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Energy Horizons

A Science and Technology Vision for Air Force Energy

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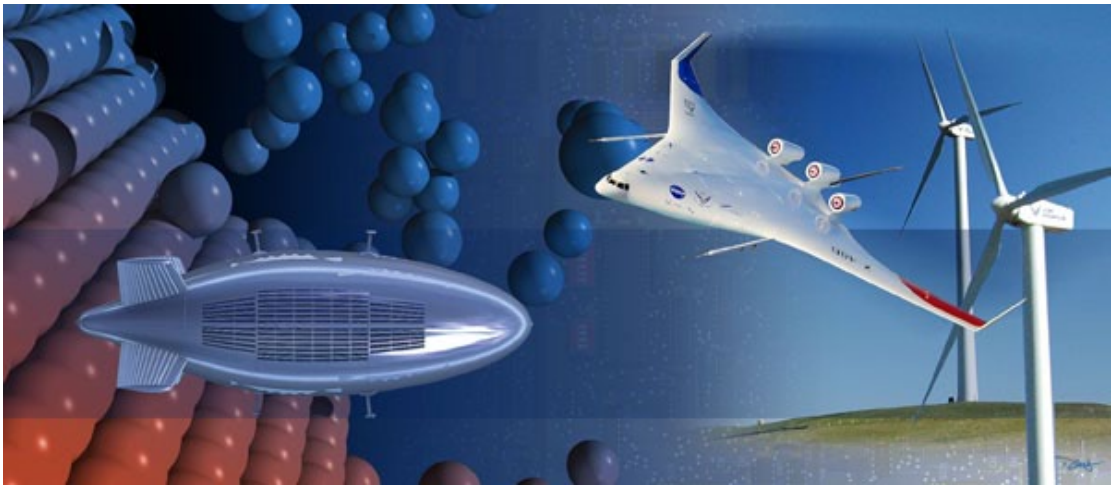

Introduction and Vision

The Air Force faces daunting energy challenges that promise only to increase in severity, given the increased global demand for energy, diminishing global energy supplies, and demands for enhanced environmental stewardship. The service spends over $9 billion a year in aviation fuels and over $100 million annually in energy for ground operations associated with space, and tens of millions of dollars in cyber energy to support command and intelligence centers. (Figure 1 shows the proportional share of operational energy.) Adversaries increasingly target energy as a center of gravity. To date, more than 3,000 American Soldiers and contractors have been killed or wounded protecting supply convoys in Iraq and Afghanistan (approximately one life per 30 convoys), 80 percent of which transported primarily water and fuel.

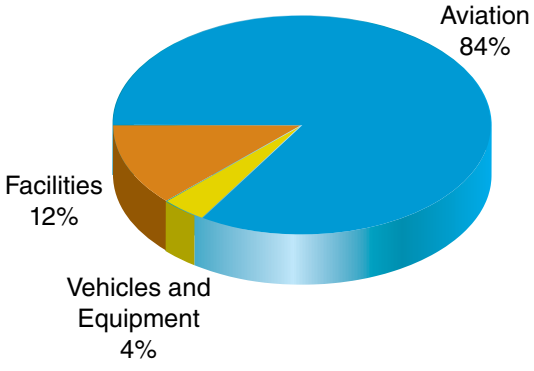

Figure 1. Cost breakdown of Air Force energy, fiscal year (FY) 2010. (Adapted from Headquarters US Air Force, *Air Force Energy Plan 2010* [Washington, DC: Headquarters US Air Force, 2010], 4, http://www.dm.af.mil/shared/media/document/AFD-101202-066.pdf.)

The Air Force report titled *Energy Horizons: A Science and Technology Vision for Air Force Energy, 2011–2026* is informed by the Department of Defense's (DOD) *Energy for the Warfighter: Operational Energy Strategy*; the *Air Force Energy Plan 2010*; and the *National Aeronautics Research and Development Plan*.[1] The Air Force's energy vision seeks to "make energy a consideration in all we do," including understanding "how energy impacts the Air Force's critical capabilities: Global Vigilance, Global Reach, and Global Power."[2] Furthermore, the *Energy Horizons* report offers a vision of "assured energy advantage across air, space, cyberspace and infrastructure."[3]

Air Energy

The Air Force is the single largest energy user in the DOD. The service uses more than 2 billion gallons of aviation fuel every year, making it the predominant form (84 percent) of energy consumed and creating one of the Air Force's largest operational expenses. Operational improvements to new platforms such as the C-17 and F-35 come with burn rates 50 percent to 125 percent more than those of legacy platforms such as the C-141 and F-16.[4] Figure 2, representing mobility air forces, combat air forces, and special air forces, depicts the projected fuel burn of the Air Force through 2040.

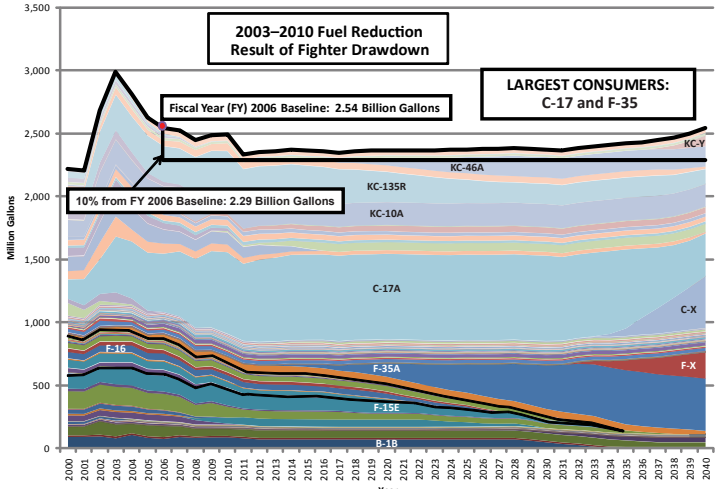

Figure 2. Air Force fuel-burn projections. (From Dr. Jackie Henningsen, AF/A9, director, Studies and Analyses, Assessments and Lessons Learned.)

In the air domain, the Breguet range equation provides a unifying method for simultaneously measuring the progress of energy efficiency, related energy use, and aircraft capabilities:[5]

$$Range = \frac{V}{SFC}\frac{L}{D}\ln\left(1+\frac{W_{fuel}}{W_{payload}+W_{aircraft}}\right)$$

In this equation, one can measure improvements to airframe efficiency via increases to the lift-to-drag (L/D) coefficient and reductions in weight of the aircraft ($W_{payload} + W_{aircraft}$). Further, one can measure efficiency gains in propulsion via the specific fuel consumption (SFC) relative to the speed (V). Linking energy to range across these factors establishes a relationship between war-fighter capability and energy-efficiency attributes. Science and technology (S&T) investments in the air domain seek to optimize one or more pertinent elements of the Breguet equation (table 1). These include advancements in aerodynamics, propulsion and power, materials and structures, aviation operations, energy harvesting, and game-changing concepts. Table 1 articulates where the Air Force needs to lead (L); where it should follow (F) by rapidly adopting, adapting, or augmenting the investments of others; and where it should watch (W) investments (other than core mission functions) that it depends upon.

Table 1. Air-energy science and technology

	Near (FY 11–15)	Mid (FY 16–20)	Far (FY 21–25)
Aerodynamics	Fairings (L)	Conformal Antennas (F)	Laminar Flow (Combat Fleet) (L)
	Center of Gravity Control (L)	Laminar Flow (Mobility Fleet) (F)	
	Lift Distribution Control (L)	Systems Integration (F) (Mobility Fleet)	
	Winglets, Finlets, Strakes (F)	Systems Integration (F) (Combat Fleet)	
	Raked Wings (F)	Blended Wing Body (F)	
	Microvanes (F)	X-Wing (F)	
		Lifting Bodies (W)	
			Plasma-Enhanced Drag Reduction (W)
Propulsion & Power Systems	Adaptive Versatile Engine Technology (L)	Highly Efficient Embedded Turbine Engine (L)	Advanced and Nutating Cycles (L)
	Efficient Small-Scale Propulsion (L)	Engine-Specific Improvements (L)	Turbofan Compounding (W)
	Heavy Fuel (F)	Subsystem Integration (L)	Ultrahigh Bypass (W)
	Geared Turbofan (F)	Power on Demand (F) (Mobility Fleet)	
		Power on Demand (L) (Combat Fleet)	
		Open-Rotor Engine (W)	
		Hybrids/Electric Propulsion (W)	
	Alternative and Biomass Fuels Qualification/Certification (L)		
	Alternative and Biomass Fuels Production (W)		
		Advanced Power Generation (F)	
Materials & Structures	Aircraft Components (Tie-Downs, Pallets, Racks) (L)	Multifunctional Materials (F)	
	Lighting (F)	Wireless Control Systems and Electric Actuators (W)	
	Composite Materials (L)		
	Composite Cargo Containers (F)		
	Morphing Materials (F)		
	Hybrids/Advanced Aluminums (F)		
Aviation Operations	Formation Flight (L)	Sustainment Improvements (L)	
	Mission Index Flying (F)		
	Distributed Mission Training and Interactive Simulators (L)		
	Improved Human Performance Considerations (L)		
	Expansion of Remotely Piloted Aircraft (RPA) Role in Mission (L)		
	Improved Weather Forecasting, Detection, Avoidance (F)		
	Enhanced Mission-Execution Efficiency Practices (F)		
	Mission-Planning Software (F)		
Energy Harvesting	Thermoelectric for Cooling (L)		
		Energy Harvesting for Small RPAs (L)	
	Photovoltaics (F)	Magnetic Braking (F)	
	Thermoelectric Exhaust Recapture (F)		
	General Thermoelectric Reclamation (F)		
		Acoustics (W)	
New		Hybrid Airships (F)	Fractionated Systems (L)

Aerodynamics

Improvements in aerodynamics for both the legacy and future fleets illustrated in the first section of table 1 include finlets, winglets, riblets, and conformal antennas among other streamlining modifications, offering 4–6 percent better fuel burn. Similarly, center of gravity controls and lift-distribution control systems enhance performance by ensuring that lift is efficiently appropriated across the aircraft in relation to the location of the carried weight. Midterm and far-term considerations include wings optimized for laminar flow (up to 15 percent fuel savings) and nontraditional airframes (e.g., blended-wing [see fig. 3], box-wing, and lifting-body constructions).

Figure 3. X-48B blended-wing body. (From NASA Dryden Flight Research Center Photo Collection, 14 August 2007, http://www.dfrc.nasa.gov/Gallery/Photo/X-48B/Medium/ED07-0192-08.jpg.)

Propulsion and Power Systems

Propulsion technologies offer potential fuel-burn reductions across a variety of platforms, as expressed in the second section of table 1. The Air Force will lead many of the technologies listed or act as a fast fol-

lower for future commercial off-the-shelf solutions. For example, Adaptive Versatile Engine Technology (ADVENT) (see fig. 4) has improved compressors and a third flow that potentially would provide significant energy savings (15–25 percent reduction in SFC) to combat aircraft. Moreover, the Highly Efficient Embedded Turbine Engine could improve the SFC of mobility and other platforms by 25 percent. Moving beyond conventional Brayton cycle (air-breathing) concepts, revolutionary midterm and far-term technologies aim for high efficiency, such as hybrid pressure-gain combustion cycles, hybrid turbocompound cycles, heat-exchange cycles (intercooled and regenerative), interturbine burning leading to isothermal expansion cycles, and positive-displacement compression cores. For smaller aircraft, initiatives like Efficient Small-Scale Propulsion look to provide an approximately 25 percent reduction in SFC, in this case for remotely piloted aircraft (RPA). Its fleet fully certified for 50/50 Fischer-Tropsch/JP-8, the Air Force will lead continued fleet qualification/certification of new, sustainable feedstocks. The service will closely watch and leverage biofuels production, given an existing joint Department of Energy / Agriculture / Navy program in biofuel production.

Figure 4. ADVENT. (From Briefing, subject: Introduction to Air Force Research Laboratory Propulsion Directorate, slide 8, accessed 26 January 2012, http://www.wpafb.af.mil/shared/media/document/AFD-080429-021.pdf.)

Materials and Structures

As detailed in the third section of table 1, materials research in composites and carbon nanotubes promises enhancements in aircraft

structure and cargo container properties such as reduced weight, tensile strength, conductivity, thermal management, and energy storage, contributing to reduced fuel burn. Improved materials can sometimes also lead to cheaper production, a significant reduction in parts (e.g., fasteners), lower maintenance costs, and minimal sustainment footprint in forward-deployed areas. Other weight-reduction technologies include wireless control systems, electric (rather than hydraulic) actuators, light-emitting diodes, and synthetic tie-downs to replace hefty chains. Further, the flexibility in composite and morphing materials holds potential for allowing certain aircraft parts—such as winglets or vortex generators—to self-adjust, based on airstreams and aircraft angles of attack, producing better fuel-burn characteristics. In the midterm to far term, multifunctional materials offer exciting possibilities for advanced energy harvesting to reduce energy lost as heat or noise.

Aviation Operations

Aviation operations, reflected in section four of table 1, offer efficiency gains with comparatively low up-front costs. For instance, experiments with C-17s' flight formation (fig. 5) have demonstrated 5–10 percent fuel savings for trailing aircraft with limited impact on aircrews, structural considerations, or scheduling. Further, following the lead of commercial airlines, the Air Force implemented mission index flying to optimize options for cruise flight levels and speeds as well as climb and descent profiles tailored to flight conditions. Maximizing distributed, interactive flight simulators (e.g., linking KC-135 and F-16 simulators) can not only decrease the training costs of live operations but also enable safe training in contested or congested conditions, thus enhancing readiness. Improved planning software that is more aware of mission elements, real-time weather, and mission requirements can reduce sorties and inefficient route planning. Additionally, future RPAs and autonomous aircraft could be tailored to specific mobility and combat missions currently carried out by traditional aircraft and do so with a reduced total-energy footprint. Finally, optimizing mission planning and aircraft basing so as to place airframes with lower maintenance

requirements in forward locations lowers the cost of second-order effects (e.g., fewer parts forward).

Figure 5. Formation flying. (From Kenji Thuloweit, "Formation Flight System Keeps C-17s in Line," 95th Air Base Wing Public Affairs, Edwards AFB, CA, 22 September 2010, http://www.edwards.af.mil/news/story.asp?id=123223228. See also "C-17 Multiple Ship Formation Flight Test at Edwards AFB," video, YouTube, 18 September 2010, http://www.youtube.com/watch?v=jBvua6nptsE.)

Energy Harvesting

Section five of table 1 shows that Air Force S&T could combine thermoelectric conversion with other energy-capture concepts such as acoustic/vibration and energy recovery from magnetic braking. The latter might reduce maintenance costs and system weight as well as capture braking energy for reuse in taxiing. Future energy-omnivorous aircraft could possibly harvest a host of energy inputs, including multifuel, solar, heat, wind, and vibration to reduce or perhaps eliminate their demand on traditional fuel. For small RPAs, novel concepts such as recharging those aircraft while perching or harvesting power from thermal or electric sources could enable continuous autonomous operations. The area of energy harvesting could transform many of our operations; however, challenges such as design, power density, system integration, and cost demand attention.

Game-Changing Concepts

The final section of table 1 notes alternative concepts that depart from the traditional airframe. In the midterm, hybrid airships (fig. 6) exploit

both the buoyancy of gas (typically helium) in their envelope and aerodynamic lift produced by airflow over the airships' large surface area. Daunting operational issues remain, such as ground handling, avoidance of bad weather, buoyancy control, and infrastructure, but the projected cost per pound of cargo moved is significantly less than that of traditional airlift. High-altitude airships also have applications for intelligence, surveillance, and reconnaissance (ISR). Furthermore, fractionated systems—which can be decomposed and recomposed, based on mission requirements—promise more efficient ISR, mobility, and swarming attack.

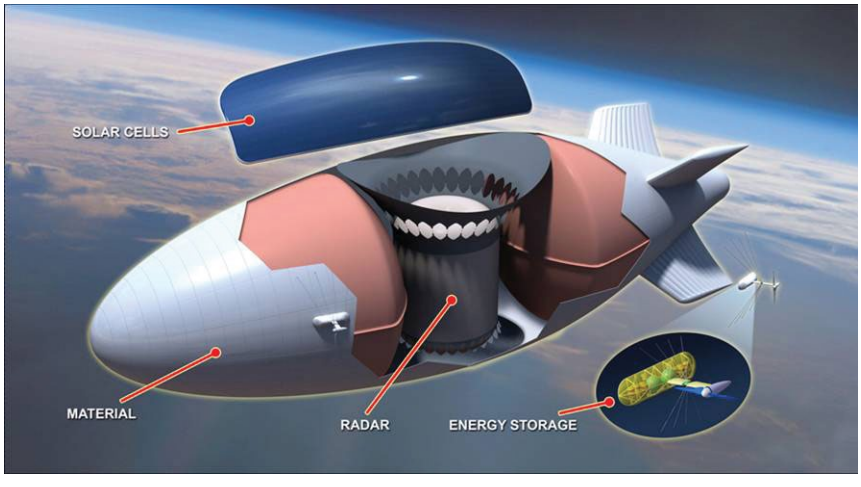

Figure 6. Sensing airship. (From "Integrated Sensor Is Structure [ISIS]," Strategic Technology Office, Defense Advanced Research Projects Agency, accessed 26 January 2012, http://www.darpa.mil/Our_Work/STO/Programs/Integrated_Sensor_is_Structure_(ISIS).aspx.)

Space Energy

In contrast to assets in the air domain, those in the space portfolio do not use traditional aviation fuels for mobility (airlift and air refueling). Indeed, once space assets reach orbit—with the very small excep-

tion of onboard consumables (e.g., propulsion for satellite maneuverability)—the primary energy expense arises from the operation of associated ground-control and data-processing facilities (over $100 million annually). Of the energy consumed for Air Force Space Command's missions, terrestrial facilities use 97.2 percent, ground-vehicle transportation uses 1.8 percent, and rocket launches account for an estimated 1 percent. Commercial space systems operate with smaller facilities, small crews, and even autonomously. Terrestrial radar and heating, ventilation, and air conditioning (HVAC) systems present another underrealized opportunity for reductions in the cost of energy. Additionally, several technologies hold promise for energy generation, storage, and transmission in support of space operations (table 2).

Table 2. Space energy science and technology

	Near (FY 11–15)	Mid (FY 16–20)	Far (FY 21–25)
Energy Generation	30–35% Efficient Photovoltaic (PV) Cells (L)	40% Evolved PV Cells (L)	70% Efficient PV Cells (e.g., Quantum Dots) (L)
	High-Power Solar Array/Integrated Blanket Interconnect System (L)	Sunshine to Petrol (F)	
		Space Nuclear Power for Orbital Systems (F) and Small Modular Nuclear for Ground Stations (F)	
Energy Storage	Flywheels for Space systems (L)	Nanomaterials for High-Power, High-Density Storage (F)	
	Domestic Lithium-Ion Batteries for Space Applications (F)		
	Facility Scale Energy Storage (F)		
Propulsion and Power	Highly Efficient Microprocessors (F)	Photonic Computing for Space Applications (F)	Quantum Computing (F)
	Efficient Orbital Thrusters (L)	Efficient Hall and Electric Thrusters (L)	Electromagnetic Propulsion (L)
		On-Orbit Satellite Refueling (L)	Electric Thrusters Powered by Local PV or Beamed Energy Systems (L)
Operations	Energy-Efficient Data Centers and Ground Stations (F), Cloud Computing (F)	Conversion of Terrestrial Base Use to Efficient Solar Energy (F)	Autonomous "Lights Out" Ground Operations (F)
	Adoption of Commercial Best Practices (F)	Development of Greater Autonomous Capabilities for Satellites (L)	Advanced Onboard Autonomy (F)
		Cross-Domain Study for Space Functionality (L)	Fractionated, Space-to-Space Power-Beamed Energy Constellations (L)
	Improvements to Efficient Launch-Booster Technology (F)	Investigation of Reusable Boost System Concept (F)	Revolutionary Small Launch/ Midlaunch, Including Air-Launched Capability for Small Satellites (L)

Energy Generation

The first section of table 2 addresses the generation of space energy, emphasizing high-efficiency and high-power photoelectric power, sun-to-petrol, and nuclear power. Current solar efficiencies range from 10 percent for flexible, amorphous silicon, to 34 percent for inverted metamorphic solar cell arrays, to (theoretically) as much as 70 percent with quantum dots and diluted nitrides in the far term. The importance of these S&T efforts lies in the fact that every 1 percent in the efficiency of solar-cell energy generation translates to a 3.5 percent increase in power (or decrease in mass) for the system. Very large deployable panels include the Air Force Research Laboratory (AFRL)–Boeing 30-kilowatt (kW) Integrated Blanket Interconnect System High Power Solar Arrays. In the midterm to far term, sunshine-to-petrol is a prototype funded by the Department of Energy to convert carbon dioxide (CO_2) and water (H_2O) into carbon monoxide (CO) and hydrogen (H_2) to create liquid fuel. In addition, 500 kW of on-orbit power could enable space-based sensing and power beaming missions. Entirely new technologies include tethers to attempt to harvest energy from the geomagnetic field and energy harvesting from a system's heat waste. Several satellite systems (e.g., radioisotope thermoelectric generators) have already demonstrated the use of nuclear energy. Moreover, modern designs exist for buried, autosafing, waste-consuming small modular nuclear reactors for assured ground-operations energy.

Energy Storage

The second section of table 2 considers energy storage. Because of discontinuation of the Teflon-30 nickel-hydrogen (Ni:H) separator material in Ni:H batteries after 2012 in response to environmental concerns, research to develop an accelerated life test for lithium-ion chemistries will become important for future national space-security missions. In the near term, storage technologies such as flywheels could provide the required energy with the added feature of reaction wheels, having the potential to assist with attitude control. In the

longer term, advances in nanomaterials promise high-power, high-density storage; high-cycling and discharge rates; and increased battery lifetime. In contrast, ground stations and data centers can leverage hybrid technologies, including traditional lead-acid batteries and large flywheels.

Propulsion and Power

The third section of table 2 considers propulsion and power in space. On-orbit systems such as sensors, communications equipment, and onboard processing require intense amounts of power.

Beyond near-term efficient microprocessors, innovations such as memristors, photonic computing, and quantum computing could produce significant energy efficiencies (further addressed in the "Cyber Energy" section, below). Advantages include smaller size and greatly reduced thermal load beyond silicon alternatives.

Advances in satellite propulsion are also essential for orbit raising, station keeping, and maneuver, particularly for low-Earth-orbiting satellites. In the midterm, the survivability and increased longevity of current-generation satellite systems demand further investigation. In the midterm and far term, technologies such as Hall and electric thrusters may lead to extended utility of limited onboard propellants. Concepts for on-orbit satellite refueling that leverages power beaming similarly promise to extend mission life. In the far term, advanced concepts in electromagnetic propulsion can provide advantages in mission duration and resiliency. Utilizing onboard power harvested from the environment, these systems can extend space maneuver without propellant, offering more weight and volume for operational capability.

Operational Innovations

As in the air domain, new methods of operation shown in section four of table 2 may generate significant savings. Given the fact that terres-

trial systems consume 97 percent of the power for space operations, in the near term, a commercial data center's best practices in HVAC and power management as well as cloud computing should be adopted, as detailed in the "Cyber Energy" and "Infrastructure Energy" sections, below. The top legacy candidates include launch ranges, control stations, data-processing centers, and ground-based space radar (fig. 7). In the midterm to far term, increased autonomy will decrease the need for operators and associated energy. Renewable energies are viable options for reducing the energy footprint of these facilities and assuring energy independence. Despite the many challenges in power beaming from space to earth, in the long term, space-to-space energy beaming could enable "fractionated" satellites, which are not only smaller but also more capable, distributed, and survivable than current systems. Also important are multidomain analyses to examine the relative energy efficiency of performing missions in the air and in space. Finally, increasing the efficiency of launch boosters will enhance access to space.

Figure 7. PAVE PAWS Radar. (From "PAVE PAWS FAQS," Peterson Air Force Base, 30 September 2010, http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=10506.)

Cyber Energy

All Air Force missions depend upon cyber infrastructures, especially the energy infrastructure itself. This dependency will increase as the service advances autonomous systems linked to each other and to service members through cyberspace to deliver more capability at less cost. Protecting our air and space missions as they traverse cyberspace for purposes of command and control, communications, ISR, or putting weapons on target is essential for power projection over global distances to ensure the Air Force vision of "Global Vigilance, Global Reach, Global Power." Adversaries will attempt to deny, degrade, manipulate, disrupt, or destroy critical infrastructures through cyberspace attack to undermine vital missions.

While device size, weight, and energy consumption drops, problems associated with compact energy storage rise. Over the past 15 years, floating point operations per second (flops) per kW have improved 700-fold, from 2.5 billion to 1,945 billion flops/kW. We envision that this trend of doubling power efficiency every 1.6 years will continue through 2020, allowing high-performance computing (HPC) system-level power efficiencies to exceed 100 billion flops/W. This will greatly improve the capacity of data centers.[6] It will also allow more sophisticated processing within embedded systems in the field.

One important metric for cyber energy—power usage effectiveness (PUE), equal to total facility power divided by information technology equipment power—measures how much additional power the infrastructure consumes over and above the servers themselves. For example, if for every watt consumed by the server, the infrastructure consumes another half watt, the PUE is 1.5. Current state-of-the-art commercial enterprises operate at PUEs of 1.2.

The Air Force vision for cyber energy encompasses four areas: empowering the mission, optimizing human/machine systems, enhancing agility and resilience, and inventing new foundations (table 3).

Table 3. Cyber energy science and technology

Thrust	Area	Near (FY 11–15)	Mid (FY 16–20)	Far (FY 21–25)
Empowering the Mission	System Efficiencies	• Algorithm/Code/Hardware Efficiencies (L) • Hardware Architecture (3-D Chips) (e.g., Memory on Memory) (L) • Efficient Software Architectures (L) • SWAP (Size/Weight/Power)-Efficient Computer Technology (F) • Energy-Efficient HPC Resource Control (W) • Lightweight Hardware (W)	• Nanosensor Development; Nanoprocessing Technology (L) • Integrated Optical Single-Photon Quantum Key Distribution/ Processing on a Chip (L) • Processor Energy Optimization (F) • Optimization of Computer Power Supplies (F) • Environmental Adaptive Computing (W) • Intelligent HPC Resource Control (W) • Optimization of Computer Power Supplies SWAP-Efficient Computer Technology (W)	• Hardware Architecture Advances (3-D Chips) (L) • Quantum Computing Technology (F) • Memristor-Based Neuromorphic Circuits for Efficient Cognitive Computing (F) • SWAP-Efficient Computing Nanostructures (F)
	Renewables	• Nanotechnology-Based Architecture (F) • Alternative Power Supplies on Chip (Batteries, Supercapacitors, etc.) (W)	• Renewable-Powered (e.g., Solar) Small Computing Systems (W) • Alternative Energy Supplies (Solar, Wind, Geothermal) (W)	• Miniature Energy-Harvesting Systems for Micro RPAs (F)
Human/ Machine	Culture Issues	• Leadership Mandates (L) • Cultural/Behavioral Changes on Energy Efficiency (L) • Metrics, Data Consistency, and Measurement (F)	• Human Trust in Cyber (L) • Sensing and Augmentation of Human Performance (L) • Server Migration (Footprint) (F)	• Trust in Collective Teams of Humans and Machines (L)
Enhancing Agility and Resilience	Electricity	• Establishment of Policy/ Procedures in Energy Savings (L) • Monitoring and Control Systems (F) • Smart Grid (F)	• Alternative Energy (Solar Cell, Fuel Cells, etc.) (W) • Green Buildings (W) • Secure Smart Grid (F)	• Remote Measurements and Control Systems (Central Command for Energy) (F) • Robust, Secure, Smart Grid (W)
	Cloud Computing	• Efficient Computing Algorithms (L) • Heterogeneous Commercial-Off-the-Shelf HPC Systems Based on General-Purpose Computing on Graphics Processing Units (W) • Distributed-Wireless Technology (W) • Cloud Computing Technology (W)	• Optimization of Server Software (L) • Cyber Security (L) • Software Architectures for Security and Assurance in Cloud Environments (L) • Optimization of Supercomputer Use (F) • Cloud Services/Computing (F)	• Cyber Energy-Management System (F) • HPC-Enabled Autonomy (W) • Use of Intelligent Systems to Decrease Labor/ Energy Usage 10%/Year (W)
New	Game Changers		• Emerging Nanotechnology (L) • Emerging Superconducting (F) • Emerging Quantum Devices (F)	• Superconducting on Demand (F) • Ready Availability of Nanotechnology (F) • Ready Availability of Quantum (F)

Empowering the Mission

Air Force missions, such as persistent surveillance of large areas, require massive data analytics on supercomputers to deliver the critical capability of finding the proverbial "needle in the haystack" and thereby help humans avoid sensory overload. At another extreme, covert special operations forces have limited communications, time, and battery capacity yet need portable computation that only a few years ago would have necessitated a supercomputer. Even more daunting, autonomous operation of bird-sized micro air vehicles demands that high-performance computer operations be carried out in micro physical spaces. This issue will become more acute as vehicles shrink to bug size by 2020. The combination of massive data analytics on supercomputers and embedded high-performance computing enables new mission capabilities for the Air Force.

