Q&A: SOUTHCOM's Lt. Gen. Andrew Croft | 10

Cancer & Aviators 46 | Hypersonics Defense 42 | Augmented Maintenance Reality 34

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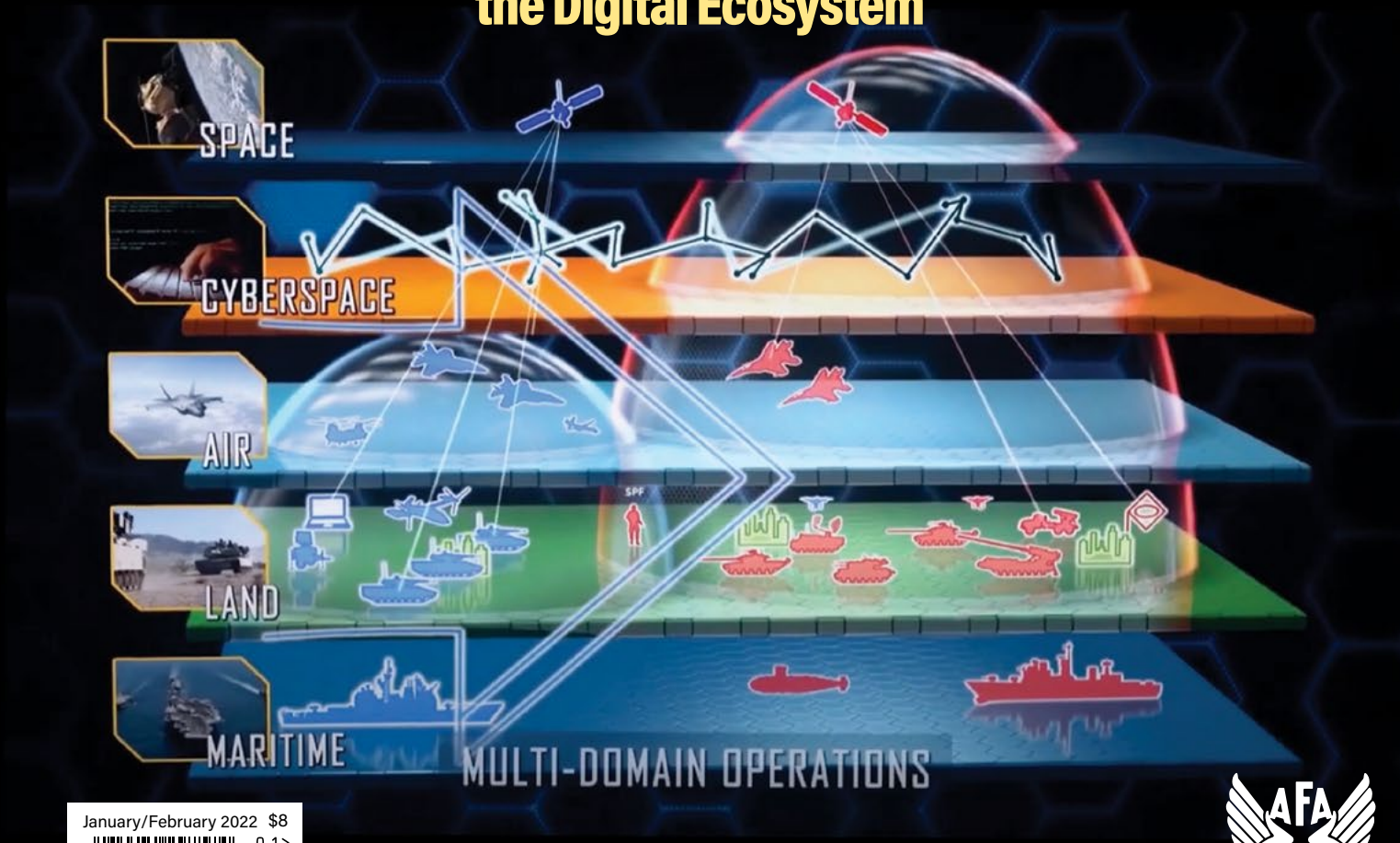

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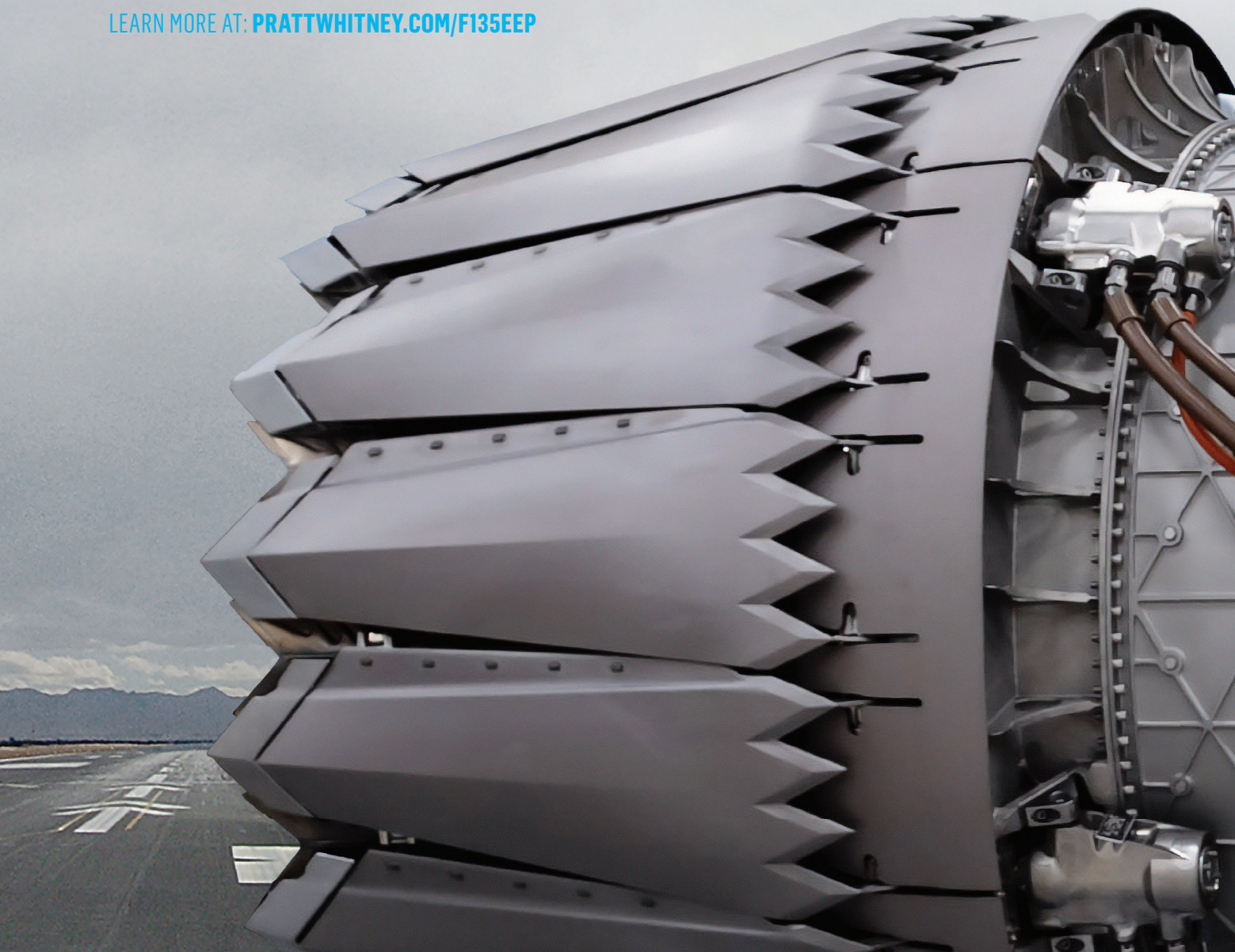

AIR FORCE

January/February 2022. Vol. 105, No. 1/2

Illustration PAC-3 Mike Tsukamoto/staff; Christian Hänsel/Pixabay; Lockheed Martin

A United Launch Alliance Atlas V rocket lifts off Dec. 7, 2021, from Space Launch Complex 41 at Cape Canaveral Space Force Station, Fla. The rocket propelled two Department of Defense Space Test Program satellites into space.

DEPARTMENTS

FEATURES

ON THE COVER

AFRL Illustration

Artificial intelligence and the impact on multi-domain operations. See "Turning Up the Heat on AI," p. 39.

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By Tobias Naegele

Russia, China, and Air Power Politics

Vladimir Putin is playing the West like a fine violin. He claims NATO is somehow responsible for his amassing 100,000 troops along Russia's border with Ukraine. He blows up a derelict satellite scattering thousands of pieces of debris and claims there is no danger as a result. He launches paratroopers into neighboring Kazakhstan to quell uprisings there and rattles sabers in Ukraine, Belarus, and Lithuania. There are ethnic Russians in each of these places, he says. Russia has sovereign interests as a result.

Putin presides over a corrupt government and a broken economy. He's overly reliant on energy exports and cybercrime may be his biggest growth industry. But Bad Vlad has two things going for him: A robust military-industrial capability that continues to develop world-class weapons, and a ring of smaller, weaker neighbors. He wants to reestablish the old order and regain as much of the former Soviet Union as possible. Hearkening to the Khrushchev era, he's even suggested deploying troops to Cuba. Venezuela is another option. Anything to irk the United States and inflate NATO as a threat to Mother Russia.

The United States and NATO, meanwhile, dance to the Russian president's tune. They warn vaguely of "far-reaching" and "high-impact" sanctions but cannot agree what those should be. Germany objects to the obvious—blocking the opening of the Nord Stream 2 gas pipeline that links the two countries and bypasses Ukraine—and other options lack the teeth to truly crimp Putin's style.

In playing the victim, Putin evokes Adolf Hitler in September 1938.

In playing the victim, Putin evokes Adolf Hitler in September 1938. Hitler insisted all he wanted was to shelter the Sudeten Germans, claimed no quarrel with the Czech state, no designs on Poland, no fight with Russia. The Sudetenland, he said, was "the last problem that must be solved."

Neville Chamberlain fell for the ploy, returning from their Munich summit that month to declare he had secured "peace for our time." His time was short. Hitler invaded Poland, Britain and France declared war on Germany, and within two years Hitler occupied Belgium, Holland, and France, plus half of Poland, and was pounding Britain and Russia.

Whether Putin really intends to invade Ukraine is unclear. He may not know himself. He could be merely trying to squeeze NATO and to rattle his neighbors. If cracks appear in NATO's armor or resolve, he can seize the opportunity; if NATO holds fast, he retains the first-mover advantage. Meanwhile, he seeks to build a stronger alliance with China, his modern-day version of Germany's tie-up with Imperial Japan. The more closely Putin can align his interests with Xi Jinping, the stronger both become as they seek to split the West.

The U.S. needs both hard and soft power to counter Russia and China's expansionist objectives. Strategic bombers with their long reach, stealth fighters that can evade enemy air defenses, and long-range strike weapons that can inflict pain from afar are the hard-power tools that can keep Russian from strategic adventurism. American needs more of all of them. Likewise, it needs a robust and resilient space architecture to dissuade China and Russia from launching military strikes in space.

These are the systems that will count most. NATO can put tripwire forces closer to Ukraine or deploy Patriot or other defenses there and in the Baltic States. But those are not the threats Russia fears; it's aerial threats that pose the greatest risks to Russia.

Soft power, diplomatic persuasion does play a role, but America and NATO cannot deal away the sovereign rights of Russia's neighbors as Chamberlain did in '38. Whether NATO expands eastward is up to NATO and those nations seeking to join the alliance, not Russia. However much it wants to regain its iron grip on Eastern Europe, the East Europeans get a say.

Diplomats must deal from a position of strength to persuade Russia where its best interests lie. The credible threat of force is essential to their argument.

Russia, of course, is not operating in a vacuum. Stirring up instability in Eastern Europe has implications throughout the world. Distracting the United States from its reasonable and healthy preoccupation with China benefits the People's Republic two ways: First, by splitting America's diplomatic attention, and second, by spreading out available military forces. The net effect is to diminish America's capacity to deter both China and Russia—let alone to fight and win.

This is where size matters. China's growing military is larger than America's and beginning to approach and in some areas surpass U.S. capability. Russia is similarly gaining ground. Worse, while America's military was once designed to fight two wars simultaneously, that is no longer the case. Our Air Force is not sized for a two-war challenge.

Drawing down at the end of the Cold War, America doubled down on a strategy that accepted a smaller force so long as it remained the most sophisticated and capable on Earth. Unfortunately, the military envisioned by planners two decades ago never materialized.

Then-Air Force Chief of Staff Gen. John P. Jumper and his successor, Gen. T. Michael Moseley, anticipated a force comprised of roughly 2,000 fifth-generation F-22s and F-35s. But that force was shot down before it was ever built. Fewer than 20 percent of USAF fighters and bombers are stealthy today, and one in three fighters—the entire F-15C/D and A-10 fleets—are useless in a peer fight.

We can look to the promise of unmanned, autonomous aircraft to supplement and defend manned fighters, but we must also be realistic. Innovative technologies rarely perform to expectations right out of the box. Artificial intelligence is remarkably good and getting better at simple tasks, but so far it hasn't replaced car drivers, let alone fighter pilots. Cultural resistance is a harder problem. Americans love the AI in Siri, Alexa, and digital maps, but we don't trust AI with medical diagnoses or TSA luggage inspection. We accept when human analysts express 95 percent certainty about a target, but if a computer professes the same 95 percent certainty, we have doubts. Either can make mistakes, but we don't yet have equal trust in the computer.

U.S. military strategy still depends on technology to be a force multiplier, but as rivals catch up, America needs more than mere promises of future capability. We need advanced capability, and we need it in volume. Without both, America will be hard-pressed to deter these major rivals.

LETTERS

Words Have Meanings

I feel that the use of the term insurrection regarding Jan. 6 is inappropriate—I think you need to counsel the writer to use terms that allow it from becoming a term which is used to describe any protest which has a violent content. The term "insurrection" can be very divisive.

Does any protest that gets violent with authority qualify to be termed insurrection?

David M. Richardson
Santa Maria, Calif.

▪ *Merriam-Webster defines "insurrection" as "an act or instance of revolting against civil authority or an established government." The Jan. 6 rioters stormed the Capitol in defiance of lawful civil authorities and successfully disrupted the business of the Congress, which on that day was the lawful certification of the Electoral College's presidential election results. The rioters marched to the Capitol from a rally near the White House, organized in opposition to those results. While they failed to change the course of events, they most assuredly delayed and disrupted them.*

But reasonable people can disagree. One can call Jan. 6 an "insurrection" while another might choose "riot" or "mayhem" or some other word. One can do so without political motivation (or fear, for that matter), and one can choose one or another for variety's sake. Those who write these early drafts of history are like umpires who "call 'em as they see 'em."

Even in an age of instant replays and calls overturned on appeal, some calls are likely to be debated for eternity.—THE EDITORS

WRITE TO US

Do you have a comment about a current article in the magazine? Write to "Letters," *Air Force Magazine*, 1501 Langston Blvd, Arlington, VA 22209-1198 or email us at letters@afa.org. Letters should be concise and timely. We cannot acknowledge receipt of letters. We reserve the right to condense letters. Letters without name and city/base and state are not acceptable. Photographs cannot be used or returned.

Ad Astra

Almost 30 years ago, several successive Air University Space Chair officers attempted to describe and teach Air War College students about potential operations within the Earth-moon system. In the October issue, Amanda Miller describes this area as "Cislunar Space" [p. 46].

