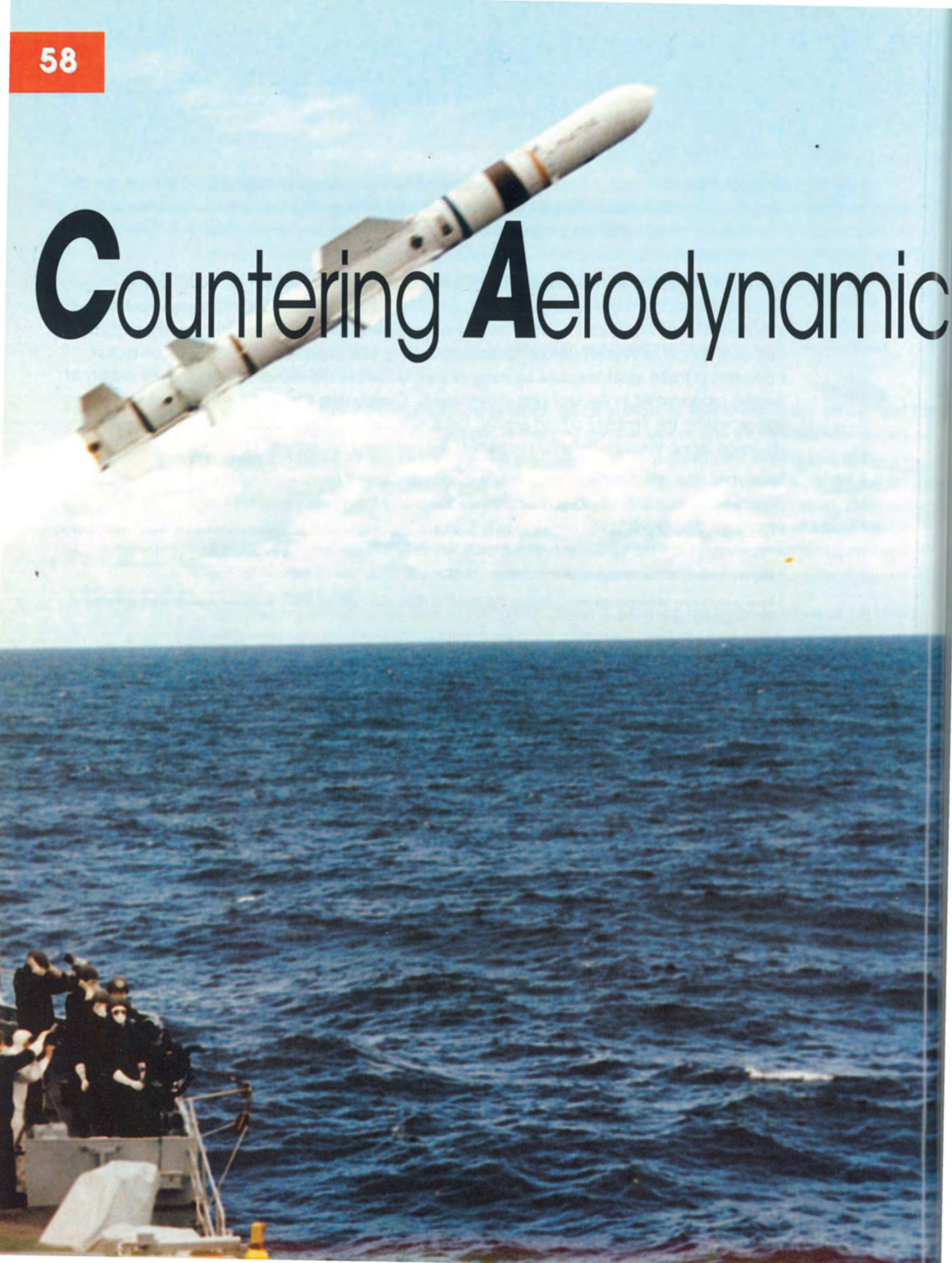
Countering Aerodynamic



and Ballistic Missiles: EXTENDED INTEGRATED AIR DEFENCE

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When coupled with current trends in the evolution and proliferation of aerospace technology, recent international political developments, notably the decision to expand NATO eastwards and the recurrent crises over Iraq's development of weapons of mass destruction (WMD) and suitable delivery systems, seem destined to make the issue of extended air-defence an increasingly salient one in NATO's military and diplomatic circles. Over the past few years, the USA in particular has invested considerable resources in the development and acquisition of armaments which might afford her and her allies some protection against attack by ballistic missiles especially. Certainly, achieving air superiority in future conflicts will demand a capacity to counter not just the customary threat of crewed aircraft but also that posed by adversaries' ballistic and aerodynamic missiles, as well as the latter's cousins, uninhabited aerial vehicles (UAVs). Indeed, integrated extended air-defence (EIAD) now forms a major element of NATO and, in some instances, national endeavours with regard to deterrence, defence and counter-proliferation.

In view of the spread of missile technology, which also overlaps with the proliferation of WMD, NATO began intensifying its countermeasures, both diplomatic and military, in 1994. Its policy on EIAD interweaves four distinct strands: deterrence, counterforce, passive defence (including arms-control) and active defence. Of these, deterrence is accorded the most significance. Although the demise of the Cold War's bipolar international order has made matters more complex in terms of whom one

Although the demise of the Cold War's bipolar international order has made matters more complex in terms of whom one might be seeking to deter and from doing what, deterrence remains the principal peacetime function of all armed forces - Vanguard class: the Royal Navy's latest SSBN

might be seeking to deter and from doing what, deterrence remains the principal peacetime function of all armed forces: their very existence endeavours to persuade any would-be opponent that a resort to violence as an instrument of policy, including defence policy, would be counterproductive; adversaries would either lose any conflict or incur disproportionate costs in winning it.

This applies to the possession of all armaments. Moreover, we should not confuse capabilities with threats, nor forget that war is - or at least ought to be - the 'continuation of political intercourse, with the addition of other means.' Most, if not all, of the states which are developing or otherwise acquiring missile technology are doing so with very circumscribed ambitions in mind, some of which have little to do with operational military considerations. Furthermore, where any use of military force does occur, be it by governments or non-state actors such as terrorists, its ultimate goal can only be either coercion or denial. In the former, there is an implicit bargain between the party meting out the violence and its victim. In the latter, brute force is employed to deprive somebody of something, or to prevent a particular pattern of behaviour, or both. Coercion and denial are both political goals and, subtle though the distinction between them might appear, it is of crucial importance: if the objectives behind the employment of violence are identified, we have criteria by which we can gauge its success or failure.