As captured in the first section of table 3, achieving energy efficiency at the system level and finding the technical means for another 700-fold improvement over the next 15 years address all of these mission needs. Technology advances such as three-dimensional stacking can be game changers but not if the stack overheats from power-hungry chips. In addition to improvements from computer architecture, packaging, and system integration, one can gain much by considering the interplay of algorithms and software with the underlying hardware and with the software architecture itself. The 500-teraflop Condor supercomputer at the AFRL (fig. 8) has shown that attaining such balance can deliver order-of-magnitude improvements in energy efficiency.[7] By combining 1,716 Sony Playstation 3s and 176 Nvidia general-purpose graphical processing units, the system can take on a variety of compute-intensive analytic problems and sustain over 50 percent of its peak performance while dissipating only 257 kW. However, case studies have repeatedly shown that mismatches among mission applications, algorithms, and architectures can lead to gross inefficiencies, sometimes causing greater than 100-fold increases in run times.

Figure 8. Condor. (From "Playstations in Racks," DoD Live, accessed 6 February 2012, http://www.dodlive.mil/index.php/2010/12/dodlive-bloggers-roundtable-condor-supercomputer/playstations-in-racks/.)

Finally, the embedded nature of much mission-oriented computing poses additional technical challenges for energy storage and generation from renewable sources. Nanotechnology advances leading to supercapacitors could dramatically extend mission capability and help meet tight size and weight constraints, as captured in the renewables section of table 3.

Optimizing Human/Machine Systems

As articulated in the second section of table 3, to reduce energy demand, the Air Force needs to advance its culture to become more aware of and conservative of its energy in conducting everyday cyber

duties. Better measurement and social media (e.g., microblogging, personalized dashboards) can enhance awareness of and guide energy-efficient attitudes, beliefs, and behavior. Improved sensing of human behavior can anticipate the latter and thereby improve performance, guard against insider threats, and elevate trust in autonomy. Research in areas such as intelligence amplification, augmented cognition, and integrated cyber and human systems is essential for effectively managing the data volumes, processing needs, and decision speeds of cyber. Optimizing human/machine systems promises force multiplication, greater efficiencies and resilience, and increased operational tempo.

Enhancing Agility and Resilience

The third section of table 3 addresses the enhancement of cyber agility and resilience through electricity efficiencies and cloud computing (the provision of computation, software, data access, and storage services that are location independent, scalable, and virtual). The Air Force must be able to continually monitor and assess our energy sources and have the agility to move amongst alternatives quickly—perhaps in an unpredictable fashion—implying secure and intelligent monitoring and control of smart power grids. Equally important, we must have agility where and when we choose to carry out missions in cyberspace—by means of cloud computing, for example. Moreover, support infrastructure can be located near low-cost energy sources. However, to ensure that the Air Force can operate in cloud environments with assured confidentiality, integrity, and availability in friendly and hostile environments, we must invest in S&T for automated mission assurance, cyber agility, and resilience.

Inventing New Foundations

The final section of table 3 depicts S&T areas that could "change the game" as regards cyber energy. These include advances in the interrelated technologies of quantum computing, nanotechnology, and superconducting materials.

Infrastructure Energy

Air Force infrastructure energy supports missions in air, space, and cyberspace in both fixed and expeditionary bases, encompassing energy acquisition, storage, and distribution. Currently, 85 renewable-energy projects at 43 bases are in operation, and another 19 are planned for FY 2011–14 (fig. 9), placing the Air Force ahead of its goal of 7.5 percent renewable energy by FY 2013. Many of infrastructure energy's needs call for ambitious but attainable implementations of technologies and best practices used in the commercial sector. Particularly problematic are energy security at the service's main operational bases and support of forward-deployed forces, the latter implying additional logistic burdens and costs associated with providing power to these increasingly capable and, thus, power-hungry forward positions.[8]

Figure 9. Green building. Cool-roof technology and a solar-generated hot water system are expected to help produce energy savings of 9 percent at the new fitness center at Tyndall AFB, Florida. (US Air Force photo, accessed 6 February 2012, http://www.af.mil/shared/media/photodb/photos/100513-F-1234E-102.jpg.)

Table 4 outlines technologies for infrastructure energy that the Air Force should lead, follow, or watch in the near term, midterm, and far term to meet energy-reduction and mission goals outlined in the *Air Force Energy Plan 2010*.

Table 4. Infrastructure energy science and technology

Area	Near (FY 11–15)	Mid (FY 16–20)	Far (FY 21–25)
Energy and Water Efficiency	• Implementation of Smart Grid Technologies Including Advanced Building Energy and Water Management Systems (F) • Development of Integrated Models to Analyze Energy and Water System Interdependence (F) • Investigation of Low-Energy Heating and Cooling Technologies (F)	• Autonomous, Multifuel (Omnivorous) Enabled Smart Grid (F) • Smart Building Technologies (F)	• Integrated Energy System Combining Renewable Energy with Nuclear Energy Sources and Innovative Energy Storage and Water-Conservation Technologies (F)
Renewables	• Expansion of Biomass for Electricity at Appropriate Air Force Installations (L) • Implementation of Petroleum-Replacement Technologies (L) • Focus on Increasing Efficiency of Current Wind and Solar Technologies (F)	• Thermochemical Production of Electricity and Fuel from Solar Energy (L) • Photovoltaic Technologies for Reducing Logistic Fuel Consumption (F) • Plastic to Tactical Fuel-Conversion Technologies Implemented at Forward Operating Bases (F)	• Flexible, On-Site Energy Harvesting/Consumption—Photovoltaic, Solar, Wind, Biomass, etc. (F) • Utilization of Microbial Fuel Cells for Waste-to-Fuel Capability (W) • New Concepts for Direct-Light-to-Electricity Conversion Technologies (W)
Energy Storage	• Incorporation of Adaptable Storage Technologies into the Base Grid; Emerging Battery Technologies (L) • Electrochemical Flow Capacitor—10X Improvement in Storage Capacity (L)	• Exploitation of Metal Hydrides—20X Improvement (L) • Exploitation of Sodium-Air Battery—10X Improvement (F)	• Superconducting Magnetic Energy Storage—Game Changer—to Enable Rapid Charge and Discharge Cycles (W)
Cultural Change	• Development of Energy Assessment and Grid-Monitoring Tools (L)	• Energy Consumption as a Mission-Impact Metric (L)	
	• Energy Efficiency as a Key Performance Parameter (F)	• Rapid Insertion and Exploitation of Emerging Energy Technologies (L)	• Adoption of Nuclear Energy Technologies (W)

Energy and Water Efficiency

The first section of table 4 concerns energy and water efficiency. Broad deployment of scalable management systems for building energy that apply advanced energy diagnostics and alternative, energy-efficient HVAC operation strategies could realize savings of at least 20 percent (more than $200 million) in HVAC energy consumption at DOD facilities.[9] Integrated and dynamic models of electricity, thermal, fuel, water, and waste systems can enable facility managers and, eventually, autonomous controllers to understand building-energy performance; diagnose building-energy faults; and assess alternative, energy-efficient HVAC operation and electrical consumption strategies to increase infrastructure efficiency, robustness, and resiliency.

Renewables

As captured in the second section of table 4, renewables promise sustainable and environmentally friendly energy supply (fig. 10). For example, biofuels can increase the supply of liquid fuels for forward-deployed tactical vehicles and HVACs. Waste-to-energy technologies can reduce energy demands and improve the environment. Although existing technologies such as biomass conversion, wind electricity, or photovoltaic cells can provide stop-gap measures for energy-independent facilities, liquid-fuel production requires the development of new solar-to-fuel technologies such as the Department of Energy–sponsored pilot at Sandia National Laboratories (the Counter-Rotating Ring Receiver Reactor Recuperator). Long-term possibilities include microbial fuel cells—bioreactors that convert energy stored in the chemical bonds of organic compounds directly into electrical energy without contributing additional carbon emissions.

Figure 10. Renewable wind. (US Air Force photo, accessed 6 February 2012, http://www.af.mil/shared/media/photodb/photos/100406-F-2907C-414.jpg.)

Energy Storage

The third section of table 4 summarizes the fact that highly efficient storage systems, which can quickly respond to changes in demand to stabilize voltage and frequency of the electrical grid, are essential to support key base operations. Given their rapid charge/discharge ability, supercapacitors show considerable potential for addressing load-leveling, power-shaving, and grid-stabilization issues. Compared to batteries, supercapacitors provide 10-times-higher power density, 100-times-faster charge/discharge rates, and 1,000-times-longer lifetimes at 30–80 percent lower cost. However, current technologies suffer from low energy density (about 20-times lower), high cost, and self-discharge issues, which limit widespread implementation. In the midterm, the federal government has invested significantly to improve the efficiency of batteries, solid-oxide fuel cells, photovoltaics, high-temperature semiconductors, and phase-change materials. In the long term, new high-temperature superconducting materials would become key enablers of magnetic-energy storage systems, yielding a smaller time delay between charge and discharge and providing almost instantaneously available power, very high output for short periods of time, and high-energy density.

Cultural Change

As captured in the fourth section of table 4, institutionalizing change will involve not only material advances but also human ones. Grid monitoring and assessment can enhance individual and collective energy awareness, which, in turn, motivates behavior change. Social media can be employed to drive community behavior. Developers, acquirers, testers, and operators must incorporate energy as a key parameter of infrastructure performance, explicitly connecting energy to mission effects and driving toward an assured energy advantage that is robust and resilient. The National Defense Authorization Act of 2010 directs the DOD to determine the feasibility of nuclear power plants on its installations. For example, autosafing, buried, and waste-reusing small

modular nuclear reactors could offer enhanced grid security to Air Force bases with requirements of less than 300 megawatts. Finally, the service should accelerate the assessment and transition of energy solutions to operations by using energy-infrastructure test beds such as experimental RPAs or select pilot bases.

Cross Cutting, Enabling Science and Technology

Illustrated in figure 11, new ideas emerging from research in basic science have the potential to fundamentally transform the energy landscape across all of the domains discussed above. For example, in terms of energy generation, these advances will enable ultraefficient photovoltaics, biofuels, and sun to petrol, as well as small modular reactors that are passively safe and use waste fuel. For enhanced energy storage, S&T developments will lead to advanced batteries with high power, density, and variable charge/discharge cycles; ultracapacitors;

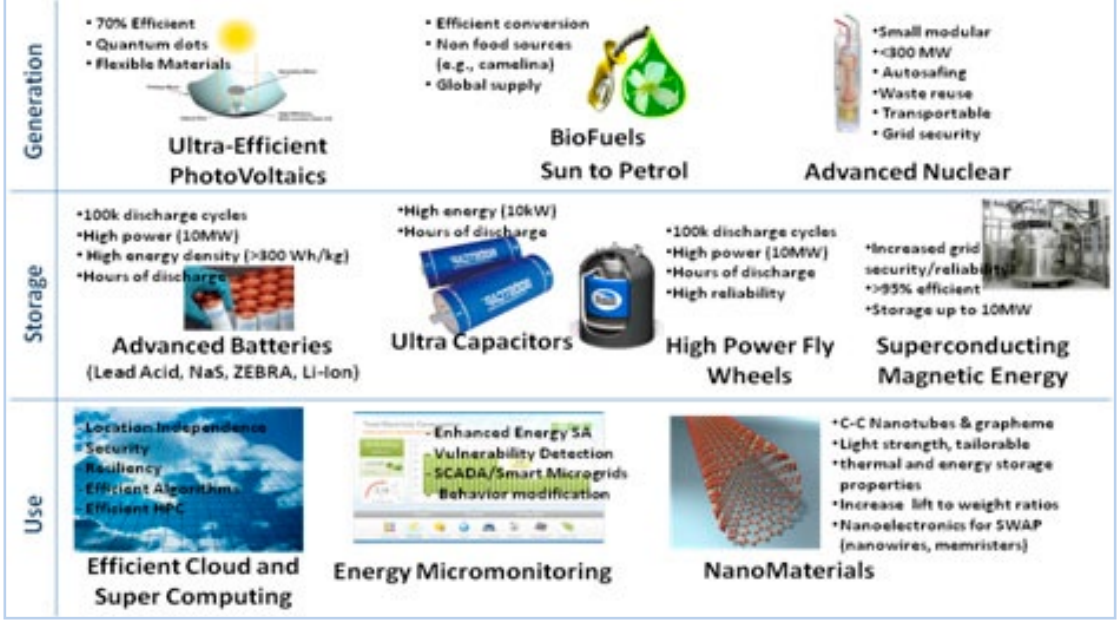

Figure 11. Cross cutting, enabling science and technology

high-power flywheels; and superconducting magnetic energy. Nanomaterials will make possible lightweight, high-strength structures as well as nanoelectronics. Furthermore, cloud and green supercomputing will enable resilient and efficient computation, and energy micromonitoring and control will enhance energy situational awareness and motivate energy-saving behavior.

Finally, in the longer term, several scientific areas that cut across multiple domains identified in the Air Force's *Report on Technology Horizons* have the potential to transform the energy landscape for the service across missions in air, space, cyberspace, and infrastructure.[10] These include collective behavior in nanostructured materials; lightweight, multifunctional structures; materials and systems under extreme conditions; bioengineering and biomimicry; control in complex systems; information and cyber infrastructure; and trust and autonomy.

The Way Forward

Science and technology can offer advances that translate into operational advantages, including cost savings, energy resiliency, system robustness, and operational readiness. Achieving an "assured energy advantage" across primary missions requires the Air Force to do the following:

- Partner with relevant federal government entities to leverage energy investments. This includes, but is not limited to, the Office of the Secretary of Defense (OSD), Navy, National Aeronautics and Space Administration (NASA), and Federal Aviation Administration in air energy; NASA and the National Reconnaissance Office in space energy; US Cyber Command and the National Security Agency in cyber energy; and the OSD, Department of Energy's Applied Research Program Activity–Energy, Department of Homeland Security, and National Science Foundation in infrastructure energy.
- Focus precious Air Force resources on the service's unique mission requirements in air, space, cyberspace, and infrastructure en-

ergy, emphasizing both financial and operational benefits as well as outcomes at a system-of-systems level.

- Deliberately choose roles that focus investments—for example, acting as an energy leader in research and development of air and space energy, a fast follower / early adopter of others' cyber energy advancements, and a watcher in infrastructure energy, except in unique Air Force niches (e.g., rapid and secure grid deployment and expeditionary energy).
- Make the efficiency of air operations a first priority and ground operations (e.g., space-operations control, data-processing centers, and infrastructure-process energy) a second priority.
- Employ a systems approach that subjects solutions to a business-case analysis prior to adoption and that considers interdependencies across the domains of air, space, cyberspace, and infrastructure, employing evaluation metrics to guide investments that comprehensively consider fully burdened costs and life-cycle costs.
- Accelerate assessment and transition through the employment of test beds such as experimental RPAs, or select bases that can pilot operations as well as process energy solutions.
- Create relevant energy education and training and develop a culture of energy understanding that motivates the desired behavior of communities to assure an energy advantage.

Because of its pervasive nature, energy is a shared responsibility, and the realization of the *Energy Horizons* vision will demand a full team effort to realize the "assured energy advantage" in the joint and coalition fight. Key stakeholder communities and required actions include the following:

- *Energy Awareness*. Increase energy awareness to guide energy-efficient behaviors through enhanced energy communication, training, situational awareness, and incentives/recognition.

- *Science and Technology*. Aggressively pursue the most promising energy S&T vectors as articulated in *Energy Horizons*, focusing on cross-cutting enablers that promise to maximize return on investment, future savings, and operational capability/advantage such as high-efficiency propulsion and photovoltaics, revolutionary materials, and high-capacity storage.
- *Test and Evaluation*. Assess and guide systems from design to operations to meet the Air Force's energy goals.
- *Analysis and Planning*. Ensure rigorous energy analysis and the supporting force mix to attain the Air Force's focused objectives. Additionally, develop an accepted methodology to calculate, monetize, or otherwise quantify the value of "energy security," considering multiple variables such as cost, environmental footprint, physical security, resilience, flexibility/adaptation, and geopolitical risk.
- *Requirement and Acquisition*. Consistent with the DOD's operational energy strategy, which articulates energy as a key performance parameter, provide an assured energy advantage in requirements and acquisitions that is resilient and evolutionary.
- *Operations*. Advance operational concepts, tactics, techniques, and procedures that simultaneously enhance efficiency, resiliency, and operational effectiveness.
- *Education and Training*. Ensure that sufficient expertise in science, technology, engineering, and mathematics exists in multiple energy sciences across the integrated force to sustain the human capital necessary to realize our energy advantage.

In summary, the vision of the *Energy Horizons* report promises an "assured energy advantage across air, space, cyberspace and infrastructure," mentioned above. *Energy Horizons* is essential to achieving the Air Force's economic, environmental, and operational imperatives while at the same time supporting national objectives of economic development, environmental stewardship, and supply independence. By carefully focusing on the near term, midterm, and far term as a delib-

erate leader, fast follower, or watcher, and by working in full partnership with other services and agencies, the Air Force can more rapidly and efficiently advance its *Energy Horizons*. Thus, *Energy Horizons* helps our service ensure not only energy robustness, resiliency, and readiness but also concomitant efficiency in peacetime operations, independence of action during humanitarian and disaster relief, and military superiority during conflict. ✪

Notes

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3. US Air Force Chief Scientist, *Energy Horizons*, 2.

4. James Mattice et al., *Technology Insertion for Energy Savings in the Legacy Fleet*, Report no. AFRL-RZ-WP-TR-2011-2092 (Wright-Patterson AFB, OH: Air Force Research Laboratory, July 2011), 132, 284.

5. Ann Karagozian et al., *Technology Options for Improved Air Vehicle Fuel Efficiency*, Report no. SAB-TR-06-04 (Washington, DC: Air Force Scientific Advisory Board, May 2006), 16, http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA456127.

6. Jonathan Koomey, *Growth in Data Center Electricity Use, 2005 to 2010* (Oakland, CA: Analytics Press, 2011), 6.

7. SSgt J. Paul Croxon, "What's under the Hood? Air Force Scientists Build Supercomputer Using Game Consoles," *Airman Magazine* 54, no. 7 (November–December 2010): 17–19, http://www.af.mil/shared/media/document/AFD-110601-016.pdf.

8. See Air Force Scientific Advisory Board, *Alternative Sources of Energy for U.S. Air Force Bases* (Washington, DC: Air Force Scientific Advisory Board, December 2009).

9. Executive Order (EO) 13423, "Strengthening Federal Environmental, Energy, and Transportation Management," 24 January 2007; and EO 13514, "Federal Leadership in Environmental, Energy, and Economic Performance," 5 October 2009. Both of these EOs implement the Federal Leadership in High Performance and Sustainable Buildings Memorandum of Understanding, including the Energy Policy Act of 2005.

10. *Report on Technology Horizons: A Vision for Air Force Science and Technology during 2010–2030*, vol. 1, AF/ST-TR-10-01-PR (Washington, DC: United States Air Force Chief Scientist [AF/ST], 15 May 2010), http://www.af.mil/shared/media/document/AFD-101130-062.pdf.

Dr. Mark T. Maybury

Dr. Maybury (BA, College of the Holy Cross; MBA, Rensselaer Polytechnic Institute; MPhil, PhD, Cambridge University) is chief scientist of the US Air Force, serving as chief scientific adviser to the chief of staff and secretary of the Air Force and providing assessments on a wide range of scientific and technical issues affecting the Air Force mission. In this role, he identifies and analyzes technical issues, bringing them to the attention of Air Force leaders, and interacts with other Air Staff principals, operational commanders, and combatant commands as well as acquisition and science and technology (S&T) communities to address cross-organizational technical issues and solutions. Dr. Maybury also interacts with other services and the Office of the Secretary of Defense on issues affecting the Air Force's in-house technical enterprise. Serving on the Steering Committee and Senior Review Group of the Air Force Scientific Advisory Board (SAB), he is the principal S&T representative of the Air Force to the civilian scientific and engineering community and to the public at large. Dr. Maybury served on the SAB as vice-chair of S&T, vice-chair of a study on remotely piloted aircraft, and a member of studies on commercial space, rapid on-orbit checkout, and operating in contested cyberspace. He also chaired an SAB information S&T review and vice-chaired a human-effectiveness S&T review at the Air Force Research Laboratory. Additionally he has served on studies for the Defense Science Board and the Intelligence Science Board. A former Air Force officer and Fellow of the Institute of Electrical and Electronics Engineers, Dr. Maybury is currently on a leave of absence as an executive director at the MITRE Corporation. He has edited or coauthored 10 books, authored over 60 refereed publications, and received several US patents.

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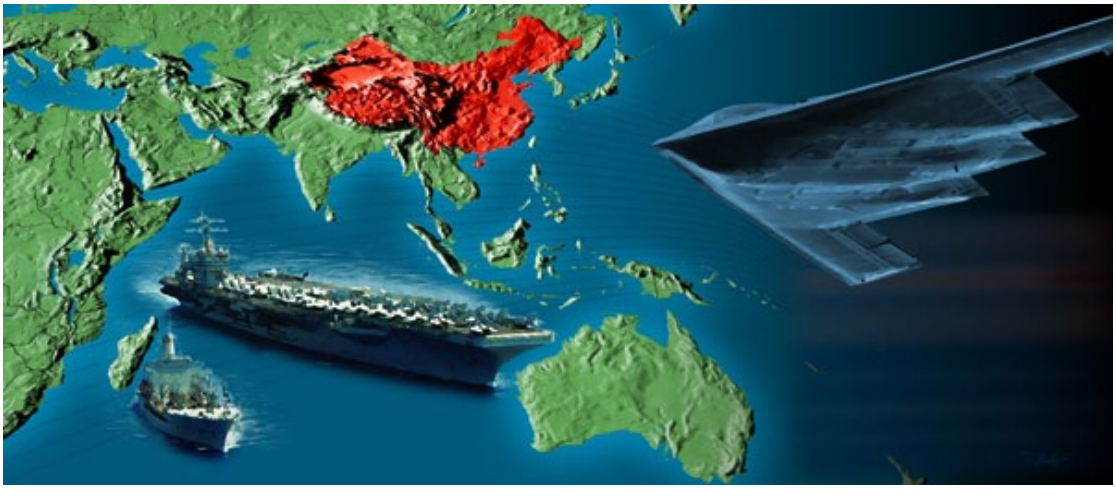
The Australian Factor in the United States' Western Pacific Strategy

Liao Kai



Recently, disputes concerning the South China Sea (SCS) have entered the world's spotlight. The United States has made multiple efforts to influence the Sino-Filipino and Sino-Vietnamese disagreements. On numerous occasions, US political and military leaders have expressed their resolve to defend the United States' interests in and sphere of influence regarding the Western Pacific. By the same token, the US military has engaged with its Asia-Pacific allies, including former foes, in a series of joint military exercises. China has strongly opposed any attempt to internationalize the SCS disputes and wishes to settle them through bilateral efforts. China regards the United States' entrance into this argument as a challenge to its interests and interference with Chinese territorial as well as foreign affairs. Though not clearly stating its stance on the SCS issue, Australia sent

troops to a joint military exercise with the United States and Japan in the SCS in July 2010. More recently, Australia allowed a US Marine force to stay permanently on one of its north coastal bases. China is likely to interpret all of these developments as acts of assisting the United States in tightening the "island chains."

This article briefly identifies the strategic landscape around and beyond the SCS, discusses the US AirSea Battle concept, and then offers a detailed analysis of the Australian factor in this concept as well as the challenges it represents for China. Finally, the article proposes a course of action that China may take in handling the evolving SCS situation.

China's Interests in the South China Sea

To predict how the SCS disputes may evolve, one must understand how China views them, where its interests lie, and whether such interests are general or core in nature. First and foremost, China claims sovereignty over the large waters of the SCS as well as the Nansha (Spratly) Islands. However, rival neighboring states have not supported this claim. Indeed, disagreements about sovereignty over the SCS have existed for many years. After the discovery of a huge reserve of strategic resources under SCS waters, this contention quickly turned volatile. Second, the Nansha Islands flank China's passage to the Indian Ocean through the Strait of Malacca. Here the ramification is twofold: (1) Economically, China's trade relies heavily on this sea line of communications. Specifically, about half of the crude oil that China imports must pass through Malacca. (2) Strategically, if conflicts erupt—in particular, if the Strait of Malacca is blocked—China will lose a considerable part of its energy supply as well as its global exports, which in turn will choke China's continued development. Finally, the SCS forms a link of the so-called first island chain off China's shores. Failure to break this chain will prevent freedom of access to the Indian Ocean and further down the South Pacific. According to the *Washington Post*,

Dai Bingguo, state councilor of China, described the SCS as part of China's "core national interest" at his meeting with Hillary Clinton, the US secretary of state, in May 2010.[1] Confirmation of this report could not be found in any official Chinese media, but there is no question that the SCS touches upon China's core interests. On another occasion, Adm Michael Mullen, former chairman of the US Joint Chiefs of Staff, heard his Chinese counterpart, Gen Chen Bingde, chief of the People's Liberation Army (PLA) General Staff, say that "China, together with its neighboring countries, has the wisdom and capability to appropriately handle SCS disputes. These disputes do not need the United States to bother with, all the less to worry about."[2] Obviously, General Chen was telling the United States not to poke its nose into the SCS disputes.

US Interests in the South China Sea and Possible US Intervention

Disregarding China's repeated warnings, the United States is determined to stay involved in the SCS disputes—a course of action that China believes will only complicate the situation, escalating rather than abating it. What are the United States' interests in the SCS controversy or the settlement thereof? In what ways will it stay involved?

The US military and think tanks generally consider the SCS vital to America's interests in the Western Pacific.[3] In her visit to Hanoi in 2010, Secretary of State Clinton remarked that "the United States . . . has a national interest in freedom of navigation, open access to Asia's maritime commons, and respect for international law in the South China Sea."[4] However, China has always interpreted what the United States upheld as "freedom of navigation" as "freedom of espionage," under which the US military may maneuver freely along China's coast to gather intelligence and monitor Chinese military activities in the water and air. Also based on the argument of defending this freedom of navigation, the United States and its allies

are forming ever-tighter first and second island chains. To contain China's expansion into the Western Pacific, over the years, the US government and its military have progressively streamlined their strategies, the most current and systematic of which is AirSea Battle. The official stand-up of the AirSea Battle Office within the Pentagon on 9 November 2011 marked the latest development in making this concept a reality.

China's Perspective on the AirSea Battle

China has been able to sustain its growth momentum since the economic reform of 1978. Its national power continues to expand, as does its military power. Recently, China rose to second place in the world in terms of military expenditures. Strengthened by its growing economic and military power, China has become more confident in handling both international affairs and its own national defense. As a logical development, China has defined—and expanded—its national interests, accompanied by a more active defense strategy. Along these lines, China has participated in patrolling and convoying in the Gulf of Aden and in United Nations peacekeeping activities. Also noticeable is the fact that China is quickly improving its surface and subsurface fleet in both quantity and quality, as well as upgrading its antiship ballistic missiles, represented by the latest model DF-21D. Such efforts are broadly construed as increasing China's deterrence as well as its anti-access and area denial (A2/AD) capabilities in the Western Pacific. Expectedly, the current sole superpower feels the pressure and worries about imminent encroachment upon its national interests along the periphery of China and on the sea. The US military believes that the PLA is postured to threaten US freedom of action on several fronts. Specifically, America's military bases in Japan and Guam are no longer safe; US forces may not be able to hold back PLA forces in Western Pacific areas; and US command and control and reconnaissance space assets above the Western Pacific are also at risk of attack.[5] To deter and

defeat China in the Western Pacific, the United States has proposed a number of counter-A2/AD strategies.

Among these, the AirSea Battle concept—supposedly first developed by the Center for Strategic and Budgetary Assessments—attracted most of the attention. Eventually, the US military adopted the concept's ideas, and key Asian allies of the United States supported it. This strategy assumes that during a China-US conflict in the Western Pacific, PLA forces would have the A2/AD capabilities to attack US bases in Guam and Japan, to launch full-scale information warfare, and to destroy the "ears and eyes" of US forces by means of antisatellite missiles and cyber attacks—the so-called assassin's mace. After studying the PLA's assassin's mace and borrowing from the AirLand Battle concept developed by the US military in the 1980s, US strategists formulated the AirSea Battle, which calls for combining air and sea powers into a coherent force and utilizing Asian allies in significant roles. Specifically, the first phase of US military operations would involve seizing and sustaining the initiative during the first wave of PLA preemptive attacks. In the follow-on stage of conventional operations, the US military would quickly "blind" the opposing forces' information and communication systems so as to thwart A2/AD efforts. AirSea Battle pursues the following course of action:

- Blind the opponent.
- Defend priority defense bases and military assets.
- Suppress the PLA's medium-range land-based ballistic and cruise missile forces.
- Strike the PLA's command and control, wide-area surveillance, and air defense systems
- Attack the PLA's surface and subsurface capabilities.
- Place serious strains on the Chinese economy, society, and leadership.[6]

In May 2010, Secretary of Defense Robert Gates remarked that "the agreement by the Navy and the Air Force to work together on an Air-Sea Battle concept is an encouraging development, which has the potential to do for America's military deterrent power at the beginning of the 21st century what Air-Land Battle did near the end of the 20th."[7] In October 2010, at an annual meeting of US and Australian foreign and defense officials, Gates vowed to boost US military deployment in Australia and increase US-Australia defense ties.[8] Just one year later, these two countries announced that Australia would provide a permanent base on its north coast for a US Marine force.[9]

Australian Defense Strategy and Its Role in the AirSea Battle

Descendants from the same Anglo-Saxon roots, Australia and the United States share many cultural and ideological identities. Australia has long remained a key US ally in the Asia-Pacific region under the Australia-New Zealand-United States (ANZUS) Treaty signed nearly 60 years ago. In every war launched or fought by the United States outside its borders, Australia offered unstinting support. Moreover, Australians attribute the peace in the region over the past decades mainly to the stabilizing force provided by the United States. In return, President George W. Bush in 2003 hailed Australia as its "sheriff" in Southeast Asia.[10] Such close ties between these two nations make China very attentive to Australia's strategic orientation. Although China and Australia in no way pose direct threats to each other and have no conflicts of interest, somehow Australia considers China a potential threat to its national security; furthermore, China is suspicious about the ANZUS and wonders how Australia would react to potential conflicts between China and the United States. Undoubtedly China understands that in any future China-US conflicts, Australia's attitude would be important. Disregarding China's scrutiny, Australia repeatedly identifies itself as a close ally of the United States. For example, during a speech at the Brookings Institution in 2010, Stephen Smith, Australian minister for

defence, assured the audience once again that "Australia is an ally that adds value. We're not a consumer of United States security who imposes tough choices on the United States military and United States public policy." However, Smith ended his speech by saying indignantly, "We value add and we do so from a vantage point of respect, not dependency."[11] From this statement, one may infer that Australia wants to act as an independent state with independent foreign affairs and security policies—not as a blind follower of the United States. Australia chooses to align itself with the United States out of its own national interests. Then how does Australia, from its independent strategic and defense perspective, view China? And how does the Australian factor, or the role it plays, affect China—both geostrategically and militarily?

