-criticised recent decision to build both vessels while not being able to afford the aircraft to make full use of them.[52]

It is frustrations such as these which prompted General Richards to advocate a very different approach. In his words, 'Technology designed to take on putative first world enemies is hugely expensive. Whilst accepting, with Allies, the need to retain these capabilities to deter and contain, the cost of equipment most relevant to population centric asymmetric conflict is much cheaper and one can afford many more of them. By so prioritising, we will also find the resources to spend more on the technology and equipment needed in all forms of conflict, whether state-on-state or with non-state actors: C-IED systems, UAVs, precision attack, or stabilisation forces'.[53] Some of the same concerns were echoed last year in the DCDC's *Future Air and Space Operational Concept*, which highlighted the need for investment in UAVs, directed energy weapons, space and cyber warfare as well as in air transport and combat ISTAR, and which concluded with a warning that, 'Fewer and more expensive platforms, the present trend, is approaching the point of diminishing returns, lacks resilience and suggests that we should also seek to rediscover the advantages of numbers and mass'.[54] The SDSR adopts a more equivocal response to this dilemma, and has been accused of simply continuing the traditional 'salami-slicing' approach.[55] With budgets increasingly tight, and with air planners understandably reluctant to accept radical reductions in their ability to conduct high intensity combat, how far and by what means to maintain flexibility in aerospace

capabilities will remain very difficult and contentious issues well after the immediate decisions reached in the SDSR.

The Human Dimension

My remarks about the characteristics and flexibility of air and space power have been based mostly on the technology involved, but as in all aspects of conflict and military force, it is actually the human element which dominates. The role of humans in aerospace power is now being rethought as fundamentally and emotively as it was during the bitter inter-service disputes of the 1920s and the Sandy's defence review in 1957.[56] At the tactical level, aircrew numbers will diminish still further under the SDSR, while UAVs and improving simulation technologies raise the prospect of a progressive 'virtualisation' of the flight experience to match that already in place with space satellites.[57] At the strategic level, it has become common for pundits to advocate the reintegration of the RAF with the other services as a source of efficiency savings.[58] In June, a TV show on the budget crisis found 65% support among the studio audience for merging the services and cutting £9 billion from defence spending, and in August, BBC Radio devoted an entire half-hour programme to asking 'What's the Point of the RAF?', with several commentators urging a similar organisational solution – journalist Sam Kiley, for instance, argued that, 'They work for the Army, they might as well be in it'.[59] Although the SDSR takes a more traditional approach by retaining capable manned fast jet fleets and laying little stress on UAVs, the structuring of the Defence Planning Assumptions around Army deployments 'with maritime and air support as required' indicates where priorities currently lie.[60] The early departure of Air Chief Marshal Sir Jock Stirrup as Chief of the Defence Staff, and his replacement by General Richards who said recently that 'Conflict has moved on from the era of the tank and aircraft', show that established air power arguments can no longer be taken for granted.[61]

I explored the pros and cons of increased virtualisation of the flight experience in my articles a year ago about UAVs and about the future of UK air power.[62] The biggest advantage of such a move is that it reduces the proportion of costly live flying which must be devoted to aircrew training, and so makes it possible to deploy a larger proportion of aircraft fleets on actual operations like those currently under way.[63] Going beyond simulation and relying more on remotely-piloted UAVs has the further benefit of defusing political sensitivities over the potential death or capture of aircrew, though it does make the aircraft themselves more vulnerable to accidents, air defences and cyber warfare.[64] If these problems can be overcome, the spare capacity aboard Britain's aircraft carriers may offer an important opportunity to boost the unmanned element within naval aviation. Despite Iran's recent trumpeting of its own new unmanned aircraft, UAVs are unlikely to become a classic 'underdog' weapon as happened with V-1s, V-2s, Scuds, Katyushas and the like – their dependence on a comprehensive network infrastructure makes them too vulnerable to disruption by

electronically superior opponents.[65] The real downside of the increasing prominence of UAVs is not that it risks undermining Western aerial dominance (rather the reverse), but that it reinforces a growing 'dehumanisation' of aerospace power and a distancing of Air Force personnel from the human dimension of combat.

