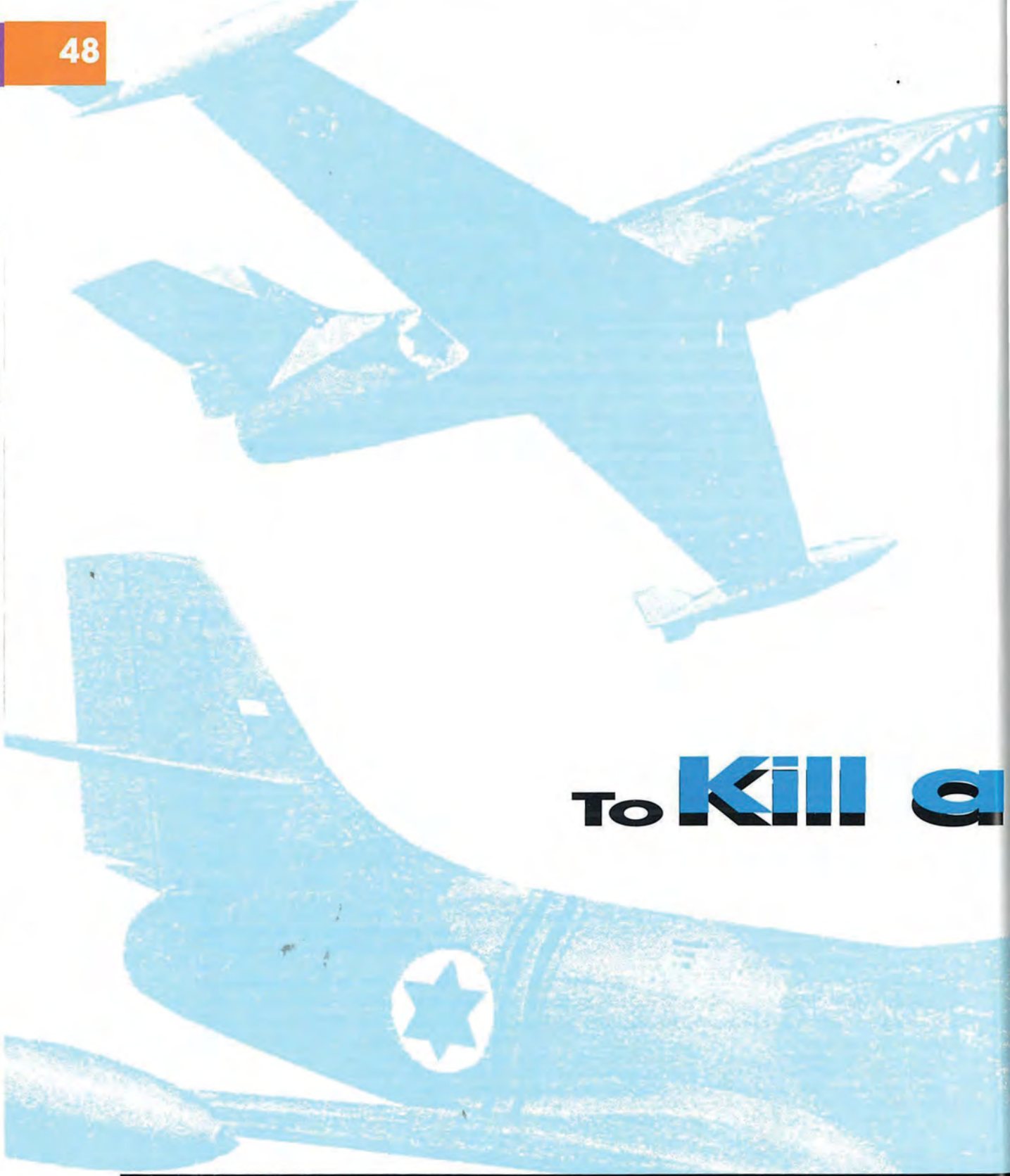

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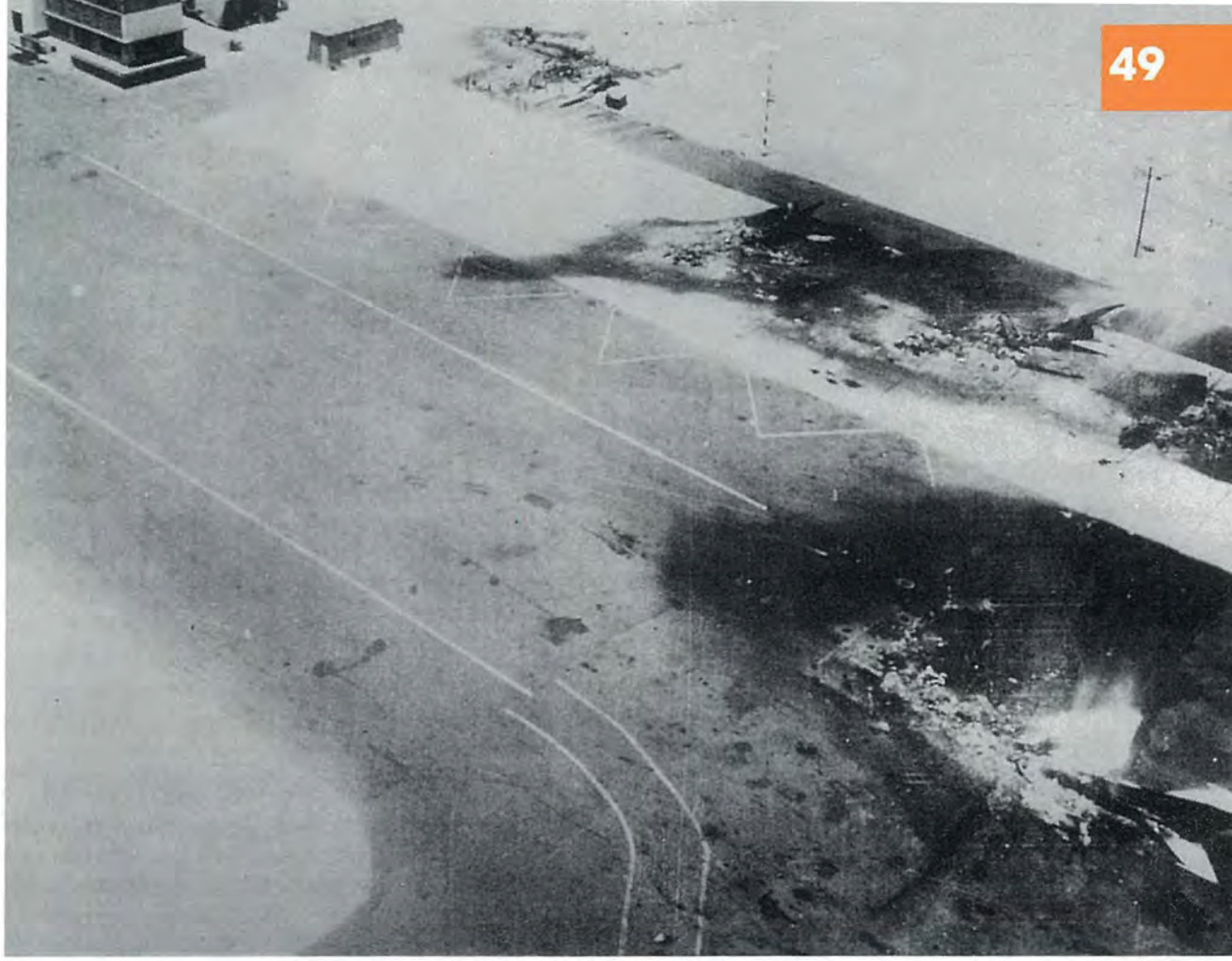