As suggested by the title of its defense white paper of 2009, *Defending Australia in the Asia Pacific Century: Force 2030*, Australia is aware that the future of its strategic outlook will be shaped by the global and regional distribution of political, economic, and military power; the transformation of major power relations in the Asia-Pacific region, especially the rise of China; and its relations with the United States.[12] Economically, China is Australia's number-one trade partner. In other words, the Australian economy is closely tied to this trade relationship. Since the beginning of the twenty-first century, Australia has enjoyed a very strong export market of gold, coal, ore, and many other resources, thanks in large part to China's rapid economic development and growing demand for resources. However, substantial gaps remain between these two countries in many areas, especially in culture and political systems. Such gaps widened in the last couple of years in the wake of China's arrest of individuals employed by Rio Tinto, a British-Australian mining company, on corruption and espionage charges. Mistrust further deepened following revelations from WikiLeaks that former Australian premier Kevin Rudd apparently told Secretary of State Clinton "to be prepared to use force against China."[13] In terms of sea territory, Australia is certainly one of the largest nations in the world; therefore, freedom of the seas is paramount to Australia's

economy and security. Claiming jurisdiction over 27.2 million square kilometers (half of which is "over ocean or sea") or 5 percent of the planet, Australia must naturally defend and expand its national interests through the sea.[14] A country with huge reserves of natural resources, Australia lacks only water and population—inherent vulnerabilities that render it a comparatively weak power economically, politically, and militarily. Consequently, Australians do not seem to have sufficient confidence in their own capabilities to defend the vast territory and resources they control.

In stark contrast, China is a crowded country hungry for resources and not very far from Australia. The vigilant Australians, therefore, cannot help worrying that, some day in the future, when China gains freedom of action over the SCS, it may expand further down to approach Australia, posing a more imminent threat to its national security. A poll reveals that 55 percent of Australians consider China the most important economic power in the world. Meanwhile, 57 percent believe that "the Australian government is allowing too much investment from China." In other words, the majority of Australians are concerned about the flood of investment from China. Forty-four percent of them feel that "China will become a military threat to Australia in the next 20 years" while 55 percent disagree.[15] Although many Australian analysts understand the importance of China to the Australian economy and trade as well as to global antiterrorism, when it comes to discussing the rise of China, they become more concerned.

So we see that, economically, Australia is already interwoven with China, but at the psychological level, its people are divided about their feelings towards the Chinese. Geologically, Australia is positioned where the Indian Ocean meets the Western Pacific. The northwestern coastal line of Australia almost touches the edge of the Indian Ocean, beyond which lies the SCS. By establishing a US joint or combined facility in Australia, the United States gains yet another forward base. This base, compared with those in distant Hawaii, facilitates logistics

in the event of an SCS conflict. Equally important, as compared to Japan and Guam, Australia remains outside the range of most of the PLA's land- or sea-launched missile attacks. The Australian base not only facilitates the operation of US deployed forces in SCS conflicts but also will play a significant role in potential Indian Ocean conflicts. Its strategic location, inland depth, natural affinity with the United States, and psychological suspicion about China, make Australia an ideal ally of the United States. In the US strategy for the Western Pacific and Indian Ocean and, in particular, for dealing with China, the Australia-US alliance will only grow closer and more important. In his book *AirSea Battle* (2010), Jan van Tol clearly states that "*AirSea Battle is not a US-only concept*. Allies such as Japan and Australia, and possibly others, must play important enabling roles in sustaining a stable military balance" (emphasis in original).[16] In this proposed AirSea Battle, Australia is expected to provide the United States with strategic depth, participate in gaining the command of the sea, support US forces in their operations in the eastern Indian Ocean and SCS, and assist US forces by diverting some PLA attacks.

If conflict erupts between China and the United States, China's trade with the United States and Japan would likely shrink dramatically. The US military would focus on cutting China's trade with the outside world, including choking Malacca and some other straits within Indonesia territory, to stop China from navigating into the Indian Ocean. Blocking the Strait of Malacca—not a difficult task for the US military—would force China to remap its line of transportation to the south through the Sunda Strait and Lombok Strait, both of which are situated to the northwest of Australia (see figure on the next page). Coincidently, careful readers may also find in the defense white paper of 2009, mentioned above, that Australia stepped up its security measures. Although their previous approach called for securing territory from the sea only, Australian military leaders have now adopted a dual-denial strategy that includes both sea- and air-denial capabilities. Furthermore, Australia's strategic scope has expanded to the eastern Indian Ocean.[17]

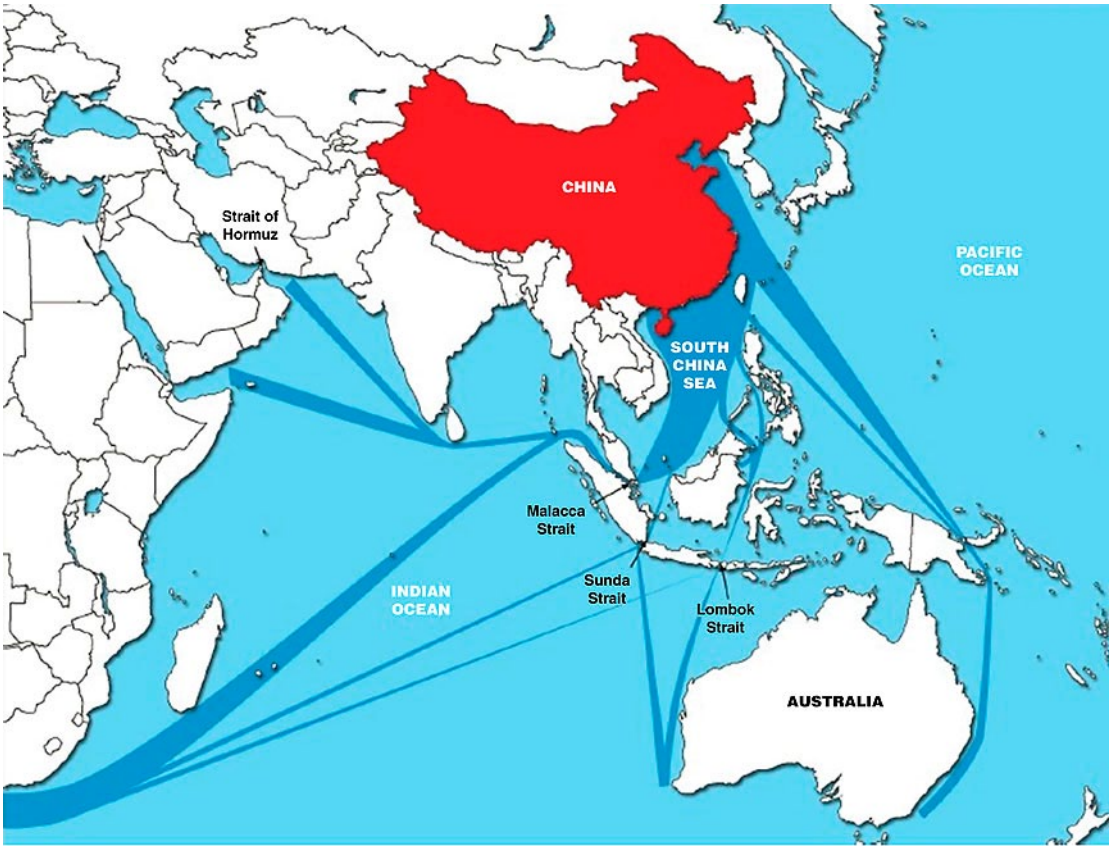


Figure. China's sea lines of communications. (Adapted from Jan van Tol with Mark Gunzinger, Andrew Krepinevich, and Jim Thomas, *AirSea Battle: A Point-of-Departure Operational Concept* [Washington, DC: Center for Strategic and Budgetary Assessments, 2010], 77, http://www.csbaonline.org/wp-content/uploads/2010/05/2010.05.18-AirSea-Battle.pdf.)

A number of influential Australian defense analysts hail the concept of AirSea Battle. Publications by Australia's military and defense researchers in the last couple of years coincide with that country's defense development, revealing that it is stepping up military preparation for a concerted AirSea Battle. For example, the 2009 defense white paper clearly states that in the upcoming years Australia will bolster its military capabilities. Specifically, the Australian government "has com-

mitted to real growth in the Defence budget of 3 per cent to 2017–18 and 2.2 per cent real growth thereafter to 2030."[18] In 2010, Australia's military expenditures reached a new high of 24 billion (US dollars), ranking number 13 in the world.[19] Prof. Ross Babbage, an adviser to that defense white paper, further suggests that, in addition to military strikes, allied states must launch a "widespread counter-trade campaign" against China. Such an action would cut China's trade and monetary transactions, in particular choking its access to energy and raw materials from Europe and the Middle East and, if necessary, interdicting its fleets "in distant locations, such as in the South East Asian maritime straits." He predicts that this "would result in very serious damage to the Chinese economy and, indeed, fundamental risks to the ruling elite itself."[20] Although this prediction itself merits serious questioning and although the Australian economy would suffer substantially because of these actions, Babbage's viewpoint does suggest that the Air-Sea Battle concept, along with its hidden hostility against China, is gathering support from the United States' Asian allies.

Australia has never clarified its stand in the possible US-China conflict. On the one hand, Australia has expressed its concern about China's expansion, as is explicitly mentioned in its defense white paper of 2009.[21] Also, in the joint communiqué of the Australia–United States Ministerial Consultations signed by US and Australian defense officials in November 2010, the two nations commit themselves to closer cooperation in the sea, air, space, and cyber domains. Australia will allow more US installations on its land and will permit the United States to use more ports, bases, and other facilities.[22] The Australian Defence Ministry confirmed that in June 2010, a special team from the US Air Force arrived in northern Australia to survey "Exmouth's top-secret Harold E. Holt base" for possible expansion of US space "surveillance of Chinese satellites and submarines."[23] On the other hand, when challenged about circumstances in which "Australia might say no to the United States when it comes to some kind of military situation in East Asia or the Asia-Pacific," Minister for Defence Smith responded, "I made the point in my speech that Australia has stood shoulder-to-shoulder

with the United States in every conflict the United States has been involved in since World War II. . . . But on every occasion that we made a decision to enter into a conflict, we made that decision on the basis of what we regarded Australia's national interest and national security interest to be."[24]

Furthermore, Australia's defense white paper of 2009 takes a similar position on this issue: "The Government recognises that Australia can and should play its part in assisting the United States in dealing with global and regional security challenges. . . . However, we must never put ourselves in a position where the price of our own security is a requirement to put Australian troops at risk in distant theatres of war where we have no direct interests at stake."[25] So, as this policy document indicates, Australia is still wavering strategically as to which course to take. Australians keep asking themselves whether the country should continue to rely on the United States for regional stability and security and what Australia should do to strengthen its own defense capabilities and develop a modern, self-reliant force. Yes, Australians are suspicious of, and in some cases dislike, China. Regardless, they are also keenly aware that China's importance to the Australian economy is growing.

Another dilemma arises from the Australian government's desire to remain shoulder-to-shoulder with the United States even though it is not confident that this big brother will remain dominant in the Western Pacific for the next 20 or so years. Similarly, the Australian government wants to strengthen its military cooperation with the United States, but it faces two hurdles. First, nearly half of the population opposes a substantial US military presence on its soil (55 percent support and 43 percent oppose, whereas 20 percent strongly support and 22 percent strongly oppose).[26] Second, the currently ruling Labour Party seems less enthusiastic about allowing US troops to stay in Australia. That country may choose to support both China and the United States in jointly transforming the regional order, or it may decide to help the United States remain the dominant power. Either way, its decision will

have enormous strategic implications for both China and the United States as well as the region. All things considered, China should pay close attention to trends within the Australian defense strategy and to the development of Australia-US military cooperation.

Suggestions for China's Decision Makers

This article suggests that Chinese decision makers take a three-phase approach—near term, midterm, and long term—to mitigate the strategic challenges China faces in the Western Pacific.

Near Term

First, China should refrain from taking measures that might cause tensions to flare into military conflicts over the SCS. Meanwhile, China should persist in solving SCS disputes through bilateral, rather than multilateral, negotiation and in all cases try to stop these disagreements from becoming internationalized. While not interfering with the internal affairs of other nations, China must also not allow a third party to meddle in any bilateral consultation between itself and rival neighbors over territorial disputes. Recent tendencies indicate that the United States or some member of the Association of Southeast Asian Nations (ASEAN) might propose an ASEAN-China bilateral negotiation or a multiparty negotiation with US participation. If strained by these proposals, China should try to divert the pressure through economic and diplomatic channels. For example, China might encourage more friendly ASEAN states (Myanmar, Cambodia, etc.) to put forward counterproposals. Moreover, using all necessary economic and diplomatic means, China should try to persuade Australia to keep its military cooperation with the United States within an appropriate scope, not going so far as to become part of the AirSea Battle. The fact that Australia recently consented to "a significant increase in the presence of United States Marines rotating through Australia's Robertson Barracks" seems to indicate that Australia has chosen to partner with the United

States in the AirSea Battle presumably designed against China.[27] Already in a passive status, China should make the best use of Australia's assurance that an Australia-US military alliance is not targeting China. Furthermore, China should propose or agree to proposals about joint military exercises with Australia—both as a gesture of goodwill and a means of curbing any military actions against China.

Midterm

China should prepare middle- and long-term strategy from a perspective that opposes the AirSea Battle. For instance, "blinding," mentioned repeatedly in the concept of AirSea Battle, is supposedly the US military's most favored tactic for gaining the initiative. To counter this attempt, the PLA should augment protection of its information and communication network, along with redundant backups. Doing so will ensure that the PLA can withstand the first wave of strikes without having its eyes "blinded." Additionally, the British Royal Navy's blockade during World War I may inspire US forces to cut off China's sea line of transportation "with an eye toward exerting major stress on the Chinese economy and, eventually, internal stress."[28] To counter this action, China should enhance its relationship with Central Asian countries to obtain their guaranteed oil and gas supply. Further, China may rebuild the "silk road" (a land route along which China started trade with Central and South Asian countries in the first century), making it an important "land line of communication" or a secured backyard. More importantly, China should continue its close partnership with Myanmar and Pakistan. This comprehensive approach will effectively dissolve any "internal stress" caused by the sea blockade. In fact, China has been executing this farsighted strategy and has made substantial progress. In the last three decades, it has not stopped building economic cooperation with the Central Asian states, Pakistan, and Myanmar, constructing cross-boundary railways and highways as well as laying oil and gas supply pipelines. The current deeply frayed relationship between Pakistan and the United States following the killing of Osama bin Laden and, more recently, of two dozen Pakistani servicemen by

North Atlantic Treaty Organization helicopters and jets has opened yet another window of opportunity for China.[29] By seizing this opportunity and filling the vacuum, Chinese leaders can keep this traditional ally more firmly on their side.

Long Term

China should actively continue its participation in operations sponsored by international organizations. Moreover, following the example of the United States, through peacekeeping, antiterrorism, counterpiracy, and humanitarian-relief activities, the PLA will gain valuable experience in overseas operations—essential to the strengthening of its sea and air powers. China can also explore the ongoing global economic crisis, renting and refurbishing foreign ports at strategic locations as well as increasing military cooperation with traditionally friendly states. One recent instance involved a proposal to set up an antipiracy base in Seychelles. China can also introduce other nations, such as Indonesia, Mauritius, and Fiji, into its calculus by aiding these countries economically and considering how to build military cooperation with them, possibly building a naval base or an intelligence, surveillance, and reconnaissance facility at some point in time. In short, China must have a secured sea line of communications (the so-called string of pearls) from the SCS all the way into the Indian Ocean. By thoroughly analyzing the US forces, both their strengths and vulnerabilities, and maximizing its own advantages, China can avoid defeat in a future conflict.

To some degree, Australians' vigilance towards China is triggered by the latter's aggressive procurement of resources from their country. By diverting its resource investments to more regions and countries, China could enjoy the twofold benefit of (1) mitigating the risk of relying too heavily on only a few sources of supply and (2) making nations like Australia understand that national interests are often reciprocal. China should devote an equal effort to building mutual confidence and reducing suspicion through more frequent dialogue and cultural ex-

change. As both the Australian defence minister's speech at the Brookings Institution and the Australian defense white paper of 2009 advised, China needs to increase "openness and transparency" in relation to capabilities and strategic doctrine.[30] China must reach out, engage, and explain persuasively the purpose of increasing its defense budget so as to establish mutual trust and address the concerns of its neighbors, both close and distant. Just as Australia is preparing for the decades-long strategic transformation in Asia, so will China have to adopt a long-term strategy that engages Australia on the one hand and, on the other, makes Australia fully aware that China is closely watching its strategic preparation and military cooperation with the United States.

To remain in concord with the South Asian countries, China should continue to use its political and economic prowess—including regional or bilateral cooperative and consultative platforms—to build conflict-prevention mechanisms. The Shanghai Cooperative Organization serves as good model that China can employ to set up similar venues for settling various disputes. Furthermore, through explicit diplomatic means, China must ensure that its neighbors clearly understand Chinese core values and interests and that they must not encroach upon them. At the same time, China (as it has always done) should remain determined to defend its core values and interests by all viable means, including force if necessary. China does not have to care too much about negative comments on increases in its defense budget. A defense budget of roughly 2 percent of the national gross domestic product (GDP) is actually small, particularly when measured per capita or compared to the gigantic US defense budget. In the coming years, China may gradually increase its defense budget to 3 percent of the GDP and maintain it at this appropriate level. Eventually China should introduce its version of the Monroe Doctrine into Chinese foreign policy—to push the US sphere of control or sphere of influence farther away from China's periphery.

Conclusion

Both the United States and Australia are crystal clear in their understanding that AirSea Battle itself is not a winning strategy. Defeating China through war largely depends upon an economic and psychological breakdown within China. Just as the United States believes that shutting down China's sea lines of communications will slow down its economy, which in turn will create internal disorder, so does China believe that it must reduce its dependence on foreign trade while boosting domestic demand and supply. Fundamentally, internal economic and political stability will prove crucial in defeating any perceived or planned blockade or military intervention. ✪

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Let us know what you think! Leave a comment!

Building Global Partnerships

112 Gripes about the French Revisited

Col Jim Drape, USAF

"You ride on the subway, and the smell almost knocks you out, garlic, sweat—and perfume!" Anyone who has ever ridden on the metro in Paris on a hot summer day can likely relate to this "gripe," in this case expressed by American servicemen posted in France after the end of World War II in 1945. Although a severe shortage of soap caused by four years of German occupation made the odor on the metro worse, a crowded metro is still not a pleasant place to be.

Since President Charles de Gaulle's decision in 1966 to withdraw from the integrated North Atlantic Treaty Organization (NATO) command structure and to expel American bases from France, no wide-scale interaction has occurred between American and French airmen. For many American Airmen, their direct impressions of France and the French likely depend upon what they retain from a weekend visit to Paris or Euro Disneyland from their bases in Germany. Without any

other references, Airmen may have picked up opinions and stereotypes unwittingly from pop culture, from other Airmen, from their families, and so forth. Insidiously, they become part of an Airman's mind-set. Although complaints about the smell on the French metro may seem innocuous, other commonly held stereotypes reflect underlying misunderstandings and prejudices against the French. At a time in which the Department of Defense (DOD) has identified "building partnerships" as one of its essential core competencies and the Air Force has embarked on an ambitious "Global Partnership Strategy," these prejudices are counterproductive, impeding the very partnership the service seeks with the Armée de l'Air (French air force). These partnerships become crucial as the DOD reduces its size and looks to cut costs whenever possible, thus leveraging off the strength of partnerships.

Identifying the Problem: Francophobes, They Are among Us

Last year, the saga of the sexual assault charges brought against Mr. Dominique Strauss-Kahn, a Frenchman and former director of the International Monetary Fund, once again revealed the all-too-familiar anti-French sentiments that exist in the United States. These sentiments are often evidenced by the open bashing of the French by everyday Americans on television, in the newspaper, and on the Internet. Justin Vaïsse, historian and researcher at the Brookings Institution, identified four categories of "francophobes" in the United States, including the State Department and the diplomatic realm; liberals; conservatives and neoconservatives; and the Jewish-American community.[1] Certainly, American military members likely fit into one of the three latter groups, but it is instructive to consider them separately as a fifth group that holds predictable (and negative) views of the French. As a distinct subculture within American society, US military members are particularly sensitive to certain actions of the French, such as their perceived abandonment of NATO in 1966, the refusal to grant overflight of French airspace in the 1986 bombing of Mu'ammar Gadhafi's

compound in Libya, and, of course, the most recent flare-up over the invasion of Iraq in 2003.

A case in point: at the Air Force Association's annual convention held in September 2011 in Washington, DC, Charles Krauthammer delivered a keynote address in which he outlined the current geopolitical landscape and national security challenges. This serious presentation addressed the threat posed by Iran and the proliferation of nuclear weapons. He made the point that nuclear weapons in and of themselves don't pose an existential threat but that the possessor could. He noted that Americans aren't threatened by Great Britain's having such weapons and that, with the dissolution of the Soviet Union, we are no longer worried about a nuclear exchange with the Russians. Nor are we concerned about the French, Krauthammer declared, but then seemed to reconsider—well, we're not so sure about the French. Alas, thence it came, out of the blue (no pun intended), an impromptu joke—and, of course, it was "just a joke." However, it wasn't so much the joke but the resultant laughter that resounded in the hall filled with senior Air Force officers, chiefs, and noncommissioned officers which made clear to even the most casual observer—and to the French *aviateurs* in the audience—the particular perception we American Airmen have of our "enemy." This took place on the same platform from which senior Air Force leaders invoked the necessity to build global partnerships and extolled the virtues of French and other European airmen.

This is not a new phenomenon. Nor is it a perception that began, as some believe, with the recalcitrant President de Gaulle and his decision to withdraw France from the integrated military command structure of NATO. Back in 1945, negative perceptions and stereotypes about the French were so prevalent amongst American GIs stationed in postwar France that the Army Department felt compelled to produce a small handbook, *112 Gripes about the French*. Issued to enlisted personnel, it served as a tool to defuse the growing tension between the American military and the locals.[2] Set out in a question-and-answer format, *112 Gripes about the French* posed a series of complaints about

the French and then provided a commonsense rejoinder to each, doing so, according to the original editors, not "to 'defend' the French or to chastise Americans who don't like the French" but to give average American Soldiers a fuller understanding of their hosts. In a straightforward manner, it presented "facts and judgments which even the well-intentioned may tend to overlook."[3]

In the same spirit, this article addresses three stereotypes of the French that many American Airmen hold—or, one could say, *still* hold, since they are all gripes taken directly from the 1945 handbook. Like that publication, this article does not make a conclusive attempt to "convince those who are hopelessly prejudiced." Rather, it offers a different perspective—an opportunity to rethink stereotypes that, unless checked, form the sole basis of one's perspective of an important ally. Like the common cold, that viewpoint often spreads to others; thus, as did the Army pamphlet, at a minimum it seeks to "keep others from being infected by the same lamentable virus."[4] However, in a more positive sense, the article hopes to complement the various Air Force efforts under way to build an enduring partnership with one of the most capable air forces on the planet, as recently demonstrated in the air operations over Libya. Reexamining our own perceptions represents an important first step in this effort.

We Saved the French (Twice) . . . How Can They Be So Ungrateful?

112 Gripes about the French: "We came to Europe twice in twenty five years to save the French. . . . We're always pulling the French out of a jam. Did they ever do anything for us? . . . They've forgotten. They're ungrateful."[5]

These were among the first gripes addressed in 1945, complaints that continue to manifest themselves to this day. Their expression is evident in the many jokes found on the Internet, such as the follow-

ing: "Q: What English word has no equivalent in the French language? A: Gratitude."[6]

To this day, when many Americans think of France, they recall the valiant acts of courage displayed by American Soldiers as they fought in the trenches of World War I and as they landed on the beaches of Normandy on D-day, 6 June 1944. The following citation sums up what many Americans, and certainly American military members, may think regarding French gratitude for American intervention:

> France is under a solemn obligation to the United States, as a matter of honor and gratitude for our having saved her independence in two terrible wars, and our having expended so much American wealth for her sake in peacetime, to refrain from enacting any measure . . . that would disclose to us . . . that she is unmindful of America's immeasurable sacrifices and generosity.[7]

Interestingly, this observation appeared in a newspaper editorial more than 60 years ago, but it still accurately captures the perspective of many Americans. Nonetheless, before we examine the perceived French lack of gratitude for these interventions, let's travel back in time to another conflict that would determine the survival of our own nation. The year was 1778; the conflict was the American Revolutionary War.

Let's start here because, simply put, had the French not saved America in the Revolutionary War, America could not have saved the French in 1944. In February 1778, two years into the war, things were going badly for the Americans, and America desperately sought France's help. General Washington unequivocally expressed this desperation in a letter imploring help from France: "We are at this hour suspended in the balance; not from choice but from hard and absolute necessity. . . Our troops are fast approaching nakedness. . . our hospitals are without medicines and our sick without nutrition. . . in a word, we are at the end of our tether, and. . . now or never our deliverance must come."[8] The needed deliverance from France did come, as the United

States entered into its first and only formal alliance prior to World War I. The Army's pocket guide reminded American GIs that

> France loaned the thirteen states $6,000,000—and *gave us* over $3,000,000 more.
>
> 45,000 Frenchmen volunteered in the army of George Washington.—They crossed the Atlantic in small boats that took two months to make the voyage.
>
> Washington's army had no military engineers; it was French engineers who designed and built our fortifications (emphasis in original).[9]

Thus, the beleaguered Continental Army received new life. To the very end, French assistance proved crucial—witness the actions of the French navy in securing the British surrender at Yorktown in 1781.[10]

Ten short years later, the French Revolution and France's subsequent war with England and other European monarchs put the "gratitude" of the young United States to the test. On one side were men like Thomas Paine and Thomas Jefferson, who argued that America must come to revolutionary France's aid to demonstrate gratitude for previous French assistance.[11] Alexander Hamilton, however, countered their proposal, saying that the country's first obligation was to itself and that it should act not on sentiment but according to the national interest. He made the point that, in helping the Americans, France had served its own national interests.[12] Accordingly, history shows that Charles Gravier de Vergennes, the French foreign minister, explained the French rationale exactly along completely nationalistic lines: "First, it will diminish the power of England, and increase in proportion that of France. Second, it will cause irreparable loss to English trade, while it will considerably extend ours. Third, it presents to us as very probable the recovery of a part of the possessions which the English have taken from us in America."[13]

Thus, Hamilton, who served at the Battle of Yorktown and knew firsthand the essential role played by the French, contended that America must now also look after its own interests. In the end, Washington accepted Hamilton's arguments rather than those of Paine and

Jefferson, and even though the formal alliance with France had never been dissolved, he issued the Neutrality Proclamation in 1794. Additionally, seven years later, President Jefferson himself had to change his approach. Even though his foreign politics had always been friendly to France and hostile to Britain, the dispute over the control of New Orleans, through which so much of the nation's commerce passed, forced him to threaten an alliance with Britain and war against Napoleon.[14]

Was Jefferson, the former ambassador to France, *ungrateful*? Had he *forgotten* his friends in Paris, of whom he said, "A more benevolent people I have never known, nor greater warmth and devotedness in their selected friendships."[15] Or had Washington, who developed such an intimate friendship with the Marquis de Lafayette, forgotten his indebtedness to the French for the role they played? After all, on the day of the British surrender, Washington said, "I wish it was in my power to express to Congress how much I feel indebted to the Count de Grasse and his fleet."[16]

At the time, many Frenchmen felt betrayed by their "unreliable" ally, a sentiment that would appropriately describe how many Americans feel today about the French. However, Hamilton did not say that gratitude, benevolence, and generosity had no place. He simply argued that these were sentiments left to *individuals*, not governments. In declaring its neutrality, the young American republic was simply acting in its own national self-interest, knowing that entangling itself in European affairs could spell doom for the fledgling nation. As Elbridge Gerry, a signer of the Declaration of Independence wrote, "Perhaps one principle, self interest, may account for all."[17]

With this historical backdrop, one can see the American involvement in both world wars in a different light. In June 1940, as Germany was routing the French army, the French prime minister cabled President Franklin Roosevelt the following plea, resembling George Washington's to the French during the American Revolutionary War: "If you cannot give to France in the coming hours the certainty that the United States will enter the war in a short time . . . the destiny of the

world will change. . . . You will then see France go down like a drowning man and disappear, after having thrown a last look toward the land of liberty where she sought salvation."[18]

Certainly such an emotional plea, coupled with American gratitude for the French intervention in the American Revolution would spur the United States into action, right? Not quite. The United States would wait a year and a half to enter the war, after the Japanese attack at Pearl Harbor, and another two years to disembark the first troops on the other side of the Atlantic Ocean in North Africa.