Back in the day, we recognized the concepts of gravity wells and trajectories in addition to Earth orbits. We spend most of our lives at the bottom of the Earth gravity well (except for those who occasionally have slipped the surly bonds of Earth) where the force of gravity is a constant. Thirty years later we have a Space Force where these concepts have had time to become part of doctrine and eventual operational procedures.

In June, the AFRL Space Vehicles Directorate published a superb 23-page article, "A Primer on Cislunar Space." This article describes the *scale* of this new domain as 1,700 times the size of conventional orbital space. It also points out how *trajectories* that exist between Earth orbit and the moon's surface become the new descriptors of space operations. Finally, we need to develop passive sensor networks that operate through this huge area.

I recommend reading this excellent primer to enable anyone to understand how different cislunar space is from either the air or near-Earth domains. Ad Astra.

Col. Victor P. Budura Jr.,
USAF (Ret.)
New Market, Ala.

Not Lower, Smarter

I am curious how closely Col. Ken Smith looked at the "new" Air Force standards ["Letters: Lowering the Bar," October, p. 4]? Yes, there are changes,

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but the majority of those include adding five-year brackets vs. 10-year brackets and inclusion of additional components to provide Airmen a choice in how they demonstrate fitness. I have observed the testing of the new components and can assure you they provide no advantage over the previous standard components. Medical professionals including exercise physiologists work to determine the standards for optimal fitness while serving in the Air Force.

We are not the Marine Corps or the Army. Our mission, standards, and requirements are different across the spectrum and attempting to compare our fitness tests is futile at best. Additionally, the Air Force recently added tiered testing for certain career fields that require different levels of fitness: special warfare Airmen, fire protection, and security forces to name a few. This ensures each Airmen is prepared to execute their mission, dependent on needs.

Finally, his comment on women and "other alphabetic genders" and reference to "snowflakes" doesn't make the Air Force laughable, it shows a lack of understanding of what our Air Force needs for today's fight and the fights of tomorrow.

CMSgt. Katie McCool
Yokota AB, Japan

A Betrayal

Maybe I was too close for too long. Since August, I've struggled with my emotions toward the events in Afghanistan [See "Evacuating to Freedom," November, p. 39]. What was once pride now swings between sadness, anger, betrayal, disbelief, loss, and emptiness to name a few. That's why I was heartened to read the account given by Col. Colin McClasky, the Contingency Response Element (CRE) commander, as he recounted the efforts of his team at the Kabul International Airport in the November issue of Air Force Magazine. As I watched the evacuation, I could see the fingerprints of the CRE, directing the airlift and running the airfield. They, along with the aircrew, the 618th AOC, the Marines, Soldiers, and Sailors on the ground all served with honor as the defeat of America unfolded. We are blessed by their honor and are a better nation because of them.

But the honor stopped at the gates of the airfield. As our defeat unfolded, nothing good came from the decisions made by our leaders at CENTCOM, the Pentagon, or in Washington, DC. The decision to close Bagram Air Base and abandon the Afghans to terrorists and fanatical fascists was naïve and abhorrent. The White House turned their backs on our 20-year Afghan allies, NATO, and the coalition partner nations who served with us. They betrayed the Americans who didn't come home from Afghanistan, 13 of whom were added to the count on Aug. 26. They betrayed our wounded who still carry the scars of the battlefield. They betrayed not only our Gold Star families, but also the families of the 800,000 of us who served in Afghanistan; all of whom are left wondering "... why ...?" They sentenced Afghan girls, 1.6M of whom were in school in 2008, to a life of poverty, enslavement, and illiteracy as many of them are sold into marriage.

At CENTCOM and in the Pentagon our military leaders claimed subservience to the decisions made in the White House, and went right along with it all, supervising the chaos of the retreat. They turned airfield perimeter security over to terrorists, while desperate Afghans fell from the sky as they lost their grip on freedom. After 13 Americans were killed, they conducted a "righteous over-the-horizon" airstrike that killed an aid worker and seven children.

The events, from the rapid collapse of the Afghan government, to the chaos in Kabul, were all predictable to every Afghanistan veteran. We saw it coming. And when it was all over, none of our military leaders—not one—resigned.

I understand that key leaders should see the retreat through to the end instead of dumping it on someone else. I get that. But when you testify to Congress about how you advised against closing Bagram, acknowledge that confidence in America is eroded, and tell the story of how 13 Americans were killed on your watch, you resign in order to stand with the Afghans, those we lost, and the 800,000 of us and our families who served with honor. But instead, our military leaders blamed policy and "confirmation bias," hoping that the horror of the American defeat would fade quickly into the background of history. By standing with and affirming the American defeat, they broke trust with Afghanistan veterans, their families, and tens of millions of Americans who were horrified as the retreat unfolded live on television.

[Gen. Ronald R.] Fogelman understood where to stand. He resigned in 1997 as Chief of Staff of the USAF in protest of bad political policy centering on disciplinary actions surrounding the Khobar Towers bombing. In effect he told us, "no one else needs to resign, this one is mine, and I'll take it for all of us; you all need to continue to serve and serve with honor." General Fogelman understood when to fall on his sword and, by doing so, he stood with and for us. Apparently, except for one Marine lieutenant colonel, that skill set has abandoned our military leadership. I ask myself, 'How bad does it have to get before someone resigns?' Apparently, the current Pentagon leadership has no bottom when it comes to Afghanistan.

So, thank you Colonel McClasky for the ray of light in my Afghanistan darkness. You and your team did good, really good, as our civilian and military leaders both supervised and then stood by our defeat.

Col. Seth P. Bretscher,
USAF (Ret.)
Lafayette, Ind.

Money, Money, Money

After the editorial statement that USAF needs new bombers, new fighters, new trainers, new tankers, I searched in vain for any indication in the editorial or the entire magazine of any responsibility for the failure of Air Force leadership to be better stewards of the vast amount of public treasure they have been entrusted with over the years ["Editorial: The Bill Comes Due," November, p. 2]. The answer can't just be more tax money to buy weapons systems (F-35) that need new engines before they have become mature weapons systems. Do we really need new ICBMs? If so why not adopt the Navy SLBM to silos?

Col. Michael R. Gallagher,
USAF (Ret.)
Hillsboro, Ore.

Long Overdue

The article by Daniel Gade and Daniel Huang ["Wounding Warriors," November, p. 43] that appeared in the November issue was spot on and to the point. Finally, someone has had the fortitude to speak out on the archaic manner in which our veterans are cared for and compensated. As soon as I finished reading it, I ordered the book. Please accept my thanks for publishing this excerpt from their book. It's a must read.

CMSgt. Bill Goodman,
USAF (Ret.)
Anamosa, Iowa

Credibility is low on the Wounded Warriors VA story. Printed material on VA compensation that does not include the words concurrent receipt is not worth reading. Because I'm military retired, the amount I receive for my VA disabilities is deducted from my earned retirement pay. Grossly unfair! Support H.R. 303, to cease this unethical and wrong policy. Career retired disabled veterans are being cheated. The authors say "combat-wounded veterans must compete with opportunities for time and attention," ... Who do they think is submitting VA claims? Lastly, nations at war for two decades will triple their VA Disability and compensation spending.

Brian Ward
Pensacola, Fla.

"Wounding Warriors" is a disservice to all veterans. The excerpted article attacks the moral integrity of wounded Soldiers who fought to keep Americans free. Going back to World War II, Korea, and Vietnam, when the draft was still used, and moving forward to today's all-volunteer force, a disabled veteran applying for benefits is framed as "working the system."

First, the Department of Veterans Affairs (VA) does not come looking for you to award appropriate benefits—the veteran has to claim and justify every benefit they get. For example, the use of the dioxin "Agent Orange" throughout Southeast Asia during the Vietnam War, unlike the TV 9/11 cancer commercials from dioxin polluted air, veterans have to find out on their own if their cancer is related to "Agent Orange" even though the VA has completed case studies linking the two.

Second, Lieutenant Colonel Gade's retired pay should be around $100,000 a year. VA 100 percent disability pay is around $42,000 a year. Worse, the VA uses a sliding scale if you have multiple injuries, say one rated at 60 percent, one at 40 percent, and one at 20 percent; they add up to a total disability of 80 percent, not 120 percent or even 100 percent. But that is then again factored into something under 50 percent of the 100 percent disability pay, for less than $20,000 a year.

Finally, when we ask volunteers to go in harm's way with motto's like, "The few, the proud ..." and "Land of the free because of the brave" we as a country had better expect to step up when some veterans come back broken. Dioxins from "Agent Orange" and "Burn Pits" disable with cancer just as effectively as an amputation of a limb by an IED, they just take longer and are not as visible. When we become so callous we even think of a system that "rejects the idea" of compensating a veteran for a disability, we better be willing to bring back the draft. Lieutenant Colonel Gade took advantage of a West Point education and two advanced degrees, plus months of lifesaving medical care overseas and at Walter Reed for his injury before arriving at his opinion. The taxpayer cost of all of that can probably not be calculated much less come close to the disability benefits he wants to end.

John Conway
Jackson, N.J.

■ *As the article and our book, Wounding Warriors, makes clear, the current VA system is fundamentally misaligned. Our argument is not that the process for getting health care and other benefits should not be improved, but rather that the objective of these benefits should be a self-sustaining veteran who can learn to work and thrive, despite the wounds of war. The VA too often channels veterans into pursuing disability increases, rather than emphasizing a speedy and successful recovery, including education and job placement. The best way to help veterans is to provide them with world-class treatment and care, and then empower their transitions into thriving civilian careers. Our conclusions and recommendations have received support from VA secretaries, policymakers, and scholars from both sides of the aisle.*—THE AUTHORS, DANIEL GADE AND DANIEL HJUANG

Say What?

I had to do the proverbial double take after reading my favorite author's first sentence in the November issue: "After nearly 35 years in development and a $4 billion dollar Air Force investment, two brand new engines are in test ..." ["Next-Generation Power for Air Force Fighters," p. 30]. John Tirpak does not raise the question about this absurd amount of money being spent on such a small problem. Someone is getting ripped off, and I believe the name is taxpayer. I may be 97 1/2 years old, but I still comprehend waste when I see it. I am sure the blame game is well underway.

Lt. Col. Bill Getz,
USAF (Ret.)
Fairfield, Calif.

Remember the Regulations

In his letter to this magazine, retired Col. [Bill] Malec accused Gen. [Mark A.] Milley of apologizing and "whining" in regard to his appearance at a promotional political event in Washington ["Letters: The End in Afghanistan," November, p. 5]. Perhaps Colonel Malec has forgotten that regulations prohibit military members in uniform from participating in partisan political events. I'm sure, if the former [president] had been aware those regulations existed, he would not have asked General Milley to stand with him in a partisan photo op. General

Milley found himself in an intolerable situation. He was participating in a prohibited political event at the request of his commander. If any other service member participated in such an event, in uniform, counseling or even a reprimand would have ensued. General Milley did the best he could to salvage the integrity of our forces by admitting his mistake. By publicly apologizing he turned the mistake into an educational opportunity thus reminding us, and the rest of America, that our military is politically neutral. More power to him for that.

MSgt. Ross McIntosh,
USAF (Ret.),
Bristol, Pa.

Blessings and Curses

I just read the editorial ["Peril, Perspective, and Resolutions"] by Tobias Naegele in the December 2021 Air Force Magazine. The opening sentence talked about the "opportunity to count our blessings and take note of what ail us."

At the conclusion of this analysis, I was curious to find what the "blessings" included. He rightfully mentioned a number of specific items that "ails us." In fact, all I found were ailments, and absolutely no blessings. What ails us include China becoming more dangerous, Russia growing more belligerent, Iran developing nuclear weapons unabated, allies questioning our resolve, and our military advantages eroding day by day. Then, add to those the feckless action of Congress by not passing a needed budget, and creating yet again, another continuing resolution. A boatload of ailments.

Where are the blessings? A republic that is stronger because it survived an attack on Jan. 6, 2021, by a bunch of renegades? Is that the blessing? A sad commentary indeed.

We have a nation that is adrift. We cannot count one positive event that has moved our nation forward, and your list highlights everything that has gone wrong. Ailments abound, and blessings are nowhere. Any idea what might turn this ship of state around? I, for one, can't see any. Unless, of course, we go back to core values. Create an atmosphere of service before self, excellence in all we do, and toss out everything that has to do with wokeness.

Col. John R. "Dick" Strifert,
USAF (Ret.)
Exeter, N.H.

Have we given up on working to remain the best of the "world class military powers" or do we, as a nation, expect China to achieve its stated goal of being "on par with the U.S. military by 2035. Indeed, it could achieve that goal by 2030." That is how I read the last paragraph of John Tirpak's "Strategy and Policy: China's No Longer Peaceful Rise," December, p. 14.

I wish it had concluded by quoting President [Joe] Biden as saying something like this.

"But, with the full support of this and future administrations, China will never be within 10 years of achieving that goal."

Lt. Col. Tom P. Currie,
USAF (Ret.)
Westerville, Ohio

Database Success

The extensive new "Weapons and Platforms" digital database, readily available at the AirForceMag.com website is outstanding! I accessed the info pertaining to two of the aircraft that I used to pilot, the T-38, and the KC-135, and the graphics, the photos, and the data, are excellent. I used to have to dig out a hard-copy my annual Air Force Almanac issue when I sought accurate unclassified USAF aircraft performance characteristics. Thank you for making us all aware of such a reliable and easily accessible source of relevant info.

Col. David R. Haulman,
USAFR (Ret.)
Ridgeland, Miss.

Fixing Enlisted Promotions

In 20 years of service almost every time I studied hard, I made the next stripe. Promotion to E-2 to E-4 is time in service/time in grade promotion; unless you get in trouble, you get promoted ["World: USAF Changing Enlisted Promotion Recommendations to Favor Experience and Performance," November, p. 26].

E-5 to E-7, you take two tests, time in service, time in grade, and performance report points are added together with test scores, and if you do well on the tests you get promoted. The first time I tested for E-6, even if I would have scored 100 on both tests, I did not have enough time in service/time in grade points to be promoted. Also, Congress limits how many can be in each rank, so that can slow down promotion to the next grade. If there is not an opening you will not be promoted. Only about 20 percent get promoted to E-8 and about 5 percent get promoted to E-9 each year.

There is no magic bullet to fix any perceived shortcomings in the promotion system. Many factors go into why—or why not—someone is promoted. Supervisors need to monitor performance reports to make sure everyone is rated fairly, as low performance report ratings is one area that can lower your promotion score. I would like to see the performance report go to a promote/do not promote system. That way time in service/time in grade and test scores would be what gets you promoted.

MSgt. Jeff L. Surratt,
USAF (Ret.)
Great Falls, Mont.

A Bloodless Victory

"Strategy and Policy: China's No Longer Peaceful Rise" [December, p. 14] provides an excellent summary of China's ability to militarily threaten and overcome Taiwan by force. Taiwan, on the other hand, is comparatively grossly under defensed, but this is not covered by the article.

There is no doubt that China could destroy Taiwan's military defenses and perhaps some of Taiwan's critical infrastructure in a few days. More defenses in Taiwan may only prolong the agony of being defeated in a few days.

In my humble opinion, Taiwan does not need more defensive military equipment. It needs an offensive capability that can destroy as much of Chinese property that it could accomplish in the first few hours after being attacked by China. This in effect would be their deterrence from being physically attacked.

This would not end China's desire to take over Taiwan. China would have to wait a little longer to peacefully overcome Taiwan's cultural, economic, and political power. By obtaining a pro-China president, legislative, economic and education system, China could again regain the hearts and minds of Taiwan without firing a single weapon. In the meantime, China could covertly infiltrate Taiwan's population and economy with pro-CCP [China Communist Party] people.