Stalking Bird:

Fodder for your Professional Reading on Air and Space Superiority.

Part Two

Air Superiority After Vietnam: For a number of years after 1972, the American air forces did not do much air fighting. There were several cases where foreign air forces got involved in combat, but they all were so limited that what emerged was largely a set of speculations rather than any "lessons."

Before the final American humiliation in Vietnam, the Israeli Air Force executed a campaign that added to its already-great mystique. In the opening hours of the 1967 war it destroyed the Egyptian Air Force in an OCA operation that would have made Douhet proud. The war began with a preemptive strike on Egyptian airfields and radar sites. More or less complete surprise was achieved, and restrikes were conducted with impressive dispatch and minimal ground times. At the end of the campaign, the Israelis claimed to have destroyed over

400 Arab aircraft, close to 90 percent on the ground. Though the missile war was in full swing in Vietnam at the time, it seems that all the air-to-air kills on both sides came from guns – there were Atoll air-to-air missiles fired, and one did some damage but apparently no aircraft was brought down by a missile. The Israelis dominated the air battle, but by far the greatest damage was done by the attacks on the enemies in their nests.[64]

The dramatic IAF victory had multiple effects. First, it set off a aircraft shelter building program not only all over the Middle East, but also among the NATO and Warsaw Pact Air Forces. Second, it accelerated the Arab move into ground-based missile defenses, not only around their air bases but ultimately to the building of a formidable missile belt along the Suez Canal. Third, it imposed such a humiliation on the Arabs, and they lost so much important territory, that it probably made another war inevitable. Finally, the additional buffer space gained by the Israelis and the ease of their 1967 victory may have lulled them into a false sense of security.

Notwithstanding the splendor of its victory, the 6-Day War may not have been the Israeli Air Force's finest hour. According to Michael Howard, doctrine is always wrong and he whose doctrine is the least wrong and whose system is the more flexible will win. This is so because he will be able to compensate for the wrongness more rapidly than can his enemy.[65]

There were plenty of signals of an impending attack, but the Israelis did not believe them

The War of Attrition from 1967-1970 taught the Israelis that a preemptive, Douhet-like strike would not likely work again. In any event, it would be too costly in terms of world opinion, and especially so in the United States. By 1973, there were missile batteries around the most important Arab bases and along the Canal, and the Israeli Air Force had largely been reequipped with American aircraft, principally the A-4 Skyhawk and the F-4 Phantom. There were plenty of signals of an impending attack, but the Israelis did not believe them. Possibly that was because they did not understand that the Arabs no longer had the destruction of the Israeli state in mind, but rather were going for more limited objectives. Possibly also, it was because of complacency, and certainly because of a false assumption that there would be 48 hours advanced warning.[66]

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This time, there would be a more complex and closer-run contest for the command of the skies. The ground-based element was to play a much larger part than theretofore. The firm doctrine that air superiority has to come first was compromised for the sake of ground support, especially on the Golan Heights where it seemed for a while that the Syrians were about to break through to the sea. It was a classical case of a ground emergency serious enough to divert airpower away from its primary task, the winning of air superiority as envisioned above in the passages on the new AFDD-1. Too, it was a wonderful demonstration of the flexibility of airpower in that the IAF was switched from the Sinai Desert in the south to the Golan Heights in the north with blazing speed. And it seems that it saved the day in so doing. The cost, though, was enormous. The Israelis had reequipped their forces with aircraft, but had not gone as far as they might have in the acquisition of

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precision-guided munitions (PGMs) and electronic countermeasures (ECM) pods. However, in this war there were significant numbers of kills by both AAMs and SAMs. Further, the shoulder-fired anti-tank missiles had a field day in the biggest tank battles since Kursk in 1943.[67] Howard suggests, then, the true measure of an air force is not when things go perfectly according to plan, but rather when the plan becomes a shambles and the force nonetheless has the presence of mind and flexibility to snatch victory from the jaws of defeat. If that is valid, then perhaps Yom Kippur is a better indicator of greatness than 1967 was.

The next air combats came in the Falklands War and the Israeli operations in the Bekaa Valley, both in 1982. In the former, most of the air-to-air kills were by missile, and the shipboard defenses seemed inadequate notwithstanding some SAM kills – the British suffered painful ship losses, and might have suffered many more if the safe and arm devices of the Argentinean bombs had worked properly (actually, it was improper launching tactics that prevented the devices from functioning as designed.) In the latter case, the IAF proved that it had learned its lessons well. It, in company with the Israeli ground forces, managed to shut down the Syrian SAM system with impressive speed, extensive use of Remotely Piloted Air Vehicles (RPVs), and an air battle that went heavily in the Israeli favor. Both experiences suggested that the command of air and space would continue to be determined by some combination of surface attack and air fighting plus fire from ground

guns and missiles. In the Falklands, the greater part of the British air-to-air kills were done with the AIM-9L Sidewinder, and the very high success ratio suggested that the reliability problems with that missile had been overcome. Practically all of the kills of the IAF at the Bekaa Valley were by missiles.[68]

The Navy and Colonel Michel were certainly right in saying that a part of the ROLLING THUNDER difficulty over North Vietnam arose from training, not technology alone. After all, there is no evidence that the communist weapons were any better than the American. The Navy moved quickly to establish a rigorous specialized air-to-air training program (Top Gun) for its F-4 pilots and that seemed to have immediate effects.