On the eve of the D-day invasion of Normandy, young GIs waited to risk their lives for their country, an act that requires courage. To do so for another country might demand more convincing. To help prepare them, the Army Department issued each GI a small guide, reminding them of why they were about to risk their lives for France:

> The Allied offensive you are taking part in is based upon a hard-boiled fact. It's this. We democracies aren't just doing favors in fighting for each other when history gets tough. We're all in the same boat. Take a look around you as you move into France and you'll see what the Nazis do to a democracy when they can get it down by itself.
>
> In "Mein Kampf," Hitler stated that his plan was to destroy France first, then get England, after which he would have the United States cornered without a fight. The Allies are going to open up conquered France, re-establish the old allied liberties and destroy the Nazi regime everywhere.[19]

One year later, as American GIs griped about life in postwar France, the Army Department felt it necessary to remind them, in a straightforward manner, why the United States intervened in the first place:

> We didn't come to Europe to save the French, either in 1917 or in 1944. We didn't come to Europe to do anyone any favors. We came to Europe because we in America were threatened by a hostile, aggressive and very dangerous power.
>
> In this war, France fell in June of 1940. We didn't invade Europe until June of 1944. We didn't even think of "saving the French" through military action until after Pearl Harbor—after the Germans declared war on

> us. We came to Europe, in two wars, because it was better to fight our enemy in Europe than in America. . . .
>
> American security and American foreign policy have always rested on this hard fact: we cannot permit a hostile power on the Atlantic Ocean. We can not be secure if we are threatened on the Atlantic. That's why we went to war in 1917; that's why we had to fight in 1944. And that's why, as a matter of common sense and the national interest, President Roosevelt declared (November 11, 1941): "The defense of any territory under the control of the French Volunteer Forces (the Free French) is vital to the defense of the United States."[20]

Thus, much like the French intervention in the American Revolutionary War, these citations make clear that the rationale for saving the French was clearly based on national self-interest. This is not to say that personal gratitude for the American intervention in France is not merited or doesn't exist. On the contrary, as any American who has traveled in Normandy or other regions of France can attest to, ample evidence exists that the French are grateful and hold a special reverence for the Americans who twice traveled across the ocean to fight alongside their countrymen in the world wars. However, as Hamilton effectively pointed out over two centuries ago, no matter how strong and appropriate these personal sentiments, they do not directly translate into national policy. One only has to look to the debate about American intervention in Libya to validate that at the end of the day, leaders must justify why or why not it is in the national interest to ally with another nation and support a foreign policy or intervene militarily at a given time and place. Before addressing the next American stereotype of the French, we close this section by examining President Barack Obama's speech at the National Defense University in March 2011, in which he emphasized the primordial place of national interest:

> But when our *interests* and values are at stake, we have a responsibility to act. . . .
>
> . . . If we waited one more day, Benghazi . . . could suffer a massacre.
>
> It was not in our *national interest* to let that happen. . . .
>
> . . . On the one hand, some question why America should intervene at all—even in limited ways—in this distant land.

> . . . Given the costs and risks of intervention, we must always measure our *interests* against the need for action. . . .
>
> America has an *important strategic interest* in preventing Gaddafi from overrunning those who oppose him. . . . I am convinced that a failure to act in Libya would have carried a far greater price for America (emphasis added).[21]

The French Would Rather Surrender than Fight

112 Gripes about the French: "The French have no courage. . . . They got off pretty easy in the war. . . . They just waited for us to liberate them. Why didn't they put up a fight?"[22]

A second major gripe, ever present in American culture, is that the French are cowards, unwilling to stand and fight. As expressed in American pop culture, the French are "cheese-eating surrender monkeys."[23] Other degrading references abound, such as the Subway restaurant advertising campaign of 2005, which portrayed a chicken dressed as a French soldier under the caption "France and Chicken—Somehow it just goes together."[24] Further, jokes such as the following abound on the Internet and on late-night television: "I don't know why people are surprised that France won't help us get Saddam out of Iraq. . . . After all, France wouldn't help us get the Germans out of France."[25]

Not much seems to have changed in 65 years. These same sentiments existed in 1945, as American GIs complained that the French hadn't put up a real fight against the Germans. The US Army addressed this gripe head-on:

> No one—least of all the French themselves—will try to deny the enormity of the defeat and the humiliation France suffered in 1940. French military leadership and strategy was tragically inadequate. But this does not mean that the French did not put up a "real fight."
>
> In the six week Battle of France, from May 10 to June 22, 1940, the French lost, in military personnel alone, 260,000 wounded and 108,000 killed. A total of 368,000 casualties in six weeks is not something to pass off lightly.[26]

All told, during World War II alone, 1,115,000 French men, women, and children died, suffered wounds, languished in concentration camps, or died as hostages—not exactly what one would call "getting off easy."

Furthermore, like the American Soldiers stationed in France after the war, most Americans today know very little about the brave French citizens who continued to take the fight to the enemy during the German occupation. Again the US Army reminded its troops of French courage during the war:

- They sabotaged production in war plants. They destroyed parts, damaged machinery, slowed down production, changed blue-prints.
- They dynamited power plants, warehouses, transmission lines. They wrecked trains. They destroyed bridges. They damaged locomotives.
- They organized armed groups which fought the German police, the Gestapo, the Vichy militia. They executed French collaborationists.
- They acted as a great spy army for SHAEF [Supreme Headquarters Allied Expeditionary Force] in London. They transmitted as many as 300 reports a day to SHAEF on German troops' movements, military installations, and the nature and movement of military supplies.
- They got samples of new German weapons and explosive powder to London.
- They ran an elaborate "underground railway" for getting shot-down American and British flyers back to England. . . . On an average, one Frenchman was shot every two hours, from 1940 to 1944 by the Germans in an effort to stop French sabotage and assistance to the Allies.[27]

However, as poignant as these examples may be, one does not have to go as far back as World War II to find examples of French willingness to fight. Since the fall of the Berlin Wall, the French have intervened in many conflicts in Africa and have courageously fought alongside Americans in nearly every recently assembled coalition, including the first Gulf War, Bosnia, Kosovo, and Afghanistan—with the notable exception of Iraq. However, despite jokes to the contrary, French opposition to the second Iraq war had nothing to do with cowardice, stemming instead from confidence in their intelligence sources, which had concluded that Saddam Hussein didn't possess weapons of mass destruction. Thus, they pushed for further weapons inspections to bear

this truth out, arguing that Saddam did not pose the immediate threat portrayed by the American administration.[28]

Currently, the French have the fourth largest contingent in Afghanistan and, correspondingly, have had the fourth largest number of servicemen die in the conflict—78 to date.[29] Beyond Afghanistan, France is one of the few countries with air force bases outside its territory, having them in strategic hot spots such as Djibouti as well as the United Arab Emirates, directly across the Strait of Hormuz from Iran. Finally, and perhaps surprising to many people, the French air force capably led the coalition's enforcement of United Nations Resolution 1973, which called for a "no-fly zone" over Libya to protect the civilian population.

In addition to these efforts at the national level, one can reflect on two recent events that highlight individual acts displaying both American and French courage in the current conflict in Afghanistan. Recently, Gen Norton A. Schwartz, the Air Force chief of staff, awarded the Distinguished Flying Cross with valor to a young French major in the 41st Rescue Squadron from Moody AFB, Georgia. During a deployment to Afghanistan, the major gallantly launched as part of a four-ship task force sent at night to rescue a British casualty whose injury put the lives of 160 British soldiers in jeopardy. Evading rocket-propelled grenades, he successfully rescued not only that soldier but also another, enabling the ground unit to complete its mission.

Three days previously, under the austere backdrop of the forward operating base in Kapisa, French brigadier general Emmanuel Maurin, commander of French ground troops in eastern Afghanistan, awarded three American Airmen the French National Defense Medal for their heroic actions during a nighttime helicopter rescue of two French airmen whose Gazelle attack helicopter had crashed in inclement weather. Dispatched to find the downed pilots, they dropped off their rescue crew, who found the French pilot waving a strobe light but unable to move his legs. The crew then found the copilot, still strapped to his seat, which had dislodged and slid to the back of the helicopter. The 37-year-old veteran of conflicts in Croatia, Kosovo, and the Ivory

Coast was valiantly struggling to breathe, so the Airmen made a small incision in his neck and inserted a breathing tube. The helicopter ferried the two injured men to the hospital at Bagram Airfield. Although the pilot survived and is expected to walk again, tragically, the copilot died, leaving behind a widow and four children in France.

As these vignettes poignantly demonstrate, the French serve courageously beside their American allies in Afghanistan, and in some cases, like the French copilot, they die *pour la patrie* (for the homeland). In the above anecdotes, the three *Americans* who received the *French* National Defense Medal for their daring rescue would not find humor in jokes about French cowardice. Neither would the downed British soldiers, saved by a young *French* major (*commandant*), decorated by General Schwartz for his service while serving as an exchange officer with the US Air Force. General Schwartz stood alongside Gen Jean-Paul Paloméros, the French chief of staff, in front of the Lafayette Escadrille Memorial—the final resting place of 66 of the very first American Airmen, laid to rest alongside their French squadron commanders.[30] The two air chiefs observed a moment of silence for five French soldiers killed that day in an ambush in Afghanistan—a poignant reminder of the military calling, regardless of the color of the uniform or the patch on the shoulder. There were no gripes or jokes about cowardice, surrender, or running away from a fight. As we move on to the third stereotype, it's time to silence and lay to rest these gripes and jokes as well.

We Can't Rely on the French. . . They Are Too Damned Independent

112 Gripes About the French: "We can't rely on these French. . . . The French are too damned independent."[31]

The story is familiar to most American Airmen—and it seems like just yesterday. The dictator of a Middle Eastern country defies the West as he provocatively evokes his dream of uniting other Arab coun-

tries under his leadership. Western countries deem his actions a threat, but one nation presses to allow more time, to find a diplomatic solution to the crisis, while another, though continuing diplomatic efforts, considers further diplomacy futile and builds a coalition for war. In the end, one goes go to war without the support of the other, feeling angry and betrayed by the lack of support from this unreliable ally.

In 1945 American Soldiers stationed in France griped that the United States can't rely on the French. To this day, much of the American public, including many American Airmen, holds essentially the same sentiment, particularly after French opposition to the second Iraq war. In response, the House of Representatives replaced French fries with "Freedom Fries," and many members called for a boycott of French products, reminiscent of the response in the mid-1960s when President de Gaulle attacked the existing international monetary order that privileged the status of the dollar as a reserve currency. American businesses responded to de Gaulle by threatening to boycott French imports, and one New York bar owner appeared on TV "cleansing" his wine cellar by pouring bottles of Bordeaux down the drain.[32]

These same sentiments existed late in 2003, when Thomas Friedman, a popular columnist for the *New York Times*, wrote a piece entitled "Our War with France." He began his column with these words: "It's time we Americans came to terms with something: France is not just our annoying ally. It is not just our jealous rival. France is becoming our enemy."[33] Along the same lines, authors John J. Miller and Mark Molesky wrote a book published the following year in which they objected to the popular historical view that France is America's oldest ally, rather unabashedly declaring that France is America's oldest enemy.[34]

At the same time, during the run-up to the 2004 campaign for the presidency, Republicans attacked Democratic candidate John Kerry for being too close to the French.[35] Late in 2003, Tom Brokaw asked Kerry, "What about the French? Are they friends? Are they enemies? Or something in-between at this point?" Kerry responded, "The French are the French." Chastised by Brokaw for the "profound" statement,

Kerry responded, "Well, trust me . . . it has a meaning and I think most people know exactly what I mean."[36]

What exactly does this mean? Perhaps Kerry, a veteran of the Vietnam War, had read somewhere the Army's response in 1945 to this same gripe about French unreliability: "[It] depends on what you mean by 'rely.' If you expect the French to react like Americans, you will be disappointed. They are not Americans; they are French."[37] Or perhaps it simply means that France is a sovereign nation and acts in its own interest. As does the United States. Does that mean that America can't rely on the French? Does it also mean that the French cannot rely on America?

Let's return to the scenario at the beginning of this section. Most readers will recall vividly the debate leading up to the second Iraq invasion. Americans are less well versed in the circumstances surrounding the Suez crisis in 1956, in which case the tables were turned, and one could consider France, not the United States, the "victim" of opposition by an "unreliable" ally. At that time, the United States favored diplomacy over force to confront a Middle East dictator. During the Suez crisis, President Dwight Eisenhower used a variety of means to undermine French and British efforts to forcibly take back control of the Suez Canal, which the leader of Egypt, Gamal Abdel Nasser, had nationalized. The brief conflict ended in Britain's and France's total humiliation and weakened their standing as global powers. As evidence, Douglas Dillon, the American ambassador to France, warned Washington of the "bitter flood of anti-American feeling now seething through France." More specifically, he noted the "deep emotional conviction" that in the Suez affair the United States proved "callously indifferent" to the vital interests of its principal allies and stood ready to "humiliate them unnecessarily."[38] A French poll indicated that as many as half of the French population had either "no confidence" in the United States or "not much."[39] From this point forward, whereas the British decided they could never go to war without the United States, the *French* concluded they could no longer *rely on the United States*. For de Gaulle,

who two years later would become the president of France, these were formative events, certainly influencing his later decision in 1966 to withdraw from the integrated military command structure of NATO. Of course, as mentioned in the introduction, his action is exactly the reference point for many *Americans* to say that we cannot *rely on the French*.

When one gripes about "reliability," one must keep in mind what we discussed in the first section—that nations act in their own self-interest. Washington never lost sight of this fact even in the midst of the Revolutionary War. He was concerned that America might defeat Britain only to have France reclaim Quebec. Washington was "heartily disposed to entertain the most favorable sentiments" of the French, but he rested on "a maxim founded on the universal experience of mankind, that no nation can be trusted farther that it is bound by its interests."[40] In a more current context, as Robert A. Levine, economist and defense analyst for the RAND Corporation, aptly perceives, "the USA and France do have different interests. And on those interests, the USA will continue to act as a unilateral superpower. It will because it can."[41] And France will continue to act, well, as Senator Kerry might say, like the French.

It is important once again to note that this gripe about reliability and independence existed well before de Gaulle became president of France and has continued throughout the half century that has since passed. In fact Franco-American relations have followed a similar cycle—with every change in administration, a certain rapprochement occurs between France and the United States, and then inevitably something happens that pushes the two countries apart.[42] One can only understand these rapprochements and cyclical "falling-outs" not as a question of reliability but within the context of two sovereign nations acting within their own self-interest. They don't, however, automatically lead to the conclusion that either country is "unreliable."

In their book, Miller and Molesky paint the picture of how French and American national interests have collided over the past three centuries, beginning with the massacres of American colonists during the

French and Indian Wars a quarter century before we declared our independence from Great Britain. Nonetheless, one has to wait until the second-to-last page of the book to find the unsatisfying conclusion—where the authors pose the question about what their 250-page tirade against the French means for the future. On the one hand, they posit that "it may not even matter whether France is an ally of the United States. . . . As the United States rose to the position of the world's most powerful country, France often has been relegated to the role of a mere irritant."[43] On the other hand, they conclude that the "future undoubtedly will bring new challenges, including many that cannot be anticipated." In this light, they write that it would be helpful to have France on board with the US agenda, but "given the distorted prism through which the French view their role in the world, this may be difficult." They conclude by asking, "Will the French, in short, continue to be the French?" In other words, will they continue to maintain a "shortsighted view of their own national interest," or will they realize "that the twenty-first century requires a wholly different vision?"[44]

To answer this question, one can look to a much-quoted editorial that appeared in *Le Monde*, the largest French daily newspaper, two days after the terrorist attacks of 11 September 2001 (9/11). The writers boldly declared in their headline, "*Nous Sommes Tous Américains*" (We are all Americans). Many Americans, and perhaps authors such as Miller and Molesky, would like this to mean that finally, after 300 years of difficult relations, the French have seen the light. Well, not exactly. The editorial was more than an outpouring of emotion after the tragic attacks—it claimed that the latter ushered in a new era, one far removed from now-distant cries of joy as the wall separating the East and West fell two decades before. It boldly stated that even with all that divides us, France would always stand side by side with America on the most vital of issues—the liberty of mankind. In this new struggle against a more ubiquitous enemy, the West will need even more resolve and unity. In this way, *Nous Sommes Tous Américains*.[45]

In this new era, we don't have the luxury of dismissing those with whom we disagree as "mere irritants" or branding them the enemy. As emphasized in the recently released national defense strategy, the United States must partner with its European allies.[46] Yes, we need the French. Through professional military education, American Airmen have become familiar with Sun Tzu, who wisely wrote that to win a war, one must know the enemy. But in this new post-9/11 era, in which fiscal realities and the diverse nature of the threat necessitate a network of global partnerships, it is perhaps more important—and at times even more difficult—to understand our allies. As articulated by Secretary of the Air Force Michael Donley and General Schwartz in the *2011 US Air Force Global Partnership Strategy*,

> The impacts of the global economic crisis, violent extremism, shifting regional balances of power, and the proliferation of advanced technologies will characterize the future security environment, making it unlikely for any one nation to address every global challenge and priority alone. With this guidance, we are increasing our emphasis on developing access and relationships with international partners while forging coalitions to meet both current and emerging global strategic challenges. Successful partnership development optimizes interoperability, integration, and interdependence between coalition forces while providing our partner nations the capability and capacity to resolve national security challenges on their own merit.[47]

As the *Le Monde* editorial observed, both France and the United States realize that what unites them, such as common democratic values, necessitates a vibrant partnership to meet the challenges of this new era. We need to move beyond our stereotypes in order to build a strong and lasting partnership with France, no matter how unreliable, independent, or recalcitrant the French may seem to be.[48]

Conclusion

As noted in the introduction, presenting a conclusive defense of an ally that we have historically perceived as independent, unreliable, un-

grateful, and even cowardly lies beyond the scope and intent of this article. Rather, it offers a starting point for further reflection. Are the French reliable? "The French are the French." This does have meaning. Our challenge lies in understanding what this means: how the French see the world. France acts in its perceived national self-interest, as does the United States. Although people may dispute what interests are "vital," in the 65 years since *112 Gripes about the French* appeared, France and the United States have steadfastly supported each other in vital interests.

In conclusion, though not yet codified in Air Force doctrine, the Air Force has adopted the DOD's joint capabilities area concept of building partnerships, defined as "the ability to set the conditions for interaction with partner . . . leaders, military forces or relevant populations by developing and presenting information and conducting activities to affect their perceptions, will, behavior, and capabilities."[49] Despite the soundness of this definition, this article suggests that perhaps the first step in building a partnership and "set[ting] the conditions for interaction" resides not in affecting *others'* perceptions but in challenging our own—not by excusing others but by examining our own stereotypes through the lens of history and common sense. One often hears the slogan "the mission begins at home." As Airmen, our efforts to build global partnerships must also begin at home, and in these times of fiscal austerity, they can begin with a simple, low-technology, cost-effective tool—a mirror. ✪

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Let us know what you think! Leave a comment!

The Combined Bomber Offensive's Destruction of Germany's Refined-Fuels Industry

Lt Col Woody W. Parramore, USAF, Retired

In May 1944 after the initial Eighth Air Force raid on Germany's synthetic oil plant, Albert Speer recalled telling Adolf Hitler that "the enemy has struck us at one of our weakest points. If they persist at it this time, we will soon no longer have any fuel production worth mentioning. Our one hope is that the other side has an air force General Staff as scatterbrained as ours!" After two months of persistent bombing attacks against the oil industry, Speer explained once again to Hitler that "it would be pointless to have tanks if we could not produce enough fuel."

—Albert Speer, *Inside the Third Reich: Memoirs*

Revisionist historians have advanced the idea that the collapse of Germany's refined-fuels industry during World War Two resulted from Allied ground forces capturing the natural re-

sources needed for refined-fuel products as opposed to the Combined Bomber Offensive's (CBO) air attacks. An examination of the facts should enable Airmen to properly assess the CBO's effectiveness against the German oil industry and enable them to appreciate the joint nature of the fight to defeat Germany.

The initial, though controversial, history that addresses this matter—the United States Strategic Bombing Survey (USSBS)—concluded that air attacks caused the oil industry's demise and "heavily contributed to the collapse of the Third Reich."[1] Contrastingly, in his book *The Blitzkrieg Myth*, John Mosier states that the USSBS's conclusions are incorrect because the survey did not factor in the loss of natural resources—specifically, the Romanian oil fields captured by Allied land forces in August 1944.[2] Similarly, in *Bombing to Win*, Robert Pape claims that the loss of those oil fields and the ones in Hungary during 1945, not air attack, crippled German oil production.[3] However, when one examines the situation in depth, it becomes very apparent that air attacks disabled Germany's refined-fuels industry rather than the capture of resources by ground forces.

German industry had difficulty meeting the military's fuel needs throughout World War Two, despite having an enormous and growing synthetic fuels production capacity at the start of the war to supplement limited resources of domestic crude oil.[4] Fuel scarcity became evident when Germany rationed fuel from late 1940 through the spring of 1941 to build up stocks for Operation Barbarossa.[5] Concerned about the lack of fuel, Gen Walter Warlimont, head of the German military's operations staff, in June 1941 wrote "War Potential 1942," a paper in which he declared that the "oil supply will be one of the weakest points of our economy; it may well influence the operational capabilities of all three Services, the armaments industry, and deliveries to our allies."[6] British and American leaders were also aware of Germany's supply issue, realizing that a reduction in the enemy's fuel levels would incapacitate the German military's mechanized forces—on land, at sea, or in the air.

In January 1943, Prime Minister Winston Churchill and President Franklin D. Roosevelt met in Casablanca along with the British and American Combined Chiefs of Staff (CCS) to determine Allied strategy. The conference decided that the Allies would cross the English Channel and invade the Continent in 1944 and that sustained air operations should enable the invasion. To this end, the CCS issued what became known as the Casablanca Directive (i.e., CCS Directive 166/1/D) on 21 January 1943, which called for a bomber offensive from the United Kingdom.[7]

British and American Airmen's interpretations of this directive varied from the CCS's intent. The Royal Air Force's (RAF) Bomber Command thought the directive allowed an attack on the morale of the German people while the United States Army Air Forces thought it meant an attack on the industrial fabric of Germany that would lead to Germany's capitulation.[8] Air Chief Marshal Charles Portal, a member of the CCS and chief of the RAF's Air Staff, understood that the Casablanca Conference endorsed bombing Germany to make it vulnerable to land invasion.[9] In April 1943, in his capacity as CCS executive agent for the direction of the bomber offensive, Portal added a clarifying sentence at the end of the CCS Directive's mission statement: "Your primary object will be the progressive destruction and dislocation of the German military, industrial and economic system, and the undermining of the morale of the German people to a point where their capacity for armed resistance is fatally weakened. This is so construed as meaning so weakened as to permit initiation of final combined operations on the continent."[10]

On 18 May 1943, the CCS then approved the CBO Plan implementing the CCS Directive. The plan added the defeat of the German fighter force as an intermediate objective and modified the prioritized CCS objectives from January. In order, these new priority systems included submarines, aircraft industry, ball-bearing production, oil, synthetic rubber, and military transport.[11] These objectives reflected the over-

whelming need to establish air superiority and to maintain control of the sea lanes in the Atlantic.

Subsequent American air attacks in 1943 failed to attain their CBO objectives due to the diversion of bombers to other theaters and the lack of long-range fighter escorts.[12] Oil targets, a low-priority objective, received only scant and infrequent attention despite the much-publicized American raid on the Romanian oil refineries at Ploesti in August 1943. The harsh truth as 1943 drew to a close was that the Germans were maintaining air superiority over Germany and preserving their fighter force's strength in order to contest the expected cross-channel invasion.

With the invasion date coming ever closer and the CBO yet to achieve the intermediate objective, on 13 February 1944, the CCS modified the CBO objective to focus air attacks on the attainment of air superiority.[13] The revised mission statement read as follows: "The progressive destruction and dislocation of the German military, industrial, and economic systems, the disruption of vital elements of lines of communication and the material reduction of German air combat strength, by the successful prosecution of the Combined Bomber Offensive from all convenient bases."[14]

This final modification to the CBO's objectives made German fighter production, ball bearings, and aviation-support facilities the top-priority objectives followed by the German vengeance missiles (V-1 and V-2). The next priority objective included Berlin and other industrial targets when Allied forces could not attack the first two priorities. Mediterranean-based bombers were to attack fighter production and support facilities or, if that proved impossible, to strike Mediterranean area targets or land-support targets.[15] The CBO did not even list oil as a priority objective.

Anticipating the defeat of the German fighter force by April 1944, in February 1944, Lt Gen Carl Spaatz, commander of United States Strategic Air Forces (USSTAF) in Europe, directed his staff to prepare plans for USSTAF support of Operation Overlord, the cross-channel invasion of France.[16] To ensure air superiority and to hamper the German mili-

tary's response to the invasion, the USSTAF staff thought that air attacks should be conducted in priority order on the oil industry, emphasizing gasoline production, fighter and ball-bearing industries, rubber production, bomber production, and, if weather prevented precision attacks on the first four target categories, transportation centers.[17] By the end of March 1944, the USSTAF, by killing or disabling Luftwaffe fighter pilots, had won the battle for air superiority and was ready to move on to attack the German oil industry.[18]

By March 1944, German refined fuels from crude oil primarily came from five sources: oil fields in the vicinity of Hamburg, Germany; the Prinzendorf field in the Vienna Basin; the Hungarian fields near Lake Balaton; the fields near Ploesti, Romania; and small fields in Estonia, Albania, and Poland.[19] These crude oil resources remained on track to provide 2.048 million tons of finished fuel products in 1944.

In addition to the limited refined products based on crude oil, Germany in 1944 was producing liquid refined fuel from coal, using the Bergius hydrogenation process and the Fischer-Tropsch synthesis process.[20] The Bergius hydrogenation process produced high-quality gasoline suitable for use as an aviation fuel, while the Fischer-Tropsch synthesis process produced high-quality diesel fuel, lubricating oil, and some low-quality gasoline that, when mixed with benzol or benzene, became suitable fuel for cars and trucks.[21] In 1944 Bergius hydrogenation plants stood ready to produce 3.780 million tons of fuel for the year, and the Fischer-Tropsch synthesis plants would add another .508 million tons of fuel.[22] Additionally, the Germans expected 65 benzol plants located near coal mines to produce 704,000 tons of benzol in 1944, over half designated for use as a fuel additive to increase gasoline octane levels and the remainder for use in the nitrogen, ammunition, and synthetic rubber industries.[23] Germany anticipated synthetic production of 4.920 million tons of finished fuel products. From both its synthetic plants and refined crude, it expected to produce 7.040 million tons of refined fuels in 1944.[24]

However, the USSTAF sent its plan to Gen Dwight Eisenhower for approval rather than to Air Chief Marshal Portal. In accordance with the Cairo conference decision by the CCS in December 1943, General Eisenhower, commander of the Allied Expeditionary Force, received control of the USSTAF and Bomber Command on 15 April 1944 and retained this control until 14 September 1944.[25] He disapproved the USSTAF plan in favor of the Allied Expeditionary Air Force's plan for the bombers to attack transportation networks in France and Germany west of the Rhine.[26] General Eisenhower chose to strike these networks to ensure that the Germans could not rapidly reinforce their defenses and possibly defeat the invasion. However, Eisenhower did indicate he would consider elements of General Spaatz's plan to attack the oil industry.

In the days that followed, German fighters did not contest the transportation attacks, and German attrition rates declined. Therefore, General Spaatz was able to persuade General Eisenhower that Allied attacks on vital oil targets would cause the Luftwaffe to fight and die. Spaatz received permission to hit synthetic oil plants during two days of good bombing weather to gauge the German response. After a delay due to bad weather (aircraft had to engage oil targets visually to attain acceptable accuracy), 649 bombers from Eighth Air Force attacked five synthetic oil plants on 12 May 1944, followed by strikes against seven synthetic plants by 410 of the Eighth's bombers on 28 May, including reattacks on plants at Leuna, Zeitz, and Lutzkendorf.[27] These two attacks prompted a vigorous Luftwaffe reaction to protect the oil plants. Furthermore, after the strikes, the Germans rushed more assets to defend the oil installations, curtailed training of ground units, and accelerated the conversion of oil-consuming vehicles to less-effective alternative fuels.[28] Albert Speer, minister of armaments and war production, reported to Adolph Hitler that the production of aviation fuel for May decreased for the first time, falling 14,000 tons short of planned Luftwaffe consumption. Speer considered the oil attacks significant and believed that continued strikes could lead to failure of the German military.[29]

Encouraged by the results, General Spaatz on 13 June 1944 proposed attacking the oil industry, concentrating on gasoline, to General Eisenhower and his deputy commander, Air Chief Marshal Arthur Tedder. General Spaatz thought that this approach would most dramatically reduce Germany's combat capability in all areas. Eisenhower did not back down from his emphasis on transportation attacks but agreed to allow Spaatz to go against the German oil industry.[30] At this point, a sustained and determined attack began on that objective, joining those already begun by the USSTAF's Fifteenth Air Force on the refineries in Ploesti, Romania.