Lt. Col. Russel A. Noguchi,
USAF (Ret.)
Pearl City, Hawaii

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INNOVATING FOR FREEDOM

VERBATIM

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"What is happening now, the tension that is developing in Europe, is their fault. At every step, Russia was forced to somehow respond, at every step the situation was constantly getting worse, worse, worse. And today we are in a situation where we are forced to decide something."

—Vladimir Putin to a Russian Defense Ministry board meeting [WSJ , Dec. 21].

2nd Lt. Ashley Goodwin/ National Guard

Approval Authority

"The Secretary of Defense is now the single approval authority for all requests that would involve District of Columbia National Guard personnel participating directly in civilian law enforcement activities or that require the deployment of DCNG (D.C. National Guard) personnel within 48 hours after receipt of the request."

—Pentagon statement, Dec. 30.

Antawne Jackson/FEMA

Sorry, Gov'ner

"The vaccine mandate to which the governor objects is the one—in addition to the nine that already apply to all service members—intended to protect service members from the virus which has, in less than two years, killed more Americans than have been killed in action in all of the wars the United States has ever fought. The court is required to decide the case on the basis of federal law, not common sense. ... But, either way, the result would be the same."

—Decision of **U.S. District Judge Stephen Friot,** rejecting Oklahoma Gov. Kevin Stitt's lawsuit Dec. 29, which sought to block the department from enforcing its vaccine mandate on his state's National Guardsmen.

Genie of the Lamp

"If there were one ask I would have of the Congress, it would be to allow the Air Force to retire its old and irrelevant airplanes so that we can free up the resources we need ... to confront China and what they're doing in their military modernization program. ... Our old iron—our 30-year-old average airplane–is an anchor holding back the Air Force right now, and we've got to get rid of some of those aircraft so we can free up resources and get on with modernization."

—Secretary of the Air Force Frank Kendall, Reagan National Defense Forum, Dec. 4**.**

Andy Morataya/USAF

Mike Tsukamoto/staff; USSF; Pixabay

Time's Up

"I think after two years, the grace period is officially over for the Space Force. ... Everyone understood from the beginning it would take time to stand up the new service and reorganize the military space enterprise, and members of Congress were willing to be patient. But the time for patience is over, and the pressure is mounting on the Space Force leadership to show tangible results."

—Todd Harrison, director of the Aerospace Security Project, CSIS, quoted in Breaking Defense, Dec. 17.

Something We Can Agree On

DOE

"We believe strongly that the further spread of such weapons must be prevented. We affirm that a nuclear war cannot be won and must never be fought."

—Joint statement signed Jan. 3 by the **five permanent members of the U.N. Security Council:** Britain, China, France, Russia, and the United States.

Final Fantasy

"The U.S. should discard the fantasy that it can compel China to follow its rules. China only accepts the international system with the United Nations as the core, and the international order with international laws as its foundation."

—Lei Wei, China Daily, editorial on U.S. "Summit For Democracy" event, Dec. 12, 2021.

Mike Tsukamoto/staff; Leif Jørgensen; Ecow

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LARGE ENOUGH TO BE GLOBAL.

Not Just a Southern Thing

Air Force Lt. Gen. Andrew A. Croft is U.S. SOUTHCOM's military deputy in Miami. He oversees five components and three joint task forces meant to address myriad threats stretching from the Caribbean to the Arctic. Abraham Mahshie, Air Force Magazine's Pentagon Editor, interviewed Croft in November 2021. This coversation has been edited for length and clarity.

Q: How does SOUTHCOM differ from other combatant commands?

A: We're the only combatant command that has a civilian deputy commander. Because we have so many partner nations down south, and so many embassy and country teams that we work with, that part's very important ... that we stay really aligned with the Department of State.

I'm the military deputy commander, doing primarily more of the military part of this, which involves our five components, and our three joint task forces, JIATF-South, we have JTF-Bravo in Honduras, and JTF-GITMO in Guantanamo Bay.

Q: How does SOUTHCOM utilize space capabilities?

A: A lot of it's about domain awareness. From space, we can track illegal logging, illegal mining, illegal fishing. … A lot of it's just open-source data. We use open-source space products.

As an example, in Peru, we were looking at space imagery of these illegal mines that are in the Amazon and they're terrible, they totally destroy the rainforest. … You can see that from space, from commercially available space products that either we see or they find, and we share them.

Then, you do things like space awareness of debris. So, that Russian A-Sat [weapon] they just [tested, produced] 1,500 trackable pieces of debris. Now, if you are Colombia, or Chile, or Brazil, you have a satellite in that orbit, we have to help tell them [by warning them] that your satellite might be threatened. So, you either need to move it or turn it so it'll survive an impact.

It's only going to get better as these commercial operations, such as SpaceX, launch constellations of low-Earth orbit satellites that have various ways of detecting things. In five or 10 years, we'll be able to see every ship on the ocean, especially the illegal fishing ships, or maybe even the drug runners at some point. If you see something that small from space, and it'll be in many cases not classified data, we can share it with our partner nations.

Q: How do things like illegal fishing in the Galápagos have anything to do with U.S. national security?

A: Illegal, unregulated, unreported fishing is a huge, huge deal. The fish stocks out off the coast of Ecuador are being wiped out. Near the Galápagos Islands, the Chinese have 300-ish big fishing ships out there that have these massive nets, they know the exact migratory routes of the fish, and they will take the entire fish stock.

Ecuador is ... really concerned about that because it takes all the money away from their fishermen. So, then what do they do? They sell fuel and supplies to the drug runners, ... they become little 7-11s because they have no other source of income.

That's where in space we can start partnering. As we have access to more space vehicles, lower-end stuff that's not classified, I think that's where you're gonna see a huge advantage. Then you have communication, obviously, navigation and timing, all things that we normally do with satellites.

Master Sgt. Justin Baker

Lt. Gen. Andrew Croft in his office at SOUTHOCM Headquarters.

Q: Competition from China and Russia in this hemisphere is growing fierce. How does SOUTHCOM make sure the U.S. is the partner of choice?

A: Proximity matters. We're obviously right here in the Americas, common cultures, common values. Roughly 20 to 25 percent of all Americans came from Central, South America, and the Caribbean. The biggest percentage are from our AOR.

Instead of just focusing on either a military capability like Russia might do, or the Chinese, ... we focus on things like values, and human rights, and rule of law, and democracy, migrant patterns. I mean, all those things we care about that the Chinese and the Russians will not, they're gonna do things that just purely benefit them. It's very transactional if you're China and Russia.

The IMET, International Military Education and Training, that is one of our biggest returns on investment as far as long-term partnering with these nations.

Q: How does the U.S. compete with cheaper Chinese and Russian weaponry in the region?

A: Keep a good relationship, keep doing training, keep doing engagements. Offer them something that benefits them. What we need to do is come in as a partner of choice and offer them a valid, affordable alternative, versus just telling them, 'Don't do that.'

We do—through foreign military financing and foreign military sales—[share weapons and technology]. There's a lot of value, especially in the counter-drug, counter-transnational criminal organization fight, those things really are helpful.

Q: Sometimes Latin American politics swings drastically from left to right. How does SOUTHCOM maintain consistent mil-mil ties?

A: That's a tough nut to crack because sometimes you can do more, sometimes you can do less. If they are more aligned with us, then we say we double down, we increase our exercises, increase our subject-matter expert exchanges, increase our training events, increase our IMET efforts. If they are less aligned with us, then we tend to do smaller things that the nation still needs and values, but it stays out of the public press.

If we have an embassy that is fully manned and staffed for a good relationship with a country, and suddenly that relationship starts to falter, I can't take all those people and suddenly move them somewhere else.

Q: Vaccine diplomacy impacted countries around the world. How did SOUTHCOM compete with the vaccines donated by China and Russia?

A: Through COVID, we got $74 million [for] humanitarian assistance programs. These are small things—field hospitals, ventilators, [personal protective equipment]—all the things you would need to combat COVID or any other diseases. And we were able to donate them.

When we were unable to deliver vaccines, when the Russians and the Chinese were doing it, this was our counter and it was very successful. And now vaccines delivered to our AOR have exceeded those of the Russia-China crowd. And ours are much better, right? But we had to get through that first eight to 10 months of China sending half a million vaccines and we send a field hospital.

And the Chinese are countering us. So, the minute we would do something, they would drop vaccines on somebody. Or, the minute we would do a key leader engagement, they would publish an op-ed. So, they're watching us really closely.

Q: A lot of what SOUTHCOM does is related to humanitarian assistance. How does that advance U.S. national security goals?

A: It gives us access and presence and partnering beforehand. If we have to do something like defend the Panama Canal, we know all the people that we're going to work with already. Or, if we're going to counter transnational criminal organizations, we know the people that we want to work with. If the Russians are going to send bombers down to Venezuela again, we know who to work with in Colombia. It's the access and presence that the humanitarian assistance and response does for us. It's also basing. So, our base at Guantanamo Bay—super critical strategic base—but we use it to respond to the Haiti earthquake. So, we exercise that system.

If we don't have those forcing functions, we tend to close those things or reduce them. And if we need them for something else, like higher-end combat operations, we wouldn't have it.

That's why that access and presence is so important. And then also with our partner nations, it's working with them. We fly F-16s with the Colombian Kfirs. So, they know each other, and we have interoperability going on there, that's a higher-end example. If we ever had to go assess Colombia to do anything, we've already been to the base, we've flown out of the base. All that stuff matters. These things all exercise our military capabilities, which then we can use short notice.

Q: You previously served as AFSOUTH Commander. What did you learn in that role?

A: The first key piece was to partner and get to know all the air chiefs from the various nations. … We have the South American Air Chiefs Conference, Central American Air Chiefs Conference, and a Caribbean Air Chiefs Conference. So, three different conferences a year, which sort of mirrors what we would do here at SOUTHCOM, but focus purely on the air chiefs. Then you can focus on just the air problems.

So, it's detection and monitoring aircraft, domain awareness from the air side of the house, sharing of data, air tracks, radar and feeds so we can build a picture for either JIATF-South or the partner nation. Transport aircraft, helicopters, and then assisting them and their air forces with either training or exchanges on the air side. And then you understand where they're struggling and where they need help, and where can we assist. And that drives all of our operations, activities, and investments for the next couple years.

Q: What Air Force-specific ideas have you brought into the deputy position in the past year?

A: AERONet is a technology using an IP-based radio system where you can communicate. It's secure, but it's unclassified. So, how do I take a sensor ball on an airplane and get it to a tablet on an interceptor boat? That's what AERONet does. So, we just had installed AERONet in Belize, and JIATF-South has the exact same technology on their special ship mission.

It's a transmitter, essentially. So, you have an airplane above here, that translates to an interceptor boat so the folks on the boat can see what the airplane is seeing. We just contracted a new ISR airplane that is a super souped-up DC-3 with turboprop on it, it has AERONet on there. So, when this thing finds a go fast on the water, it can then transmit it to El Salvador, Guatemala, Honduras, Panama, whoever's there. Any partner nation that has AERONet … will then have an immediate feed from the airplane.

So, that's one that we just saw that has been pushed primarily from Air Forces Southern that came from the Air Force.

Q: There's a new commander at SOUTHCOM, Gen. Laura J. Richardson, an Army aviator. What changes have you discussed moving forward?

A: She's an aviator-focused person. So, we do things methodically. That makes it a little bit more fun. It's actually hard to fly a helicopter, we were talking about that the other night.

The biggest thing that the commander wants to focus on is information operations. You know, we're doing so many great things, but we've got to get it out there. So, how do we get it into written publications, doing it through social media, through other media forms? How do you lump it together and just have an outreach program where we're actually advertising all the great things we're doing … and then people realize that we are a partner of choice that is actually trying to do good.

Big focus efforts are going to be women, peace, and security, and senior NCO development. In the U.S. military, our NCOs, our enlisted corps, about 80 percent of the military, depending which service, do all the work. And they're empowered. And they're given responsibilities. And we develop them professionally through their careers, whether it's technical schools or education or higher-end schools. A lot of the other partner nations don't do that. And we're trying to bring them around to that model. The Honduran Air Force took our model and is going to implement it.

A lot of discussion is the environment, right? So, illegal mining, illegal logging, illegal fishing is destructive to the nation that it's in—it benefits people that don't live there. It actually mortgages your future in many ways. I was thinking about this other day: We ought to treat space as an environmental issue because if you destroy space with debris, if you make a debris field, then we can't use it. ✪

By John A. Tirpak

Air Base Squadrons

Airman 1st Class Zachary Rufus

Contingency Response Squadrons specialize in training and rapidly deploying personnel to quickly open airfields in austere locations around the world to establish, expand, sustain and coordinate air mobility operations. U.S. Air Force Maj. Tory Lodmell, a quick-response assessment team lead, clears a C-17 Globemaster III for take takeoff.

The Air Force is about to roll out another aspect of its new Force Generation model (AFFORGEN): Air Base Squadrons are designed to provide forward-deployed units the necessary support to conduct operations from widely dispersed and likely austere locations with a minimal footprint of people and gear.

The new concept is the connective tissue between Agile Combat Employment (ACE)—the scattering of forces to many operating locations—and AFFORGEN, which seeks a more rational and sustainable deployment rhythm for the Air Force writ large.

Air Combat Command envisions sending elements to forward bases, comprised of Airmen who already know each other and train together on a daily basis. They'll have prepared together for the specific areas where they'll be deployed, and take with them the aircraft and equipment they already know and work with.

It's a break with the "crowdsourced" model of the past 20 years, in which Airmen were plucked from units servicewide and deployed individually, meeting their new teammates at a major, centralized base, and falling in on some other unit's aircraft and gear. It was an efficient personnel model for the wars in Afghanistan and Iraq, where the enemy was limited to small-force ground attacks, but is considered unworkable to deter or fight a modern peer adversary.

AFFORGEN sets a new four-phase deployment rhythm, in which units 1) receive broad training for full-spectrum warfare; 2) receive theater-specific training for where they're going, with exercises and certifications; 3) are available to deploy or deploy on taskings from defense leaders, and 4) return for rest and reset, depot maintenance of equipment, upgrade of personal training and education.

Initial Operational Capability (IOC) for Air Base Squadrons is targeted for October 2022, said Col. Frank Marconi, Chief of ACC's Logistics Readiness Division at Air Combat Command. Full Operational Capability (FOC) is targeted for fiscal 2025, he said. For now, Air Base Squadrons is an initiative of ACC but may be expanded to other commands.

"This is an ACC concept," he noted. "This is not an Air Force concept. We will fall under [USAF's] air base elements. This is how ACC is going to present forces."

The concept will develop in exercises "we're calling 'Agile Flag' ... over the next couple of years," Marconi said. Some of these will take the form of "Dynamic Force Employments," similar to Global Strike Command's Bomber Task Force deployments. There will be a few repetitions before units take on real-world assignments from combatant commanders.

Because the deploying unit will already be fully equipped with the people and gear needed, it can "get out the door in a timely manner," Marconi said. "They won't be crowdsourced downrange." Under the previous model, a forward-based squadron could have personnel from as many as 70 different locations, who would "meet each other at the line of scrimmage," as ACC commander Gen. Mark D. Kelly says.

The composition of the unit will only be "exactly what we need," to keep the footprint as small and light as possible, said

Lt. Col. Scott Johnson, Deputy of ACC's Future Operations Division. The unit may deploy to a "main operating location, but then also be able to split off [and] ... maneuver to dispersal locations," along the lines of USAF's "hub-and-spoke" concept for ACE.