As noted, Michel argues that the USAF leadership did not want to admit a weakness and blamed it instead on technology. Perhaps that was true, but it is also true that there was but four years between the bombing halt and LINEBACKER, and that is not all that much time to get a major training operation started. Soon after, though, the RED FLAG exercise was set up on the ranges at Nellis AFB, complete with electronic tracking and recording methods and elaborate video debriefing systems. The range was equipped with accurate simulations of practically all of the ground threats the West was liable to face, and American and allied units were cycled through the program at frequent intervals.[69]

The USAF Fighter Weapons School was collocated with RED FLAG, and played an important role in the reforms. It brought in select instructor pilots from the field units and subjected them to an intense training program unusually rigorous. If those students graduated, they went back to their units with a special status and expertise to pass on the latest thinking about air combat to their colleagues.[70]

Additionally, again following a Navy lead, elaborate Air Combat Maneuvering Instrumentation (ACMI) systems were installed at various locations around the U.S. and at some places overseas. Though not as elaborate as the installations at Nellis, they nevertheless were able to accurately track and record fairly complex mock air battles over their local ranges. Then the recorded material was used in a new and rigorous debriefing program that vastly improved the realism and effectiveness of continuing training.

For some time after the fall of Saigon, the USAF maintained both a Soviet Awareness Group and an aggressor squadron. Both were charged with becoming expert in Soviet culture, technology and doctrine and to travel about the U.S. to pass on their expertise to the users. The aggressor squadron was equipped first with T-38s and later with F-5s so as to permit dissimilar air-to-air training. Practice air combat maneuvering between F-4s had limited effects in preparing US crews to face MiGs, and the F-5s were a fairly close approximation of the MiG-21. According to Michel, the results were at first much in the favor of the F-5 aggressors, but fairly soon the line crews were able to reduce the gap.[71] Added to this was a new, more aggressive policy toward home-unit training that many fighter pilots feel was the most significant factor.[72]

Finally, there were some highly important reforms in areas other than the air-to-air battle that impacted it in a significant way. One of them was to develop the stealth bomber, the F-117. That was important because it was so hard to detect on radar that if it flew at night the support package

needed for other attackers to protect them from the stalkers was unnecessary. Another item was that the increasing availability of PGMs and their substantial advantage in accuracy over unguided bombs meant that a strike package containing few "shooters" would administer a higher level of damage to the target that would have been the case in Vietnam. That meant that the U.S. could afford to include many more support aircraft to protect the "shooters" from the enemy airborne and ground-based stalkers. It also meant that the easing of the requirements for air-to-ground training released more time for air-to-air practice.

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By the 1990s, though we had not yet deployed lethal instruments in space, the non-lethal ones were making a substantial contribution to air and space superiority. Certainly the space-based weather reconnaissance contributed in many ways even in the days of the Vietnam War. By 1990, it yielded a substantial advantage in planning attacks and providing for force protection. Space assets also were a large help in reconnaissance and the air-"reccy" units had all but disappeared from the forces. Also, in conjunction with the new Airborne Warning and Control System (AWACS) in the jet aircraft that replaced the "College Eye" in the C-121 "Connies" of which Marshall Michel complained, space assets were making warning and battle damage assessments (BDA) much more effective than they had been. Although it was to prove impossible for the air campaign to completely shut down Saddam Hussein's communications, their degradation combined with the enormous benefit of the new U.S. space based communications links yielded another huge advantage.

Finally, the Goldwater-Nichols Act of 1986 had greatly strengthened the role of the Chairman of the Joint Chiefs of Staff and the area Commanders-in-Chief (CINCs) and that was arguably a substantial step in the direction of the traditional Air Force organizational and doctrinal preference.[73] The legislation and the policies growing therefrom made it not only feasible, but also advisable for the CINCs to appoint a Joint Force Air Component Commander (JFACC).[74] This seemed to promise that the ideal of centralized control of airpower at the theater level by a coequal air commander would finally be realized.

The Gulf War: Some have suggested that any old strategy would have brought the Iraqis down in 1991. The implication might be, then, that the battle for the command of air and space against a paper tiger means little for the future. It is true that it was a lopsided victory. The OCA part of the campaign in its air-to-ground dimension worked like a charm. The F-117 did always get through.[75] The degradation of the Iraqi detection and command and control systems was quickly accomplished, and it certainly added to the ease with which the air-to-air part of the campaign was completed. The F-15s cleared the skies of the few enemy aircraft that ventured forth, and the Coalition suffered no more than one suspected air-to-air kill itself. The combination of stealth and lethal and non-lethal SEAD largely suppressed the SAM threat and in turn permitted coalition aircraft to do their missions at medium and high altitudes above the AAA and shoulder-fired SAM threats. The spread of PGM technology enabled them to actually hit targets from those altitudes. They also made feasible what John Warden called "parallel attack" (as opposed to sequential.)[76] That empowered the Coalition to overwhelm the defenses as a synergy arose from the destruction of so many OCA targets nearly simultaneously.

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The stout aircraft shelters built by Iraq and many other nations in reaction to the "lessons" of the 1967 Arab-Israeli War proved useless – except perhaps as magnets attracting PGMs to empty shelters. The combination of precision and penetrating bomb bodies made it so.[77]

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Added to those great advantages was the fact that the Coalition enjoyed a huge information edge by virtue of an extreme imbalance in the access to space resources – it was called the first Space War. In short, the Coalition enjoyed air and space supremacy.[78] This time, the adversary did not even enjoy the access that the Arabs had in the Yom Kippur War through the Soviets. The Cold War having ended, the Russians were no longer the patrons of the Iraqis, and the only access Saddam Hussein might have had was through commercial space assets. But was that imbalance just a flash in the pan, or can we hope for more to come?