Frustrated with the CCS requirement not to strike oil-production facilities in Romania, General Spaatz directed Fifteenth Air Force to attack the three marshalling yards in Ploesti, knowing full well that many bombs would hit the 10 refineries surrounding the town, seven of them within one mile of the yards.[31] These refineries produced 25 percent of the Axis power's refined oil products; thus, denying this fuel to the enemy was critical to the Allied war effort.[32] Because of these "marshalling yard attacks," Ploesti production dropped by 44 percent during April 1944.[33] Subsequently, General Spaatz persuaded Air Chief Marshal Portal and General Eisenhower that Fifteenth Air Force had sufficient bomber strength to strike transportation targets in support of ground operations as well as oil targets, obtaining their permission on 1 May 1944 to strike Ploesti.[34] The attacks generated dramatic results, dropping production from 186,000 tons a month to 81,000 tons in May. Twenty-four missions spanning the summer months involving 5,633 bomber sorties destroyed the Ploesti refineries, which ceased production prior to the Russian occupation on 22 August 1944.[35] The destruction of Ploesti accelerated the shortage of refined oil products that had already crippled the Luftwaffe and that was in the process of reducing the German army's mobility.[36]

US Air Force photo

Remains of the Merseburg-Leuna synthetic oil plant, 10 April 1945

The success of the attacks on Ploesti and Germany's crude-oil-based industry as well as its synthetic fuel industry confirmed General Spaatz's conviction that such action would inflict immediate and growing harm on the German war effort. In June 1944, air attacks reduced refined oil production from 734,000 tons to 511,000 tons. Aviation fuel production continued to drop, down to 53,000 tons. Diesel fuel also decreased from the April tally of 88,900 tons to 66,000 in June.[37] German training and operations suffered as a result of this Allied effort. According to decrypted Luftwaffe message of 5 June 1944, fuel supplies had become so low that the air arm had to tap its strategic reserve and that it had made fuel available only for training; bomber, fighter, and

ground attack; and some transport flights. The Allied bombing also had an effect on land operations in Normandy. During the interrogation of a captured German battalion commander on 16 June 1944, he complained about the complete lack of fuel for motor transport for the infantry in France, which could move only by rail or by foot.[38] All of the refined-oil output continued to drop, with only 438,000 tons produced in July 1944.[39] On 10 July 1944, the Luftwaffe stopped all training of bomber crews except to replace losses and began the process of ending operations in less vital areas due to the lack of fuel. To replace losses and protect oil-production facilities, the Luftwaffe recalled all of its fighter units from France despite the need to help stem the Allied advance. Overall, at this point in the war, Germany was consuming more than twice as much gasoline and diesel fuel as it produced.[40]

Seeing the drop in production and realizing that the Allied air forces were engaged for the first time in a sustained effort to wreck the oil industry, Speer appointed Edmund Geilenberg as a special commissioner to lead a repair force for oil-production facilities.[41] One of Speer's most able subordinates in the Ministry of Armaments, Geilenberg had directed German munitions production.[42] As part of his new duties, he personally inspected all affected plants after an attack and directed their repair, requisitioning skilled workers from locomotive and tank factories in addition to other construction workers to man the repair workforce. Further, Geilenberg began construction of underground facilities for oil production; in fact, he used parts from equipment intended for those facilities to repair the unceasing damage to above-ground plants.[43] The special commissioner engaged in a back-and-forth battle with the bombers, restoring plants to full production in no more than six to eight weeks only to see them reattacked and out of production within two or three weeks.[44] In this attempt to keep industry operating, by 1 September 1944, Geilenberg was directing 150,000 workers in the repair of oil plants—a number that increased to 350,000 by late fall.[45]

By the end of August 1944, beleaguered by persistent Allied air attacks that negated defensive and restorative efforts, Germany had a

finished oil production of 345,000 tons—just 42.6 percent of April's production figures. This reduction in the oil industry's output was solely the result of Allied air attacks.[46] By 11 August 1944, Luftflotte Three, responsible for defending the German border with France, had restricted all flying operations to fighter air defense sorties.[47] In other theaters, the Luftwaffe severely restricted flying operations, directing fighters in Greece, for example, to fly only if a prospect of combat existed.[48] Lack of fuel caused cuts in German night-fighter operations from August 1944 until the end of the war.[49] Land operations were curtailed or delayed. Speer's August report to Hitler noted the absence of fuel for offensive moves planned for October 1944.[50]

After General Eisenhower returned control of Allied strategic air forces to the CCS on 15 September 1944, the latter directed control of the USSTAF and Bomber Command to their respective national chains of command. General Spaatz at USSTAF and Air Marshal Norman Bottomley at the RAF Air Staff, who shared joint executive responsibility for operations, maintained a close, cooperative working relationship.[51] After collaborating, the USSTAF and the RAF Air Staff issued Strategic Bombing Directive Number One on 25 September 1944, which prioritized oil as the most important target, followed by military equipment.[52] In September, Germany's totals for all finished oil products fell to 281,000 tons.[53] To ensure that the Luftwaffe would not recover its strength, Spaatz focused the USSTAF's September attacks on the four synthetic plants that produced aviation fuel. Intelligence continued to report that the German military faced a debilitating lack of fuel, even to the point of collapse. Shortages of pilots and gasoline rather than aircraft became limiting factors for the Luftwaffe because Speer managed to increase German fighter production during the summer of 1944.[54]

The German oil industry was on the road to complete collapse in October 1944, but four months of bad weather allowed it to begin recovering. In fact, all production of refined fuels did temporarily cease from 11 to 19 September 1944.[55] Despite the inclement weather, the

USSTAF and Bomber Command continued to attack the oil industry. Bombing results for the USSTAF were poor as bombers had to aim using radar; consequently, more often than not, most bombs missed their targets.[56] Given a respite by the weather and buoyed by heroic repair measures, the industry continued to function, though just barely. Refined oil production for October, November, and December totaled 316,000; 337,000; and 303,000 tons, respectively.[57] One can attribute the increases in production during October and November to the weather and the decrease in December either to the RAF's expanded efforts or to the attacks on transportation.

Concurrent with the onset of unfavorable weather in October 1944, Air Chief Marshal Tedder attempted to aid the bogged-down ground campaign near the Franco-German border by requesting that Bomber Command and the USSTAF attack the German transportation system. According to the agreement, on cloudy days the American forces would bomb railroad marshalling yards using radar and on the infrequent clear-weather days would attack the oil industry.[58] With this agreement backed by intelligence indicating the effectiveness of both the oil and transportation attacks, on 28 October 1944, the USSTAF and the RAF Air Staff issued Strategic Bombing Directive Number Two, which dropped all target objectives other than oil and transportation.[59] However, RAF Bomber Command was slow to increase its attacks on oil targets. For example, in October 1944 the command dropped only 6 percent of its bomb tonnage on oil targets in response to Strategic Bombing Directive Number One and then, under pressure, increased its tonnage on oil and transportation targets to 38 percent by January 1945.[60] The RAF's contributions were most needed and valuable because at this time in the war, that air force's bombing accuracy, combined with its larger bombs, inflicted greater damage on oil facilities than did the USSTAF.

Devastating attacks on Germany's transportation network occurred simultaneously with the accelerated effort against the oil plants.[61] These strikes proved so severe in the Ruhr area that on 11 November

1944, Speer reported to Hitler that the Ruhr was effectively cut off from the rest of Germany.[62] This fact raises the question, Did the lack of the basic raw material—coal—cause the synthetic oil industries to stop production? Eighty percent of all German coal was mined in the Ruhr and sent to other industries by rail and barge transport.[63] However, because the coal and chemical industries initially developed the synthetic oil industry, they quite naturally built the new plants adjacent to developed coal fields for ease of production and cost reduction.[64] Transportation of coal to the plant should not have presented a problem.

Nevertheless, the transportation crisis might have affected production at the Fischer-Tropsch synthesis and Bergius hydrogenation plants. Tedder thought that by December 1944, some oil plants in western Germany were out of action due to bomb damage, and some because they could not obtain coal to make synthetic oil.[65] Interestingly, all Fischer-Tropsch synthesis plants in the Ruhr area stopped production simultaneously with the attack on transportation. Production at the Bergius hydrogenation plants is less consistent: of the five western plants, two ceased operations prior to initiation of the transportation attacks, and one of the other three remained in production until January 1945. Neither the USSBS or other records offer data referring to production stoppages due to loss of coal. Logically, the correlation between the transportation attacks and the decline in production suggests that the western synthetic oil plants may have stopped because they could no longer obtain coal, store fuel on site, or transport fuel to the end user.[66] But no data exists that can definitively prove causation. Regardless of whether shortages stemmed from bombing or the disruption of transportation, air attacks caused the western synthetic oil plants to fail.

Thus, by the end of January 1945, the air attacks had neutralized the Ruhr's synthetic oil industry and had crippled the synthetic oil plants in central Germany.[67] Specifically, in March 1944, Germany produced 181,000 tons of aviation gasoline; 134,000 tons of motor gasoline; and 100,000 tons of diesel fuel.[68] By January 1945, those figures had de-

clined to 11,000 tons of aviation gasoline; 50,000 tons of motor gasoline; and 64,000 tons of diesel fuel. The numbers for January may seem to indicate a good deal of fuel, but the following description reflects the practical effect for Germany by the end of the war: "Pilots sent into combat with only 40 to 45 hours flying time. . . . Tanks and armored vehicles moved to the front by oxen. Every motor trip exceeding 60 miles had to be approved by a General Officer."[69] Without these facts, one could look at the ground situation in January 1945 and easily conclude that Allied armies advancing on Germany from the east and west caused the oil industry's collapse.

An in-depth examination of the situation readily reveals that air attacks crippled Germany's refined-fuels industry rather than ground forces' capture of resources. The Soviets did indeed seize the Romanian oil fields in August 1944, but, as previously noted, air attacks had already brought a halt to the production and shipment of refined fuels. The Soviets captured the Hungarian oil fields and their refineries in early April 1945.[70] Germany's surrender only a month later, on 7 May 1945, makes it difficult to accept any assertion that the loss of the Hungarian oil fields disabled the German oil industry. The same can be said for the Austrian oil fields in the Vienna basin. The Soviets took control of this area even later in the war than the capture of the Hungarian fields. This is not to say that Germany did not lose some crude-oil resources prior to the final collapse of the oil industry in January 1945. Germany exploited crude oil from Estonia, Albania, and Poland (occupied territories) during the war. These minor crude-oil resources provided only 5 percent of all German finished oil products, but one must acknowledge that Germany experienced losses due to captured territory rather than bombing. However, such loss hardly dealt a crippling blow to the German war machine.

One might also ask whether the drop in refined oil products stemmed from the capture of synthetic oil plants on the German borders. Again this was not the case. In 1944, as the British, American, and Soviet armies moved closer to the German border, several syn-

thetic oil plants became vulnerable to seizure or production stoppages. Four such plants located in Silesia became vulnerable near the end of 1944: Blechhammer, Heydebreck, Auschwitz, and Schaffgotsch. The Heydebreck and Auschwitz plants never produced any fuel as a result of air attacks during their construction, and the Schaffgotsch plant ceased production in October 1944.[71] This left Blechhammer as the only operating synthetic fuels plant that the Soviet army could take out of production. When the Germans evacuated Silesia in January 1945, the Soviets captured Blechhammer, but by then air attack had reduced its production from an all-time high of 16,500 tons in November to 3,000 tons in December 1944.[72]

On Germany's western border, all the Fischer-Tropsch synthesis plants were located in the Ruhr (with the exception of the Schwarzheide plant south of Berlin) or on the Rhine River. All of the plants except for Schwarzheide ceased production by November 1944, with some doing so in September 1944.[73] The British and American armies reached the Rhine near the Ruhr in late February 1944 and physically cut off the Ruhr from the rest of Germany only in April 1945.[74]

The Bergius hydrogenation plants located on the western border included Scholven, Gelsenberg, Welheim, Wesseling, and Ludwigshaven. Gelsenberg ended production in September 1944; Welheim in October 1944; and Scholven in November 1944, along with Wesseling and Ludwigshaven.[75] Neither the British nor the American armies forced the Fischer-Tropsch synthesis or the Bergius hydrogenation plants to stop operating—air attacks did.

By March 1944, after almost five years of war, Germany had performed a minor miracle in supplying its forces with adequate fuel for operations. Unfortunately for Germany, Britain and America had also performed a minor miracle during the same time period, creating two strategic air forces that denied Germany adequate amounts of refined fuels. The collapse of the German refined-fuels industry during World War Two was the result—or effect—of the CBO's air attacks and certainly not the result of ground forces seizing crude oil needed for re-

fined fuel products. However, Airmen also need to remember that air attacks on German industries in 1944, with the exception of the oil industry, only slowed down the production of essential war supplies until all industries in Germany felt the catastrophic effects of Allied attacks on transportation.

In just five months of measured and persistent attacks, the CBO put the German oil industry on life support. Despite heroic efforts to repair the bomb damage, German land and air forces increasingly had to restrict their operations due to the lack of fuel. The persistent attacks prevented the oil industry from recovering and continued its decline. If winter weather had not come early and restricted visual bombing, the oil industry's collapse very possibly would have occurred in October or November 1944 rather than January 1945. Aerial attacks on this industry, combined with attacks on the German transportation system, had a crippling effect on the oil industry, which, in turn, incapacitated the mechanized portions of the German military. This situation enabled the military end state of the land forces' successful occupation of Germany. While taking pride in their heritage, Airmen should remember that the collapse of the German oil industry did not win the war in and of itself; rather, it resulted from successful execution of the mission assigned by the Casablanca Directive in what we should now view as a joint fight to defeat Germany. ✪

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Common Sense at the Crossroads for Our Air Force

Col Russell J. Smith, USAF, Retired

According to Joel Rubin,

> As the dust settles on the debt ceiling deal, it's become clear that major cuts to defense spending have not only been approved in a bipartisan manner by Congress, but that even more are on the way. This means that the days of unlimited defense spending increases, where all systems can be purchased, are over.
>
> So now is the time for tough choices to be made between defense programs that serve our warriors and those that we have maintained for too long due to bureaucratic, parochial or ideological reasons. It's time to stop spending dollars that we don't have on programs that we don't need and that don't make us more secure.[1]

An old proverb states that every cloud has a silver lining. Perhaps the recent debt-ceiling crisis and subsequent failure of the congressional supercommittee, together with continuing financial instability within the United States and global markets, have opened a small window of opportunity for reevaluating current Air Force budget priorities. In fact, the absolute necessity to get maximum bang for the buck could now serve as a catalyst in acquiring a credible and affordable counter-insurgency (COIN) capability for both the United States and its partner nations. In light of the tough budget decisions ahead, will the Air Force shed its affinity for technological wizardry and finally get serious about equipping its forces to fight effectively and efficiently in the battles they will most likely face in the near term?

Background

Global and regional ideological and political struggles have continued to increase the complexity of the security environment; these struggles have directly challenged traditional US military approaches, which have remained focused primarily on large force-on-force engagements in major combat operations. Faced with the powerful conventional war-fighting capability of the United States, our enemies (and those of our allies) have chosen to fight using a hybrid mix of irregular, disruptive, catastrophic, and traditional capabilities as a way to achieve their strategic objectives.[2] Our adversaries' timeline often does not match our own; those enemies seek to exhaust rather than confront us in direct military engagements. They will continue their attempts to undermine and erode the national power, influence, and will of the United States and its strategic partners.[3] Adaptive adversaries such as terrorists, insurgents, and criminal networks as well as states will more frequently resort to irregular forms of warfare as effective ways to challenge conventional military powers.[4] Given the prevalence of irregular threats in the current and expected operating environments, the US military must become as proficient in addressing irregular threats as it is in confronting conventional or regular ones.[5]

The Department of Defense's (DOD) *Quadrennial Defense Review Report* (QDR) of 2010 gave specific guidance to the armed forces of the United States. Two of the six key mission areas specified in that report include topics especially germane to irregular warfare (IW) or COIN operations and the light attack aircraft: (1) "succeed in counterinsurgency, stability, and counterterrorism operations," and (2) "build the security capacity of partner states."[6] A key, explicit QDR initiative to carry out the aforementioned missions gives direction to the Air Force to field a light attack aircraft in its general-purpose forces as a means of enhancing its ability to partner with a wide range of coalition air forces.[7]

One would have anticipated that the Air Force would move swiftly to follow the secretary of defense's guidance on the light attack aircraft;

however, the aftermath of the QDR's release has been flecked with painfully sluggish and intermittent activity amidst mixed and/or muted signals from the Air Force's senior leadership.[8] To be honest, the budget forecast at the time (affecting all US services) was abysmal; although it didn't happen, the forecast for the national defense budget of 2011 predicted a 17 percent decrease in funding.[9] Couple this fact with the stark reality that any further budget cuts could have directly affected the Air Force's ability to procure its desired share of Joint Strike Fighters (JSF) (1,763 F-35s), and one can clearly view the fiscal landscape where any additional procurements confronted outright skepticism. Undoubtedly the Air Force has made the F-35 its number-one priority for the upcoming budget debate. In fact, speakers at a recent airpower symposium that highlighted the Air Force's priorities made no mention of light attack.[10] Later, this article presents options and benefits for procuring light attack aircraft for the Air Force, an especially tough but necessary chore considering the recently announced defense budget cuts, which will likely trim $330–450 billion over the next 10 years.[11]

In December 2008, Air Combat Command (ACC) released its *OA-X Enabling Concept*, which laid out the framework for the fielding of a light turboprop attack/observation aircraft. Although senior leadership initially proved very supportive, the backdrop has changed over the last two years. Faced with the reality of looming budget cuts, current senior leaders at ACC now view any new aircraft procurement as a "zero-sum game."[12] Thus the addition of a new light attack aircraft fleet is now viewed as offsetting funds already allotted toward the purchase of new F-35 JSFs.[13] That perception, though technically correct, is extremely shortsighted and does not account for the massive cost savings that would accrue by purchasing a fleet of light attack aircraft to supplement the current air-to-ground workhorses (i.e., the A-10, F-16, and F-15E). Indeed, these light attack aircraft would pay for themselves in far less than three years' time (through proven sustainment savings) while at the same time meeting real-world combat training and operational needs. Unfortunately, in an ironic and classic DOD bureaucratic

twist, the sustainment savings that would accrue from using the light attack aircraft (operations and maintenance costs) are "colored" differently than procurement funds in the budget and thus cannot be used to directly offset "new" aircraft expenditures. As addressed later, the business case for light attack aircraft supplementing our air and space expeditionary task force deployments while reducing the burden of the A-10, F-16, and F-15E is stark and convincing and could save the Air Force billions of dollars over a decade.

Budget realities aside, former secretary of defense Robert Gates had good grounds for mandating development of the light attack aircraft for the Air Force. Certainly, the United States needs a light attack capability for many reasons, but this article confines itself to an examination of the four principal ones.[14]

Capability of the Light Attack Aircraft

Don't bring a knife to a gunfight.

—Jimmy Malone, *The Untouchables*

Many senior Air Force officials feel that the present complement of fighter aircraft arrayed in Operation Enduring Freedom and Operation Iraqi Freedom can adequately perform the predominant missions of close air support (CAS) and intelligence, surveillance, and reconnaissance (ISR).[15] However, what if our Air Force could carry out these missions just as effectively but at a fraction of the current cost? And what if light attack aircraft could actually provide numerous ancillary benefits to the US military and partner nations while performing successful CAS, COIN, and ISR? Most importantly, what if our nation could realize these goals, all the while preserving the lifeblood of our frontline combat aircraft (A-10s, F-16s, and F-15Es) for initial "kick the door down" actions during future major combat operations?

We must be precise about the niche that the OA-X aircraft will fill; specifically, it is not designed as a one-for-one replacement for our

current air-to-ground fighters. When phase two (seize initiative) and phase three (dominate) of our next major combat operation commence, the OA-X probably will not be involved, at least initially.[16] Rather, it is designed for COIN operations, which typically occur during phase four (stabilize) operations but may take place anytime throughout the life of a conflict.[17] Keep in mind that any major combat operation (once the decision is made) seeks to minimize the time spent in phase two and phase three, as the United States so eloquently demonstrated in both Afghanistan and Iraq. When President George W. Bush stood on the USS *Abraham Lincoln* and announced the end of major combat operations, he essentially heralded the transition to phase four. In Iraq the total time spent in phases two and three amounted to less than two months; since then, the Air Force continued to utilize the same mix of fighter/attack aircraft in Iraq until withdrawal in December 2011. In the eight-plus years that followed President Bush's speech, the Air Force could have successfully deployed the light attack aircraft, saving hundreds of millions of dollars while preserving our frontline fighters for future phase two and three operations.

The decision to utilize the light attack aircraft will depend primarily on the threat environment. OA-X aircraft cannot carry as much ordnance or traverse the battlespace as swiftly as our current suite of air-to-ground aircraft. However, they have already demonstrated sufficient combat capability that certainly could supplant and/or augment our workhorses in reduced threat environments across the globe. Given the current environment in Iraqi Freedom and Enduring Freedom, light attack aircraft could fill 95 percent of all mission sets occurring today. They have demonstrated state-of-the-art digital connectivity; full-motion-video transmission; data-link connectivity, including J-series messaging via Situational Awareness Data Link / Link 16; advanced sensor pod capability (with laser designation/illumination/range finding); and secure tactical communications via satellite communications. In fact OA-X aircraft have already validated air-to-ground voice and data links with every operational US and North Atlantic Treaty Organization communication suite.[18]

Neither is precision-munition capability an exclusive bastion for the Air Force's frontline fighters today. Using an Embraer Super Tucano (or A-29), Colombia's air force killed a leading member of the Revolutionary Armed Forces of Colombia (FARC) in 2008 with a laser-guided Griffin munition.[19] Hawker Beechcraft's AT-6 Military Standard 1760 bus compatibility allows outfitting the aircraft with a myriad of US precision-guided bombs, rockets, and missiles.[20] The IW arena, which depends upon winning the support of the relevant population and limiting collateral damage, demands precision targeting.[21] As we have heard, in IW operations what you "do not" hit is as important as what you "do" hit.

Finally, the light attack aircraft has demonstrated impressive numbers for deployment range and on-station loiter. The AT-6, for instance, boasts a no-wind deployment range of 1,725 nautical miles (nm) while landing with a fuel reserve exceeding 45 minutes. In addition the AT-6 has calculated an AGM-114 Hellfire standard configuration load with a 400 nm combat radius and loiter time of two hours on-station. Reducing the combat radius, say to 200 nm, doubles the on-station loiter time available.[22] In essence this capability equates to continuous A-10 or F-16 ISR/CAS coverage without having to rendezvous with a tanker for aerial refueling. The presence of light attack aircraft for the entire coverage period would benefit ground troops tremendously.

Enabling Partnership Capacity with the Light Attack Aircraft

Arguably the most important military component in the War on Terror is not the fighting we do ourselves, but how well we enable and empower our partners to defend and govern themselves.

—Secretary of Defense Robert M. Gates, 2007

Do not try to do too much with your own hands. Better the Arabs do it tolerably than that you do it perfectly. It is their war, and you are to help them, not to win it for them. Actually, also, under the very odd conditions of Arabia, your practical work will not be as good as, perhaps, you think it is.

—T. E. Lawrence, 1917

The strategic importance of building partner capacity is well documented both throughout history and in current DOD directives. The QDR of 2010, as did its predecessor in 2006, gives specific direction to ensure that the United States continues to build up the security capacity of its partner states.[23] Similarly, the Air Force adopted 12 new service core functions in 2010, among them building partnerships.[24] Although the Air Force has since reversed course on its fledgling building partnerships doctrine, the priority of enabling partnership capacity remains. In fact, in November 2011, Lt Gen Dick Newton, the assistant vice-chief of staff and director of the Air Staff, stated that building international partnerships is crucial, "particularly with a distressing economy that persists in convergence with other geopolitical uncertainties that are out there."[25] Finally, ACC's IW operating concept notes that "Building Partnership Capacity . . . is effectively both a preventive measure and an exit strategy for the United States for operations across the spectrum of conflict."[26] We can measure partner capacity in many ways, but certainly modern history has taught us that we cannot maintain security in the midst of COIN without the effective use of aviation resources.

Unlike the administration of President John F. Kennedy, whose initial response involved building up a US special forces capability to address his nation-building strategy, the current strategy concentrates on building up the capacity of other nations to obtain and maintain their own security and stability.[27] Therefore, the US Air Force should not provide the air assets for all of our partners but should assist in the buildup of their organic air operations capability (as should the other services). Unfortunately, military strategists ignored this approach in Iraq for several years.[28] In fact, one could easily make the case that the

United States' "large force" departure in Iraq was delayed by years due to our poor and incomplete exit strategy, specifically with regard to rebuilding Iraq's air force, which we decimated during phase two and phase three operations. After the destruction of that air force, more than six years passed before we delivered the first T-6 Texan II (military training platform) for Iraqi pilot training! We should have established a comprehensive plan to supply replacement training and operational aircraft as well as rotary-wing assets well prior to March 2003, when Iraqi Freedom kicked off.

A study by the RAND Corporation, *Air Power in the New Counterinsurgency Era*, observes that creating a wing-level organization for aviation advising "is likely the single most important initiative [the] USAF can take to enhance its own counterinsurgency capabilities."[29] Although the Air Force has established an air advisory group based at Randolph AFB, San Antonio, it has much to accomplish in order to comply with RAND's guidance. In an Air Force Special Operations Command white paper, Col Billy Montgomery outlines the general concept of an IW wing comprised of aircraft capable of six distinct functions: light mobility, medium mobility, heavy mobility, light strike, rotary wing, and manned ISR.[30] Note that the light attack aircraft adeptly fulfills two of these roles (light strike and ISR). The concept of the wing entailed providing a cohesive structure to train, deploy, sustain, redeploy, and reconstitute together. Units under the IW wing were designed to conduct both operational and partner-training missions in-theater while the structure inherent in the wing provided an institutional safeguard to prevent approaching IW and building partner capacity in a haphazard, ad hoc manner—which happened in the Vietnam era.[31] We could have avoided many of the problems intrinsic to our painfully slow progress in Iraq had the Air Force formed an IW wing trained and prepared to support partner ground forces with ISR, mobility, and strike missions in 2003.

Currently, the only alternative the United States can offer a partner nation in the way of fixed-wing, armed aircraft is the F-16. Many of our

partners find themselves in Iraq's former and present situation. That is, they don't necessarily need F-16s to rebuild their air forces (although they definitely want them and will receive them eventually); instead, they need reliable, capable, easy-to-maintain, and affordable airframes to train their pilots and maintenance crews and to conduct basic sovereignty missions such as border security, ISR, and CAS. The F-16 offers tremendous capability, but it clearly is not the right fit for most of our allies. The light attack aircraft, however, fulfills all of the traditional sovereignty roles while providing an extremely reliable airframe with low life-cycle costs—something the F-16 does not offer. The air forces of many other partner nations (e.g., Afghanistan) are simply less adept at handling the complexity of an F-16 fleet, from both a flying and maintenance perspective. After a successful transition to the light attack aircraft, Afghanistan (and many other countries like it) may consider bolstering its air force with additional, more technically sophisticated aircraft, but it should first acquire a reliable, easy-to-maintain light attack aircraft.

As we saw in both Iraq and Afghanistan, building a partner nation's air force takes time, and in the meantime, insurgents continue to get a vote. Therefore, the United States should position itself to prosecute air-to-ground COIN operations at any time—with a light attack aircraft in its arsenal. In this manner, the United States could augment a partner nation's air force by providing simultaneous operations and training missions in-country immediately. Furthermore, the light attack aircraft, which can operate from austere runway environments, does not need robust, hardened, and million-dollar aerodrome facilities. The United States needs an indigenous light attack capability to "stave off the wolves" when necessary, while it builds the partner nation's air force.[32] And let's not forget the F-20 debacle, whereby the United States attempted to sell an air-to-air capability that it wouldn't purchase itself, thus defacing any credibility in the weapons system. Without question, the Air Force must develop a cadre of experienced light attack instructors who can impart their proficiency to our partner nation's air forces.

Second- and Third-Order Effects of the Light Attack Aircraft

The US Air Force is facing a crisis. Its inventory of aircraft is in critical condition, and the drawdown asymmetry will worsen the situation unless something fundamentally changes. . . . On paper, the Air Force's aircraft are old. In reality, they are even older than the numbers show. It is a fact that military equipment wears out faster in the harsh environment and high operations tempo of the Middle East. The heat, sand, and wind combine to create one of the harshest climates on Earth, especially for high-tech equipment.

—Lt Col Clint Hinote, "The Drawdown Asymmetry," 2008

This can't go on. At some time in the future, they will simply rust out, age out, [or] fall out of the sky.

—Secretary of the Air Force Michael W. Wynne

Creating a Ready Pool of CAS/COIN Assets and Pilots While Preserving Our Legacy Air-to-Ground Aircraft

Establishment of an indigenous light attack fleet within the Air Force would have numerous ancillary benefits for both that service and the nation. First, it would create a pool of experienced COIN and CAS instructor pilots who could conduct both operational and training missions with/for a partner nation. As we have observed throughout our Air Force's history, our tactical prowess in CAS and COIN has ebbed and flowed with the termination of each major engagement.[33] Historically, Air Force competencies in COIN have simply atrophied as soon as circumstances permitted. Outside of Air Force Special Operations Command, no systemic protection of these capabilities has saved the critical core elements from extinction, and resurrecting the professional competencies that once existed is a difficult and time-consuming task. This author knows from firsthand experience that piloting and

planning skill sets for COIN and CAS are fleeting and perishable without consistent practice.