Since strategy is the art of distributing and applying military means to fulfil the ends of policy, it can prove very difficult to incorporate the active use of WMD especially into this process. Yet the political influence that accrues from the possession of any type of armaments - including WMD - is ultimately based on the potential military utility of that weaponry. Deterring aggression is palpably preferable to having to defeat it, but conventional deterrence, at least, is inherently contestable. Furthermore, the elements of EIAD are not only mutually reinforcing but also competitive to a degree. Arms-control or effective counterforce capabilities, for instance, could diminish if not obviate the need for active defence preparations. Conversely, strong counterforce or active defence capabilities could reduce the passive defence burden. Unfortunately, furnishing an appropriate level of passive and active defence for anything but deployed forces would be prohibitively costly. Nor could pure defence offer total protection; providing passive defences for entire populations is largely impracticable and would offer only scant protection against WMD. Active defences, by contrast, could be circumvented by unconventional delivery means, including terrorist attacks involving WMD, and, in any case, could not be made wholly impermeable to orthodox threats. A major difficulty is discerning and achieving the appropriate blend of EIAD ingredients in a dynamic, scenario-dependant environment, for this is the key to force design and strategic planning. Capabilities take years to develop or redevelop once lost, yet political intentions can alter overnight. Moreover, force-balance issues affect each pillar of the defensive triad, complicating research and procurement decisions as well as operational matters.

Currently, NATO's greatest strength lies in its deterrence and counterforce capabilities, while its passive-defence safety net is steadily improving. However, active defence is a relative weak spot and is likely to remain so for some years to come. The updated Military Operational Requirement endorsed by SHAPE in 1997 envisages sufficient capacity to deal with, above all, land-based missile threats emanating from within 3,500 kilometres of NATO's frontiers. Nevertheless, EIAD is a complex, costly and controversial issue which is viewed somewhat differently from the two sides of the Atlantic, not to mention other points on the globe. Whilst, for the time being, the emphasis is on developing 'theatre' and point defences to help safeguard key allies and deployed forces, a national umbrella to protect the USA itself is a long-term aspiration of some American policy-makers that is likely to directly affect relations with other major powers, notably Russia and China, and could indirectly affect those with states such as Britain and France, which have missile-based strategic deterrents.