Practically all of the air-to-air kills in the Gulf War were done by missiles. The reliability and kill ratios for the AIM-7s and the AIM-9s were much better than they had been in Vietnam. The AWACS performed much better than had College Eye in the 1960s and 1970s. There really was not that much of an air-to-air battle, certainly not in the form of dogfights. The result was that the major improvements made in the F-15C design for the sake of air combat maneuvering were not fully tested in combat. The same is true for the F-16 which had been designed as a dual-role fighter, though with much more attention to air combat than had been the case with the F-105 and the F-4. The great advantage that the U.S. had in air refueling made the maintenance of a continuous

Combat Air Patrol feasible. This had advanced considerably since the Vietnam War by the acquisition of the KC-10 which helped greatly with the refueling deployment (and with the airlift), and also the reengining of the KC-135 fleet to create the R model which greatly enhanced its ability to sustain extended combat operations.[79]

There was a good deal of self-congratulation in the aftermath of the Gulf War that the Goldwater-Nichols Act worked. The centralization of the command and control of theater air forces was really accomplished. Later, though, there were those who argued that the reason it appeared that way was the accommodating personality of the JFACC, General Charles Horner.[80] They argued that his great preponderance of air assets permitted him to avoid the hard choices and to allow all the air forces (save perhaps his own USAF) to fly whatever missions they wanted. As with the campaign in France in 1944, when one has wall-to-wall airpower, doctrine does not matter very much.

SINCE DESERT STORM:

Many critics were quick to say that the conditions in the Gulf War were nearly ideal for airpower. That was true. Still, spells of bad weather slowed the air campaign. The Laser Guided Bombs, the infrared weapons, and the television guidance all required at least a modicum of visibility. Since the Gulf War, the U.S. has moved to close that weather sanctuary just as she has eliminated the shelter of darkness.

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The Joint Direct Attack Munitions System (JDAMS) is going into service at this writing. It uses a guidance system that is not quite as precise as laser or television guidance, but one that can operate in all weathers – as long as there is good intelligence on the location of the target. It operates with an inertial kit that steers the bomb toward its objective aided by a Global Positioning System (GPS) receiver that takes signals from space to correct the inertial trajectory and deliver a Circular Error Probable[82] of about 15 meters (that for some LGBs is about 3 meters). This accuracy is fine for the vast majority of targets – if a 2000 pounder falls within 15 meters of a soldier in the open, his day is done. This can be done from above the clouds and at medium altitude, either day or night. Another beauty of it is that the cost of each JDAMs kit is only $14,000, far lower than that of a laser kit which itself is far cheaper than all other forms of guidance. Some argue that the day of the "dumb" bomb appears to be done.[83] The implications of this for the air and space superiority battle is that far fewer shooters will be necessary to destroy a given set of targets than heretofore, and consequently it will be far easier to protect them from the stalking birds. Too, early in the next century it is anticipated that an autonomous seeker[84] will be developed for some of the JDAMs so that when the last increment of precision is indeed required JDAMs will be able to deliver it. The F-117 will be able to carry two of these weapons in the 2000-pound size, and a smaller version of 1000 pounds is being developed so that it may be carried inside the weapons bay of the oncoming F-22. That is necessary to preserve its stealth qualities, though where that is not necessary the Raptor will be equipped with pylons to carry the larger bombs externally.[85]

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An attractive feature of the JDAMS we noted was its moderate price. But another development has been designed especially as a strap-on kit for the standard munitions dispenser. It does not contain the GPS feature and relies wholly on an inertial system that takes out the effects of the wind when the weapon is dropped from medium altitudes. It costs about half the price of a JDAMs kit and the initial production will take place in 1998. Called the Wind Corrected Munitions Dispenser (WCMD), it will be capable of carrying the standard submunitions to include the Sensor-Fuzed Weapon, mines, and the Combined Effects Munition. It is not quite as accurate as JDAMs, but extreme accuracy is not required for scatter weapons.[86] It would play a part in the battle for command of air and space because submunitions are especially effective against SAM and AAA sites or aircraft in the open.

To be able to fire at an enemy stalker who cannot reach you is a capability longed for since ancient times. The Air Force has been the lead service in the development of the JDAMs; the Navy is leading another development with a common guidance system – the Joint Stand Off Weapon System (JSOW) also designed to fire at an enemy who cannot shoot back. Its initial operational capability (IOC) is just around the corner. It is a glide bomb with wings that extend after release. The idea is that the weapon will be used at a distance to degrade the enemy air defense systems to make it safe for aircraft to go in with JDAMS and even dumb bombs to strike other targets. It too will be released from medium altitude or above and from a much greater distance than with JDAMS. The initial versions will be equipped to deliver the various submunitions in the inventory, like the Combined Effects Munition (CEM) or the Gator mines.[87] One version is being built to deliver a unitary bomb as well. Later phases of the program in the next century will marry the GPS/inertial guidance system with a terminal seeker that will give some of the JSOWs the same precision that the LGBs now enjoy. Usually scatter weapons like the CEM have no need for the last increment of precision, so there will not be the need to use up an expensive seeker and processor for them. Still the JSOWs will be more expensive than the JDAMs and will not therefore be procured in as many numbers.[88]

Still more expensive than the JDAMS is the Joint Air-to-Surface Standoff Missile (JASSM.)[89] There typically are some nodal points in an integrated air defense system that are vital but are too dangerous to approach even to JSOW ranges. Before the fall of the USSR and the Warsaw Pact, the services had a joint program for a similar missile with stealth characteristics which were deemed necessary to attack such targets. However, to get the last increment of stealthiness would have been an expensive proposition. When the Communist empire fell, we decided that that requirement could be relaxed a bit so the original program was cancelled (for that among other reasons) and the JASSM was designed for the same mission at about half the cost.[90] It will nonetheless be expensive and not ready until the next century when it will become the longest range standoff weapon available for Air Force fighter aircraft.