The destination will be important in determining how big the team will have to be, since "if we're only going to one location it will be a lot lighter than if it goes to two or three," considering each operating location will need a core group of Airmen.

The deploying team will be "like a 'Mission Support Group Plus,'" Marconi said. "It has airfield operations ... [and] base security, so it will be able to defend [itself]. It's got logistics readiness—that's your fuels guys, your transportation and supply. It's got civil engineers, and contracting," to negotiate the purchase of local food and water, and there will also be communications and medical personnel.

Operators and maintainers—"mission generation force elements"—are a separate grouping "and will not fall under the Air Base Squadron." The final element will be command and control, Marconi said, which will also "likely come from the same location."

The support, operations, and command and control elements are sourced separately because of the way the Air Force presents forces to regional commanders, Marconi said, enabling the gaining unit to "scale it to what they need." The combatant commander will be able to "order it all up ... or just pieces."

"We want a cohesive team that's trained together before [a] crisis," Marconi noted, "so they're ready to operate under pressure with the extra challenges that are presented when you're deployed."

The concept makes for "a light, lean, and agile [unit], which gets after [Chief of Staff Gen. Charles Q. Brown Jr.'s] concept of Agile Combat Support," he added.

Johnson said the concept is well suited to "strategic messaging" and strategic competition because it can deploy forces in places an adversary wasn't "previously aware of or anticipating."

ACE can be a cost-imposing and confusing challenge for an adversary, by spreading assets over a wide area and multiplying the number of sorties or missiles needed to strike them. This shell game is an acknowledgment that relying on well-provisioned mega-bases makes the deployed force too vulnerable.

The ability to "disaggregate and then re-aggregate" is one of the key tenets of the concept, Johnson said. "We've built those fault lines into the construct."

Flexibility is the key, Marconi said.

Combatant commanders "can order it up, we can tailor it, they can move it, we can move and maneuver." He likened it to "the queen of the chessboard."

The concept will be employed differently in the Pacific theater than in Europe. In the Pacific, aircraft will be needed to ferry units around to different operating locations, while in Europe, Johnson said, "You have a lot of NATO allies, you have a lot of other logistical advantages, so the mode of transportation is different."

Staying "light and lethal" will mean consolidating specialties among Airmen. Fuels specialists, for example, might also be trained for security or weapons handling—what Brown has called "multi-capable Airmen." This idea "buys down some of your logistics" requirements for support and personnel, Johnson said.

The theater will also be expected to provide some basic support capabilities so the Air Force doesn't have to send everything forward.

"I could build a package that takes 30 C-17s, but that's not agile," Marconi said. While in some cases fire trucks, fuel trucks, and fuel bladders may go forward, the ABS will rely as much as possible on capabilities already on hand, or depend on the theater commander to provide them.

"I'm not going to bring in fuel tucks. I expect my fuel trucks to be there," Marconi noted. "The major muscle movements, the large stuff ... will already be there for us."

Johnson noted that as ABS takes shape, the Air Force must develop "this nascent capability with a 'crawl, walk, run' approach," and must still provide personnel for current taskings, because "those don't stop in the meantime."

"It will be refined through shorter-duration, smaller chunks of the greater capability," exercised over the next year or two, he said. Some exercises have already been conducted, and more will take place soon.

"In broad-brush terms, there'll be some Dynamic Force Employments over the coming year across the world, where the ACC units we're providing this capability to ... execute this concept in coordination with allies and joint partners," Johnson noted.

The wings designated as "lead" wings are "writing their own local exercises," he added, and have done drills over the last year "to hone some of the elements of these concepts and find where their gaps are and their resource constraints and best practices."

When the Air Expeditionary Force construct was created in the mid-1990s, one of the unintended consequences was that units deploying to an AEF wholesale left their home base with too few firefighters, security forces, or medical professionals. ACC plans to avoid that mistake with ABS.

Instead of sourcing 100 percent of the ABS from the home base, "if they can't do the local mission, we will ... backfill those from another base." He said the right ratio of people to take from a single location hasn't been determined yet, but could be around 85 percent.

Instead of bringing in backfill from another base, the Air Force may contract for some services, he said. "We're still working through that," but Marconi said it's a high priority not to leave the home base empty-handed. "We don't want to break the in-garrison unit."

If additional people must be drawn into an ABS from another base, the plan is to bring them into the deployment model early, "practice as a team and prepare as a team," Marconi stated. Firefighters, for example, would host other firefighters at exercises.

"The plan is to stress them a little bit but not break them," Johnson said.

"It's where you buy your risk, right?" he added. "If you have less people than you'd like, are you going to buy the risk in garrison or are you going to buy it downrange?"

The bigger picture must also be kept in mind, he said. Retirees and families near bases have to be considered, as they would also be affected by the sudden departure of whole capabilities from that location.

"So our Total Force partners," the Air National Guard and Air Force Reserve, may "play a big part in supporting our other Active-duty units," or there may have to be contracted support, Johnson said.

An ACC spokeswoman said ABS "has been primarily constructed with Active duty in mind, but we're looking at collaborating with our Guard and Reserve partners to develop the construct further." There are a lot of tools the Air Force is researching to make sure the in-garrison mission continues to provide support for the military and their families and the retirees," Johnson said.

"We are not breaking the bench," Marconi insisted. ✪

A C-17 Globemaster III from the 305th Air Mobility Wing, Joint Base McGuire-Dix-Lakehurst, N.J., took off from Delamar Dry Lake, Nev., during an Air Force Weapons School event in December 2021. The Air Force has 222 C-17s, its most versatile airlifter, and they now average greater than 19 years of age. No plans exist today to develop a next-generation replacement, even though new starts typically take 10 years or more to develop and no commercial aircraft can do the range of missions—from carrying an M-1 Abrams tank to taking off and landing on expeditionary runways.

Airman 1st Class Zachary Rufus

Air Force Staff Sgt. Von Peoples marshals an F-22 Raptor from the 525th Fighter Squadron for hot-pit refueling at Joint Base Elmendorf-Richardson, Alaska, in December 2021. In hot-pit refueling, the pilot remains in the cockpit and the jets' engines remain running, enabling the aircraft to return to the skies in as little as 30 minutes. Raptors in Alaska defend the homeland from threats crossing the Pacific and Arctic Oceans and can project power when needed throughout the Pacific and Arctic regions.

Airman Andrew Britten

A B-52 Stratofortress from the 96th Bomb Squadron at Barksdale Air Force Base, La., prepares to take on fuel above the Rocky Mountains in December 2021. The Air Force's 76 remaining B-52s will soon get new Rolls-Royce F130 engines, replacing the 59-year-old Pratt & Whitney TF-33s that have powered the bombers since their inception six decades ago. Those modern, commercial engines are 40 percent more efficient, which means the bombers can fly longer and further between refueling rendezvous.

2nd Lt. Mary Begy

2022 Will Be a Big Year for USAF

Northrop Grumman/USAF illustration

The B-21 will take its first flight and new weapons will face critical tests.

By John A. Tirpak

Strategy and posture reviews coming in 2022 could significantly shape the Air Force, even as the service is slated to make major strides on programs and conduct critical tests. How the Air Force manages to pay for all that as the bills come due for major modernization efforts, particularly in the nuclear arena, will be a challenging balancing act.

The Biden administration will release its National Security Strategy and National Defense Strategy (NDS), early this year, which will set the conditions for USAF's force structure. The interim NDS released in March did away with President Donald Trump's theme of "Great Power Competition," replacing it with the more nebulous "Strategic Competition." China remains front and center as the pacing U.S. military threat, with Russia a second but crucial case—and still the principal nuclear competitor to the U.S.

Also this year, the Pentagon will roll out its Nuclear Posture Review and Missile Defense Review, setting the stage for how the Biden administration plans to modernize its strategic arsenal and counter rising threats from Russia's "novel" nuclear weapons—such as Moscow's tidal wave-generating nuclear torpedo—as well as Chinese and Russian hypersonic missiles and China's nascent fractional orbital bombardment system. While the B-21 bomber and B-52 re-engining seem to have full support on Capitol Hill, the new Ground Based Strategic Deterrent intercontinental ballistic missile and Long-Range Standoff Weapon still face opposition. The Nuclear Posture Review will be the first clear indication of how the Biden administration will support these programs.

USAF will make major program strides in 2022 as it reveals and flies the B-21 Raider for the first time and launches other new program starts.

Together, these reviews will effect how the Air Force is sized for the 2020s and beyond. Its force structure is likely to be somewhat different from that laid out in 2018's "The Force We Need" notional Air Force of the future, which called for about a 25 percent increase in the size of the force to 386 combat squadrons. The shift to "high-end" combat capabilities and away from counterinsurgency is likely to gain momentum, in the wake of last year's withdrawal from Afghanistan.

AIRCRAFT

In 2022, the Air Force will reveal and fly the B-21 Raider for the first time and launch new program starts that will have influence on how the service is organized for air combat.

The B-21 is slated to take to the air mid-year, its first flight likely a hop from Northrop Grumman's facilities at Air Force Plant 42 in Palmdale, Calif., to nearby Edwards Air Force Base. Rapid Capabilities Office Director Randall Walden predicted a year ago that the B-21 would roll out in the spring of 2022 and has only hedged a bit since then as pandemic delays slightly affected the program's progress.

Although Walden said the rollout will be a public event, Air Force Secretary Frank Kendall has indicated it will still be kept under wraps to avoid giving China a "head start" in countering the new bomber.

Five B-21s are under construction, suggesting that additional test aircraft will take to the sky in fairly short order. Expect funding for the bomber—which seems to have support from both sides of the aisle on

Capitol Hill and is regarded as a generally well-run effort—to shift significantly from developmental activities to production in the fiscal 2023 budget request.

New funding requests for autonomous, unmanned combat aircraft that will fly as escorts for fifth-generation fighters, such as the F-22, F-35, and Next-Generation Air Dominance platform, and for bombers such as the B-21, could be in the next budget. The aircraft programs will be "acknowledged classified," meaning their funding streams will be public records, but little about them will be disclosed to preserve operational surprise.

Early in the year, the F-35 Joint Program Office and the Air Force owe Congress their plans for improving the fighter's operating costs and mission capability rates as well as how to provide power for the fighter's advanced Block 4 configuration. General Electric and Pratt & Whitney stand ready to build new-generation engines for the F-35 based on their prototype Advanced Engine Transition Program (AETP) powerplants, but the Air Force would have to bear the whole cost of such development and production, as F-35B variant users cannot use the AETP engines and the Navy's F-35C would need significant modification to accommodate the adaptive engine.

More may be revealed in 2022 about the Next-Generation Air Dominance system, which will include a manned (and potentially unmanned) fighter, along with a family of related systems.

Expect the Air Force to make an even harder push to retire aging aircraft to free up money to develop advanced capabilities, and for Congress to remain stubborn in holding onto old systems until new ones are in hand. The fiscal 2022 National Defense Authorization Act prohibited the Air Force from taking any steps to retire more B-1B bombers until they are being replaced, one for one, with B-21s.

Besides the two new "loyal wingman" programs of record—one to escort fighters and one for bombers—the Air Force will likely get formally underway on the new Advanced Tactical Trainer, a replacement for the T-38 in the lead-in-fighter/companion trainer role. It received information from industry on the art of the possible in November. The Air Force will likely partner with the Navy on this aircraft, and there could well be a memorandum of agreement for cost sharing or at least pledging high commonality. Boeing and Saab will offer a variant of their T-7A while Lockheed Martin will enter a variant of its T-50 trainer, which it developed in partnership with Korea Aerospace Industries. Other competitors that didn't succeed in the T-X competition may enter as well.

WEAPONS

The Air Force is under pressure to make progress on hypersonic missiles. The AGM-183 Air-launched Rapid Response Weapon (ARRW) failed to fly on its own in several attempts last year. Successful test flights in 2022 are essential if the service is to enter production in 2023, as it plans. Likewise, test flights of the Hypersonic Air-breathing Weapon Concept (HAWC), a Raytheon product that's a precursor to the Hypersonic Attack Cruise Missile, an air-breathing Mach 5-plus weapon that the Air Force would buy in even greater numbers than ARRW because it will be smaller and more can be loaded on bombers and fighters.

As the Air Force migrates away from the RQ-4 Global Hawk in the strategic reconnaissance role, look for more to be revealed about its stealthy successor, a high-flying stealthy unmanned aircraft that has been called the RQ-180.

While Kendall has indicated USAF will keep mum about new capabilities, flight-testing of the new AIM-260 long-range, multimode-guidance air-to-air missile is likely to step up, as the service plans to field the first versions in the next couple of years. Little is known about the AIM-260, which is being developed by Lockheed Martin.

ACE IN THE HOLE

The Air Force will also sharply expand its agile combat employment (ACE) exercises and experiments in 2022, with more aircraft deployed to austere locations with progressively smaller logistical footprints, supported by Airmen trained to fill multiple roles.

The Air Force announced the release of its first doctrine publication on agile combat employment Dec. 14, laying out its core frameworks and concepts as the service looks to codify and develop the new operational approach.

The new doctrine note, signed by Air Force Chief of Staff Gen. Charles Q. Brown Jr., defines ACE as "a proactive and reactive operational scheme of maneuver to increase survivability while generating combat power throughout the integrated deterrence continuum."

The approach relies heavily on multi-capable Airmen who can operate in austere locations and move quickly, and is defined by five core elements in the doctrine note: posture, command and control, movement and maneuver, protection, and sustainment.

Taken together, these elements "complicate the enemy's targeting process, create political and operational dilemmas for the enemy, and create flexibility for friendly forces," the doctrine note reads

Affording all of this, even with a defense budget at $768 billion, will be challenging. Look for USAF to budget for fewer munitions and accept more tiered readiness. The Air Force anticipates approval for its new system of presenting forces to combatant commanders, which will formalize unit downtime and stop what the service has called the "burning up" of its people and equipment on endless deployments without any opportunity for reset. ✪

Congressional Editor Greg Hadley contributed to this report.

Tech. Sgt. Paul Duquette

On Dec. 15, 2021, Airmen from the 163rd Attack Wing demonstrated Agile Combat Employment (ACE) skills in their C-130J when they retrieved a Ground Control Station (GCS) from Beale Air Force Base, Calif., and moved the massive GCS back to March Air Reserve Base, Calif.

Minot B-52s Visit Canada, California, to Practice Bomber Version of ACE

By Abraham Mahshie

Preparing for conflict in the Pacific will require more than learning to fly fighters out of austere locations—it will also call for small bomber crews to go on quick consecutive missions to unfamiliar places.

In a kinetic "bomber agile combat employment" (BACE) exercise Dec. 6-8, two B-52s from the 5th Bomb Wing at Minot Air Force Base, N.D., conducted a mission in Canada then flew to Edwards Air Force Base, Calif., for a second mission, this time working alongside Navy counterparts.

"This was laying the foundation and the bed for getting to that austere and unfamiliar location," Air Force Capt. Austyn Wilson, a weapons system officer in the wing's 23rd Bomb Squadron, said in an interview. Wilson flew on one of the B-52s from Minot to Edwards and back for the two missions in three days.

Pacific Air Forces has spent decades adapting to operations in contested environments, first under the dynamic force employment concept and now under the Air Force's new priority, agile combat employment (ACE).

Wilson said bomber ACE is about flexing new muscles and adapting to situations that were not part of prior operations and planning.

"You're challenging assumptions, previous predictability, and you're allowing the Air Force, and really our joint defense operations, to have adaptability that we haven't seen in previous years," she said.

Wilson said some of the questions the mission sought to answer were tactical: How are we going to conduct these missions? How are we demonstrating that flexibility? How are we sending a set of bombers to an austere location, making sure that they are self-sustained and able to execute combat out of an unknown location?