Some Historical Cases of Missile Defence

The concept of missile defence is, of course, not new. As long ago as the Second World War, Britain became the first country to undergo bombardment by such weapons and had to improvise the best shield that the technology of the day permitted. An integrated defence comprising aircraft, radar, anti-aircraft guns, barrage balloons and air-raid shelters was eventually cobbled together. Although, given their primitive design, which inevitably made them indiscriminate, and the Nazis' failure to subordinate their employment to a viable political and military strategy, the V-Is and V-IIs were never likely to prove much more than a localised nuisance, they did cause appreciable disquiet among the communities they overshadowed. At a time when the Allies were in the ascendancy, these 'Vergeltungswaffen' gave the Germans the capability to mount random, insidious attacks on a round-the-clock basis. Roughly one third of all the V-Is launched penetrated the United Kingdom's defences, while the supersonic V-II could strike with utter impunity.

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- Iraqi Scud B on mobile launcher

Similarly, the Iraqi bombardment of Israeli and Arab cities in the course of the Gulf War highlighted not only the susceptibility of even quite sophisticated populations to demoralisation in the face of attacks by ballistic missiles but also the substantial political damage that the most militarily insignificant of blows could inflict. Whereas his manned aircraft were wholly unable to challenge the Allies' mastery of the skies, Saddam slew 28 American soldiers and injured 97 others with a solitary Scud. This alone constituted a propaganda coup if only in so far that it was the first time an American soldier had perished in an air raid since 1953. Inconsequential though the Scud attacks were, militarily speaking, they formed part of a political strategy with which the Allies frequently struggled to cope.

Indeed, the scale of the 'Great Scud Hunt' is adequate testimony to the political danger that these crude rockets represented. Among the many resources committed to the operation were Patriot Advanced Capability Version 2 (PAC-2) missiles. Their effectiveness in this, the first attempt under campaign conditions to shoot down one missile with another, has been hotly disputed. By contrast, Allied planes and special forces appear to have constrained the Iraqis' scope for using their Scud missiles as efficaciously as they might have. The incessant search for their transporter-erector-launchers (TELs) disrupted their operations somewhat, though few, if any, TELs were actually destroyed. Whatever the shortcomings of the Patriot and however modest its interception rate might have been, the Allies' various countermeasures against the Scud enjoyed a degree of success. Nevertheless, if the USA's aerial superiority was to be preserved, some dependable way of dealing with ballistic and aerodynamic missiles would have to be found.

Aerodynamic and Ballistic Missiles

Despite the restraining hand of the Missile Technology Control Regime (MTCR), ballistic missile technology continues to proliferate and undergo refinement. Yet ideal though they might be for the delivery of nuclear weapons, ballistic missiles are in fact inferior to aerodynamic models so far as the mounting of precision attacks is concerned. Indeed, it is extremely probable that, in future, the weapons of influence preferred by most less-developed states will be the cruise missile and its relative, the UAV.

There are several reasons for this. To begin with, developing or buying cruise missiles is a relatively straightforward matter. Nor is it as costly. As the Germans first discovered with the V-I, the development of a ballistic missile proceeds sequentially and calls for a substantial investment of time and resources, including a highly skilled workforce, advanced supporting industries and extensive testing facilities. It is pre-requisites such as these which have also placed the possession of sizeable numbers of sophisticated combat planes beyond the reach of all but the most affluent and developed states. Whereas in the past ballistic models were the best if not the only alternative to crewed aircraft, today the cruise missile and UAVs provide a far better, more flexible one.