Another part of the armament program that is aimed at similar effects is the High Speed Anti-Radiation Missile (HARM) – but it does not have the long range JASSM. We saw that the stalking birds in Vietnam had a huge advantage working inside their own Ground Controlled Intercept environment, and HARM is designed to suppress the radars essential to that direction. It homes on radiation and travels at very high speeds in the hope of arriving at the antenna before the enemy operator can shut it down. HARM was first used in the raid on Libya in 1986, and in the Gulf War it was not necessary to keep on firing very many of them. The Iraqi controllers quickly discovered that emitting was hazardous to their health so that the mere presence of HARM shooters in the vicinity was enough to keep their radars off the air – which enabled the free passage of non-stealthy strike forces.[91]

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We saw above that substantial improvements were made in air-to-air weapons before the onset of the Gulf War. However, perhaps the most important one achieved its Initial Operational Capability only in September 1991 and could not be deployed to the Gulf in time to get a combat test. The Advanced Medium Range Air-to-Air Missile (AMRAAM) had been under development for many years, and the goals for its program had been ambitious indeed.[92]

We have noted that it was necessary for the US fighters over Vietnam to direct their radar missiles until they hit the target and that was a disadvantage compared to the "launch-and-leave" characteristics of IR missiles. One of the AMRAAM goals was to develop a weapon that could guide itself to the target without the assistance of the launching aircrew after it departed the missile racks. That would permit the crew to either begin their escape or to launch other missiles at other targets before the first one had impacted. Yet another goal was to make the AMRAAM light enough to be used aboard the F-16, the most numerous plane in the fighter force. Most of the latter did not have any beyond-visual-range capability because the AIM-7 Sparrow needed a fairly sophisticated aircraft guidance system and the F-16 radar was inadequate.[93]

The weight of AMRAAM is perhaps seventy percent of that of the Sparrow, and it is fully compatible with the avionics of the F-16. It has a higher speed too, and there is less smoke generated by its motor. Multiple AMRAAMs can be managed at one time by a single fighter, and one of their modes of operation is autonomous – launch-and-leave weapons. For all of that, though, the world of air combat is a hard one – it is difficult to stay ahead, and in some respects the Russians have better missiles – though the combination of stealth in the F-22 and the AMRAAM will likely be better than the combination of Russian fighters and missiles.[94]

If the threat of Russian fighters and radar missiles were not enough to keep one awake, then there have also been developments in the world of IR weapons and Helmet-Mounted Displays (HMDs) that will. In the days of Vietnam, as we have seen, it was necessary to drive up behind an enemy and maneuver into a moving cone behind his exhaust to get a lock-on and fire an IR missile. Such missiles have now been improved to the point where they are all-aspect weapons. They can be fired from the forward hemisphere of the enemy and they will home in perhaps on the leading edges of the wings which have been heated by air friction but more likely on the jet exhaust which can be sensed even from the nose aspect.[95] But, at first it was still necessary to point one's aircraft at or nearly at the enemy before the missile could be fired. By moving the sighting display to the visor on the pilot's helmet and giving the seeker on the missile itself a wide field-of-view (FOV), it can be launched at very large "off-boresight" angles – precious seconds before the enemy can fire one at our airplane.[96] The Russians and the Israelis have had such missiles and helmets for some time now, and they do have some limitations.[97] The F-22 will come equipped with a Joint Helmet-Mounted Cueing System and a new IR missile (AIM-9X), but that is not scheduled to gain its IOC until 2004.[98] Several European nations have missile programs also looking toward that kind of weapon/helmet combination.[99]

Another advantage of the IR missiles is that they are passive – that is to say they send forth no electromagnetic emissions to warn the enemy that he is about to be attacked (some Sidewinders *do* have proximity fuzes that emit radio frequency energy – and using the aircraft radar to measure range even with IR missiles can be a big help.) The unfortunate part of it is that IR weapons are short range. However, the Russians and the US Navy (aboard its F-14s) have had operational Infrared Search and Track Systems (IRSTS) which enable them to spot other aircraft at considerable distances without turning their radars on. This has the potential to permit the first shot as radars

theoretically can be detected by radar warning receivers at twice the distance that they can themselves identify the target (the energy has to make a round trip for the attacker's antenna, but only a one-way journey to the target's antenna.) This may be especially troublesome in that the Russian AA-10 has a longer range than most other IR missiles that might enable it to reach out and touch someone when combined with an IRSTS.[100] A well established notion of air combat is that he who takes the first shot is very likely to win.

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The Air Force has so far not specified an IRSTS for the F-22, though it tested some in the late 1980s. Apparently, the stealth combined with a radar set that seems to be difficult to intercept is enough to make the inclusion of an IRSTS unnecessary. Such equipment already on Russian and late model USN fighters is soon to be included on other European aircraft. Too, it has got other potential uses where its passivity may help: like finding a tanker without making emissions or identifying SCUD plumes as they fire.[101] U.S. fighters so equipped have a similar capability through their LANTIRN (Low Altitude Navigation and Targeting, Infrared Night) pods.[102]

But balanced against those technological gains has been a huge force structure drawdown. The USAF is now about a third the size it was at the height of the Vietnam War. In 1997, the enlisted strength of the USAF was lower than in any year since Pearl Harbor except 1947. The continuing commitments in the Persian Gulf and elsewhere has created an operations tempo so high that opportunities for realistic training are often lost. The aggressor units are much diminished from what they once were.[103]

Added to that, there has been a huge overseas base drawdown and a greater concentration of units in the continental U.S. There has been some reorganization and consolidation among the major commands and composite wing experiments have been conducted. Work has been done on developing a doctrine and organization for quick redeployment overseas in the form of Air Expeditionary Forces, but that has not yet had a large-scale combat test. Most of the plans associated with that call for the front-loading of air superiority assets in the redeployments, and doubtless it would be better done now than in TORCH in 1942. But excessive confidence that our technological, doctrinal and organizational cleverness will compensate for low numbers and the lack of bases and radar sites in the stalkers' backyards would make us victims of Michael Howard's lament. Doctrine is always wrong, and he who can adapt to its errors after combat has revealed them will win. If the world turns out to be different from the way we picture it, will we be able to react more quickly than enemies now far less knowable than the Soviets were for fifty years?

A CENTURY OF THINKING ON THE COMMAND OF AIR AND SPACE:

We are now in the twilight of the first century of the air age. What have we got to show for the huge intellectual effort that has gone into the development of air and space superiority doctrine? There has been little disagreement that we should command the medium. The rub comes in when the discussion turns to the methods of doing so.

During World War One and the 1920s, in America at least, the emphasis was on the air battle. Different thinkers placed varying values on the offensive methods of fighting that battle. Douhet was among the earliest to assert that to command of the air could be best won through attacks against ground targets. The American thinkers moved toward that position in the 1930s, but not all the way.