Answering those questions was exciting to the small maintenance team and aircrew of less than 20 who took part, she said, motivating them even as they prepared to board the aircraft Dec. 6 with temperatures hovering at negative 10 degrees with a negative-20-degree wind chill factor.

The bombers first flew to the range at Canadian Forces Base Shilo, Manitoba, working with Canadian Joint Tactical Ground Stations to drop 54 weapons. The aircrews then set course for Edwards for mission planning and an aircraft turnaround of less than 48 hours.

"One of the things that upgraded this mission … is our ability to operate jointly with the Navy," Wilson said.

"Not only did we take off with our own weapons, and employ them en route to Edwards, but we were able to get the Mark 62 Quickstrike mines," which are delivered into the water by air, "that we would also potentially be tasked with to support the Navy," she added. "We were able to get those … built for us at Edwards, loaded, and employed the very next day.

Speaking Air Force bomber language to Navy personnel was something she had to be ready for.

"Two different branches, two different languages, and two different ways of operating, processes, regulations," she said. "Making sure that you're speaking very clearly with what your intent is, and the meaning, [and] the requirements."

After landing at Edwards, a minimal support crew, some that flew ahead and some with the bombers, prepared the aircraft for its next mission at the Navy's San Clemente Island Range Complex, a range off the California coast rarely used by B-52 pilots.

Image from Minot Air Force Base video

Capt. Austyn Wilson, a weapons system officer, during the December 2021 Bomber Agile Combat Employment exercise at Minot Air Force Base, N.D.

"We flew low level, at 3,000 feet over the water," Wilson said, noting that the B-52 is one of the few platforms that can deliver mines. "We are getting our aviators ready to do so, if we're called upon."

Wilson also pointed out how bomber ACE was meant to challenge the assumptions of adversaries.

"I think our adversaries have seen us, especially B-52s, go to known locations over time, at predictable cycles," she said.

"With bomber ACE, we are challenging that predictability. We're making sure that our fleet is flexible, and that increases and strengthens our survivability," she explained. "So now, when you send bombers to demonstrate these mission sets en route, and land somewhere else, you're distributing the fleet. You're decentralizing that control, and now you're completely complicating the targeting solution for any of our adversaries."

For Wilson, the sense of accomplishment and the excitement of the mission came from the series of milestones that had to be met by a small, willing 5th Bomb Wing team working with the Navy.

Bomber ACE milestones included getting into the aircraft within 20 minutes, getting off the ground in the next hour, dropping the bombs, and loading the mines. Each milestone was an accomplishment within a more complex mission set.

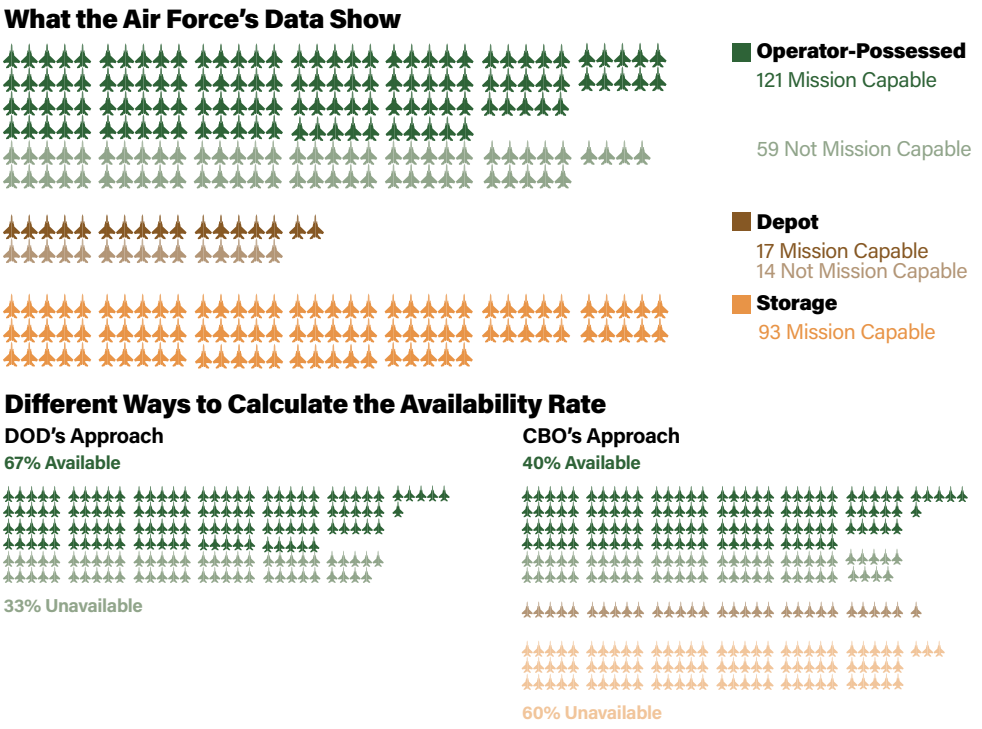
"Once we land at Edwards, you know, you want to take a sigh of relief of, 'We did it,' but that was only half the job. You have to do an entirely different mission set within 24 hours and get back home and get back home safely, with two B-52s that really are STRATCOM assets," she said.

"The most exciting portion for me is [saying], 'Hey, I want to challenge this tactic, this assumption. I want to go to the next level. Can you go here with me?' And every single person that was involved in the planning and execution absolutely did that," she said. ✪

Measuring Fleet Availability: It's All in What You Count

The Air Force and the Congressional Budget Office differ on how to measure fleet readiness. The Air Force calculates the percentage of jets available by considering only those jets that are "operator possessed." CBO, meanwhile, also takes into account jets in depot or storage.

The Air Force had 304 F-15Cs in 2019, of which 121 were mission capable and possessed by operators. By DOD's measure, 67 percent of aircraft were available (121 of 180); but by CBO's measure, only 40 percent were available (121 of 304).



Source: Congressional Budget Office

USAF Aircraft Availability On Long Downward Trend, CBO Says

By John A. Tirpak

The Air Force and Navy are both experiencing declining aircraft availability, a long-term downward trend exemplified by flying fewer hours per aircraft, according to a new report from the Congressional Budget Office (CBO). The data suggests readiness is worse than what the Defense Department reports.

The Pentagon's stated aircraft availability is higher because the Defense Department counts some aircraft as ready for action even if they are torn down for maintenance at their owning unit or are in storage, the audit agency said. The Air Force measures "availability" as "mission capable" rates, metrics that have changed in recent years.

The CBO provided only broad graphs and not specific numbers, but its data show availability for USAF aircraft declining from about 60 percent in 2000 to less than 45 percent in 2020.

Flying hours for USAF aircraft declined from an average of about 300 per year to only about 230; fighter/attack aircraft averaged 200 hours per year in 2000, but only 125 hours on average in 2020. Both availability and use peaked in 2008.

For a more granular look, the CBO examined the F-15C/D and F-16C/D jets, finding availability declined from just under 70 percent in 2000 to about 55 percent for the F-16 and 45 percent for the F-15s in 2020. Flying hours fell from about 260 in 2000 to about 150 for the F-16 and 110 for the F-15 by 2020.

For rotary and tilt-rotor aircraft, USAF saw availability rates at around 60 percent through 2012, after which rates declined to about 55 percent through 2016, followed by a modest recovery to about 58 percent.

The Air Force saw a bump in availability of all aircraft due to the COVID-19 pandemic, CBO reported, with availability rising "from 49 percent in February 2020 to a peak of 54 percent in April 2020," before returning to 49 percent in September 2020.

CBO compared its calculations for F-15C availability to the Air Force's to illustrate its conclusion that the Pentagon's data is misleading. Citing data from 2019, CBO said, "The Air Force had 304 F-15Cs," with an average of 121 mission capable "and possessed by operators" at any given time. But it found that 110 airplanes "coded as mission capable ... could not be flown on combat or training missions." The reason: "17 were undergoing depot-level maintenance and 93 were in storage."

By DOD's counting, "67 percent of F-15Cs were available" in 2019, while CBO concluded the actual percent was closer to 40 percent. The total number of aircraft was the same, with the difference in how one counts those planes not in service. CBO said that its method is a more realistic way to assess the true availability of aircraft for training or combat.

The Navy's decline in availability of the 2000 to 2020 period was more pronounced than the Air Force, but the Navy flew its aircraft more per tail than USAF did over the same period. The availability of the F/A-18C/D has fallen more than any other fighter that CBO looked at.

New Data Indicates Declining Demand for Air Power in Central Command

By Abraham Mahshie

The Pentagon released previously withheld statistics Dec. 17 indicating changing demand for air power in Afghanistan as the U.S. prepared to withdraw from that country last spring. U.S. Air Forces Central (AFCENT) withheld the data for the months February 2020 through November 2021 "due to sensitivity surrounding the implementation of the U.S.-Taliban agreement," said Pentagon Press Secretary John F. Kirby ahead of the data release.

Data for the Iraq and Syria campaign during the same period show steady demand for air power, with 2021 sorties for airlift and airdrops; and intelligence, surveillance, and reconnaissance holding steady, while demand for supplies and passengers increased. Tanker and strike sorties, however, were down from 2020, furthering a downward trend since 2019.

Kirby said Defense Secretary Lloyd J. Austin III directed the release by AFCENT, which provided two slides showing data for 2014 to 2021. Earlier data is available on AFCENT's website and goes back to 2012.

The new data shows airstrikes in Afghanistan ramped up quickly in the fall of 2020, with the number of weapons released increasing from 56 in September 2020 to 246 in October. Weapons released remained over 100 through April before beginning a steady decline to 18 in July, before the U.S. pullout in August. After expending 153 that month, airstrikes ceased.

Kirby did not interpret the trends, but said the department is committed to providing regular summaries again. AFCENT, Air Mobility Command, and Air Combat Command did not immediately provide context on the data.

Numbers of sorties by manned strike aircraft fell steadily in both Afghanistan and Iraq/Syria from 2016 to 2021 with a notable drop in actual strikes—sorties with at least one weapon released—in Afghanistan in the last three years.

Manned strike sorties flown in Iraq/Syria actually started out more than five times higher than in Afghanistan in 2016 (21,181 compared to 5,162), but the sorties fell steadily in both missions since then, with Iraq/Syria's dropping by two-thirds to 7,059 in 2021; and Afghanistan's dropping by more than half to 2,596.

However, manned strikes did tick up in Afghanistan for a time.

Strikes by manned aircraft more than doubled in Afghanistan from 2018 to 2019, from 966 to 2,434; then dropped by three-quarters in 2020, to 660; then again by nearly half in 2021, to 372. Nevertheless, such strikes in Afghanistan still far outpaced those in Iraq/Syria during the same three-year period.

The Air Force's slides do not report numbers of strikes by remotely piloted aircraft, nor how many RPA sorties were flown, instead providing totals of weapons released by both manned and remotely piloted aircraft. The slides don't make clear how many weapons were fired by RPA versus how many were fired by manned aircraft.

Staff Sgt. Christina Graves

Airman 1st Class Ella McDevitt unties munitions during an Integrated Combat Turn at Prince Sultan Air Base, Saudi Arabia, Nov. 18, 2021.

Nevertheless, a trend in strikes can be discerned, with the Afghanistan campaign outpacing the Iraq/Syria effort in total weapons released from 2019 to 2021. In 2019, 7,423 weapons were fired in Afghanistan, compared to 4,729 in Iraq/Syria. In 2020, total weapons fired in Afghanistan numbered 1,631 compared to 1,188 in Iraq/Syria. The following year, in 2021, total weapons fired in Afghanistan amounted to 801 compared to 554 in Iraq/Syria.

ISR missions in Afghanistan outpaced the Iraq/Syria campaign from 2016 to 2020 then dropped dramatically from 14,834 in 2020 to 4,814 in 2021. ISR missions in Iraq/Syria remained consistent around 13,000 from 2019 through 2021.

From 2016 to 2021, Afghanistan received the most airlift and airdrop sorties, airlift cargo, and airlift passengers between the two theaters in all but two cases—airlift cargo in 2016; and airlift and airdrop sorties in 2021—while Iraq/Syria led in tanker sorties, fuel offloaded, and aircraft refuelings in all six years.

In the Iraq/Syria campaign, tanker sorties began to decline in 2017, from 13,243 to just 2,716 in 2021. More drastically, aircraft refuelings dropped from 80,912 in 2016 to 13,137 in 2021.

The Afghanistan noncombat evacuation operation in August 2021 likely contributed to that country outpacing the Iraq/Syria campaign in both airlift cargo and airlift passengers despite reporting fewer months.

Declining Strikes

Manned sorties with at least one weapon released.

	Iraq & Syria	Afghanistan
2016	11,825	615
2017	9,944	1,248
2018	1,591	966
2019	976	2,434
2020	255	660
2021	116	372

Source: AFCENT

Space Force Focuses on Fighting

By Amanda Miller

The leaders of the Space Force foresee the service continuing to become more "lethal" in 2022, inventing new tactical scenarios in its third year while maturing its organizational charts and carving out roles for outside entities.

"I hope I am able to say that in Year 3, you'll see us really putting our tires on the track and just really moving out and delivering the things that we've been thinking about and working on and designing," said Space Force Lt. Gen. Nina M. Armagno.

The Space Force's director of staff, Armagno summed up the service's first two years and looked ahead to 2022 in a Potomac Officers Club webinar in December.

Staff Sgt. Kirsten Brandes/USSF

Tech. Sgt. Brandon Osborne takes the oath of enlistment as one of the first members of the U.S. Army to transfer into the U.S. Space Force Oct. 1, 2021, at Peterson Space Force Base, Colo.

MATURING ORGANIZATIONS

Having now established all three of its field commands, the Space Force still needs to finalize where to base the headquarters, which is for Space Training and Readiness Command, temporarily at Peterson Space Force Base, Colo.

The Space Force will double the size of its Pentagon headquarters staff, expecting to add 300 people in 2022, said Armagno.

People and satellites from the Space Force's sister services will transfer to the new service in 2022. This second batch of transfers will include 670 Marines, Sailors, and Soldiers. They, and 259 civilians also transferring, will have a new orientation class to help bridge cultures. The Space Force also plans to add another 521 new enlisted Guardians and about 70 officers in 2022.

The Space Development Agency will move out of the Office of the Secretary of Defense and into the Space Force. It will take along its plan for a multilayered, multifunctional constellation of relatively low-cost satellites made of readily available parts.

"I call it 'cracking commercial'—hacking commercial," Armagno said, referring to SDA's role. That means figuring out how companies in the private sector "move so quickly—to capitalize on some of their innovation and inventiveness and bring it into the hands of operational warfighters sooner."

INTO THE FOLD

Partnerships now formalized with 11 universities will get off the ground in 2022. Selected in part for having Air Force ROTC detachments, the 11 also feature aerospace research programs.

On a visit to the University of Colorado Boulder, Vice Chief of Space Operations Gen. David D. Thompson said the Space Force's training and education needs are "very, very focused and very, very high tech."

To "operate successfully in an incredibly complex physical and technical domain," Thompson said, Space Force leaders realized the service needed to adapt.

Armagno, who attended the partnership signing at Georgia Tech, said the program is meant to benefit the Space Force on multiple levels: "world-class research, advanced education, and leadership development."

In terms of working with companies in the private sector, Armagno cited a successful business fair by the new Space Warfighting Analysis Center as "a recipe for success, and we're going to repeat it." The new center brought in companies for briefings "so that industries understood exactly what we need and why we need it."