Ballistic missiles are in fact inferior to aerodynamic models so far as the mounting of precision attacks is concerned - Cruise missile launch

Indeed, they offer several operational advantages. Cruise missiles function in accordance with the same principles as crewed aircraft. They remain aloft through aerodynamic lift and, steered by on-board computer or remote control, are powered and guided throughout their flight. Whilst this does enable them to mimic inhabited aircraft, it also liberates them from the constraints that the presence of aircrew inevitably entails. Unlike people, cruise missiles and UAVs do not get tired or frightened. Nor do they 'grey out', allowing pilotless platforms to achieve a level of agility that inhabited ones cannot.

The propulsion units of ballistic rockets, by contrast, function only during the initial boost-phase, carrying the missile to the apogee of a parabolic flight-plan. Thereafter, under the interactive influence of gravity, inertia, bodylift and atmospheric drag, it coasts back to Earth. Most older ballistic missiles are rather inaccurate, with a circular error probable measured in hundreds of metres. Advanced aerodynamic missiles, by contrast, are accurate to within a few metres, making them much more suitable for 'surgical' strikes with conventional warheads. Similarly, their precision, variable flight-paths and comparatively low velocity makes them far superior platforms for the dispersal of biological or chemical agents. Furthermore, as they are prone to be bulky and need to be stabilised before launch, ballistic rockets are not as versatile as relatively compact cruise missiles. The latter require less logistical support, can be transported in protective canisters and can be unleashed from a variety of surface and airborne platforms.

The US Army's Theatre High Altitude Area Defence (THAAD) rocket is an example of a ballistic missile defence (BMD) system which uses the 'kinetic-kill' approach. Inset shows test launch of THAAD from White Sands in 1995.

These characteristics make cruise missiles that much more elusive so far as counterforce operations are concerned, but the real strengths of the modern aerodynamic missile are the ease with which it can be replicated and its 'smartness'. The latter depends upon software which can be duplicated endlessly and relatively cheaply. Particularly in the larger, modular-design versions, refinements can be incorporated with little difficulty, be they to the payload, reach or 'intelligence' of the missile. The components necessary to do this are mostly quite readily to hand on international markets.

All of this suggests that the capabilities of aerodynamic missiles could leapfrog. Indeed, a new generation could suddenly arise which, deployed in large numbers and combining range, accuracy, 'intelligence' and 'stealthiness', would be extremely formidable weapons which inferior powers might see
as relatively inexpensive and reasonably flexible instruments with which they might offset the West's present dominance of the skies. Given the increasing proliferation of such weaponry, it seems probable that in no aspect of aerospace power will millennial technology have a greater part to play than in missile attack and defence.

The Mechanics of Missile Defence

Cruise and ballistic missiles present a defender with contrasting difficulties. In the latter's case, their sheer speed is the fundamental problem. A 3,500-kilometre range missile can attain speeds of 5 kms/sec (11,000 miles-per-hour). Clearly, the interception of such rapidly-moving and relatively small targets demands the utmost accuracy in time and space. Moreover, as the missile's flight lasts only a few moments and early interception is desirable so as to minimise the scope for collateral damage, exceptionally swift intelligence-gathering, processing and dissemination capabilities are called for, as well as interceptors which can be launched immediately, can home in on their quarry within moments, and have sufficient range, power and accuracy to reach and destroy their targets. In any event, if an opportunity for more than one shot at an incoming missile is to be practicable, then a tiered defence is essential, with shorter-range endo-atmospheric interceptors seeking to mop up any missiles that permeate the upper, exo-atmospheric layer. A defence of some extent is also desirable so that space can be traded for time.

The period available for active defence measures to be implemented is, however, predicated upon the reach of the interceptor and the quality of the supporting surveillance system in so far that this effectively determines the maximum range at which an approaching missile can first be engaged. Only once the defence's control cell is alerted to an incipient attack can other sensors can be 'cued', the missile tracked, an interception vector plotted and weapon systems activated. The difficulty with all this is that no single type of sensor is universally dependable; a variety of surveillance systems has to be integrated into a network. Whereas space-based missile-defence sensors might contravene the spirit if not the letter of the ABM Treaty, geosynchronous or low earth-orbiting satellites with infra-red (IR) seekers cannot offer the same degree of early warning. Not only can the effectiveness of IR sensors be degraded by dense cloud, but also, once a missile has left its boost-phase, it is difficult to discern against the Earth's background emissions. This necessitates some radar complement for the IR system. However, radar emissions attenuate with range, and over-the-horizon transmissions can be disrupted by atmospheric instability. Radars' radiant energy also makes them very susceptible to direct attack. Geosynchronous satellites, by contrast, might be less vulnerable but suffer from other drawbacks, notably their operating altitude.