Soon after the onset of World War II, the limitations of the Douhet approach began to show themselves. The coming of radar was everything. The ability to spot the attackers in the footless halls of space enabled the stalkers to implement the principle of mass – to hold their forces on the ground and launch them directly at the threat without dispersing their power all around the perimeter looking for the bombers. The British bombers had to go over to the sanctuary of night to survive – but for a long time that entailed such a loss of target acquisition ability and accuracy that it ruined their potency. In the end, the survivability evaporated because the radar helped the German interceptors, but the British gunners and escorts could have little effect at night. The Americans attempted for a while to find sanctuary behind the many .50 caliber turrets they hung on their bombers. But that failed because it was too easy for the stalkers to mount even larger weapons and hold back their assault until radar told them the escorts had gone home. Then they could quickly find the attacking formation, hover just outside .50 caliber range and pop away until they made their lethal hits. Finally, the impractical was made practical by the partially fortuitous combination of technologies in escort fighters, growing numbers, and changes in tactics – and the stalking birds were killed in such huge numbers that it was not long before Germany lay prostrate before the Allies now in command of the air.

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Unhappily, the emergent doctrine obsolesced as rapidly as did the World War II airplanes. In both Korea and Vietnam, the U.S. was unable to apply the full force of OCA attacks because of the constraints arising from the limited war scenario. Too, her great advantage in air superiority technology and experience eroded with seemingly blazing speed. From the Eisenhower administration forward, though, the exploitation of space in a non-lethal way tended to counteract that erosion. That, combined with the fall of the communist empire to enable the Coalition to fully exploit the potential of its technological and doctrinal advantages against Iraq and achieve an air supremacy not often witnessed in the past.

But the Wall is down. The "threat" has become so diffuse that thinking about the methods of commanding air and space is more difficult than ever. Technology seems to be changing as rapidly as ever, but the force structure is much diminished. There are no more Vietnam veterans in the cockpit; only a fraction of the force got combat experience in Desert Storm and that too is disappearing. The doctrine has really not changed greatly. One wonders whether a full Revolution in Military Affairs (RMA) is really afoot – whether all the technology and readiness training will be enough to yield air and space superiority in the next century. Certainly the potential adversaries have learned as much or more from the Gulf War as we have. Doubt remains whether we had solved the problems of command of the air in a guerrilla war context. Because of Watergate, LINEBACKER III never came to measure whether or not the first two were exceptions to a general rule.

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One of the pillars of our self assurance in the struggle for air and space superiority has long been the notion, perhaps the conceit, that our people have more initiative than those elsewhere – especially those in the communist empire. But the centralized command and control system, the wonderful instant communications systems, and VIP jet travel may have led to micromanagement over the last half century that has eroded the degree to which junior people have developed that initiative. The Air Force Academy is about to graduate its thirty-ninth class. The student body there has been drawn down much less than has the officer corps in general. Their retention, as disappointing as it has been, has nonetheless been higher than that of other sources of officers. Diversity on the faculty and among the Air Officers Commanding is much diminished. The last two Chiefs of Staff and the greater part of the current three and four star generals are Academy graduates. We live in an age of "political correctness" wherein a single mistake is often thought to be the death knell of a career. If indeed we do bank on individual initiative among our warfighters and their leaders, are we counting on a chimera? Is Marshall Michel correct in his low estimate of the open-mindedness of the senior officers of the service?

Another of the great advantages upon which we found our confidence is "Information Warfare" superiority. But that, combined with our doctrine does much to drive centralization even further – and to make us all the more dependent upon centralized technological systems with obvious nodal points. Just as the last great wave of imperialism was brought to an end when the colonials learned how to use the Maxim Gun too, is it inevitable that this lead in IW will disappear? As we have noted, the Global Positioning System has become increasingly central to our operation in many ways and the technicians assure us that it is ECM resistant – but that is what they said about the German Enigma machine. It was a code that could not be broken – but it was.[104] Similarly we now possess an enormous lead in Space, and perhaps the law of diminishing returns will set in. Meanwhile, the rest of the world may still be on the steep part of their development curves and the gap there will also close. Will it close all the more rapidly if those of us who would end the "Freedom of Space" policy have their way? If they succeed in militarizing space will that only so threaten the rest of the world as to stimulate their efforts to close the gap even more rapidly? Would we then be able to duplicate the kind of air and space supremacy that we enjoyed in the Gulf War of 1991?

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But what can the professional air warrior/scholar do about it? How can he help to assure that somehow his country will be able to sustain air and space superiority? There is no need to deliver a sermon about being the best that one can be in his own specialty. But are we in general as competent to think about war as opposed to battle, engineering, maintenance, logistics and the like? One cannot do much to practice war, and even those things that simulate battles, campaigns, and wars are always wrong. They are also expensive and time consuming. They have to be supplemented with an organized professional reading program. Certainly that is an imperfect substitute for experience, but it is the only substitute you have available in a lifetime limited to, say, seventy-six years. You cannot live it all, so you must supplement your real world experience with the vicarious experience called professional reading. As the most important of the USAF core competencies *is* air and space superiority, you should concentrate on that area above all – all the more so if you are not directly involved in that area in the course of your day-to-day work. The "Ten-Book Sampler" given below is intended to help you get started in that effort.

Could that Sampler also be a useful aid in repairing one of the glaring deficiencies of the officer corps? I had five flying tours in four different major commands, including bomber and fighter wings in SAC and PACAF, and never once saw anything faintly resembling an organized mentorship effort. Why not use the books below to start a mentorship program in your unit?

Finally, if you were king for a day, would you ever replace a congenial dummy as your chief of staff with a nasty genius? Are you capable of resisting the temptation to kill the bearer of bad tidings? Will you ever be able to do anything to erode the impression in the officer corps that it is a One Mistake Air Force?

A Ten-book Sampler on Air and Space Superiority Works for USAF Professional Development*

Two for the Macroview: Benjamin Franklin Cooling, ed., *Case Studies in the Achievement of Air Superiority*, (Washington: Center for Air Force History, 1994), this being an official USAF history done by various authors. It is better than most anthologies as the chapters were done under contract and the editors had more control over the coherence than is the usual case.

Mike Spick, *The Ace Factor: Air Combat and the Role of Situational Awareness*, (Annapolis, MD: US Naval Institute, 1988), lest the title stimulate the wrong image, you should be aware that this work is much better than many of the aviation books in the popular market.

Eight for More Detailed Knowledge: Lee Kennett, *The First Air War: 1914-1918*, (NY: Free Press, 1991), by a longtime professor at the University of Georgia, see especially, Chapter 4, "The Development of Air Combat."