As evidence of growing collaboration with other countries' militaries, Armagno offered the example of Chief of Space Operations Gen. John W. "Jay" Raymond's "chiefs' summit." The summit hosted chiefs from 12 partner nations in 2020 and will grow to 22 in 2022.

Space Force's "partnering arrangements" have delivered cost savings, plus "opportunities to grow our relationships with the international community," Armagno said. "For example, Norway is hosting a Space Force payload on one of its satellite launches, and it's providing Arctic communications two years sooner than we could do it."

FIGHTING COMES INTO FOCUS

Only a few years ago, talking about "fighting in space" was taboo: "I can remember when 'space superiority,' 'offensive and defensive operations in space,' 'warfighting in space'—you couldn't even use these words, said retired Air Force Gen. Kevin P. Chilton, a former astronaut and commander of Air Force Space Command and U.S. Strategic Command. "It was against policy to talk about these things."

Now the Mitchell Institute's Explorer Chair for Space Warfighting Studies, Chilton talked about the military's changing mindset with Space Force Lt. Gen. B. Chance Saltzman in a conversation rounding up some of the service's accomplishments.

Saltzman suggested that provocative activities such as Russia's debris-generating anti-satellite test in November are "a natural consequence of military behaviors."

"When you are behind, you look for ways to seek vulnerabilities of your adversary and your competitor so that you can regain the strategic advantage, and we're seeing that play out," Saltzman said.

To be ready in the event that "a very bad day happens in space and the country needs to recover," Armagno said the Space Force practiced a "groundbreaking event" in June 2021—the service's first "tactical responsive launch mission." Space Systems Command, another of the three field commands, compressed what Armagno described as "the normal multi-month preparation timeline" for a launch "to just under three weeks."

The exercise "demonstrated a possible rapid reconstitution capability for the nation," Armagno said.

Armagno predicted that the service will publicly unveil a new force design for missile warning and missile tracking in 2022, "and we'll continue to evaluate force designs for other missions."

To help the Space Force prevent "bad actors" from causing more havoc in space, Armagno said globally accepted norms of behavior are the first step.

"From a military perspective, what's important about norms of behavior is that we're going to be able to tell who's not following them," Armagno said. ✪

New Year, New Rules

Personnel Changes Are Coming in 22

By Greg Hadley

The Air Force is revising rules for deployments, physical fitness tests, promotions, and more in 2022. Here's a rundown of what's ahead.

Staff Sgt. Dustin Mullen

Airmen listen to a briefing during a large-scale readiness exercise at Fairchild Air Force Base, Wash.

NEW DEPLOYMENT MODEL

In an interview with Air Force Magazine in August 2021, Air Force Chief of Staff Gen. Charles Q. Brown Jr. outlined a new force generation model for the service, based around a 24-month cycle divided into four six-month phases.

The four phases—Available to Commit, Reset, Prepare, and Ready—are aimed at standardizing the process for deployments across the Air Force, Brown said. Under previous force generation models, the service was often stretched thin with high demand and little downtime or readiness, especially after two decades of war in the Middle East.

The move to a new deployment model coincides with the Air Force's increasing emphasis on agile combat employment, the concept of multi-capable Airmen deploying and operating in disparate locations as needed. To support ACE, Brown said, units need to have a standardized deployment process to be as interoperable as possible.

The goal for the new force generation model is to reach initial operational capability in fiscal 2023, which begins in October 2022. But the shift has already begun and will continue through 2022 as major commands such as Air Combat Command, Air Force Special Operations Command, Air Mobility Command, and Air Force Global Strike Command transition squadrons to the new cycle.

Exact details on what the Space Force will do, however, remain to be seen.

NEW PT MODEL

The Air Force introduced a revamped physical fitness test that went into effect Jan. 1, 2022, with alternate exercises to the classic 1.5-mile run, pushups, and situps. Now, Airmen can choose between:

- A 1.5-mile run or a 20-meter high-aerobic multi-shuttle run (HAMR).
- One minute of pushups or two minutes of hand-release pushups.
- One minute of situps, two minutes of cross-leg reverse crunches, or a forearm plank held for as long as possible.

One option that's not on the table is a 1-mile walk that was previously previewed by Air Force leadership. In a Facebook post, Chief Master Sgt. of the Air Force JoAnne S. Bass wrote that the walk was removed "until we are able to standardize the VO2 measurement equipment across every installation."

EQUITY EFFORTS

In 2021, the Air Force released reviews and reports showing that female Airmen and Airmen from racial and ethnic minorities often faced disparities in discipline, promotions,

USAF Hasn't Approved a Single Religious Exemptions To COVID-19 Vaccine; Up to 10,000 Could Be Forced Out

Air Force and Space Force commands turned down more than 2,000 requests for religious accommodations to the COVID-19 vaccine mandate without approving one, the Department of the Air Force said in December. Another 8,636 requests were still pending before Christmas.

When religious accommodation requests are denied by their major command or field commands, Airmen and Guardians may either appeal the decision to the Surgeon General of the Air Force or start the process to separate or retire, if eligible.

As of year end, 135 appeals had been filed, but none had been approved.

According to Department of the Air Force Instruction 52-201, a Religious Resolution Team of commanders, chaplain corps personnel, medical providers, judge advocates, and other subject-matter experts work to evaluate religious accommodation requests before making a recommendation to the commander. As part of that process, a chaplain conducts an interview with the person seeking the exemption.

DAFI 52-201 contains a checklist for chaplains to consult as part of that interview, asking chaplains to evaluate whether the person's beliefs "seemed honestly, consistently, and sincerely held" based on five factors:

■ Requestor is credible (consistently keeps tenets, practices, etc.).

■ Requestor's demeanor and pattern of conduct are consistent with the request.

■ Requestor participates in activities associated with the belief(s).

■ Other persons supporting the claim are credible.

■ Request is supported by letter(s) of verification or endorsement from an organization espousing the beliefs, which are the basis for the claim.

According to a memo signed by Air Force Secretary Frank Kendall, service members whose religious exemption requests are denied at the MAJCOM/FLDCOM level have just five days to exercise one of three options:

■ Start the COVID-19 vaccination process.

■ File an appeal with the Air Force Surgeon General.

■ Request to separate or retire, "if able, based upon the absence of or a limited Military Service Obligation."

Once an appeal is denied, the five-day clock restarts. Under the 2022 National Defense Authorization Act, those booted from service solely for refusing the vaccine will be discharged under honorable or general under honorable conditions.

Department data indicates 95.7 percent of Airmen and Guardians are at least partially vaccinated. Among the unvaccinated, about 2,000 have medical exemptions and another 2,200 have administrative exemptions. Members who remain unvaccinated and without an approved exemption will not be allowed to deploy or PCS to a new assignment.

and opportunities in the military, as well as instances of interpersonal violence.

Air Force Undersecretary Gina Ortiz Jones has taken particular interest in this issue, pushing for the service to conduct further analysis of the disparities facing women of color in the Air Force. She and Secretary of the Air Force Frank Kendall have framed the issue as a readiness problem—lower-level Airmen don't always trust their leaders, which prevents them from serving to their full potential.

Kendall has also tied these reports to the ongoing issue of suicide, saying Airmen need to be able to go to their commanders if they are struggling and seek help.

A 2021 Pentagon report found that the total number of suicides across the services increased in 2021, but the rate of suicides per 100,000 individuals did not increase by a statistically significant margin from 2019 to 2020, assuaging some fears that the COVID-19 pandemic would lead to a surge. Suspected suicides did decline through the first part of 2021.

PROMOTIONS

Several major changes are coming for the Weighted Airman Promotion System in 2022. First, potential NCOs taking the Promotion Fitness Examination will no longer face 100 knowledge-based questions. Instead, they'll have to answer 60 knowledge questions and 20 "situational judgment test" questions.

For the situational judgment questions, test-takers will "read the description of a situation relevant to their potential rank and duties, examine four possible responses to the situation, and then select the most effective and the least effective response," according to an Air Force press release.

The Air Force is also changing how it evaluates Enlisted Promotion Reports. While up to three years of EPRs will still be considered, the service will no longer weight point totals based on the number of EPRs evaluated, a practice that leaders said sometimes unfairly disadvantaged more experienced Airmen.

Now, for their most recent EPR, Airmen will receive 250 points for a "Promote Now" recommendation, 220 points for "Must Promote," and 200 points for "Promote." And for Airmen with only one eligible EPR, that will be the extent of their score.

But Airmen with a second EPR can receive anywhere from 10 to 20 points based off the promotion recommendation they received in that review, and Airmen with a third EPR can add an additional five to 15 points.

The new system also eliminates any point value for the "Not Ready Now" recommendation and does away with the "Do Not Promote" recommendation entirely.

Tweaks are also being made to the DAF's prom otion boards. The Air Force and Space Force will have separate schedules, with the USSF considering promotions from sergeant to master sergeant in May, followed by major through colonel in October, and senior master sergeant and chief master sergeant in November. The Space Force is also shifting to selection boards for all noncommissioned officers.

The Air Force, meanwhile, will have its promotion boards for chaplain, colonel, and some lieutenant colonels meet several months earlier than they did in 2021, "moving the colonels' promotion boards earlier in the year to better align with the colonel assignment process," said Col. Scott Arcuri, Air Force Selection Board Secretariat chief.

The Air Force is also establishing a new board to consider candidates for lieutenant colonel in the cross functional operations developmental category—the new category is for Foreign Area Officers who now have their own Air Force Specialty Code.

DRESS AND APPEARANCE CHANGES

The Air Force significantly changed its grooming standards in 2021, allowing women to wear longer ponytails and braids, loosening restrictions on how far their hair is allowed to extend side-to-side, permitting men to grow their hair to 2.5 inches in bulk, and making it easier for men to obtain shaving waivers by letting medical officials authorize waivers instead of only commanding officers.

The service also made a few seemingly simple but major changes to its dress and appearance standards, allowing Airmen to put their hands in their pockets while standing, as well as to use their phones or take a drink while walking.

On the uniform front, the Air Force unveiled new PT gear, which will be available later in 2022, followed by a four-year transition period.

For service dress, the Space Force will continue to solicit feedback on its prototype uniform, with the potential for wear-testing starting in 2022. The Air Force, meanwhile, might have an issue with its service dress, as the Defense Logistics Agency recently announced it is expecting limited availability of uniform items starting in the third quarter of fiscal 2022, around April. Looking to proactively address a potential uniform shortage, the Air Force has already started issuing fewer uniform items to some BMT graduates. ✪

Hackers Balk at Rules Changes in Latest Hack-A-Sat Contest

By Shaun Waterman

The Space Force's second-ever Hack-A-Sat competition challenged hackers to find vulnerabilities in earthbound satellite hardware, drawing eight hacker teams to vie for tens of thousands of dollars in cash.

But while last year's inaugural competition proved inspirational, this year's ended amid complaints by participants, who said rules changing on the fly and poor communication by the organizers undermined the event.

Even those who performed well were frustrated. "We had really high hopes ... for the contest, but at the end the disappointment and frustration completely took over, even after finishing second and winning a big cash prize," wrote Michał Kowalczyk on CTFTime.org, a blog where contestants rate and review different capture-the-flag (CTF) competitions. Kowalczyk, whose hacker handle is Redford, is a co-founder for the team "Poland Can Into Space," which was the runner-up both this year and last. "I wish it was different, but I have to say that this was a pretty bad CTF."

Hack-A-Sat Twitter

First, second, and third place winners at the virtual Hack-A-Sat 2 final event. The Space Force's second-ever Hack-A-Sat competition challenged hackers to find vulnerabilities in earthbound satellite hardware.

Organizers said they are working on the issues and trying to communicate directly with participants to ensure problems this year can be addressed ahead of future competitions.

CTFs have grown since the 1990s into an international hacker subculture, with hundreds of contests every year. The competitions build teamwork and develop a collaborative muscle memory while at the same time helping security researchers hone and practice defensive and offensive skills.

The Space Force said the contest is "designed to inspire the world's top cybersecurity talent to develop the skills necessary to help reduce vulnerabilities and build more secure space systems."

Hack-A-Sat 2 was organized by representatives from the Air Force Research Laboratory, the Space Force's Space Systems Command, and Cromulence, a contractor. Organizers said they will address the criticisms in follow-up meetings with the eight teams.

"We appreciate feedback and just as we did last year, we plan to have individual feedback sessions with each team to learn what worked well and what can be improved on for next year," organizers wrote in a statement to Air Force Magazine.

DISAPPOINTMENT AND FRUSTRATION

In an "attack-defend" CTF such as Hack-A-Sat, teams of "white-hat" hackers compete over an intense and often sleepless 24 to 48 hours. Each team must both defend its own satellite replica while attacking the replica systems defended by the other competitors.

"Hackers tend to be very direct people, very open about their opinion," said Rubin Gonzalez, a founder of FluxRepeatRocket, a team based in Germany and the fourth-place finisher this year. "So if something went wrong they will generally have no problem with publicly stating that something was wrong."

Gonzalez said his team wasn't invited to the Slack channel used to communicate with competitors until well after the final round began, an oversight that left the team blind. "So for the first three hours, we had no idea what was going on," he said. "We weren't getting any of the information or announcements."

Tyler Nighswander of Plaid Parliament of Pwning, a storied team connected with Carnegie Mellon University, complained that "lots of things regarding how the game operated were not explained clearly."

Joshua Christman of Pwn-First Search described "a lack of communication and a lack of transparency."

Poor communication made it hard for competitors to understand scoring awards and other decisions that, left unexplained, appeared arbitrary.

"Part of the problem is that organizers were and are ignoring our questions," Kowalczyk said. "So we don't really know the explanations and details for some of the things which happened."

The organizers, in their statement, defended their communication style, noting that answering competitors' questions had to be done in a way that didn't unfairly influence the competition.

"Due to the nature of an attack/defend CTF, where teams are progressing at their own individual pace through the challenges, we have to address all [teams' questions] in a manner that doesn't disclose the solutions [to] the other teams because this would provide unfair advantage to the inquiring teams. If one team has figured something out, then it's unfair to them to provide any hints or additional information to other teams," the statement explained.

The organizers said that—as they did last year—they would publish an archive of all the Slack messages during the game

Some participants defended the organizers. "No CTF is without its flaws/mistakes, but these organizers have always run good competitions in the past," said Jonathan Elchison, one of the founders of SingleEventUpset, a team put together especially for Hack-A-Sat.

ATYPICAL CHALLENGE

All CTFs are technically challenging to stage, noted Elchison, but running one on hardware systems such as satellites, with embedded software and very different architecture from the conventional IT systems that most CTFs stage their competitions on, is "particularly difficult."

Organizers used eight centrally located flat sats—real satellite hardware, but earthbound—as the systems that each team had to attack and defend. But they also provided teams with a digital twin of the satellites, a software emulation of the hardware systems on the flat sats.

"The contest goals were very ambitious," agreed Nighswander, noting that "with such a complicated game to create, there was certainly a higher amount of technical effort than usually needed."

"In a typical CTF," explained the Hack-A-Sat organizers, the different parts of the competition, known as "challenges," tend to be independent from one another. But satellites—even the ground-based simulators or "flat sats" used in the contest—are "systems of systems" in which functions, also called services, depend on each other.

"For HAS2, the challenges were interrelated and sometimes dependent on each other due to the nature of the flight software running on the flat sat hardware," the organizers said. "This architecture drove many of the decisions made about scoring and the rules of engagement for the competition."

Most criticism centered on these two elements. Gonzalez and other competitors said rules of engagement changed mid-game; and that the scoring system lacked the accustomed transparency—teams couldn't tell why they were gaining or losing points.