Nor are most early-warning radars ideal instruments so far as the co-ordination of interceptions are concerned; terminal guidance has to be provided by the interceptor's organic sensors. S- and X-band HF radars, if 'cued', can fulfil fire-control functions over ranges of 500-1,000 kilometres. However, radars can only discriminate between missiles, decoys and debris because of the contrasting atmospheric-drag effects these objects experience during the final 100 kilometres of their descent. Most states at all capable of using ballistic missiles for military purposes would probably have little difficulty in devising safeguards against this. The defender, obliged to engage every target that presented itself, would then be susceptible to rapid exhaustion. In any case, a discriminative technique based on atmospheric effects will leave the defender with little time to effect an interception, rendering him vulnerable to being overwhelmed.

The minimum altitude and guidance requirements of anti-missile missiles compound this danger. Although the latest active-array multi-function radars should help defensive weapon systems to cope with saturation attacks by missiles (which can have a very small RCS), the altitude at which any interception occurs remains an important factor in determining the degree of damage-limitation which the defender can achieve. When countering missiles with nuclear or radiological warheads, for instance, even a successful interception could well lead to irradiated material falling on the defending state's territory or on that of its neighbours. FAE and cluster-munition payloads need to be dealt with at high altitudes to avoid a residual threat being created, while the neutralisation of chemical and biological warheads demands the creation of circumstances too adverse for the agent to survive under. Thus, simply scoring a hit on an incoming missile will not always prove sufficient. In any event, unless wreckage from the target is burnt up, such debris might still be capable of inflicting considerable damage through its kinetic energy.

This makes the type of explosive warhead to be fitted to an interceptor a vital consideration. If, however, a a relatively small and rapid interceptor can be made to strike a ballistic missile, the amount of energy thereby released is enormous. The US Army's Theatre High Altitude Area Defence (THAAD) rocket is an example of a ballistic missile defence (BMD) system which use this 'kinetic-kill' approach. However, the encounter has to be co-ordinated with tremendous exactitude. This is dependent upon the interceptor's organic sensors and nimbleness.

A shrewd adversary can, moreover, compound the defender's problems with comparative ease. For instance, simply enhancing an attacking missile's agility would pose considerable difficulties for an opponent. After re-entry, aerodynamic manoeuvres can be effected through the use of fins and thrusters. In any case, the impact of atmospheric drag on missiles tends to vary, giving rise to contrasting rates of deceleration. 'Corkscrewing' can also occur or be deliberately induced, whereby a re-entry vehicle is sent spiralling around its trajectory; executing turns of 10-15 g, the warhead becomes a much harder target to engage. Boosted descent is also possible, while atmospheric buffeting can cause missiles to break up or tumble. This was the fate that befell several Iraqi Scuds during the Gulf War and can give rise to not only unpredictable accelerations but also to multiple sensor 'echoes'.

An attacker might also avail himself of other countermeasures. For instance, ballistic and aerodynamic missiles could be used in tandem. The latter can prove as elusive as the former are fast. Capable of nap-of-the-earth flight, a cruise missile poses obvious problems for terrestrial, line-of-sight radars. Indeed, sensors mounted on aerostats or low-orbit satellites might be the most dependable way of detecting such targets, while either fighter aircraft or air-directed surface-to-air missiles (ADSAM) would be required for their destruction. An attacker might also endeavour to mount saturation attacks, perhaps through the use of submunitions or multiple warheads delivered by ballistic missiles. Decoys could assist in this process, as could discardable, insulated shrouds

or special paints which alter a body's thermal characteristics. Alternatively, hot separation debris might be exploited as IR screens, or missiles could be made more 'stealthy'. Nor should it be forgotten that whilst, for the defender, the interfacing of contrasting types of sensor - such as IR and radar - is as alluring as it can be technically difficult, an opponent might only need to mislead one element to effectively delude the system as a whole. Actively interfering with the defence's battle-management and command, control, computing and intelligence network would also have much to recommend it, and could be achieved either through 'software warfare' or other means.