Second, consider the airframes in our nation's arsenal in 10–15 years. Which aircraft will be capable of conducting CAS/COIN? The answer to this question is significant, especially in light of the announcement on 27 January 2012 that the Air Force will retire five of its A-10 squadrons over the next decade.[34] Certainly JSFs would prove proficient for most air-to-ground roles, but the Air Force will likely reserve these aircraft primarily for deep-strike strategic attack, interdiction, or high-value target roles. In addition, the service projects the F-35A as the only variant to sport an internally mounted gun, specifically the General Dynamics GAU-22/A Equalizer 25-millimeter (mm) (0.984-inch), four-barreled Gatling cannon, internally mounted with a meager 180 rounds.[35] Why is this point important? Often, the gun represents the most important weapon in a COIN aircraft's arsenal because it allows precision fire while minimizing collateral damage and injury to noncombatants. Consequently, the A-10 is generally regarded as the world's most effective COIN and CAS platform.[36] Aimed cannon fire permits tactical ground parties to "call for fire" with friendly troops in close proximity to enemy troops; moreover, terminal attack controllers can observe an aircraft's nose position (the bullets have to travel in the same direction as the nose/fuselage of the aircraft) and determine with confidence whether or not the attacking aircraft is positioned correctly to avoid fratricide. Light attack aircraft can carry 400 rounds of .50 caliber internally (A-29 Super Tucano) or 800 rounds of .50 caliber / 20 mm externally with two gun pods (A-29 or AT-6). Furthermore, no COIN scenario could persuade combined force air component commanders to apportion and allocate a $250 million aircraft for a role that an $11 million aircraft could aptly fill.[37]

Finally, the Air Force is operating the oldest fleet in its 64-year history. Our current fleet of F-16, F-15E, and A-10 aircraft is already stretched thin by overuse in the Gulf region. If we continue to use these aircraft at the current flying-hour rates, attrition may prevent

them from providing significant assistance in 10 years.[38] In fact the average age of our most effective COIN/CAS airplane today, the A-10, is 29.8 years.[39] Like the F-16, it has already gone through a service life extension program.[40] Finally, as mentioned before, the light attack aircraft offers the only logical solution for conducting both training and operational COIN missions with our partner nations.

Improving Air-to-Ground Integration with the Light Attack Aircraft

> *Additionally, once in theater, there is little to no cross tell or interaction between the key leaders of the air and ground units. Each service is attempting to improve its COIN capability individually, but there is no joint effort to do so. This lack of unity of effort unnecessarily hinders the joint force from reaching its operational objectives. . . . In such operations [COIN], tactical air units providing support should be intimately familiar with the ground commander's scheme of maneuver, short and long-term objectives and overall plan for air on a particular mission.*
>
> —Col Sam Milam, 2009

The Air Force has done an admirable job standing up a division tasked with documenting all lessons learned from major exercises and combat deployments. One lesson, captured consistently from every major combat deployment, tells us that air-to-ground integration between Air Force and Army units needs improvement.[41] One might correctly label this a "lesson observed" but never fully "learned." One of the most salient lessons reveals that the Army's and Air Force's planning cycles often do not intermesh, leading to missed opportunities to exploit the asymmetry realized with a properly executed ground commander's scheme of maneuver backed up by all the capabilities of a properly executed air maneuver plan. Too often Army battalions plan their operations without any Air Force input.[42] The light attack aircraft has a tremendous opportunity to improve air-to-ground coordination by colocating at Army forward operating bases. Historically, Air Force air support operations units (charged with liaising between forward Army

units and aircraft/aircrews allocated to support these units) have had to be extremely proactive to ensure a seamless connection between airpower and ground power. Part of the reason for this discontinuity derives from the fact that the traditional positioning of aircrew and ground-maneuver leaders across the battlespace makes face-to-face briefings and debriefings a rarity. Consequently, aircrews fly their armed reconnaissance and/or CAS missions and seldom receive feedback on the effectiveness of their sorties, whether they employed kinetic options or not. Since light attack aircraft do not require expansive, built-up airfield facilities, we can locate them closer to the units they will actually support. According to Army Field Manual 3-24 / Marine Corps Warfighting Publication 3-33.5, *Counterinsurgency*, "Unity of effort must be present at every echelon of a COIN operation. Otherwise, well-intentioned but uncoordinated actions can cancel each other or provide vulnerabilities for insurgents to exploit."[43] Finally, the light attack aircraft's ability to land on short, austere runways and refuel overwing gives it limitless opportunities to liaise directly with elite special operations forces.[44]

Currently, the fact that rotary-wing platforms can immerse themselves completely into the ground commander's scheme of maneuver lends them a major COIN advantage over legacy Air Force aircraft. For this reason, Army attack aviation platforms conduct close combat attack rather than the CAS outlined in Joint Publication (JP) 3-09.3, *Close Air Support*. Army attack pilots employ with an abbreviated five-line close combat attack procedure versus what they would term JP 3-09.3's "cumbersome" and "time-consuming" CAS nine-line procedure currently utilized by all fixed-wing CAS platforms as well as Marine Corps attack aviation.[45] Imagine having the benefit of this close coordination with the Army plus the ability to fly much longer distances, loiter on station for more hours, and traverse the battlespace quicker, all the while employing precision munitions from distances far in excess of those typical of attack aviation. These examples highlight the fact that basing aircraft closer to the fight has its advantages—not only for battlefield coordination but also in terms of response time. This proximity to the

fight would enable light attack aircraft to respond to incursions into a forward operating base's perimeter defense as well as participate in small-unit clearing operations, whether in a surveillance or direct-fire mode. Light attack aircraft can (and should) be deployed to locations where our frontline fighters wouldn't dare land—which, by the way, describes a large portion of our partner nations' backyards (Afghanistan, Mali, Yemen, Nigeria, etc.). The OA-X is the ideal aircraft for our mission of building partner capacity in developing countries!

An additional benefit for air-to-ground integration lies in the fact that air support operations squadrons (ASOS) could regularly receive dedicated currency support from joint terminal attack controllers (JTAC). Historically, JTAC controls with live aircraft have always been in high demand, never more so since the catastrophic events of 11 September 2001. In fact, part of the Air Force's resistance to raising the total number of JTACs (a perennial request by the Army, which appreciates their services and wants hundreds more of them) concerns the argument that the number of sorties available does not justify keeping more JTACs current and qualified. To placate the Army, the Air Force developed the joint fires observer (JFO) program, which places qualified Army Soldiers in a "JTAC-like" role without giving them the authority to grant clearance to aircrews for live drops (except in emergencies).[46] These JFOs also have currency requirements, but they are less onerous than those for JTACs—and their currencies can be updated concurrently with their paired JTACs. The Air Force could assign or directly align light attack aircraft to support these ASOSs, thereby guaranteeing a steady pool of current and qualified JTACs—a colossal luxury. Further, assigning these aircraft directly to the ASOSs would give many of the service's "shiny pennies" (fast-track pilots / aircrew members on the road to becoming generals) an incentive to get their hands dirty and learn firsthand about joint integration and the operational level of war with a sister service. (Typically these shiny pennies want to fly their entire career.) Finally, since the light attack aircraft would be flying locally, they could stay on station easily for a three-hour training session (without external tanks), a major improvement

over current training opportunities, which often result in only 20–30 minutes of air support at a time. Additionally, with the state-of-the-art communications suite, JTACs could actually practice with all the combat tools of the trade (full-motion video, secure voice, data link, digital nine-lines, remotely operated video enhanced receiver [ROVER] feed, etc.). Only rarely do JTACs get to practice with all of these tools.[47]

Unfortunately, the empirical data clearly shows that the Air Force does not value joint air-to-ground interdependence, certainly not over shiny, new fifth-generation capability like the F-35. Three salient data points illustrate this fact. First, in 2003 ACC put the finishing touches on a yearlong effort by a select tiger team and published its ASOS manpower study. This study outlined the recommended billets and manning authorizations to execute the mission of the tactical air control party (TACP) and represented truly groundbreaking integration work by the Air Force. After the study's publication, ASOS commanders and Army battalion commanders were jubilant—finally the JTAC mission had the priority it deserved; however, the manning gains were short lived. In early 2005, ACC published its Interim TACP manning guidance, which effectively chopped ASOS manning in half. Unfortunately, this "temporary" guidance became permanent. Today, TACP and JTAC manning sits at approximately 40 percent of the 2003 study's recommendations.[48] Second, as an answer to the Army's transformation efforts in 2004, ACC announced it would increase its JTAC force to 1,100 billets from 535 current billets. The deal brokered with the Army was part of a compromise to support the Army down to the company level with Air Force JTACs, some of them dedicated and others from a "pool" of JTACs. The Army would have preferred to garner an independent clearance authority for its Soldiers, especially for its field artillery forward observers, to "clear" fighters and bombers "hot" for bomb drops and strafing runs. Nevertheless, the Air Force convinced it to accept a new designation for its highly qualified forward observers to act as JFOs, essentially the eyes and ears of the JTAC. In 2011 the Air Force was nowhere near 1,100 JTACs and, in fact, hadn't crested over the 600 mark.[49] Finally, and perhaps most ominously, the Air Force an-

nounced on 27 January 2012 that it was disbanding five A-10 squadrons (three Air National Guard units, one reserve unit, and one active duty squadron), mentioned above: "Facing a new age of fiscal austerity, the Defense Department is trying to pivot away from the counter-insurgency campaigns of the past decade."[50] Clearly, this move preserves newer antiaccess and fifth-generation capability at the expense of a credible COIN competence.

Improving Our Tactical Pilots with the Light Attack Aircraft

By colocating the light attack aircraft at A-10 bases, the Air Force would directly improve its conduct of COIN missions.[51] Recall how the service used to train its fledgling A-10 pilots: with no simulator, only a cursory check in a rudimentary aircrew-training device, and then off for a solo ride in the A-10 (there are no two-seat A-10s). Today, A-10 pilots benefit from a high-fidelity simulator, but they still have no two-seat trainers. Numerous benefits accrue to having an aircraft with a similar mission set and two seats, not to mention the preparation for that first solo flight. Nothing can take the place of having another set of eyeballs to examine foibles in flight, in real time. For instance, if students experience difficulty with bombing, only one ride in a two-seat light attack aircraft could reveal the problem: perhaps they are setting their aim-off distance improperly, something that can be corrected on the spot. Similarly, if students can't determine when to pull lead on a simulated "bandit," a real-time input and/or demonstration could save hours and hours of costly flights, remedial training, and debriefing. Several other benefits come to mind: currency flights won't necessarily tie up limited instructors in a squadron, and combat search and rescue missions can include a backseater to enhance situational awareness and data recall/transmission. Furthermore, as long as A-10 pilots utilize the light attack fighter to keep their skills honed razor sharp, they won't generate any high-cost-per-flight-hour bills, and they won't age our frontline fighters.

We could also utilize light attack aircraft at F-22 bases and F-35 bases, where enormous operations and maintenance costs will likely keep the number of flying hours low for the foreseeable future.[52] Skills accumulated with flying the light attack aircraft could apply to aircraft across the board because all fliers could keep piloting acumen up to speed without piling on onerous bills. What's more, the light attack aircraft would increase the number of absorbable cockpits for the Air Force. For many years, the service has struggled to create enough experienced aviators to fill demands for rated staff duty—a situation that will only get worse as combat aircraft are drawn down and more pilots are channeled over to remotely piloted aerial systems.[53]

The Business Case

Under the current specter of decreasing DOD budgets, we would do well to look for measures that would garner savings while still giving the military the muscle it needs to prosecute the COIN fight around the globe. Given the fact that the light attack aircraft has a proven COIN capability, let's compare its sustainment figures with those of the A-10, F-16, and F-15E (see figure on the next page).

One can see quickly why the argument for a light attack aircraft corps is so compelling. ACC performed two studies, one in 2008 and the other in 2009. The first study concluded that replacement of just one-and-a-half squadrons of deployed fighters with the light attack aircraft would save well over $300 million per year in fuel and operations costs.[54] The second study focused strictly on fuel costs alone, concluding that deployed air expeditionary task forces could save nearly $90 million per year in fuel expenditures.[55] Increasing fuel costs and maintenance requirements for an older, end-of-life-cycle fighter fleet today and in the future will only magnify those savings.

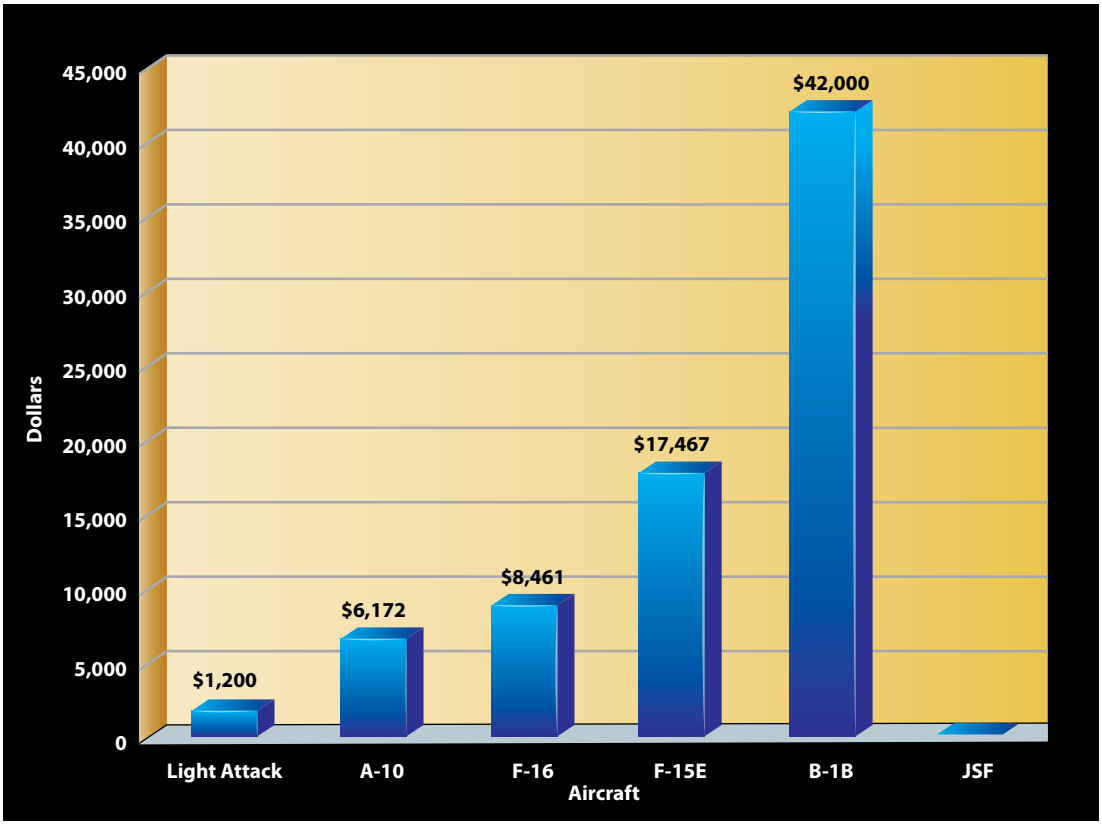

Figure. The business case: Estimated cost per flight hour. (Calculations of cost per flight hour vary according to the entering arguments and source. Figures for fiscal year 2010 come from Air Force Instruction 65-503, *US Air Force Cost and Planning Factors*, 4 February 1994, http://www.e-publishing.af.mil/shared/media/epubs/AFI65-503.pdf, and "Department of Defense FY 2011 Reimbursable Rates," Office of the Under Secretary of Defense [Comptroller], http://comptroller.defense.gov/rates/fy2011/2011_f.pdf, with a conservative 10 percent hike for current fuel rates. For A-10, F-16, and F-15E aircraft, figures include costs for fuel, depot-level repairables, and other depot maintenance. AT-6 and A-29 [Super Tucano] open sources serve as the basis for the $1,200 estimate per hour.)

Now let's take this cost per flying hour further to demonstrate substantial savings annually. Admittedly this example is simplistic and not all-encompassing, but the entering arguments are conservative and ex-

tremely thought provoking. In 2010, US Air Forces Central (AFCENT) flew 33,679 CAS missions.[56] Let us assume that light attack aircraft could have performed 95 percent of those sorties (31,996). The comparison of cost per flight hour across the board assumed the following mix of AFCENT sorties: 40 percent A-10 (12,798 sorties), 30 percent F-16 (9,599), 20 percent F-15E (6,399), and 10 percent B-1 (3,200). Furthermore, calculations used a nominal four-hour sortie (probably a grossly conservative number considering the average duration of all these aircraft after air-to-air refueling). Based upon the estimated cost per flight hour above, 31,996 sorties were flown at a total annual cost of $1,625,510,912.[57] Compare this with a light attack cost of $153,580,800.[58] That's a savings of $1,471,930,112 in 2010 alone, an amount that could purchase 136 light attack aircraft—more than enough to augment COIN capability in-theater for years to come. Also keep in mind that AFCENT does not track Marine Corps sorties (AV-8) in its yearly total and that the calculation made no allocation of savings due to dramatically diminishing tanker hours, so the potential savings are drastically higher than the approximately $1.5 billion reported above.

So why the tepid response for the light attack aircraft from today's senior leaders in the Air Force? Perhaps other than fighter pilots' natural aversion to considering a turboprop aircraft (an aversion that disappears after their first sortie), one major reason comes to the forefront. The OA-X represents a new procurement; therefore, its acquisition becomes part of a "zero-sum" game. Senior leaders view any additions of the light attack aircraft as cutting into other procurements of new aircraft—specifically, the F-35 JSF.[59] Reluctant to take any of the future 1,763 JSF slots, they are unwilling to remove current fighters from the inventory. Never mind the fact that these light attack aircraft would pay for themselves in a matter of years (based upon savings accrued from reducing the legacy fighters' hours, thus extending their life expectancy as well). Those savings accrue in another "bucket" of money separate from new aircraft procurements. Surely this accounting stratagem can be transformed to allow for common sense. Unfortunately, given the escalating costs of the JSF program and the debt-ceiling

agreement for a $330–450 billion reduction in defense spending over the next 10 years, resistance to adding additional numbers of light attack aircraft to the budget may only grow.[60]

It is becoming abundantly clear that light attack aircraft, either for our partner nations or our own Air Force, are not a priority. In November 2011, Secretary of the Air Force Michael Donley listed the Air Force's priorities: JSF, KC-46A tanker, new long-range bomber, continued development of remotely piloted air systems, and modifications of space systems for improved communications and missile warning.[61]

Nevertheless, another option may allow further purchases of the light attack aircraft without necessarily affecting the JSF buy. The OA-X could be "noncombat" coded for Air Force usage, as was the T-33 in a bygone era.[62] In this case, we could purchase the light attack aircraft in large numbers for training but not necessarily for combat. The Air Force could still use the aircraft as a trainer for air advisers engaged in building partner capacity, a JTAC trainer for ASOSs, and a companion CAS/COIN/forward air control–airborne / combat search and rescue trainer for ACC—but not for direct combat operations. In this capacity, it is uncertain whether the State Department could still employ the OA-X for slow-moving intercept, border patrol, or counternarcotics activity.

Summary and Conclusion

The US military's COIN operations are not going away. If the Air Force developed a terrific, fearsome airborne COIN capability without a reasonable chance of ever employing it, then clearly the service would have wasted the time and money necessary to develop that capacity. So it is indeed prudent to evaluate the next most likely region for conflict. The International Crisis Group lists the following hot spots as probable areas for what it calls "Next Year's Wars": Syria, Iran/Israel, Afghanistan (we're already there), Pakistan, Yemen, Central Asia, Burundi, Congo, Kenya/Somalia, Venezuela, Tunisia, and Myanmar.[63]

The next logical question that follows is, In which of these regions would one expect the light attack aircraft to play a significant role? The answer is all of them. That's right—all of them. Iran would pose an initial challenge since our legacy phase-two and -three workhorses (as well as other elements of our conventional forces—Tomahawk missiles, bombers, naval air, etc.) would have to suppress the electronic surface-to-air threats. That done, however, a COIN-like environment would exist in which light attack aircraft could flourish.

Former secretary of state Gates tried for years to persuade the Air Force to take small wars seriously, but, as he remarked, "It's been like pulling teeth." The secretary wanted to "institutionalize and finance our capabilities to fight the wars we are in today and the scenarios we are most likely to face in the years ahead." Gates spoke of his aversion to the "99-percent exquisite service-centric platforms that are so costly and so complex that they take forever to build."[64] If the Air Force ever becomes serious about adopting Gates's mantra, then it will have to make some hard decisions with respect to the technologically advanced approach it has taken to fighting our nation's wars. Perhaps the service could reduce or postpone some of its planned F-35 buy to accommodate a near-term surge in COIN and building partnership capability, thereby reducing the rapid devaluation of its current frontline fighters.

Simply by postponing the development and/or purchase of the over-budget and delayed F-35 and instead purchasing light attack aircraft, the Air Force would find that these platforms would pay for themselves in a very short time. Ponder this point: such a fundamental change in strategy regarding a light attack platform can result in ongoing sustainment and life-cycle savings; after paying off the OA-X purchase price, the Air Force could use that near-perpetual windfall every year thereafter to procure the same number of postponed F-35s. The correct paradigm is not an "either or / zero sum game" decision but a "both and / win-win game." The light attack platform represents an investment that actually improves the likelihood of the Air Force's actually being able to afford the F-35.

The light attack aircraft is built specifically to conduct COIN and CAS missions in the environment in which the United States will most likely operate in the coming years. This new paradigm results in the following for every hour flown in the OA-X:

- Money back to Air Force coffers for current and future needs through enormous savings in cost per flying hour.
- A significant increase in the United States' building partnership capacity.
- More training opportunities for ground personnel (JTACs, JFOs, special forces teams, SEALs, etc.), resulting in better trained ground troops.
- Enhancement of CAS and COIN proficiency among fighter/attack pilots.
- An increase in flying proficiency and flying time for pilots assigned to our most advanced airframes (F-22, F-35, and B-2).
- An improved currency and training regimen for our fighter squadrons (two-seat instruction for A-10 pilots, landing currency, and combat search and rescue training).
- Improved opportunities in air-to-ground integration for Airmen to interface directly with deployed special forces and Army units.

None of these improvements will come to our Air Force without hard decisions about the future buy of F-35s. As the Air Force ponders its future, one can only hope that it will consider beefing up its COIN and CAS capability in the near term with the light attack aircraft. If the service is truly serious about developing what Gen Edward Rice (commander of Air Education and Training Command) calls a "culture of cost consciousness," then surely it will make the right decision and develop the best Air Force to combat the next most likely threat to America's interests.[65] ✪

Notes

1. Joel Rubin, "How the Debt Deal Creates an Opportunity to Cut Nuclear Weapons," *Ploughshares Fund* (blog), 3 August 2011, http://www.ploughshares.org/blog/2011-08-03/how-debt-deal-creates-opportunity.

2. Department of Defense, *Irregular Warfare (IW) Joint Operating Concept (JOC)*, Version 1.0 (Washington, DC: Department of Defense, 11 September 2007), 16, http://www.fas.org/irp/doddir/dod/iw-joc.pdf.

3. Ibid.

4. Department of Defense, *Irregular Warfare: Countering Irregular Threats; Joint Operating Concept*, Version 2.0 (Washington, DC: Department of Defense, 17 May 2010), 4, http://www.au.af.mil/au/awc/awcgate/irregular/iw_joc2_0.pdf.

5. Ibid., 8.

6. Department of Defense, *Quadrennial Defense Review Report* (Washington, DC: Department of Defense, February 2010), 17, http://www.defense.gov/qdr/qdr%20as%20of%2029jan10%201600.PDF.

7. Ibid., 29.

8. "Air Forces in Irregular Warfare," Center for National Policy, 6 May 2010 [review and transcript of remarks by Gen Norton Schwartz, Air Force chief of staff], http://www.centerfornationalpolicy.org/ht/display/ContentDetails/i/18324.

9. Office of the Under Secretary of Defense (Comptroller), *National Defense Budget Estimates for FY 2011* (Washington, DC: Office of the Under Secretary of Defense [Comptroller], March 2010), 1, http://comptroller.defense.gov/defbudget/fy2011/FY11_Green_Book.pdf.

10. Ben Lambeth, Senior Fellow for the Center for Strategic and Budgetary Assessments and an adjunct associate for the RAND Corporation, conversation with the author, September 2011. Ben, who served as an introductory speaker for Gen Philip Breedlove (Air Force vice-chief of staff) at the Daedalians' Airpower Symposium in September 2011, had originally included two slides in his remarks addressing light attack. However, he was discouraged from mentioning them since the Air Force had no interest in tackling the topic.

11. Josh Rogin, "Jack Lew Tries to Explain the Defense 'Cuts' in the Debt Deal," *Foreign Policy*, 4 August 2011, http://thecable.foreignpolicy.com/posts/2011/08/04/jack_lew_tries_to_explain_the_defense_cuts_in_the_debt_deal; and Jill Laster, "Priorities Emerge As Budget Woes Intensify," *Air Force Times*, 29 November 2011, http://www.airforcetimes.com/news/2011/11/air-force-priorities-emerge-budget-woes-dick-newton-speech-112911w/.

12. Air Combat Command, *OA-X Enabling Concept* (Langley AFB, VA: Air Combat Command, 23 December 2008); and Carlo Munoz, "House Appropriators Eye Major Reductions to Joint Strike Fighter Funding," *Inside the Air Force*, 1 October 2010, 3. "All told, the Air Force could lose $4.1 billion from its FY-11 budget request" (ibid.).

13. Gen William M. Fraser III, ACC commander, conversations with the author during Joint Forces Command Component Commanders' Conference, March 2010; and Maj Gen Thomas K. Andersen, former ACC/A5R chief (Requirements), conversations with the author, August 2011.

14. On the topic of light attack aircraft, see the following: Richard Mesic et al., *Courses of Action for Enhancing U.S. Air Force "Irregular Warfare" Capabilities* (Santa Monica, CA: RAND Corporation, 2010); Lt Col Albert M. "Buck" Elton II, "An Air Commando Solution to an Irregular Warfare Problem," research report (Maxwell AFB, AL: CADRE/AR, May 2008); Air

Combat Command, *OA-X Enabling Concept*; Col Billy Montgomery, *USAF Irregular Warfare Concept*, white paper (Hurlburt Field, FL: Air Force Special Operations Command, 2007); Maj Brett Blake, "AT-6—the Best USAF Investment for the Long War," research report (Maxwell AFB, AL: Air Command and Staff College, 2007); Maj Arthur Davis, "Back to the Basics: An Aviation Solution to Counter-Insurgent Warfare," research report (Maxwell AFB, AL: Air Command and Staff College, 2005); Lt Col Michael W. Pietrucha and Lt Col J. David Torres-Laboy, *The Case for OA-X* (Langley AFB, VA: ACC/A3D Joint Integration Division, June 2009); Maj Steven J. Tittel, "Cost, Capability, and the Hunt for a Lightweight Ground Attack Aircraft" (master's thesis, US Army Command and General Staff College, 2009); Col Robyn Read, USAF, Retired, "Irregular Warfare and the US Air Force: The Way Ahead," *Air and Space Power Journal* 21, no. 4 (Winter 2007): 42–52; Maj David L. Peeler Jr., "A Method and Estimate for Counterinsurgency Aircraft Procurement," *Small Wars Journal*, February 2008; and Lt Col Clint Hinote, "The Drawdown Asymmetry: Why Ground Forces Will Depart Iraq but Air Forces Will Stay," *Strategic Studies Quarterly* 2, no. 2 (Summer 2008): 31–62, http://www.au.af.mil/au/ssq/2008/Summer/hinote.pdf.

15. "Air Forces in Irregular Warfare."

16. Joint Publication 5-0, *Joint Operation Planning*, 11 August 2011, III-42, III-43, http://www.dtic.mil/doctrine/new_pubs/jp5_0.pdf.

17. Ibid., III-43.

18. AT-6 aircraft have participated in three major Air Force / Air National Guard / joint exercises (Joint Expeditionary Force Experiment, April 2010; ANG Operational Assessment, October 2010; and North American Aerospace Defense Command's Falcon Virgo, November 2010), validating all of the aforementioned attributes and capabilities. Derek Hess, AT-6 director, Hawker Beechcraft Defense Corporation, conversation with the author, 18 August 2011.

19. The Israeli Griffin laser-guided bomb is not to be confused with Raytheon's 33-pound Griffin small tactical munition missile, which provides the AT-6 light attack aircraft a precision capability paired with standoff ranges up to 12.5 kilometers. See "Griffin Small Tactical Munition (STM)," Defense Update, 2011, http://defense-update.com/products/g/31122010_griffin_sgm.html.

20. Chris Kraul, "Modest Brazil Warplane Fitting into Nations' Plans," *Los Angeles Times*, 23 February 2010, http://articles.latimes.com/2010/feb/23/world/la-fg-ecuador-warplane23-2010feb23. Derek Hess validates AT-6 precision-weapon capability—among them Joint Direct Attack Munitions, laser-guided bombs, ATK's Direct Attack Guided Rocket, AGM-114 Hellfire, and Raytheon Griffin. Hess, conversation with the author, 18 August 2011. What's more, the AT-6 recently demonstrated a deployment range in excess of 1,725 nm with four external fuel tanks. Derek Hess, AT-6 director, Hawker Beechcraft Defense Corporation, conversation with the author, 22 November 2011.

21. Mesic et al., *Courses of Action*, 39.

22. Hess, conversation with the author, 18 August 2011.

23. Department of Defense, *Quadrennial Defense Review Report*, 17.

24. House, *Department of the Air Force, Presentation to the House Armed Services Committee, United States House of Representatives, Fiscal Year 2010 Air Force Posture Statement, Statement of the Honorable Michael B. Donley, Secretary of the Air Force, and General Norton A. Schwartz, Chief of Staff, United States Air Force*, 111th Cong., 1st sess., 19 May 2009, 3, http://www.au.af.mil/au/awc/awcgate/af/posture2009.pdf.