A dashboard representing the flat sats' systems and subsystems showed a system in green if it was functioning normally or in red if it wasn't. Teams thought red meant they were losing points, but the organizers announced during the course of the game that if a system turned red, "that does not necessarily mean that you are losing points for it, it is simply a basic visualization."

The organizers said they had to strike "a delicate balance in releasing just enough information about the scoring so that teams cannot game the system." In a contest centered on hacking satellites, their statement continued, "the expectation was that teams knew what services on the satellite are critical."

Nonetheless, they promised to do better next year. "With that said, we could improve our dashboard in the future to be more representative of the SLA metrics that were a factor in scoring." Most of the points contestants could earn came from a service-level agreement, or SLA—they got points for keeping the various systems on their satellite functioning at a certain minimum level.

HIGH EXPECTATIONS

In the end, Nighswander said the contest reached the right result: "I think the first and second placed teams Solar Wine and Poland Can Into Space were the 'correct' teams. They both did a great job, and they deserved their places, and I think that is very important."

He suggested that expectations for Hack-A-Sat were high. "I think all of the participating teams have played in CTFs which were run worse than this contest was," he said. But given that Hack-A-Sat was backed by the resources of the U.S. military, competitors expected a flawless execution. "There was an expectation level that I don't think was cleared," he said.

Gonzalez said the contest this year took "a step in the wrong direction," but he hoped the organizers would listen to the criticisms because it's "a really cool event."

Solar Wine, the multinational Francophone team that won the contest and the $50,000 first prize, declined to comment on the controversy. "We will communicate our feedback to [the organizers] privately, as we did last year when we missed the podium for a technicality," said team member Aris Adamantiadis.

He hoped the controversy wouldn't overshadow their victory. He noted that, as well as a personal achievement for Solar Wine team members, the result also represented something of a breakthrough. "The big American CTFs are usually led by American teams," he said, noting that Hack-A-Sat 1, although won by a U.S. team, had Polish and German teams in second and third places.

Solar Wine has members from France, Belgium, and Mauritius, Adamantiadis said, but the diversity that helped them win was their "diversity of skills. We have people specialized in the security aspects of reverse engineering, exploit development, cryptography, networks, IT infrastructure, scripting languages, and now even space packets, astrophysics, and satellite operation. All of these skills were key to navigate through Hack-A-Sat," he said.

Winning, Adamantiadis concluded, was "an achievement that we are very proud of on a personal level of course, but there's a bit of nationalistic pride, too!" ✪

RAF Lakenheath Becomes USAF's First European Base to Get F-35s

By Abraham Mahshie

RAF Lakenheath on Dec. 15 became the first European base to receive a U.S. F-35A Lightning II, six years after plans for the delivery were announced as part of an eventual basing of two squadrons of the fifth-generation aircraft.

A 2015 decision to close RAF Mildenhall and realign its missions led to the plan to base 48 F-35As at Lakenheath, with deliveries to start in 2020. COVID-19 and base infrastructure improvements forced the timeline to slip, but U.S. Air Forces in Europe still got its first F-35 before the end of 2021.

"The Valkyries are leading our F-35 integration across Europe," said USAFE Commander Gen. Jeffrey L. Harrigian in a statement.

The 495th Fighter Squadron was nicknamed the Valkyries in 2020 for the female figure in Norse mythology who chooses who will live or die in battle.

"We've come a long way, and now we're extending our reach as a coalition force and what we will accomplish together," Harrigian said.

RAF Lakenheath's selection was based on existing infrastructure and combined training opportunities with the United Kingdom. The U.K. is critical for training and combat readiness for Air Forces in Europe due to its participation in the F-35 program and excellent airspace, noted USAFE.

The new F-35 squadron will consist of 60 personnel and 27 F-35s, delivered in a phased approach. Lt. Col. Ian D. McLaughlin assumed command of the 495th on Oct. 1. New range infrastructure and training are projected to be in place by 2022, Harrigian previously said.

Senior Airman Koby Saunders

An F-35A Lightning II lands on the flight line at Royal Air Force Lakenheath, U.K., Dec. 15, 2021. The arrival of the fifth-generation aircraft has been planned since 2015.

Speaking to reporters at a media roundtable at AFA's Air, Space & Cyber Conference in September, Harrigian highlighted the number of European partners and allies choosing the F-35.

"We've already got some pretty good plans as we start thinking about how we leverage that capability, particularly with many of our partners that already have F-35s in the theater," he said. "I really think it'll be a truly important step as we continue to demonstrate the importance that the F-35 has baked into it from an interoperability perspective."

The F-35 is the high-end fighter of choice for the United Kingdom, Norway, Italy, the Netherlands, Denmark, and Israel. Switzerland announced in June that it will purchase the fighter, and non-NATO partner Finland ordered 64 of the jets Dec. 10 to replace its aging F/A-18 fleet.

Chad McNeeley/DOD

Secretary of Defense Lloyd Austin III, left, congratulates U.S. Navy Adm. Christopher Grady as the 12th Vice Chairman of the Joint Chiefs of Staff.

Grady Sworn in as Vice Chairman

By Abraham Mahshie

The Pentagon confirmed Dec. 20, 2021, that Adm. Christopher W. Grady was sworn in as the 12th Vice Chairman of the Joint Chiefs of Staff.

The swearing-in fills a monthlong vacancy following the retirement of Air Force Gen. John E. Hyten, whose last day was Nov. 19. The Senate confirmed Grady on Dec. 16 after his nomination testimony Dec. 8.

Pentagon Press Secreta ry John F. Kirby said that among Grady's duties will be leading the Joint Requirements Oversight Council and serving as a senior member of the Nuclear Weapons Council.

Grady served as commander of U.S. Fleet Forces Command/U.S. Naval Forces Northern Command since 2018. In that role, he oversaw the naval leg of the nuclear triad.

At his confirmation hearing, Grady was asked to address one aspect of China's military growth—its rapid nuclear buildup.

"I think that China's breakout is, as [U.S. Strategic Command] Adm. [Charles A.] Richard has called it, is, indeed, spectacular and, indeed, breathtaking," Grady said, calling for deterrence against both China and nuclear-armed Russia. "Modernization of the nuclear triad will be the underpinning of that deterrence effort against two nuclear competitors."

MacDill is the Next KC-46 Base

By Greg Hadley

The Air Force selected MacDill Air Force Base, Fla., as its next preferred location for the KC-46 on Dec. 21, 2021, setting up the Florida installation to receive 24 of the new aerial tankers in the coming years.

The KC-46 will replace Active-duty KC-135s currently at MacDill with the 6th Air Refueling Wing, the Air Force said in a statement.

"This basing action and the KC-46A Pegasus coming to MacDill is representative of the commitment to air refueling and air power and what this does for our country," Col. Benjamin R. Jonsson, 6th ARW commander, said at an event celebrating the announcement. "So to be able to do this for decades to come, it shows the importance of that refueling capability and

what it means for our nation and our nation's defense. … We are excited for this big news at MacDill."

MacDill's selection comes over Fairchild Air Force Base, Wash., the other candidate location announced by the Air Force in May. A final basing decision is still forthcoming, dependent on the results of an environmental impact analysis, which is expected to be completed in the fall of 2023. Fairchild, tabbed as a "reasonable alternative" to MacDill, will also undergo an environmental impact analysis.

Airman 1st Class Joshua Hastings

The KC-46A, soon to undergo operational tests and evaluations on the way to initial operating capability, represents the beginning of a new era of aerial refueling.

"The KC-46 mission factors [are] considered central to what our partners do every day," Rep. Kathy Castor (D-Fla.), whose congressional district includes MacDill, said at the announcement event, adding that she was "thrilled."

"They were looking at the capacity of MacDill. They were looking at environmental issues, and they were looking at support from the community—how do we support our military families," Castor said.

Pentagon Releases New Rules to Control "Extremist" Activity

By Abraham Mahshie

Just shy of a year after the Jan. 6 Capitol riot, the Defense Department released a detailed report defining what constitutes extremist activity and recapping DOD efforts to date to reduce and prevent extremism within the ranks

The department will not make a list of prohibited groups, but DOD has defined a two-part test for commanders to assess a violation: Does the act constitute extremist activity; and did the service member "actively participate?"

New regulations go much further than past guidance in defining extremist activities and even state that a "like" of an extremist comment on social media constitutes a violation.

"The physical act of liking is, of course, advocating," Pentagon Press Secretary John F. Kirby told reporters Dec. 20—"advocating for extremist groups, certainly, [or] groups that advocate violating the oath to the Constitution, overturning of the government, terrorist activities."

The new instruction includes a glossary defining terms such as "liking" and "sharing" on social media along with platform-specific terms such as "re-tweeting." The term "widespread unlawful discrimination" is also in the glossary, defined as extensive discrimination of individuals or groups on the basis of race, gender identity, sexual orientation, and other factors, which deprives those persons of constitutional or other rights, such as civil rights and fair housing.

Kirby made clear that the department will not actively monitor the social media accounts of service members. He said extremist ideologies or a membership in an extremist group are not in themselves violations. Membership in an extremist group, however, will make it hard for a service member not to violate a regulation.

"In order to prove your membership, you're probably going to run afoul of one of these criteria sets," he said.

Taking part in extremist activities, such as violent protests, fundraising, or otherwise promoting the extremist group are some of the prohibited actions.

Upon taking office, Defense Secretary Lloyd J. Austin III established a Countering Extremist Activities Working Group and took four immediate actions that included calling for an extremism standdown across the department. The event gave service members the opportunity to discuss the growing problem and solutions. Among the requests from the force was greater clarity on what constituted extremist activity.

Revising the DOD instruction that defines what constitutes extremist activity was one result, while adjusting recruiting and separation briefing activities was another. Training and education within the service will come next, Kirby said.

Other next steps suggested by the working group include reforms of military justice and policy, investigative and screening processes, training and education, and the department's Insider Threat program.

Austin also commissioned a new study on extremism in the ranks, but no further details were provided.

Kirby said DOD does not have a comprehensive way of tracking cases of extremism but in the past year found that fewer than 100 individuals violated regulations on extremist activity. The six service members who participated in the Capitol riot were likely among the 100.

Potential violations of the prohibition on extremist activity will be considered like any other violation, Kirby said, on a "very case-specific" basis.

Oklahoma ANG Member Awarded Distinguished Flying Cross

By Amy Hudson

An Oklahoma Air National Guard Member received the Distinguished Flying Cross—the nation's fourth-highest award for valor in combat—earlier this month for his actions during a Taliban attack in Afghanistan in 2018.

On April 30, 2018, Lt. Col. Michael Coloney was assigned to the 125th Expeditionary Fighter Squadron when more than 80 Taliban fighters attacked U.S. and Afghan Special Forces who were clearing a village in the Kapisa province.

The F-16 pilot was already airborne on another previously assigned mission when he was immediately retasked to provide air support to the U.S. and Afghan troops as the Taliban launched rockets and grenades and shot small arms and high-powered machine guns at them.

He worked with combat controllers on the ground for approximately five hours, employing GPS-guided bombs and conducting high-angle strafe attacks on the Taliban fighters, sometimes less than 30 meters from friendly forces.

Airman 1st Class Allen Tyler

Retired Lt. Gen. Harry Wyatt III presents Lt. Col. Mike Coloney the Distinguished Flying Cross for actions performed on April 30, 2018, in the skies over Afghanistan.

There were 11 casualties that day, including one American Soldier who was killed in action, but Coloney's fire power enabled the friendly forces to escape the enemy without further loss of life.

"It was his exemplary skill, outstanding airmanship, and devotion to duty under extremely hazardous conditions that allowed Coloney to save the lives of so many U.S. and Afghan Special Forces troops that day, for which he earned the Distinguished Flying Cross," according to an Air National Guard release. ✪

Cost of Rebuilding Offutt Will Top $1 Billion, Congressman Says

By Greg Hadley

Inflation, imperfect early estimates, and rising construction costs associated with the COVID-19 pandemic have combined to significantly raise the expected cost of rebuilding Offutt Air Force Base from the floods of 2019, said the Nebraska lawmaker who represents the base in Congress.

In an interview, Rep. Don Bacon (R-Neb.)—a retired USAF brigadier general—said the new estimate is between $1.1 billion and $1.2 billion. That's roughly $300 million more than currently authorized by Congress for the base's reconstruction.

It's not the first time estimates of the rebuilding cost have risen. In the months after heavy rainfall and melting snow combined to flood the Missouri River and cover one-third of Offutt, including the runway, projections put the reconstruction at more than $650 million. That number then rose to $790 million, with the base's commander warning it could go even higher.

There are multiple reasons for these increases, Bacon said, citing discussions he has had with base leaders.

"Those floods occurred in March [2019], and [Congress members] did the markup that spring. We sort of pushed the 55th Wing team to give us an estimate, because I wanted to get some of that money in the NDAA, and we ended up getting just under $800 million for Offutt through that 2019 markup. … But since then, between inflation and—I would say they did the best they could on the estimate—but as they scoped it out more, they realized it was going to be more. On top of that, you've got building costs going up," Bacon said.

Knowing the base needed more funds to rebuild, Bacon and other Nebraska lawmakers pushed for an extra $100 million in the 2022 NDAA. That leaves, he said, "probably about $300 million more to do in the next year or two."

Bacon declined to speculate on whether the cost might continue to rise in the years ahead, noting the extent of the destruction caused by the floods and the extra steps the Air Force is taking in rebuilding. But he did indicate that he would support whatever funding is necessary.

"I know the wing commander and the folks working. I know they're doing their very best to get it right," Bacon said. "I want to have a strong Offutt Air Force Base. STRATCOM headquarters is important to America's security. They're one of the biggest reconnaissance wings in the Air Force. It's the second-largest employer for Nebraska. And I'll just be blunt about it: I'm going to be a guardian angel for that base."

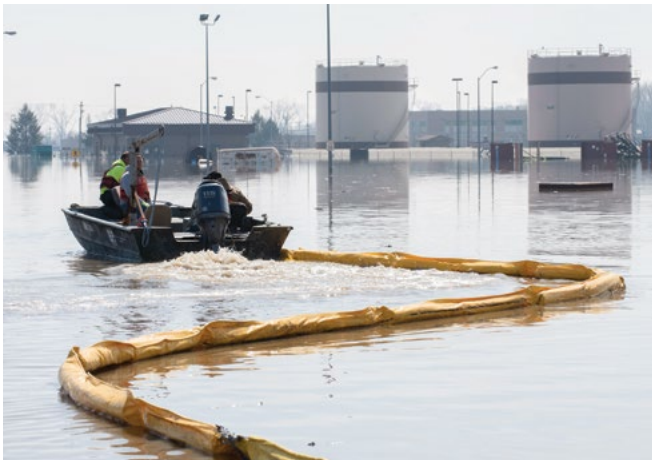
Bacon has a long history with Offutt, dating back to the early days of his career as an Air Force officer. He first served at Offutt from 1986 to 1990, returned from 1998 to 2000, and went back once more as commander of the 55th Wing in 2011-2012.

And as wing commander, Bacon witnessed firsthand a precursor to the 2019 floods. In 2011, floodwaters crept to within 50 feet of the base's runway. During his time in the Air Force, he said, it became clear that the base was in need of repairs even before the destruction of 2019.

"I was a base commander at Ramstein, base commander at Offutt, worked at the Pentagon as a general. Offutt had been falling behind [in] repairs, I would say, for a while," Bacon said. "So I see this as an opportunity to get Offutt to be state of the art. And I'd love to see it be the flagship for the United States Air Force."