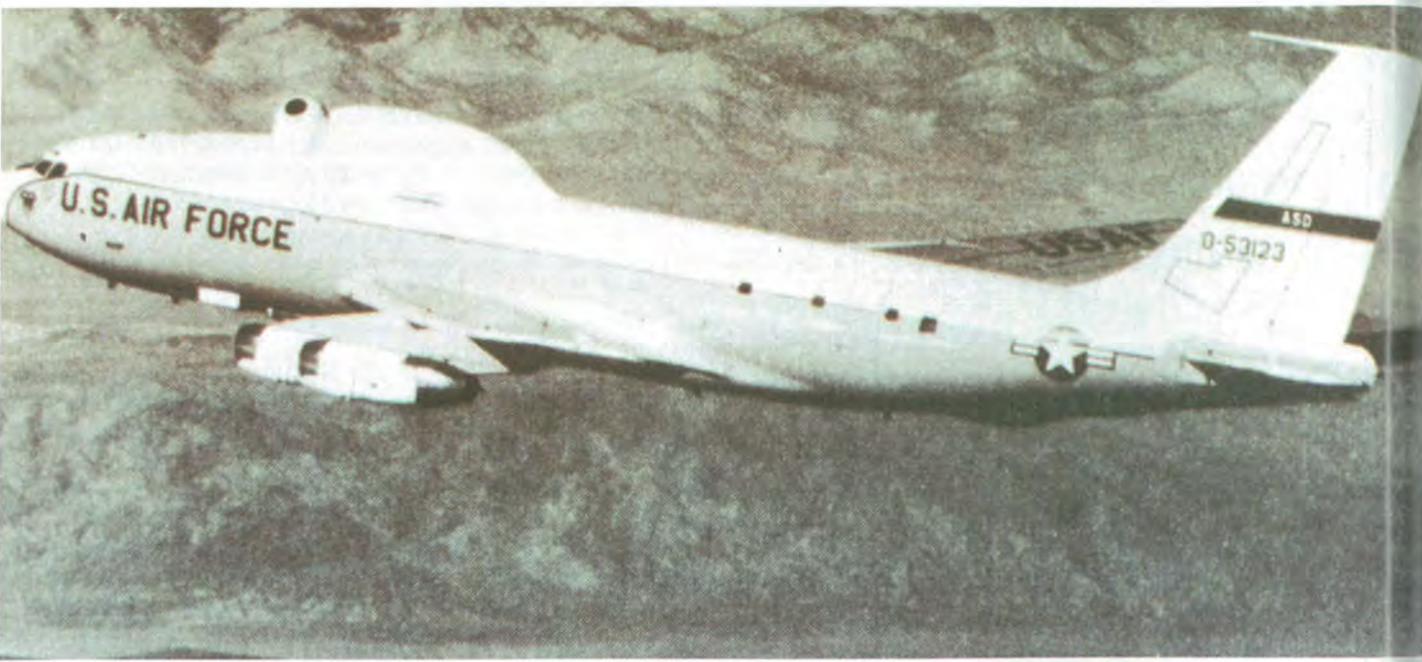
Deciding exactly when, in the light of emerging but often very nebulous threats, to end a given weapon system's development and deploy it is one of the riddles confronting policy-makers. A second is choosing from the range of possible solutions to the problem of missile defence. American technology predominates the BMD arena and the US Ballistic Missile Defense Organisation is involved in several research and development programmes. Whilst the USA in particular is reluctant to be seen to be daunted by the technological hurdles encountered in the sphere of BMD especially, these difficulties should not be underestimated. Getting each component of this intricate and exotic technology to function sufficiently well is difficult enough; successfully combining it all into a network is still harder.

The USA recently threatened to take unilateral action to retard Iraq's WMD programme, the UNO's views notwithstanding - *USN F-14 Tomcats operating in the Gulf*

Legal, Political and Economic Complexities

Given the difficulties involved in intercepting a missile once it is in flight, it is tempting to stop this occurring by means of a pre-emptive attack. Following its experience in the 'Great Scud Hunt', the USA especially is investing heavily in 'real-time' surveillance systems geared to the location of mobile targets. That counterforce operations will encounter attempts to thwart them is only to be anticipated, however. This could be achieved by various deception techniques, by enhancing the defences, concealment or mobility of possible targets, by dispersing them or by granting them greater operational independence. Not only do pre-emptive blows call for an intelligence-gathering and dissemination mechanism which is almost infallible, they also constitute a questionable policy, from both a legal and moral standpoint, which, moreover, can all too easily prove counterproductive. What, exactly, is to be pre-empted and what is expected to ensue? Likewise, preventive attacks intended to halt the perceived acquisition of a capability have also been contemplated by the great powers on several occasions. Indeed, the USA recently threatened to take unilateral action to retard Iraq's WMD programme, the UNO's views notwithstanding.