25. Laster, "Priorities Emerge."

26. Air Combat Command, *Irregular Warfare Operating Concept* (Langley AFB, VA: Air Combat Command, 25 July 2008), 13.

27. G. Hale Laughlin, "Aviation Development in Nation-Assistance Strategies," *Horizons Magazine*, no. 3 (Fall 2009): 19–21.

28. "The 1991 Gulf War, the intervening years of no-fly-zone enforcement, and the invasion of 2003 left the Iraqi air force completely devastated. With the exception of some base infrastructure, almost nothing remained to build upon. . . . The US Air Force in particular never developed a capability to conduct a project of this magnitude. . . . MNSTC-I created an entirely new organization, called the Coalition Air Force Transition Team (or CAFTT . . .) to oversee the creation of the Iraqi air force. This organization has taken some time to mature. . . . In fact, the CAFTT did not make use of the extensive expertise of USAF Special Operations Command forces until 2005." Hinote, "Drawdown Asymmetry," 43, 44, 61n38.

29. Alan J. Vick et al., *Air Power in the New Counterinsurgency Era: The Strategic Importance of USAF Advisory and Assistance Missions* (Santa Monica, CA: RAND, 2006), xviii, http://www.rand.org/pubs/monographs/2006/RAND_MG509.pdf.

30. Montgomery, *USAF Irregular Warfare Concept*, 12.

31. Conversation between Col Billy Montgomery and Mr. Jerome Klingaman, former director of strategy and plans, 6th Special Operations Squadron, 14 December 2006.

32. Lt Col George Monroe, USAF, retired, editor, *Comancheros*, e-mail conversation with the author, 13 January 2010.

33. For a discussion of this aversion to keeping a perennial skill in COIN activities, see Elton, "Air Commando Solution," 16–26.

34. Jeff Schogol, "5 A-10 Squadrons to Be Cut," *Air Force Times*, 30 January 2012, http://www.airforcetimes.com/news/2012/01/airforce-5-a10-squadrons-cut-013012.

35. "F-35 Joint Strike Fighter Media Kit Statistics," JSF.mil, August 2004, http://www.jsf.mil/downloads/down_mediakits.htm. See also *Wikipedia: The Free Encyclopedia*, s.v. "Lockheed Martin F-35 Lightning II," http://en.wikipedia.org/wiki/F-35_Lightning_II#cite_note-F-35_Stats-145.

36. The A-10 sports the GAU-8 Avenger 30 mm Gatling gun, capable of carrying 1,174 rounds and delivering accurate fire from more than 9,000 feet.

37. Forecasts of JSF per-unit costs are all over the map, depending upon the model priced and the source consulted. "In February 2011, the Pentagon put a price of $207.6 million for each of the 32 aircraft to be acquired in FY2012, rising to $304.15 million ($9,732.8/32) if its share of RDT&E spending is included." *Wikipedia: The Free Encyclopedia*, s.v. "Lockheed Martin F-35 Lightning II." See also "US Acquisition Costs by Weapon System," defense-aerospace.com, accessed 1 February 2012, http://www.defense-aerospace.com/article-view/reports_ar/122979/us-acquisition-costs-by-weapon-system.html; and Office of the Under Secretary of Defense (Comptroller)/CFO, *United States Department of Defense Fiscal Year 2012 Budget Request: Program Acquisition Costs by Weapon System* (Washington, DC: Office of the Under Secretary of Defense [Comptroller]/CFO, 2011). Estimate of light attack acquisition cost courtesy of Mr. Derek Hess, AT-6 program director, Hawker Beechcraft.

38. The F-16C model, for instance, has undergone a service life extension program (SLEP), raising its lifetime hours to 8,000; however, the average F-16C already has nearly 5,500 hours. Many F-16 experts believe that the SLEP has added a maximum of 10 more years to the airframe. Lt Col Will Sparrow, F-16 pilot with 4,000 hours and squadron commander, Alabama Air National Guard, conversations with the author, August 2011.

39. Kent Harris and Jennifer Svan, "War Puts Strain on Air Force's Aging Fleet," *Stars and Stripes*, 6 April 2008, http://www.stripes.com/news/war-puts-strain-on-air-force-s-aging-fleet-1.77360.

40. The A-10 SLEP boosted airframe longevity from 8,000 hours to 16,000 hours while the F-16 SLEP increased its longevity to only 8,000 hours. "F-16 Fighting Falcon: Service Life," GlobalSecurity.org, 7 July 2011, http://www.globalsecurity.org/military/systems/aircraft/f-16-life.htm.

41. For more detail, see Office of Air Force Lessons Learned, *Integration of Airpower in Operational Level Planning* (Washington, DC: Headquarters US Air Force/A9L, 8 August 2008). See also any Center for Army Lessons Learned (CALL) Collection and Analysis Trip report over the past seven years. CALL is based at Fort Leavenworth, KS.

42. A germane case in point is the study of Operation Anaconda, during which 10th Mountain Division planners did not initially include Air Force planners in their preparation. See Headquarters US Air Force/XOL, *Operation Anaconda: An Air Power Perspective* (Washington, DC: Headquarters US Air Force/XOL, 7 February 2005).

43. Army Field Manual 3-24/Marine Corps Warfighting Publication 3-33.5, *Counterinsurgency*, December 2006, 1-22, http://www.fas.org/irp/doddir/army/fm3-24.pdf.

44. The AT-6 demonstrated an austere landing capability early in 2011 by landing on a dry lake bed in Nevada and joining up with a special operations MC-130 aircraft for overwing refueling in the desert.

45. Joint Publication 3-09.3, *Close Air Support*, 8 July 2009, V-40, https://jdeis.js.mil/jdeis/new_pubs/jp3_09_3.pdf. From 2006 to 2010, the author worked at the Air Force Doctrine Center (renamed the LeMay Center for Doctrine Development and Education), Maxwell AFB, AL, where his frequent interaction with the Army's Directorate of Training and Doctrine at Fort Rucker, AL, taught him the perspective of Army attack aviation.

46. See US Army, US Air Force, and US Special Operations Command, memorandum of agreement, subject: Joint Fires Observers, 14 November 2005.

47. The author's experience with ROVER technology offers a perfect example. Most JTACs under his command never practiced with ROVER feeds until they found themselves in Iraq in combat—obviously not the ideal time to learn.

48. The author was an ASOS commander from 2004 to 2006. In late 2004, his squadron reaped the benefits of the ACC manpower study of 2003 and gained an additional 15 JTAC billets; however, every one of those billets was taken back after publication of the subsequent ACC interim TACP manning guidance in early 2005. Today, ASOS commanders deploy with such small numbers of JTACs that often they are forced to keep them in the battalion tactical operations centers and not in the field where they would better integrate with the Army. (Current manning morsel provided by Lt Col Robert Moseleski, recently deployed commander of an expeditionary ASOS in Afghanistan.)

49. Gen Martin Dempsey, the current chairman of the Joint Chiefs of Staff, lamented this fact at the 2010 Component Commanders' Conference, Joint Forces Command, May 2010.

50. Schogol, "Squadrons to Be Cut."

51. Brig Gen Paul Johnson, an A-10 pilot with hundreds of combat missions under his belt, first communicated this idea. General Johnson received the Air Force Cross for his leadership during a hazardous combat search and rescue mission near Baghdad in 1991.

52. F-22 pilots are currently utilizing T-38 trainer aircraft to supplement their flying hours in the F-22, which have been far and few between due to an oxygen generator malfunction.

53. Pietrucha and Torres-Laboy, *Case for OA-X*, 5.

54. Air Combat Command, *OA-X Enabling Concept*, 4.

55. Pietrucha and Torres-Laboy, *Case for OA-X*, 7.

56. Marc V. Schanz, "Boom Time in Afghanistan," *Air Force Magazine* 94, no. 6 (June 2011): 28, http://www.airforce-magazine.com/MagazineArchive/Documents/2011/June%202011/0611afghanistan.pdf.

57. See the following calculations for the estimated total annual cost: $6,172/flight hour x 4 hours x 12,798 sorties = $315,957,024 (A-10 sorties) + $8,461/flight hour x 4 hours x 9,599 sorties = $324,868,556 (F-16 sorties) + $17,467/flight hour x 4 hours x 6,399 sorties = $447,085,332 (F-15E sorties) + $42,000 x 4 hours x 3,200 sorties = $537,600,000 (B-1B sorties) = $1,625,510,912.

58. 31,996 sorties x 4 hours x $1,200/hour = $153,580,800.

59. Fraser, conversations with the author; and Andersen, conversations with the author.

60. On 30 December 2011, the Air Force awarded a contract to Embraer for 20 A-29 Super Tucano light attack aircraft as part of the Light Air Support (LAS) proposal for Afghanistan. The service will likely award a contract for six additional light aircraft as part of the Light Attack and Armed Reconnaissance (LAAR) proposal for a US training capability. Senior Air Force officials are reluctant to commit to any other additional light aircraft.

61. Guy Norris, "Donley Vows to Protect F-35, KC-46, Bomber," *Aviation Week*, 21 November 2011, http://www.aviationweek.com/aw/generic/story_generic.jsp?channel=aerospacedaily&id=news/asd/2011/11/21/01.xml&headline=Donley%20Vows%20To%20Protect%20F-35,%20KC-46,%20Bomber.

62. Col Matt "El Cid" Neuenswander, USAF, retired, an established and current Air Force expert in airpower, joint doctrine, and air-to-ground integration, conceived this idea.

63. Louise Arbour, "Next Year's Wars," International Crisis Group, 27 December 2011, http://www.crisisgroup.org/en/publication-type/commentary/next-years-wars-2012.aspx.

64. David Axe, "Air Force to Get New 'Light' Fighter," Wired.com, 11 August 2009, http://www.wired.com/dangerroom/2009/08/air-force-to-get-new-light-fighter.

65. SSgt Clinton Atkins, "Air Education and Training Command Symposium Begins," Air Education and Training Command, 20 January 2012, http://www.aetc.af.mil/news/story.asp?id=123286143.

Col Russell J. Smith, USAF, Retired

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Let us know what you think! Leave a comment!

The Downfall of Adaptive Planning

Finding a New Approach after a Failed Revolution

Lt Col John F. Price Jr., USAF

The dream that was adaptive planning (AP) is slowly dying. Despite great fanfare during its launch more than six years ago, this strategic transformation initiative within the Department of Defense (DOD)—intended to revolutionize the approach to war planning of the world's largest bureaucracy—has failed by almost any measure. Ironically, this failure is not the result of budget cuts or wartime distractions; rather, it is a casualty of its own institutional culture. Fixated on the virtues of planning, the military could not see that the desired outcomes depended on a revolution in strategic thinking, not strategic planning. Although planning will remain a cornerstone of military culture, today's environment demands more focus on the application and development of adaptive thinking as our primary discipline. Only then will we position ourselves to realize the dream of AP.

The Adaptive Planning Revolution

The US military has a rich history of strategic planning. In fact, one may reasonably argue that the entire DOD system is a perfect model of what Henry Mintzberg, Bruce Ahlstrand, and Joseph Lampel call the "planning school" of strategy.[1] In a recurring cycle, senior leaders create policy to direct planning by the services and combatant commands (COCOM), which creates requirements to feed the services' programming and budgeting processes. This system results in the creation of massive strategic and contingency plans intended to guide commanders through the perilous future landscape. The process of strate-

gic planning has obvious value, but its cumbersome, time-consuming nature puts it at odds with the demands of senior leadership at the turn of the century.

Following the review and subsequent execution of Operation Plan 1003V for the invasion of Iraq, Secretary of Defense Donald Rumsfeld expressed his dissatisfaction with the output and pace of the existing planning process. His guidance to find ways to conduct planning "quicker and better" led to development of the AP concept. On 13 December 2005, Secretary Rumsfeld signed out the *Adaptive Planning Roadmap 2005* to formalize implementation of a concept that had been maturing for several years.[2] The first of what would soon become two road maps highlighted dissatisfaction with the existing system: "The traditional contingency planning process is insufficiently responsive to the demands of today's security environment."[3] To substantiate this claim, the road map cites the following shortfalls:

- Existing deliberate plans are difficult to implement, or adapt.
- The 24-month deliberate planning cycle is too long and inflexible. . . .
- Plans do not incorporate sufficient branches and sequels. . . .
- Authoritative data is stovepiped [and] not readily accessible for planning. . . .
- . . . No formal mechanisms [exist] to ensure early and frequent consultation among civilian and military leaders during plan development. . . .
- . . . Interagency involvement generally occurs very late in plan development.[4]

To address these issues, developers intended AP to become "the Joint capability to create and revise plans rapidly and systematically, as circumstances require" (fig. 1).[5] The idea called for identifying and addressing significant roadblocks at the primary area of implementation—strategic plans divisions on the COCOM staffs—to allow production of better contingency plans. This initial concept quickly morphed into Adaptive Planning and Execution (APEX) in order to include both the development and execution of plans.

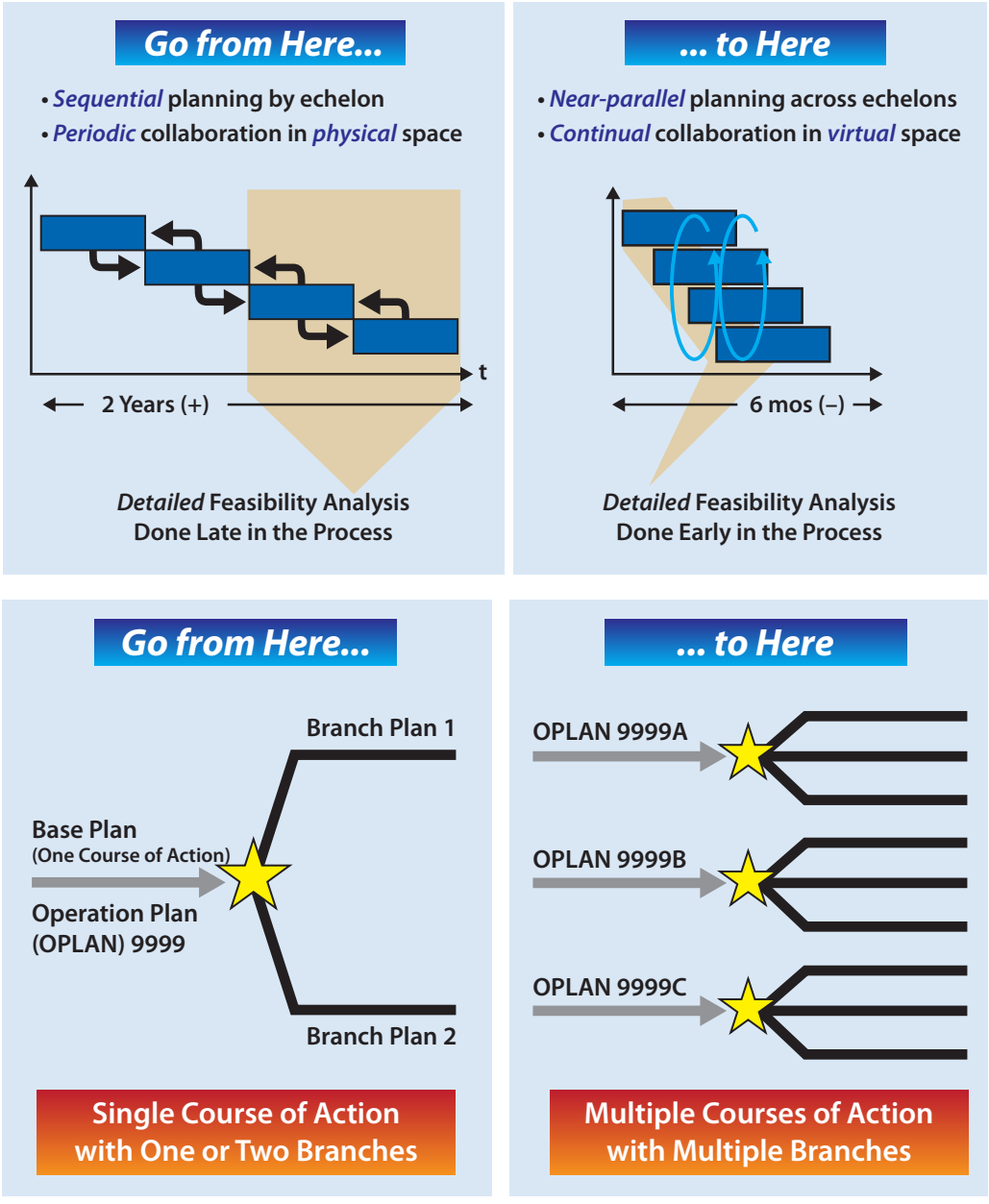

Figure 1. What are we trying to do? (Adapted from Briefing, Andrew Hoffman, Joint Forces Staff College, subject: Adaptive Planning, February 2006.)

The vision of AP was indeed revolutionary. Developers envisioned it "produc[ing] plans significantly faster, . . . and to a higher level of quality than is currently achievable" and "produc[ing] [relevant] plans with enough embedded options (e.g., branches and sequels)" designed for rapid execution.[6] The grand dream involved "net-centric 'living plans'" capable of rapidly reacting to "triggers" within a collaborative planning environment (fig. 2).[7] Implementation of AP would use spiral development that emphasized products, process, people, and technology (P3T), with the goal of reaching full operational capability in 2008. Unfortunately, at the dawn of 2012, we can no longer recognize the original timetable, and we have little chance of realizing the grand vision in the absence of significant changes.

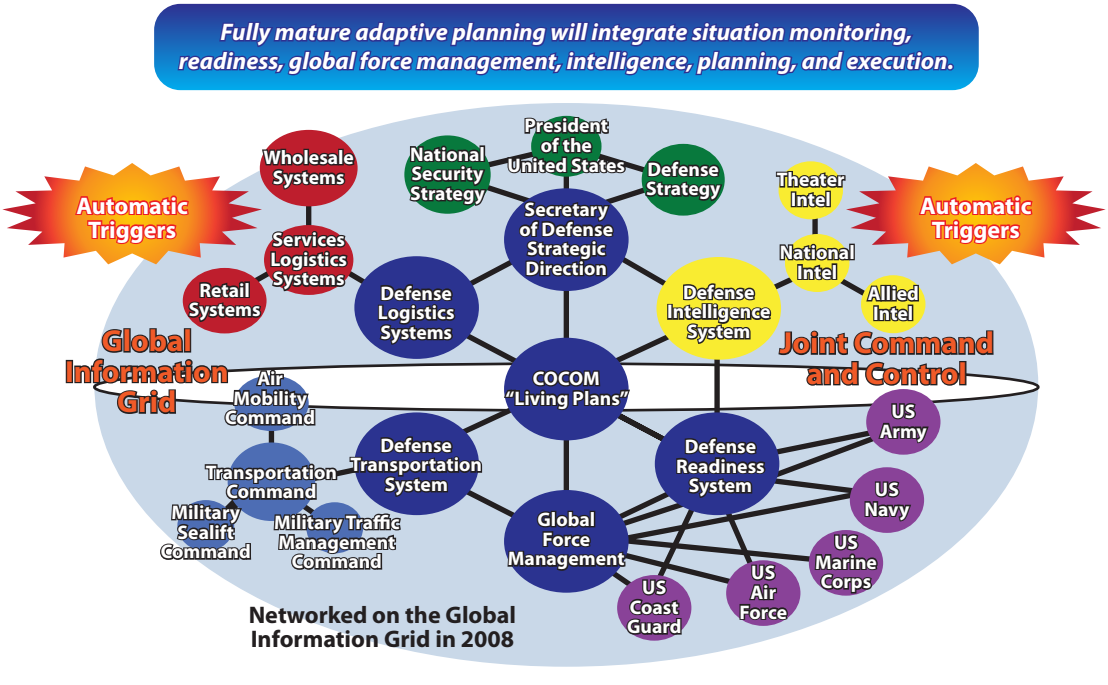

Figure 2. The dream that never was: Vision for mature adaptive planning. (Adapted from Office of the Secretary of Defense, *Adaptive Planning Roadmap 2005* [Washington, DC: Office of the Secretary of Defense, 13 December 2005], 12.)

View from the Ground Floor

As a joint "Jedi in training" at the Joint Advanced Warfighting School in 2005, I watched the emergence of AP with great interest. The basic idea of revolutionizing the joint operation planning process by using technology and process improvements seemed ideal, especially since I would soon serve as a strategic planner at US Pacific Command, tackling some of the nation's toughest planning issues. However, despite this interest, it was disconcerting to see that the content of the revolution seemed to concentrate solely on process, not purpose.

All of AP's tools emphasized increasing the speed of the same basic planning process. Instead of realizing that the primary shortfalls of the existing process stemmed from a lack of strategic thought, all efforts sought to make the existing system work faster and provide more options. Rather than fundamentally questioning the entire process, developers assumed that it was correct and simply needed fine tuning. AP intended to optimize the presentation, writing, coordination, and sourcing of the massive plans but failed to address the most fundamental aspect of plan credibility—critical and creative thought.

The military's penchant for process and its fixation with planning did not allow questioning of the most fundamental assumptions about the chosen method for generating and delivering sovereign options. No one could challenge the presupposition that the vaunted military decision-making process would always deliver. In the end, the very community that prides itself on the ceaseless examination of planning assumptions failed to critically examine the one assumption that could have saved the concept.

The Fall of Adaptive Planning

One can trace evidence of the downfall of AP back to the P3T changes designed to fuel the transformation. First, in the realm of personnel, developers acknowledged that AP "may overload planning staffs" with work initially and "will require far more experienced planners" when it

matures.[8] However, a "comprehensive human resource strategy [would address] shortfalls in the selection, education, training, professional development, and personnel management of Joint contingency planners."[9] Unfortunately, the "care and feeding" of the military planning community has not changed, and the overload of planning staffs became the only fulfilled promise of AP. Since 2005 the production of formally trained planners has not increased. In fact, the decision to make the sole joint planner training institution (the Joint Advanced Warfighting School) only a senior developmental education school instead of a dual junior-senior school saw an actual decrease in the effective number of trained planners produced each year by the DOD.

The products realm promised to expedite planning by using better and timelier guidance to "generate plans with multiple branches and sequels . . . and alternate base plan[s]."[10] Although this realm improved slightly with the emergence of the documents *Guidance for the Employment of the Force* and *Guidance for the Development of the Force* to replace the *Contingency Planning Guidance*, they made no changes to the basic approach to planning that the DOD has executed for decades. Massive, annex-laden plans continued to grow at the COCOMs while entire war plans devolved into single PowerPoint slides for discussions in Washington. In the end, the menu-of-options concept proved elusive.

Of all these areas, the technology realm generated the greatest disappointment, realizing only a fraction of the original grand design. AP promised to create "collaborative, . . . web-based planning technology and tools with easily accessible, linked databases."[11] Instead, most of the tools intended to foster collaboration and reduce planners' burdens never materialized, and one of the proven sourcing tools—Collaborative Force-Building Analysis, Sustainment, and Transportation (CFAST)—terminated prematurely in 2009.

The final realm, process—ripe for improvement—should have experienced the most drastic change but produced only lackluster results. Formalization of in-progress reviews (IPR) between combatant commanders and the secretary of defense has enhanced the flow and fre-

quency of plan reviews, but the 45-minute discussions of major strategic concepts rarely brought about the advertised revolution in strategic guidance. No significant changes have occurred in plan development or review processes, leaving the bulk of thought and effort to a small group of planners on the COCOM staff. The promise of reducing the planning timeline from 24 months to "days" with the new process never materialized (fig. 3). Indeed, the initial mandate of cutting the process in half—from a two-year development cycle down to one year—did not survive implementation and became significantly less stringent.

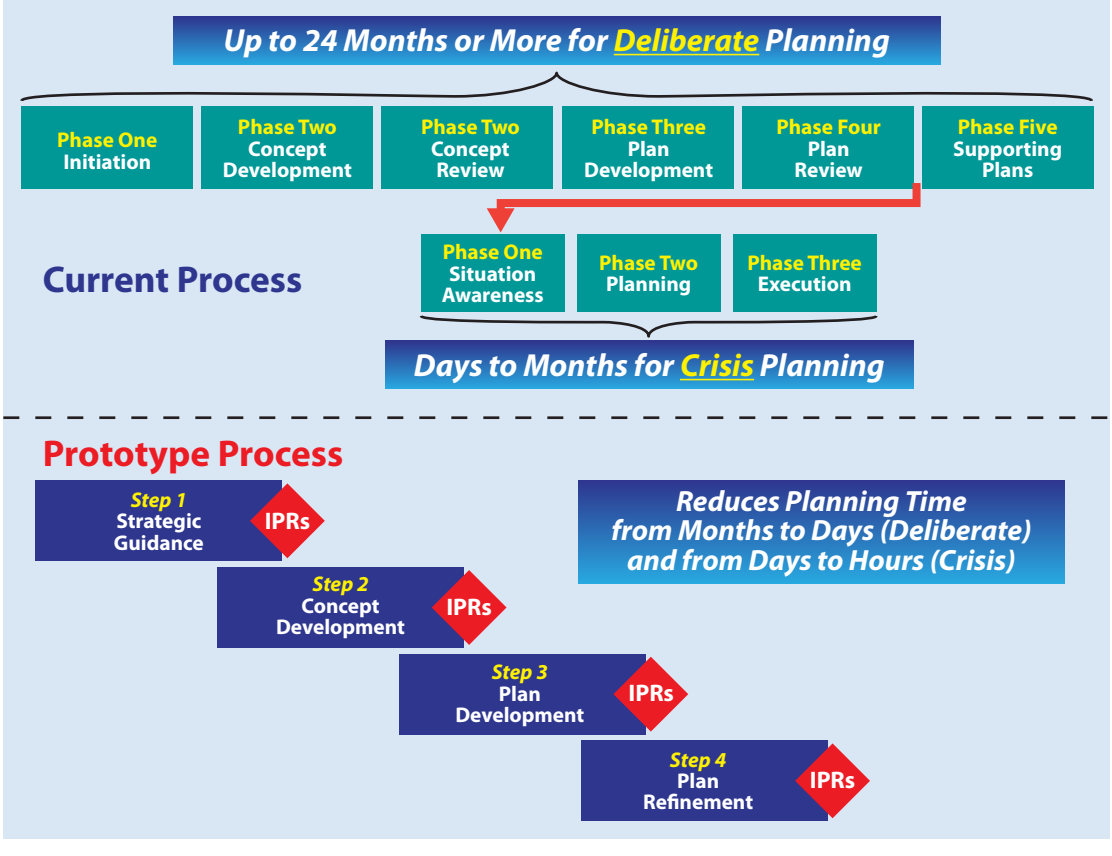

Figure 3. Comparison of adaptive planning process with current process. (Adapted from Office of the Secretary of Defense, *Adaptive Planning Roadmap 2005* [Washington, DC: Office of the Secretary of Defense, 13 December 2005], 19.)

Based on this review, even by the most generous standards, the AP revolution has failed. It did so because the complexity and duration of the strategic planning process resist simplification sufficient to accommodate the radical demands of agility and flexibility without significant restructuring. To attain the desired outcomes, we must initiate a fundamental shift from sole reliance on a complex planning process to dependence on strategic thinking and planning in a more agile framework.

Strategic Planning versus Strategic Thinking

For too long, US military circles have assumed that strategic planning and strategic thinking were synonymous. This premise, combined with the military's penchant for bureaucratic process, has led to placing the preponderance of intellectual effort on the planning process. Consequently, planners have endlessly pursued deeper and deeper mission analysis, intelligence preparation of the battlespace, and excursions into effects-based operations in order to fine-tune the development, selection, and refinement of the course of action (COA). Even now as the planning community slowly embraces the latest fad of design, it still fails to understand that strategic planning and strategic thinking are two distinct activities.

Strategic planning, a process-based activity, focuses on analysis, logic, and procedures while strategic thinking, an idea-based cognitive activity, emphasizes synthesis, creativity, intuition, and innovation.[12] Strategic planning translates strategy into actionable content. Strategic thinking generates insight into the present and foresight regarding the future.[13] It fuels the start of the strategic planning process but often becomes overwhelmed by concentrating on the next step in the process or by making PowerPoint slides for the next IPR. As T. Irene Sanders points out, "Most strategic planning models are still too complicated and take too long; they are too confusing, too inflexible, and too disconnected from the dynamics of the real world context they are designed to navigate. . . . Strategic thinking is often abbreviated or overlooked completely."[14]

The military has long held that "it's not the plan, it's the planning." Though typically employed to caveat the less-than-perfect results of the planning process, this quip actually points to the core issue that purposeful thought about the issues is more important than the process or products. According to Jeanne Liedtka, "The ability of a strategic planning process to deliver on its promise rests upon the quality of the questions it asks, rather than the answers it demands."[15] Strategic thinking keeps leaders in receive mode throughout the process, allowing concepts to emerge and adaptation to occur along the way instead of relying on the false expectation that everything is figured out in advance or will happen according to the planner's timeline.

Credible, Living Plans . . . with Options!

AP transformation had the objective of creating credible, living plans that provide multiple options to senior leaders. As someone who has been intimately involved in the planning process, I know that this outcome is possible only through a flexible, responsive framework and the exercise of sustained critical thought. Only practiced strategic thought can provide the agility and creativity required to keep pace with emerging threats while developing the menu of options necessary to counter them.

A great challenge occurs in the mesh of timelines between strategic thought, which operates continuously and on a scale of minutes and seconds, and strategic planning, which operates sequentially and on a scale of months and years. Members of the planning community resist continuous strategic thought because they cannot afford to keep the "good-idea window" open since doing so prevents completion of that step and delays movement to the next steps in the process. The inertia of the planning process creates a natural resistance to embracing strategic thinking apart from its role at specific junctions in the process.