Marshall L. Michel, III, *Clashes: Air Combat over North Vietnam, 1965-1972*, (Annapolis, MD: US Naval Institute, 1997), Colonel Michel was a fighter pilot, and the work is colored somewhat by that viewpoint. Many of his viewpoints are widely shared by crew members outside the fighter community as well. Still, it is the best work available in print about the air battle over Vietnam.

David R. Mets, *Checking Six is Not Enough: The Evolution and Future of Air Superiority Armament,* (Maxwell AFB, AL: Air University Press, 1992), this pamphlet is included not because of my high regard for its author, but rather because to my knowledge it is the only recent, compact treatment of the air armament part of the struggle for air and space superiority.

Lon O. Nordeen, *Air Warfare in the Missile Age*, (Washington: Smithsonian, 1985), Though this work was published before Desert Storm and takes a case study approach, it is worthwhile. Nordeen was employed by McDonnell-Douglas in public relations for some time, but he has a better than average grasp of the technical and tactical details of the subject. The book covers more than the air superiority dimension of airpower.

Lon O. Nordeen, *Fighters Over Israel*, (NY: Orion, 1990), there is a substantial literature on the Israeli AF, and often it has had the most recent air combat experience with US equipment against air forces instructed and equipped by the USSR. Thus, the history of its struggle for air superiority in the Middle East is a worthy topic for study by USAF warrior/scholars.

David N. Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, (Colorado Springs, CO: Air Force Space Command, 1997), though the Gulf War was widely advertised as the first space war, there as yet has been no combat there – and possibly there will never be any. The implication for us is that the literature is highly speculative, though it is becoming vast. The Spires book is a good start, though it has many more subjects than just space superiority.

Kenneth P. Werrell, Archie, Flak, AAA, and SAM: A Short Operational History of Ground-based Air Defense, (Maxwell AFB, AL: Air University Press, 1988), Carl Builder's assertion that Air Force officers are more interested in their airplanes than they are in air war receives some support in the way that the U.S. has dealt with ground based air-defenses. Surely, they are as much a part of the air superiority equation as are fighters, but the literature on air combat far outweighs that on the surface defenses. Back in World War II, the ground defenses were a part of the Luftwaffe, but there never has been much thought[105] here about making them a part of the air arm. Werrell's book is therefore an essential part of our study.

Derek Wood with Derek Dempster, *The Narrow Margin: The Battle of Britain 1940*, (Washington: Smithsonian, 1961, 1990), there is a huge literature on this clash and the battle indeed was a seminal event in the evolution of airpower theory and doctrine. It remains the closest approach to a pure air battle, and the Luftwaffe was operating under many of the same handicaps that the USAF had over North Vietnam. This book was written by two British journalists with good writing skills and a grasp of the technical and tactical details. The Battle proved that the bomber would *not* always get through.

One for Good Measure: US, Air Force, Air Force Basic Doctrine, Air Force Doctrine Document 1, September 1997. You will have to read this sooner or later, why not now? At the very least it will familiarize you with the standard conceptual framework and vocabulary and those things will certainly facilitate your further study on air and space superiority.

* The Sampler is intended only to provide a baseline for the generalist professional officer. It is not for the specialist in military or airpower history, nor for the specialist in air combat (though some of the latter might find some instruction in the historical dimension of their own specialty.) A bibliography covering the whole field would be many pages long and would quickly become outdated in any event.

NOTES

64 Lon O. Nordeen, *Air Warfare in the Missile Age*, (Washington: Smithsonian, 1985), 111-123; Brereton Greenhous, "The Israeli Experience," Chapter 11, in Cooling, ed., *Air Superiority*, 578-82.

65 Michael Howard, "Military Science in an Age of Peace," Chesney Memorial Gold Medal lecture, 3 Oct 1973, reprinted in *Journal of the Royal United Services Institute*, Vol 119, (Mar, 1974): 3-11.

66 Greenhous, "Israeli Experience," 586-96; Nadav Safran, "Trial by Ordeal: The Yom Kippur War, October, 1973), *International Security*, Vol. 2, (Fall, 1977), 130-62.

67 Nordeen, *Airpower in the Missile Age*, 158-72; Safran, "Trial by Ordeal," 130-62.

68 Nordeen, *Airpower in the Missile Age*, 201-06; Matthew M. Hurley, "The Bekaa Valley Air Battle, June, 1982: Lessons Mislearned," *Airpower Journal*, III, (Winter, 1989), 60-70; Nick Kerr, "The Falklands Campaign," *Naval War College Review*, Vol. 35, (Nov-Dec, 1982), 14-21.

69 Major Geralod R. Volloy, USAF, "Red Flag in Perspective," *USAF Fighter Weapons Review*, (Spring, 1979): 2-5; "Training and Simulation: Filling the Missing Link," *Jane's Defense Weekly*, (13 April 1991): 606-09.

70 Interview, Wight, 7 April 1998.

71 The F-5 had an advantage throughout, however, because of its greater maneuverability, Donovan, interview, 23 March 1998.

72 Walker interview, 25 March 1998.

73 AFM 1-1, *Basic Doctrine*, Vol. I, March 1992, 18; AFDD-1, *Basic Doctrine*, Sept 1997, 12-3.

74 Winnifeld and Johnson, *Joint Air Operations*, 100-01.

75 That fact seems to support the Air Corps Tactical School bomber advocates in their arguments against Chennault. Without radar, they were right and their prediction then that radar was a serious prospect would have been a superhuman act of foresight? (Doubtless it will occur to the reader that the Luftwaffe was a much tougher opponent in a total war than the Iraqi AF was in the Gulf War.)

76 Warden, Colonel John A., III, USAF, "The Enemy as a System," *Airpower Journal*, IX, (Spring, 1995): pp. 40-55; John A. Warden, III, "Air Theory for the Twenty-first Century," in *Challenge and Response: Anticipating US Military Security Concerns*, ed. Karl P. Magyar, (Maxwell AFB, AL: Air University, Aug, 1994), 311-332.

77 Keaney and Cohen, *Revolution in Warfare?* 15.

78 Thomas A. Keaney and Eliot A. Cohen, *Revolution in Warfare? Air Power in the Persian Gulf*, (Annapolis, MD: Naval Institute Press, 1995), 48-9, the book being one of the best sources on the Gulf War; Michael R. Gordon and General Bernard E. Trainor, *The Generals' War: the Inside Story of the Conflict in the Gulf*, (Boston, MA: Little, Brown, 1995), 205-26, 473-74.