Although the provisions of international law and state practice suggest that neutral polities have an obligation to prevent their airspace being violated by belligerents' aircraft, including aerodynamic missiles, the position with regard to ballistic models is less clear. As long ago as 1957 the USSR's Sputnik I highlighted the fact that there is no clear-cut neutral boundary which separates outer space from the Earth's atmosphere. The Outer Space Treaty of 1967 did not tackle this issue, leaving several legal matters relating to the launch, operation and re-entry of aerospace vehicles, satellites and ballistic missiles unresolved - notably what rights and obligations states have concerning the passage of such objects through their airspace. On the other hand, such are the legal and political constraints on the mounting of preventive or pre-emptive attacks under the rubric of self-defence that NATO counterforce operations will probably only occur in reaction to an act of aggression.



One weapon system which, in theory at least, could pose a threat to both theatre and strategic ballistic missiles is the airborne laser (ABL), which is intended to destroy targets while they are still in their boost-phase.

That said, EIAD does entail grave political and command problems since, in the event of a crisis, there will be little, if any, time either to delegate responsibility or to seek political endorsement for military action. The empowerment of military personnel through enhanced aerospace technology raises significant questions regarding rules-of-engagement. Certainly, congested as it is with civil air-traffic, the West's airspace is not the easiest of environments in which to initiate an aerial defence, particularly if any attack involved both aerodynamic and ballistic missiles. Indeed, distinguishing the former from friendly aircraft could prove very difficult. Nor is the interception of missiles, which might be carrying WMD, over its sovereign territory or that of neighbouring states a matter which any Western government would contemplate with equanimity.

New technologies and refinements to established types also have implications for the ageing ABM Treaty. The circumstances which prevailed at the time that this pact was formulated ineluctably led to some nebulous phrasing and a failure to prohibit active BMD measures altogether. It did not stipulate which armaments were proscribed, merely referring sweepingly to those systems employed 'to counter strategic ballistic missiles or their elements' in-flight trajectory.' Nor was the threshold between permitted 'theatre' systems and equipment which might be used for strategic defence elucidated. This distinction is too vague for today's geopolitical and technological environment. Indeed, whilst it is not apparent that the USA will find sufficient resources to bring all the BMD systems it currently envisages to maturity, there is a danger that the need to maximise the military advantage derived from the investment of billions of dollars in exo-atmospheric interceptors will eventually compel a US government to deploy weapons or sensors, or both, which violate the ABM Treaty.

One weapon system which, in theory at least, could pose a threat to both theatre and strategic ballistic missiles is the airborne laser (ABL), which is intended to destroy targets while they are still in their boost-phase. Nevertheless, even in the case of, say, a 1,000-kilometre-range model, this window of opportunity exists for just 55 seconds. Existing and planned surface-to-air interceptors might lack either the reach or the velocity to catch a ballistic missile during the boost-phase. Similarly, customary airborne platforms, though more flexible, might have difficulty in engaging such targets sufficiently quickly, even if they are equipped with sensors which can 'see' far enough and with advanced conventional armaments. Indeed, recognising the limitations of traditional air-to-air weaponry, NATO is developing the concept of Airborne Terminal Intercept. This would offer a limited point defence using fighters directed by the existing Air Command and Control System.

By contrast, directed-energy weapons have the potential to strike targets almost instantaneously and across 360°. Adverse weather and atmospheric conditions make the projection of a laser beam over long distances extremely difficult. However, 'adaptive optics' promise to overcome this problem, allowing a chemical oxygen-iodine laser, mounted on a Boeing 747, to engage targets from over 300 kilometres and at altitudes above 40,000 feet. Although the USAF's ABL is very much in its infancy, the implications that such capabilities could have for the ABM Treaty, not to mention SALT, are considerable. Certainly, one wonders what the rules-of-engagement for such a weapon system might be, and how putative foes might respond to its deployment. In any event, obliged to be continuously on station and well to the fore, perhaps within an adversary's airspace, the ABL could prove a vulnerable target.