Current Western perceptions of warfare, as embodied in images from Afghanistan and elsewhere, are very much that 'Aircraft observe and kill, while soldiers fight and die'. Apart from helicopter crew, who are lauded for sharing the same risks as the troops they transport and supply, the Western exercise of aerospace power is no longer viewed as a particularly 'heroic' endeavour.[66] The pervasive image of the soldier as hero and martyr helps to explain why the conflicts in Iraq and Afghanistan are so commonly perceived as 'ground wars' rather than as quintessentially joint campaigns. Although the greatest experts on local patterns of life are often the UAV operators who watch given regions day in and day out on their screens in Nevada, the complete physical separation of these observers from the conflict theatre makes it very hard for them to 'keep in touch' either with locals or with their Army colleagues on the ground. Even in our increasingly networked and virtual age, humans are tactile mammals for whom real human contact is important, especially in the traumatic environment of deadly conflict.

The other side of the story, is, of course, that losses suffered by troops on the ground for unclear strategic ends have historically been the main motor causing nations to rethink their interventions and withdraw, as happened to the US in Vietnam, Lebanon and Somalia, the Israelis in Lebanon and the Occupied Territories, and the USSR in Afghanistan.[67] Aerospace power may be detached and 'unfair', but by minimising the losses of its own operators and by providing the intelligence, firepower and transport (including aeromedical evacuation) needed to safeguard friendly ground forces, it plays a major role in limiting the potential for such casualty-driven demoralisation.[68] The dominant issue in Western military operations ever since the 1991 Gulf war has been where to strike the balance between air and surface power, so as to achieve the desired strategic effect while reducing exposure to friendly casualties. Suggestions that aerospace capabilities are merely a supporting adjunct to ground forces are a gross caricature, as is illustrated by air-led campaigns like those in 1991, 1995, 1999, 2001, and over Pakistan today. The blood price paid recently in Iraq and Afghanistan gives soldiers powerful political weight in the current defence debate, but it is far from clear that the eventual outcome of these traumatic conflicts will be worth the sacrifice involved, and to make them into the dominant model for future planning requires an almost Nietzschean assurance that 'What does not kill us makes us stronger'.

As in the 1920s, calling into question the very existence of a separate Air Force is likely to prove counterproductive, by increasing inter-service tensions and jeopardising the joint thinking which is now more necessary than

ever. Military service is a highly emotive profession rooted in culture and tradition, and too much focus on impersonal calculations and theoretical efficiency risks undermining the unquantifiable human strengths on which British military excellence ultimately rests. The challenge for airmen and airwomen is to move away from the flight experience itself as the defining qualification for air leaders, and to build a more enduring identity around expert employment of the distinctive strategic characteristics of air, space and cyber capabilities. Rather than inspiring subordinates to risk (and often sacrifice) their own lives as in the gruelling attritional engagements of the past, airmen must shift their focus towards other human dimensions of conflict, in particular the discriminate use of aerospace intelligence and firepower to safeguard friendly surface forces and to reduce the will and ability of opponents to resist, without creating martyrs and so triggering politically counterproductive effects.[69] Although aerospace power will remain inextricably bound up with technology, its successful exploitation requires a deep understanding of human psychology, since it is in the minds of men and women that wars are eventually won and lost.

Conclusion

The SDSR has been a traumatic process for UK air power, with several programmes and bases being cut, and with further personnel reductions on top of those already suffered over the past two decades. However, the outcome has not been all bad, and the SDSR has clearly rejected the more extreme suggestions for radical restructuring of aerospace capabilities. As we move from an entangling current conflict into a fundamentally unpredictable future, air and space power will play an increasingly integrated and indispensable role in our overall defence effort, based on the unique strengths which flight brings. In the face of unprecedented budgetary constraints, defence and aerospace planners will continue to face some nightmarish dilemmas about how best to maintain real flexibility and cost-effectiveness, and how the human dimensions of air and space power should evolve to adapt to technological possibilities and to the challenges from adaptive opponents (especially in the cyber field).[70] The dilemmas have triggered some significant inter-service disagreements over the best way forward, but now that the SDSR has been conducted, it is vital for the different services to reconcile their differences and to cooperate even more closely in delivering joint military capability. If the services do not hang together, they will most assuredly hang separately in whatever difficult and unpredictable conflicts the future may hold.

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