The predictive nature of planning represents another significant hurdle for strategic planning as it pursues the adaptive goal. Strategic

planning is plagued by what Mintzberg, Ahlstrand, and Lampel call "the fallacy of predetermination." They write that "to engage in strategic planning, an organization must be able to predict the course of its environment, to control it, or simply to assume its stability." Mintzberg, Ahlstrand, and Lampel also observe that, effectively, "the world has to hold still while the planning process unfolds" and then unfold in the manner forecast.[16] Since this scenario remains highly unlikely, these characteristics seriously undermine the credibility, adaptability, and currency or "living" nature of the plans.

A final set of barriers in the current system comes from underlying structures that comprise the strategic planning framework. The DOD continues to use the Cold War–era Joint Operation Planning and Execution System (JOPES) to prescribe the format of its contingency plans. This colossal structure, described in Chairman of the Joint Chiefs of Staff Manual 3122.01, *Joint Operation Planning and Execution System (JOPES)*, vol. 1, *Planning Policies and Procedures*, 14 July 2000, prescribes nightmarish detail that leads to massive planning documents in excess of 1,000 pages. Added to this already unwieldy beast is an entire family of plans that cascades down from the COCOM through service components to the unit level and across to supporting commands such as US Transportation Command or US Strategic Command. These plans can easily top tens of thousands of pages, and the sum total of this strategic planning effort is about as agile as Mount Rushmore. Serious change in this domain would require a direct confrontation with the "JOPESter" tribe who vigorously defends the system as the only part of planning that works, failing to realize that JOPES is part of the anchor that prevents institutional progress.

If military leaders truly wish to reach their goal of having current, credible, and multiple options for confronting the threats that America faces, it is time to stop trying to breathe agility into the rigid planning process. Instead, they must generate agility and creativity by making strategic thinking our primary strategic discipline.

Thinking Ahead

The way ahead demands a return to the proper relationship between strategic thinking and strategic planning. Both are vital to the continued preeminence of the US military, but if we wish to reach the original objectives of AP, we must turn our attention from strategic planning to strategic thinking. This transition will neither occur overnight nor prove easy because it will assail some of the long-standing cultural norms and processes of the armed forces. However, the alternative is to continue using our outdated processes and live with products that fail to meet the needs of the president and secretary of defense.

Although this article does not presume to address all of the aspects of the proposed transition, five actions present themselves for consideration:

1. *Develop and strengthen strategic thinking skills*. As a discipline, strategic thinking requires training and practice, as does strategic planning; therefore, we should direct developmental efforts toward accession sources and professional military education forums. At a minimum, specific training should include scanning (assess where we are), visioning (determine where we want to go), reframing (look at things differently), making common sense (translate what we "know"), and systems thinking (discern interrelationships and complexity).[17]
2. *Expand the community*. Unlike the relatively closed elite community of strategic planning, the new strategic thinking culture should widen its aperture. We will retain a select cadre of formally trained planners, but we can significantly expand participation in strategic thinking to include more perspectives and creativity. Training and participation in the discipline of strategic thinking offer benefits that go well beyond its strategic planning applications.
3. *Break the mold*. Although still useful for static topics, the JOPES construct has outlived its utility for addressing the dynamic planning environment. We should eliminate the JOPES framework and replace it with streamlined requirements that allow creativity

and innovation to deliver options in the most appropriate and expeditious format. In these days of remotely piloted aircraft and satellite communications, we cannot allow our nation's premier planners to waste countless hours formatting planning documents in Microsoft Word. Because the real measure of quality for a strategic plan lies in its content, not its format, we need to adopt a new method for capturing and presenting strategic thinking and planning that reflects these priorities and our technological status.

4. *Change the process*. The current deliberate planning process needs modification to reduce time and wasted effort. The most useful aspect of the process occurs during mission analysis and COA development, when most of the strategic thought occurs. Refocusing the process at this point can provide greater coverage to multiple potential futures since it does not force the selection of a single COA and saves significant time and resources. To offset this change, COCOMs should institute regular crisis action planning reviews of their concepts since these processes bring the plans into execution. These reviews will shape refinements or changes of the strategic concepts.

5. *"Red-team" the review*. We must restore credibility to the plan-review process by completely overhauling the current administrative joint planning and execution community (JPEC) review and installing a "red team" review. Although good in concept, the JPEC often amounts to little more than a haphazard collection of action officers across the DOD who possess neither the skills nor motivation to effectively supply the intended review. Instead, COCOM planners receive several hundred comments from the JPEC pointing out misspelled words on page 17 instead of substantive comments on the operational design or logistical concept of operations. Socializing plans with the planning community will continue to have value, but it is time to stop treating this as a validation process. The red team, comprised of objective, experienced strategic planners and thinkers, would critically review the underlying

logic, creativity, and feasibility of the strategic concept while enhancing consistency in plan development.

Conclusion

The objectives of the AP transformation effort are even more relevant today than they were when the program began, but we stand little chance of reaching them without significantly changing our approach. Even at this writing, the AP executive committee showed the dismal future of AP by terminating development of the "son of CFAST" suite of planning tools and reducing IPRs for COCOM plans because they were overwhelming senior leaders' calendars. Meanwhile, our COCOMs continue to struggle with insufficient numbers of trained planners, outdated planning tools, and an ever-increasing number of complex plans to maintain. We must acknowledge that the AP revolution has failed and shift our direction. As the dominant military intellectual discipline, strategic planning has served the DOD well, but it is not suited to stand alone as the primary strategic mechanism because it lacks the agility and creativity to deal with the pace and diversity of today's threat environment. By emphasizing the development and employment of strategic thinking and moving away from the sluggish, constraining aspects of our planning structures, we can create current, credible options for addressing America's security challenges. ✪

Notes

1. Henry Mintzberg, Bruce Ahlstrand, and Joseph Lampel, *Strategy Safari: A Guided Tour through the Wilds of Strategic Management* (New York: Free Press, 1998), 49.
2. Office of the Secretary of Defense, *Adaptive Planning Roadmap 2005* (Washington, DC: Office of the Secretary of Defense, 13 December 2005).
3. Briefing, Andrew Hoffman, Joint Forces Staff College, subject: Adaptive Planning, February 2006.
4. Office of the Secretary of Defense, *Adaptive Planning Roadmap 2005*, 2.
5. Ibid., v.
6. Ibid., 7.

7. Ibid., 8.
8. Ibid., 23.
9. Ibid., 24.
10. Ibid., 22.
11. Ibid., 24.
12. Fiona Graetz, "Strategic Thinking versus Strategic Planning: Towards Understanding the Complementarities," *Management Decision* 40, no. 5/6 (2002): 457.
13. T. Irene Sanders, *Strategic Thinking and the New Science: Planning in the Midst of Chaos, Complexity, and Change* (New York: Free Press, 1998), 10.
14. Ibid., 137.
15. Jeanne Liedtka, "Linking Strategic Thinking with Strategic Planning," *Strategy and Leadership* 26, no. 4 (October 1998): 34.
16. Mintzberg, Ahlstrand, and Lampel, *Strategy Safari*, 66–67, 68.
17. Richard L. Hughes, and Katherine Colarelli Beatty, *Becoming a Strategic Leader: Your Role in Your Organization's Enduring Success* (San Francisco: Jossey-Bass, 2005), 44.

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Let us know what you think! Leave a comment!

DEVELOPMENT OF AIR DOCTRINE 1917 – 41*

James L. Cate

Among its colored charts and uncolored judgments, the sober report of the *U. S. Strategic Bombing Survey* contains this figure of speech: "Air power in the last war was in its infancy.... In this war, air power may be said to have reached a stage of full adolescence."[1] Whoever is curious to understand that growth in maturity in the U. S. Army air arm between Chateau-Thierry and Rouen-Sotteville No. 1 may find that there is a political, a technological and an intellectual phase to his problem. He may study the long and bitter struggle for an independent air force; or the constant search for bigger and better bombers; or the development of a new concept of war built around the air weapon. Those phases were mutually interdependent, and to determine which was the controlling factor might involve the student in some "hen-first-or-egg-first" sort of metaphysics, but either might serve as a convenient avenue of approach. American interests being what they are, we need fear no neglect of politics or technology; we may leave the independent air force with Congress and the heavy bombers with Boeing and Consolidated, and examine the growth of doctrine as if we were proper theologians. Without stretching the evidence too greatly one might suggest the thesis that it was the growth of a new

*A paper read at the Fortieth Annual Meeting of the Mississippi Valley Historical Association, Columbus, Ohio; April 24, 1947. The author has written a fuller account of the growth of air doctrine in the first volume of a general history of the Army Air Forces which should appear soon. *Editor.*

[1] *The United States Strategic Bombing Survey*, *Over-all Report* (*European War*), September 30, 1945 (Washington, 1945), p. 1.

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concept of air employment which guided the air arm in its struggle for a more suitable command structure and its efforts to develop an efficient heavy bomber. For that concept was built around a type of operation, called since 1917 "strategic bombardment," which required for its effective use some degree of independence from the ground arm and aircraft of long range and great bomb load. In the limited space at our disposal we cannot develop this thesis, but can sketch in briefly the main lines of doctrinal development.

To trace the genesis and growth of an idea is always a hazardous venture, and here there are pitfalls of a special sort: the anonymity or composite authorship of Army documents; an Army publication code which encouraged repetition and made a virtue of plagiarism; and the difficulty of determining the reading habits, if any, of the unidentified authors. Properly we should be able to trace the evolution of air doctrines in the appropriate training manuals and directives, but the assembling and perusal of a complete file of such texts would prove a task more arduous than profitable. Composed in that classic War Department prose style, and studded with such irrefutable truths as "The mission of bombardment aviation is the bombardment of ground objectives,"[2] the official manuals convey a most erroneous impression of the progress of thought in the Air Corps. If air officers accepted perforce the doctrines contained therein, it was often with the sort of lip service which might be paid by a liberal clergyman to an outworn creed.

In February 1942, when the advance echelon of the VIII Bomber Command was just arriving in the United Kingdom, General Arnold informed the commander of U. S. Army forces in that area that the RAF should be impressed with the fact that "only

[2] *Field Service Regulations, U. S. Army* (Washington, 1924), p. 23.

American doctrines and principles" must guide our operations.[3] Like the nation itself, the AAF had been nurtured in a European tradition, borrowing especially from British ideas, and this brusque statement might be interpreted as a new declaration of independence. Actually the difference between AAF and RAF doctrines lay rather in the techniques to be employed than in the ends desired. But the point of interest here is that, while Arnold's meaning was clear to his correspondent, the contrast he referred to was not explicit in the most recent official pronouncement on air employment — War Department Training Circular No. 70.[4] That manual erred, as had all promulgated since 1935, in giving both sides of all controversial issues with no firm preference. This "straddling," as a bombardment-minded officer termed it,[5] was indicative of divided counsel rather than of judicial impartiality, and the texts, as perhaps some of you who taught from them will remember, were but feeble instruments of indoctrination. Worse still, most of the manuals published before 1935 were actually antagonistic to the most advanced thought in the Air Corps.

The reason is not far to seek. Control over the formulation and dissemination of combat doctrines was vested in a General Staff composed of ground officers and the air manuals had to be denatured to suit their taste. The tone had been set in 1919 when returning veterans of the Air Service, AEF, had first attempted to reduce wartime lessons to peace-time training guides.[6] Whatever ideas of an

[3] CM-OUT-576 (21 Feb. 42), Arnold to Chaney, AF #2/353, 21 Feb., 42 (paraphrased). [MS materials cited in this paper are from archives of the AAF Historical Office at Washington, D. C., except those coded AAG, which are from the Air Adjutant General's files.]

[4] WD TC No. 70, Army Air Forces Basic Doctrine, 16 December 1941; a mimeographed pamphlet issued pending revision of FM 1-5 and publication of FM 100-15.

[5] Maj. W. R. Carter, Employment of Army Air Forces, 12 April 1938; in AAG 321.9, Doctrines of Air Corps, Unclassified Files.

[6] Wm. Mitchell, "Our Army's Air Service," *American Review of Reviews*, LXII (September, 1920), pp. 281-90.

independent air mission they may have entertained were effectively scotched by official pronouncements in that year by the Dickman Board,[7] by General Pershing[8] and by Secretary of War Baker.[9] The theory of war endorsed in these reviews of recent experiences received its most authoritative statements in the 1923 revision of the Field Service Regulations, U. S. Army. This starts from an axiom borrowed from Clausewitz: "The ultimate objective of all military operations is the destruction of the enemy's armed forces by battle. Decisive defeat in battle breaks the enemy's will to resist and forces him to sue for peace."[10] Victory in the offensive requires cooperation of ground and air forces: "No one arm wins battles," but the "....coordinating principle which underlies the employment of the combined arms is that the mission of the infantry is the general mission of the entire force. The special missions of the other arms are derived from their powers to contribute to the execution of the infantry mission."[11] Briefly, the chief role of aviation was close support.

For ten years the manuals of the Army air arm, while attempting modestly to enhance the importance of the role of aviation, adhered closely to the central thesis of the Field Service Regulations. Thus Training Regulation 440-15 (1926) states that the organization and training of air units should be "....based on the fundamental doctrine that their mission is to aid the ground forces to gain decisive success."[12] Even at the Air Service Tactical School the handbook on bombardment published the same year dealt only

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[7] *Hearings before the President's Aircraft* [*Morrow*] *Board*, I (Washington, 1925), 21.
[8] *Ibid.*, p. 23.
[9] *Report of the Secretary of War for Fiscal Year Ending June 30, 1919*, in *War Department, Annual Reports*, 1919, I (Washington, 1920), *passim* and especially pp. 68 ff.
[10] *Field Service Regulations*, p. 77.
[11] *Ibid.*, p. 11.
[12] *T. R. No. 440-15, Fundamental Principles for the Employment of the Air Service* (Washington, 26 January, 1926), para. 4.

with ".... operations in support of, or in conjunction with, large forces of ground troops ....," deliberately omitting consideration of ".... independent air force operations."[13] Indeed, the authors deplore the fact that ".... the strategical employment of bombardment in stabilized warfare is popularly conceived to be the true role of that class of aviation."[14]

This was a flank attack on Billy Mitchell, forced to resign from the Army a few months before, who had popularized that view in America. But the implied criticism was not wholly candid, for Mitchell's ideas had infected the Air Service as well as the public; they are then far more significant than the official pronouncements. Mitchell's crusading ardor, his flair for publicity and his posthumous canonization have made familiar to all the general outlines of his concept of Air Power, so that it should here suffice to point out several important factors in the development of his thought. Perhaps the most powerful of the early influences was Sir Hugh Trenchard, who commanded the Royal Flying Corps in France when Mitchell first met him in May 1917. Entries in Mitchell's diary indicate how profoundly he was impressed by the advanced views of the Britisher, and suggest that this was the source of two of Mitchell's cardinal principles: that the airplane was essentially an offensive weapon and that the first mission of aviation was to gain air ascendancy through offensive action. In 1918 Trenchard was given control of the RAF's Independent Air Force, and his design for the bombardment of Germany, originally conceived as a retaliatory measure, developed into the first articulate program of

[13] ASTS, Langley Field, Va., *Bombardment* (Washington, 1926), p. 54.
[14] *Ibid.*, p. 72.

strategic bombardment.[15] By Armistice Day arrangements had been made for Americans to cooperate in this program as a part of the Inter-Allied Independent Air Force,[16] and Mitchell was apparently in sympathy with its underlying philosophy.

But if Mitchell's ideas were originally derived from foreign sources, they were conditioned both by his own experience in France and by the American environment after his return. It was axiomatic with him that the aviation problems of each nation differed, and while his earliest publications on Air Power — magazine articles published in 1919[17] — were largely descriptive of Air Service combat in close support of ground armies, he soon adopted an approach more typically American in viewpoint. Traditionally we had thought of war in terms of national defense; in the reaction which followed the "great crusade" it appeared unlikely that we would again fight a continental war in Europe of the sort described in Mitchell's early articles or in the Field Service Regulations. Close support of field armies would be necessary only after an enemy had landed an expeditionary force on this continent, and whereas the Navy had always constituted the first line of defense against that contingency, Mitchell proposed to substitute for it an air force. As early as 1919 he had suggested tentatively the idea which was responsible for much of his fame (or notoriety, depending on your point of view) — that the airplane had doomed the capital ship and hence the entire surface navy, and throughout his career that thesis was to occupy in his thought a prominence justified only by national geography and national patterns of thought. Thus in his first book, published in 1921, he only hints at the pos-

[15] H. A. Jones, *The War in the Air,* VI (Oxford, 1937), chs. III, IV.
[16] *Ibid.,* Appendices No. V, VI, IX, X, and XIX (in separate volume).
[17] Wm. Mitchell, "The Air Service at St. Mihiel," *World's Work*, XXXVIII (August, 1919), 360-70; "The Air Service at the Argonne-Meuse," *Ibid.* (September, 1919), pp. 552-60.

sibilities of air attack on an enemy's economy and names the armed forces as the ultimate objective: "Our doctrine of aviation, therefore, should be to find out where the hostile air force is, to concentrate on that point with our Pursuit, Attack and Bombardment Aviation, to obtain a decision over the hostile air force, and then to attack the enemy's armies on the land or navies on the water and obtain a decision over them."[18]

But improvements in aircraft performance, always projected into the future by Mitchell's enthusiasm, and his concern with island bases lying along the great circle routes of the higher latitudes, suggested the possibilities of air attack against the United States. Those islands pointed away from, as well as toward, the United States and perhaps it was political acumen which led him, in the isolationist America of the 1920's, to describe his theory of strategic bombardment first in terms of what might happen to New York, not of what we might do to Berlin. You will remember that he called the books in which he laid down operational principles for his *offensive* weapon, *Our Air Force: the Keystone of National Defense* and *Winged Defense*.[19] But for all his circumlocution, he had by 1925 advanced a theory of war based on an air attack against the enemy's national resources rather than against his armed forces, and had suggested, in his plan for seizing island bases, a means by which the United States could conduct such a war against either Europe or Asia. Perhaps his most succinct statement of his theory appears in *Skyways*:

> War is the attempt of one nation to impress its will on another nation by force after all other means .... have failed. The attempt of one

[18] Wm. Mitchell, *Our Air Force, The Keystone of National Defense* (New York, 1921), p. 15.
[19] *Winged Defense, The Development and Possibilities of Modern Air Power, Economic and Military* (New York, 1925).

> combatant, therefore, is to so control the vital centers of the other that it will be powerless to defend itself.[20]

Armies and navies were developed as a means of preventing an enemy from getting at the strategic spots and with the advantage given the defense by modern weapons, war had become a slow and bloody affair. But

> The advent of air power which can go to the vital centers and entirely neutralize or destroy them has put a completely new complexion on the old system of war. It is now realized that the hostile main army in the field is a false objective and the real objectives are the vital centers. The old theory that victory meant the destruction of the hostile main army, is untenable. Armies themselves can be disregarded by air power if a rapid strike is made against the opposing centers.... [21]

In December 1925 a journalist wrote, apropos of the court-martial of the Air Service's stormy petrel, "Mitchellism will remain after Col. Mitchell has gone."[22] In the organizational dispute which had been the chief cause of his downfall, Mitchellism scored but limited gains in the Air Corps Act of 1926 and the formation of the GHQ Air Force in 1935. In the subtler realm of doctrine its influence was perhaps more important. In that respect we may discern a right wing and a left wing among the prophet's followers. The GHQ Air Force did provide in theory an instrument capable of independent operations, and the nature of those operations became an issue of cardinal importance for the Air Corps. With the growing unrest in Europe and Asia in the middle thirties the problems of national defense were studied with increasing seriousness, and there were those in the Air Corps who because of conviction or of

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[20] *Skyways* (Philadelphia, 1930), p. 253.
[21] *Ibid.*, p. 255.
[22] *New York Evening Post*, quoted in Isaac D. Levine, *Mitchell: Pioneer of Air Power* (New York, 1943), p. 331.

expediency were willing to go along with the War Department and the Joint Army-Navy Board in limiting the role of GHQ's air striking force to quasi-independent activities. These were largely defensive in character, subordinating strategic bombardment to counter-air activities and to such over-water operations "in support of or in lieu of naval forces" as were allowed by the Joint Action of the Army and Navy of 11 September 1935.[23] This view is epitomized in an Air Corps memo of 1935:

> National policy, geographic location of bases and the present range of planes which does not permit the air attack of the national structure of any probable enemy, dictate the role of the GHQ Air Force as one of air defense and fix its true objective.[24]

When in 1938-1939 "hemisphere defense" supplanted "national defense" as a slogan, this theory was extended to cover new territories, but strategically it remained much the same. Ostensibly, at least, the B-29 was designed in 1940 to prevent Axis powers from establishing bases in Latin America rather than to carry the atom bomb to Hiroshima. In June of that year an Air Corps general, anxious to secure the aid of the automobile industry's most prominent pacifist, could write in all seriousness: "It should not be difficult to convince Mr. Ford that the bomber, as far as we are concerned, is not an offensive weapon but the best means we have available to defend the United States."[25]

If this group of air officers adopted only the early aspects of Mitchell's thought, the others, whom I have called the radicals,

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[23] Para. 22, a (31).
[24] ACTS Study of Proposed Air Corps Doctrine Submitted by WPD on 4 December 1934, Maxwell Field, 31 January 1935; in AAG 321.9, Doctrine of Air Corps, Unclassified Files.
[25] Maj. Gen. B. C. Emmons, CG, GHG AF, to OCAC, Commercial Manufacturers of Aircraft, 12 June 1940; in AAG 452.1 "C" Heavy Bombers.

were willing to accept the whole of his doctrine. In the early thirties the Air Corps Tactical School came to be dominated by men of that stamp. This had not always been so. As late as 1928 the Chief of the Air Corps had rejected a paper on "The Doctrine of the Air Forces" submitted by the ACTS commandant because it subordinated the air force to the ground force.[26] But lectures delivered at the school from 1931 on leave no doubt as to the thoroughness of the revolution in thought. One of the instructors has later told of their difficulty in getting detailed materials for courses, and something of their reading: Clausewitz (who was "right in his time"); Frank Simon's *The Price of Peace* ("a very good book, too"); "old" Liddell Hart; Goering; and Douhet (who "really struck the first blow").[27] I believe that the first English translation of Douhet was a mimeographed edition done for the school in 1932.[28] For the most part, however, their lectures could have been written with Mitchell as a sole authority. They taught an offensive type of warfare, aimed at the enemy's will and power to resist, in which the three arms cooperated but in which each arm had a special mission. The air role, they modestly suggested, was to attack the whole of the enemy national structure. Modern war with its extravagant material factors places an especial importance upon a nation's economic structure, particularly upon its "industrial web." A nation could be defeated by disturbing the delicate balance of this complex organization, which is vulnerable to air attack. Disturbances in this close-unit web might wreck the enemy's will to resist, but the real target was industry itself, not national morale.

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[26] First ind., the Commandant, ACTS to C/AC, 30 April 1928, OCAC to Commandant, ACTS, 1 September 1928; in AAG 321.9, Doctrines of Air Corps, Unclassified Files.

[27] Interview with Brig. Gen. H. S. Hansell at Norfolk House, England, 5 October 1943; in Eighth Air Force Files.

[28] Edward Warner, "Douhet, Mitchell, Seversky," in E. M. Earle, ed., *Makers of Modern Strategy* (Princeton, 1944), p. 489.

In two important practical aspects of the air war, the lecturers went further than had Mitchell. They realized the improbability of our fighting a major war single-handed: "If we were dragged into a war which had been precipitated by other great powers among themselves, we would inevitably find allies. Those allies being themselves within the sphere of air influence, could provide operating bases for our Air Force .... [to which] it is possible, with modern aircraft, to fly direct .... from the Western Hemisphere."[29] And they realized too that to disrupt an enemy's industry by bombardment requires more than random strikes at targets of opportunity, so that ".... it is a function of peacetime strategy to weigh the war potential of possible enemies and uncover those relatively defenseless areas that can be profitably exploited by our attack."[30]

Those practical considerations, as well as the general theory, were to assume more tangible form in 1941. By March of that year, Anglo-American staff conversations had assured us of advanced air bases in the United Kingdom if we entered the war.[31] And for some time before that the tiny Economic Analysis Branch of the Intelligence Section in the OCAC had begun on a modest scale a systematic study of profitable targets in Axis territories. When the AAF staff was created in the spring of 1941, its Plans Division (AWPD) was staffed almost entirely by former instructors of the ACTS, and the theory they had taught inspired the first of the air plans for World War II. That document, known as AWPD/1,[32] I should like to submit as Exhibit A for the defense in the recent

[29] Much of the substance of these lectures may be found in a paper by Gen. Hansell on Development of the U. S. Air Forces Philosophy of Air Warfare Prior to our Entry into World War II. The present quotation is from a lecture by Hansell himself in 1935/6, on The Functions of Air Power in our National Economy.
[30] Lecture by Capt. Harold L. George, Air Force Objectives, 1934/5, quoted in the same source.
[31] United States-British Staff Conversations, Short Title ABC-1, 27 March 1941, Para. 47.
[32] Munition Requirements of the AAF for the Defeat of Our Potential Enemies, Short Title AWPD/1, 12 August 1941.

debate in *Harper's* on the "military mind." Composed in a few days of frenzied effort by a handful of officers, including Hal George, Possum Hansell, Larry Kuter and Ken [Walker], it gave a preview of the European phase of the war which was in most important respects remarkably accurate. AWPD/1, which listed the aviation requirements for the so-called "Victory Program," was incorporated into the Joint Board Estimate of U.S. Over-all Production Requirements of 11 September 1941—the famous "secret war plan" published by the Chicago *Tribune* three days before Pearl Harbor as a scoop to greet the first dawn of the Chicago *Sun.* The air plan contemplated a long and intensive bomber offensive against Germany which would reach its climax in the spring of 1944; this alone *might* finish off Germany (note the qualification), but provision was made also for support of a landing on the continent and a subsequent land campaign.

In broadest outline this theory of the air war was akin to that held by the RAF, though Bomber Command's Sir Arthur Harris was more openly confident that Air Power alone could defeat Germany.[33] But as to the means of accomplishing the desired ends, the two air forces differed sharply. Two years of war had convinced the RAF that only night bombing was regularly feasible against German defenses, and limited experiments with the B-17 inclined them to extend this judgment to the AAF. Night bombing with instruments then available meant area bombing, and because of the proximity of workers' homes to industrial concentrations, the British tended to stress more than Americans the morale effects of bombardment.

[33] See book review by Col. Dale O. Smith in this issue [*Air University Quarterly Review*, Winter 1947, 95–98]. *Editor.*

AWPD/1, on the contrary, was dedicated to the principle that the German war potential could be paralyzed by the destruction of a limited number of strategic targets, vulnerable only to daylight precision bombing — "pickle-barrel bombing" it was optimistically called. Such bombing had been taught at Air Corps schools, and under ideal training conditions had enjoyed some success. The origins of this tactical doctrine are hard to account for — in World War I practice and in Air Corps theory as late as 1926 strategic bombardment was a night operation. Possibly the American tradition of expert marksmanship had an indirect influence. Distaste for indiscriminate bombing of civilian areas, so general in that old-fashioned world which was ours before Guernica, Warsaw and Rotterdam, put a premium on accuracy. So too did the emphasis placed in our national scheme of defense on attacks against naval craft. The impressive scores of the 1920's had been made in low to medium altitude attacks against defenseless ships at anchor. As antiaircraft weapons improved, superchargers carried bombers above the effective range of flak; improved bombsights (Norden and Sperry) and formation pattern bombing compensated partially for the increased altitude. Techniques and equipment designed for defense against naval forces could easily be adapted to offensive use against land targets and they were. Air strategists considered precision methods to be no more than a refinement of the principle of economy of force which was basic to the whole concept of strategic bombardment.

Obviously no one could object to accuracy, though the objectives in the RAF's saturation attacks were not wholly to be accomplished by destruction of a limited number of pin-point targets. It was the question of feasibility, not desirability, of precision tactics

which distinguished RAF from AAF thinking. Precision bombing meant daylight bombing, and the RAF was convinced from its own and from the Luftwaffe's experience that such tactics were too expensive against constantly improving defenses over Europe. AAF planners were confident that daylight operations *could* be conducted profitably. They had urged, somewhat belatedly, the development of a long-range escort plane to protect the heavies against GAF fighters, but it was to be late in 1943 before such a plane was to appear. When the United States entered the European war, the AAF had to depend on the rugged construction of the B-17 and B-24; upon the firepower of tight formations of those planes, each mounting ten .50 caliber machine guns; and upon the saving grace of 25,000 feet of altitude. In their friendly debates the RAF could argue from experience, the AAF only from faith. Perhaps even that wore a little thin at times. Through circumstances of a sort not always common in war, some of the staff planners who had given the final theoretical formulation to the doctrine of high altitude, daylight, precision bombardment were in command positions when their tactics were first put to test. One of them has since written that "There were, frankly, many times when we seriously doubted the practical adherence to such a high-flown motto."[34] Nevertheless, they were willing, as the couplet runs in *Hudibras,* to

Prove their doctrine orthodox
By apostolic blows and knocks.

What more could you ask of a staff officer?

[34] Hansell to the author, 24 February 1947.

The all-important initial crisis of any future war must be met by the Air Force we have when war starts. We cannot rely on a cadre Air Force, for during a war of hours, days or weeks, we would have no time to expend it.

-- General Carl Spaatz,
in *Collier's*
(December 8, 1945)

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