Sea-based interceptors could cruise almost anywhere for prolonged periods if necessary, often provoking far less suspicion than the deployment of land or air forces entails. But whilst maritime forces could make an important contribution to missile defence, they would not be sufficient by themselves; they would have to be integrated into a wider EIAD. Indeed, it is difficult to see how any approach other than jointery could be adopted to combining a variety of celestial and terrestrial units and sensors. Nor should we forget that sea power's flexibility and poise could be exploited by adversaries, too; they could use, say, land-attack cruise missiles to strike at not only European but also American targets from relatively short ranges.

This is an unpalatable possibility that the USA has been slow to recognise. To date, her geostrategic position has usually enabled her to differentiate between 'strategic' and 'theatre' weaponry more neatly than her allies and foes on the Eurasian land mass. Today, Cyprus - where Britain has sovereign bases - and the whole of NATO's southern flank lie within range of 'theatre' missiles based in Africa and the Middle East. Early interception is essential for European security. This, in turn, demands a layered, international defence. Although NATO's worst-case scenario is that, by 2010, most of its territory will be vulnerable to attack by ballistic missiles, many of which might be armed with WMD, the Americans are likely to expect their exposed European partners to shoulder much of the responsibility for dealing with any threat themselves.

However, ineluctably there are interlocking legal, political, economic and military dilemmas in European thinking about EIAD. The expansion of NATO can only compound existing interoperability problems. How will aircraft, ships, surface-to-air interceptors, and space-based as well as terrestrial surveillance systems drawn from a variety of countries be integrated into a single command? Who will formulate its doctrine, and how will the system as a whole be exercised and tested? Equally, which political institution should take responsibility for EIAD? NATO is the obvious candidate, but not even all the occidental European states are members of the alliance. Nor do they all participate fully in the Western European Union or the European Union. How then can the various strands of EIAD be drawn together and legitimised, particularly as this has to be founded on an international basis, if only because, unlike the USA, no single European country could afford the financial costs involved in the construction of a comprehensive defence?

Moreover, procurement decisions are complicated by force-balance issues within each element of the defensive triad. So far as active defence is concerned, there is a need to counterpoise air defence, theatre BMD and cruise missile defence. The systems needed to deal with, say, aerodynamic missiles have contrasting performance characteristics from those required to parry ballistic models. In fact, formidable though the technical challenges confronting THAAD and the ABL are, such considerations pale into insignificance when compared with the wider force-equilibrium. Given sufficient time, money and endeavour, such technological problems might well be resolved. On the other hand, premature or excessive investment in, say, BMD could deprive programmes for countering aerodynamic threats of essential resources, leaving NATO vulnerable to an efficacious attack. Alas, regardless of how much time, resources and effort NATO commits to the force-balance conundrum, it can at best expect to acquire a hazy view of the optimum solution, assuming such a thing exists. The outcome is likely to be founded more on empirical than objective factors.

The ramifications of all of this transcend the operational sphere, percolating into commerce, industry and high politics. Such are the uncertainties surrounding the force-balance issue, let alone the potential threats or risks against which EIAD should be directed, that European governments have every excuse for delaying investment in any or all of the technical options to hand. Commercial rivalry is also a significant factor which might not only sway politicians but also slow down any acquisition process by offering so many possible solutions to the problem that planners might be reluctant or unable to choose between them. Consequently, despite the considerable investment of thought and resources in active defence that is now occurring, tangible results are likely to be slow in coming, at least as far as Europe is concerned. In any case, active defence is not a panacea. Whilst the Americans typically emphasise the technological dimension of EIAD, for the Europeans matters are more complex; if their air space in this regard is indivisible, then so too are the moral, political, legal, operational, commercial and technical elements of the problem. With the Europeans prevaricating and with the US Congress no longer debating whether to build a national defensive system but rather when to begin it and what it should consist of, there is a strong likelihood that EIAD will soon become a divisive issue in Western political and military circles.