79 Keaney and Cohen, *Revolution in Warfare?* 159-60.

80 Winnefeld and Johnson, *Joint Air Operations*, 146-47.

81 Colonel John D. Waghelstein, "Some Thoughts on Operation Desert Storm and Future Wars," *Military Review*, LXXI, (Feb, 1992): 80-83.

82 The radius of a circle within which 50 percent of the bombs, missiles or projectiles may be expected to fall.

83 Bill Sweetman, "Scratching the Surface: Next Century Air-to-Ground Weapons," *Jane's International Defense Review*, vol 30, (July, 1997), 55-63; Stacey Evers in November 1997 reported that the unit cost would be about $18,000 and that the program, then in Low Rate Initial Production, would be delayed in going to full rate production until some design flaws revealed in testing were overcome, "Experts count Costs to fix JDAM Design Flaws," *Jane's Defense Weekly*, Vol. 28, (5 November 1997): 6.

84 Millimeter wave radars, ladars (laser radars), and Synthetic Aperture Radars are all under consideration. Without them and a sophisticated set of algorithms, only versions of JSOW and JDAMs carrying dispenser warheards with appropriate submunitions will have any chance against moving targets.

85 Bill Sweetman, "The Progress of the F-22 Fighter Program," *Jane's International Defense Review, Quarterly Report*, Number 1, (1997), another development is the effort to develop the Small Smart Bomb (SSB) at 250 lbs with such accuracy that it will have the same effect as the 2000 pound LGB, yet six of them will fit in the F-22 weapons bay.

86 Sweetman, "Scratching the Surface," 57; "USAF plans intertial dispenser selection this month," *Jane's International Defense Review*, Vol. 30, (January 1997):10; U.S., Air Force, Hq Air Combat Command/DRPW, "Final Operational Requirements Document, Wind Corrected Munitions Dispenser," 23 September 1994.

87 In November 1997 it was reported that the first JSOWs were deployed aboard the aircraft carrier *USS Nimitz* in the Persian Gulf even though they had not achieved their IOC and were still in LRIP. The versions deployed were said to be the ones containing CEMs particularly useful against air defense sites, "Nimitz is Carrying Latest Stand-off Weapon," *Jane's Defense Weekly*, Vol. 28, (19 November 1997): 4.

88 Sweetman, "Scratching the Surface," 55-63; Glenn W. Goodman, Jr., "Mining Silver Bullets: Navy and Air Force Pursue Longer Range, Autonomous Standoff Weapons," *Armed Forces Journal International*, (July, 1997): 26-7, cites an accuracy of 33 feet for JDAMs and JSOW, and states that Low Rate Initial Production has been approved for both the JSOW and the Navy's Standoff Land Attack Missile, Expanded Response; Roy Braybrook, "Not-too-close Encounters of the Air-to-Ground Kind," *Armada International*, Vol. 20, (February/March 1996): 28-39; James W. Canan, "Smart and Smarter," *Sea Power*, Vol. 38, (April, 1995): 93-6.

89 David A. Fulghum, "'TSSAM Follow-On to Take Shape This Year," *Aviation Week & Space Technology*, (27 February 1997): 49; U.S., Hq Air Force/XORW, "Joint Air-to-Surface Standoff Missile, Program Management Directive," PMD 2389 (1), 2 February 1996.

90 Stacey Evers, "JASSM Struggles on Low Budget Pending Study," *Jane's Defense Weekly*, Vol. 28, (8 October 1997): 11, wherein it is reported that the unit cost range is stipulated to be between $400,000 and $700,000 per round.

91 Keaney and Cohen, *Revolution in Warfare*, 195-96, where it is reported that soon the HARM shooters were coming back to base without having fired their weapons, and only 5 Coalition aircraft were lost to radar SAMs during the war.

92 "Eglin's AMRAAMs Join War," *Northwest Florida Daily News*, (22 February 1991): 3, and Jeffrey Lenorovitz, "Allied Air Supremacy Keeps Air-to-Air Engagements Limited," *Aviation Week & Space Technology*, (18 February 1991): 45-46, and on the first kill of the new missile, News Release, Hughes Aircraft Company, Canoga Park, CA, "Hughes AMRAAM Intercepts Mig-25 in Iraq 'No-Fly' Zone," January, 1992; Bill Sweetman, "Russia Sets the Pace in the race for Air-to-Air Missiles," *Jane's International Defense Review*, Vol. 30, (November, 1997): 70-9.

93 An Air Defense Fighter (ADF) version of the F-16 was fielded to use AIM-7s, but the system was put together as an interim solution until AMRAAM came on the line and was not very satisfactory, interview, Donovan, 23 March 1998.

94 Sweetman, "Russia Sets the Pace," 70-9; Sweetman, "Progress of the F-22 Program," 9; Jean Dupont, "Europe Competing Strongly in AAMs," *Interavia*, Vol. 53, (January, 1998): 42-44, wherein the Russian R-73 and 77 are identified as the threats to beat but also the AMRAAM is called "the reference" missile.

95 Wight interview, 7 April 1998.

96 A similar combination is being designed to retrofit our fleet of F-16s and F-15s, Walker interview, 25 March 1998.

97 Dupont, "Europe Competing," 42-3.

98 Sweetman, "Progress of the F-22 Program," 14.

99 Jean Dupont, "Europe Competing Strongly in AAMs," *Interavia*, Vol 53, (January, 1998): 42-4.

100 Donovan Interview, 23 March 1998

101 Mark Hewish and Joris Janssen Lok, "Passive Target Detection for Air Combat Gathers Pace," *Jane's International Defense Review*, Vol. 31, (Feb 1998): 32-37.

102 Walker interview, 25 March 1998.

103 "Personnel Facts," *Airman*, XLII, (January, 1998), 29; Donovan interview, 23 March 1998.

104 Furthermore, civil society here and abroad is becoming so dependent upon GPS that it might prove politically and economically difficult to shut it down in time of conflict.

105 At the time of the debate on the Unification Act of 1947, there was an effort on the part of the USAAF staff to carry the Air Defense Artillery with the airmen into the new USAF. It never came to fruition, though, because of the airmen's desire to avoid antagonizing Generals Dwight Eisenhower and George Marshall whose support they needed. Additionally, there was not much enthusiasm for the idea among the officers in the Air Defense Artillery because they feared that the Air Force would be owned by the pilots.