A member of Congress since 2017, Bacon said he's been pleased to see that the 2019 floods haven't affected Offutt's operational readiness. But the real impact, he said, has been on morale. Because of damage to facilities in the flood, some units have had to relocate to a World War II-era bomber plant with questionable safety.

"A lot of these folks are operating in a place that was actually built as an airplane factory. The plan is to tear that building down at some point.," Bacon said. "So you've got hundreds, I don't know the exact number, but hundreds upon hundreds of people working in decrepit facilities, and so we need to get them out of there and get them a better work environment. I think it's good for the morale. I think their work productivity will go up. And [if] we want to retain America's best, give them a good working condition." ✪



Delanie Stafford/USAF

Contractors deploy a spill containment boom around the Offutt Air Force Base, Neb., fuel storage area as a precautionary measure March 18, 2019, following flooding of the southeast portion of the base.

FACES OF THE FORCE

Sean M. Worrell/USAF

One of the last living Tuskegee Airmen, retired **Brig. Gen. Charles E. McGee**, celebrated his 102nd birthday on Dec. 6 at Joint Base San Antonio, taking a heritage tour of the 99th Flying Training Squadron, getting presented with a bottle of cola in honor of the tradition of shooting down an enemy aircraft, speaking to 99th FTS pilots, and visiting a flight simulator before being presented with a model T-7A Red Hawk and serenaded by squadron members with cake.

Courtesy photo

Special Tactics Officer **Maj. Chris Walsh** and **Staff Sgt. Matt Beach**, a combat controller, both from the 24th Special Operations Wing, competed together at the International Bobsleigh and Skeleton Federation North American Cup for a chance to represent Team USA at the 2022 Winter Olympics. Beach first started bobsledding in 2020, mentored by Walsh and another AFSOC teammate and bobsled athlete, Capt. Dakota Lynch. The pair finished in sixth place despite an equipment issue.

Courtesy photo

Five Air Force pararescuemen helped to save the life of a British mariner showing signs of a heart attack on a U.S. cargo ship, taking part in a two-day mission from Nov. 13-14 in the Indian Ocean, approximately 500 nautical miles east of Kenya. The pararescuemen flew aboard MV-22B Ospreys to rappel aboard the ship and stabilize the patient, then remained onboard overnight as the vessel maneuvered closer to shore. The next morning, they helped airlift him to a medical facility.

Staff Sgt. Juliet Louden

Col. Colleen Kelley, an ER doctor and commander of the 910th Medical Squadron in AFRC, has taken the stress and frustration of her job during the COVID-19 pandemic and turned it into something positive, writing "COVID SCHMOVID: A Primer for Survival." The book, inspired by a comment she made during a Zoom call with fellow doctors in Vermont, is intended to "lighten the frustration and fatigue that we all have experienced," and all the proceeds are being donated to two local organizations in Kelley's hometown in Vermont.

Samuel King Jr./USAF

Airman Justin Staton on Dec. 1 became the North American champion of the Air Force's Super Smash Bros. Ultimate video game tournament, finishing second overall in the worldwide competition. Staton joined the Air Force in October 2020, following in the footsteps of his father, mother, and younger brother, and quickly found Air Force Gaming. "I love [that] the Air Force is involved in something I love to do. There are not a lot of careers that let you pursue your hobbies to the extent the Air Force does," he said.

Nicholas Pilch/USAF

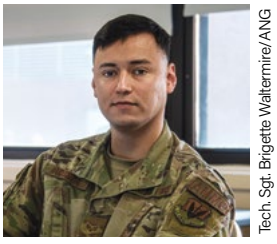
Tech. Sgt. Eric Fanslau, 60th Maintenance Squadron Dash-21 Aircraft Support section chief, has saved USAF $10 million, with the potential to save $20 million more, by creating a C-5M Super Galaxy winch repair solution. Fanslau and his crew have been able to reduce the amount of time needed to swap out winches and properly respool them from days to hours. Fanslau came up with the idea when thinking about his hobby, off-roading, and how his winch on his vehicle sometimes breaks, but he doesn't replace the entire winch, he only replaces the cable.

Senior Airman Aaron Irvin

Tech. Sgt. Jennifer Weigl, 19th Medical Group diagnostic flight chief, received the 2021 Lance P. Sijan U.S. Air Force Leadership Award in the junior enlisted category. The award recognizes the accomplishments of Airmen who demonstrate the highest qualities of leadership in the performance of their duties and conduct of their lives. At DOD's only Level 1 trauma center, she and her team handled the challenges of COVID-19 and drove the 37th TW's BMT COVID-19 mission. "For that to be recognized, and for my leadership to feel that I was even in the same realm as someone like Sijan, is surreal," said Weigl.

Senior Airman Reilly McGuire

It only costs about four cents to manufacture, but the plastic spacer designed by **Master Sgt. Shannon Fulmer** of the 7th Security Forces Squadron has the potential to save the Air Force over $30 million. Fulmer designed the spacer to mount the cutting-edge PSQ-20B Enhanced Night Vision Goggle onto security forces' combat helmets—before then, security forces simply had to use old equipment because the new goggles couldn't mount onto the helmets. Fulmer's 3D-printed plastic spacers were submitted as part of the USAF's 2021 Spark Tank competition.



Tech. Sgt. Brigette Waltermire/ANG

Senior Airman Ezequiel Acosta arrived at JB McGuire-Dix-Lakehurst, N.J., for Operation Allies Welcome, and ended up in charge of accountability for all Afghan evacuees in one of the base's "villages." The job involves helping the nearly 9,000 Afghan refugees obtain citizenship or resident status in a fifth of the time it normally takes, a process often called "organized chaos." As a naturalized citizen of the U.S. himself, though, he knows the importance of the work. "I requested to extend beyond my first set of orders because I want to see this come to fruition and be a part of it," he said.

Senior Airman Emily Farnsworth

Lt. Gen. David Krumm on Dec. 13 was honored by the Alaska Federation of Natives for his service and active engagement with the Alaska Native community. The Iñupiaq group gave him the name Siulliuqti ("leader"), and the Tlingit group gave the Kitch yaa ("under Raven's wing"). Krumm is the fourth Active-duty service member to be so honored by the Alaska Federation of Natives. "I am grateful for the relationship we have … . I am humbled to be honored with the names and the gifts. … I will try very hard to live up to each of these names you have given me," he said at the ceremony.

Tell us who you think we should highlight here. Write to afmag@afa.org.

Image from video by Senior Airman Timothy Kirchner

Senior Master Sgt. Powell Crider first thought of using augmented reality for aircraft maintenance more than a decade ago. In 2018, his idea caught the attention of service leaders as a finalist in the annual Spark Tank competition, and in 2021, his concept finally emerged as an official AETC requirement.

Augmented Reality Goes Mainstream

How a flight line superintendent turned an inspired idea into the Air Force's one-stop shop for Augmented Reality. It only took 10 years.

By Amy Hudson

Senior Master Sgt. Powell Crider saw a need to revolutionize the way the Air Force does aircraft maintenance. The Air National Guardsmen envisioned maintainers wearing augmented reality goggles that enable them to see pertinent data and graphics as they complete a task without dividing their attention between a computer monitor and the aircraft they are working on. The goggles would free up both hands, making it easier for maintainers to work on the aircraft.

For years, he spent his free time developing the concept, and in 2012 he started "socializing" the idea of using augmented reality for maintenance operations and training. He talked with industry to see what commercial off-the-shelf technology could easily be utilized and attended numerous Air Force conferences on maintenance training and operations. At the time, Crider owned and operated a toy and game store in his civilian life and worked as a flight flight line superintendent for the 164th Airlift Wing out of Memphis, Tenn., while on Guard duty.

"When she held up the name of my project, I knew I was funded."

—Senior Master Sgt. Powell Crider in 2018 when Secretary Heather Wilson picked his entry as her favorite

It took six years for the Air Force to pick up the idea.

Crider, then a master sergeant, was selected to represent the Air National Guard during the inaugural Spark Tank competition at AFA's 2018 Air Warfare Symposium in Orlando, Fla. Although his idea didn't win the competition, it did catch the attention of then-Air Force Secretary Heather Wilson, who picked it as her favorite.

"When she held up the name of my project, I knew I was funded," Crider told Air Force Magazine during a 2021 visit to Washington, D.C.: Originally called

Technology Changed the Way We Learn

The development of the iPod in 2001 and iPad in 2010 revolutionized the way information could be presented and shared. The devices meant information could be more easily bundled and modularized, and the interface between a student and the learning tool could take advantage of a color display, video, a camera, speakers, and other features. But the way the Air Force presents information to the force, has largely stayed the same.

Eighteen-year-olds coming into the service today were in preschool when Apple released the iPad.

"I had crayons and construction paper; they're required to have an iPad as part of the training," said Maj. Jesse Johnson, commander of Air Education and Training Command's Detachment 23, which falls under the command's new innovation directorate.

"We have to recognize in the Air Force that every year after this year, it's going to be harder and harder to teach students in our traditional methods. We're not going to be able to give them that PDF and tell them to learn from it. They're going to look at and go, 'Yeah, what's this,' and throw it away. Then they're going to want to Google it," Johnson added. "The teacher or the instructor is no longer the smartest person or entity in the classroom—my smartphone is. We have to capitalize on that. We have to start building our training, so that those Airmen can connect to our training the way they connect to the rest of their life."

The human brain reaches its full physical size around the age of 11 for girls and 14 for boys, but the brain continues to develop through a person's mid-20s. Johnson said between the ages of 18 and 25 a person is still learning how to apply what they learn. This is the stage, he said, when learning styles become truly part of the individuals' personalities.

That's also the primary recruiting age for the U.S. military.

Col. Thomas Wegner, head of AETC's analysis and innovation directorate, which includes Det. 23, said the Air Force needs to think now about how to train tomorrow's Airmen.

"The Air Force, and maybe in DOD, we only think about [Future Years Defense Program]. We don't think beyond the FYDP," he said. "But, unless we're thinking about what the Air Force is going to look like in the year 2040, and how we're going to train Airmen in the year 2040, then work backward through programs like MOTAR, we're still going to be using death by PowerPoint."

Staff Sgt. Renee Scherf, a curriculum engineer at AETC and an MC-130H subject-matter expert, demonstrates a virtual reality training system. MOTAR applies AR, VR, and AI to develop effective, realistic training.

Staff Sgt. Keith James

"Maintenance Operations and Training in Augmented Reality" (MOTAR), Crider's program has evolved over the years. The MOTAR acronym now stands for "Member Operations Training Analytics and Reports." It has become a one-stop shop for aumented and virtual reality training prgrams within the Air Education and Training Command.

Now, those working on MOTAR are shopping it around to other major commands, and marketing its potential applications across the entire Department of the Air Force in the hopes of keeping it alive until it can become an official program of record.

The new technology, developed by Dynepic, Inc., collects user data into a single interface, creating digital training records for Airmen, and includes live learning dashboards so instructors can monitor students' progress.

It is the only Spark Tank concept—so far—to become a

Image from video by Senior Airman Timothy Kirchner

As seen through Augmented Reality goggles, hazard warnings can be superimposed on top of the actual view to highlight dangerous conditions, such as an engine running. MOTAR seeks to develop a standardized interface for AR using commercial hardware and software.

validated requirement. But MOTAR must first make it through what AFWERX, the Air Force's innovation arm, refers to as the "valley of death"—the complicated and time-consuming period where a program attempts to transfer from development to sustainment.

INNOVATION EVOLUTION

After the Spark Tank Contest, Crider was given about $500,000, put in contact with representatives at Google and AFWERX to help further define his pilot concept, and then placed on Active-duty orders to see the project through. AFWERX's 2019 Mixed Reality Challenge asked companies to make MOTAR a reality. More than 120 companies submitted proposals, and three were selected for the first design sprint cycle, including Dynepic, on whose DX system MOTAR is now based.

Dynepic won a series of Small Business Innovation Research phase one and two contracts, then a multi-year phase 3 contract supporting Air Education and Training Command's Maintenance Training Next program, which has since evolved into Technical Training Next.

During the pilot program, MOTAR powered a revamped Crew Chief Fundamentals Course at Sheppard Air Force Base, Texas, with a single login and consolidated dashboard for various augmented reality/virtual reality (AR/VR) applications. The web-based, device-agnostic platform also hosted 360-degree videos, documents, and assessments so participants in the crew chief course could learn the way that suited them best.

Maj. Jesse Johnson, commander of AETC's Det. 23, which is leading the innovation push behind the Technical Training Next initiative, said the original goal in the Crew Chief Fundamentals Course was to prove that Airmen could learn in virtual reality. Once they proved that was possible, they handed that mission over to the schoolhouse tasked with training crew chiefs and started looking at how the Air Force can scale this new technology to every single Air Force Specialty Code (AFSC), and how it can make it available quickly.

That "led us down the path of building a massive Airman learning record that can house all of our student performance data, and then layering that with artificial intelligence that can help commanders make better-informed decisions," Johnson said.

Stages of the Adolescent Brain

Embryo to about 4 years old: Human brains are growing and learning how to make connections. During this phase, a child's relationship to the world is based on the five senses and their connection to their parents. That's all they know and it's how memory is stored, but it's not the deeper memories we have as adults.

From age 4 to about 14 years: The brain undergoes a process called synapses pairing, where you figure out how to learn. During this stage, the brain deconstructs all those synapses to figure out what resonates and how to store memory. That's why "most people can't remember anything prior to the age of five," Johnson said. "It's also the reason kindergarten starts at age 5. It's actually science."

From 18 to 25: The brain starts to go through synapses pairing again and begins developing the medial prefrontal cortex, which plays a critical role in cognative functions such as attention, habit forming, spatial and long-term memory, and impulse control.

During the Crew Chief Fundamentals Course, the small, 11-person team that makes up Det. 23 "had this epiphany," Johnson added. "If you could real-time monitor student performance inside that environment, you could do the same thing at a higher, more aggregate level."

And, if you can monitor an Airman or Guardian's training completion in real-time, commanders can quickly identify and fill capability gaps. This could not only vastly improve response time during a contingency, it can also be used to build multi-capable Airmen.

Multi-capable Airmen are a key component in Chief of Staff Gen. Charles Q. Brown Jr.'s Accelerate Change or Lose directive, which not only calls for quicker innovation, but also new ways of operating. Future deployments likely will be based on the Agile Combat Employment concept, where small teams of Airmen will operate at dispersed locations around the globe, making it more difficult for an adversary to target USAF assets and personnel.

But this approach requires Airmen to wear multiple hats. "I might not have the 18 maintainers that I need to operate the aircraft" in an Agile Combat Employment environment, Johnson said. "But I do have some logistics planning folks, and I do have some security forces folks, and if I can cross utilize those skill sets from one AFSC to another, I can build that multi-capable Airman."

So, if a particular mission requires all Airmen on a deployment to know how to marshal aircraft, for example, a commander or training manager can log into MOTAR, see which Airmen have already completed that competency, and load a virtual training program onto the other Airmen's training records that teaches them how to accomplish the task. Those Airmen can then log on and complete the training while deployed, adding that competency to their record.

"So, now I have a group of Airmen who have a variety of different AFSCs, but they share a central core multi-capable Airman skill set—the basic things I want to operate in an austere environment," Johnson noted.

The same thing can be applied to a contingency situation. When Hurricane Michael nearly destroyed Tyndall Air Force Base, Fla., in October 2018, it took the Air Force several weeks to pull together the right contingency response team with all the AFSCs needed to assess the damage and start to put the base back together again. MOTAR could put a similar team together in 10 minutes, said Johnson.

"If our system can read the training records of every Airman and compare it to a mission, why can't I have a commander just on the spot, write a mission, have the AI analyze it, and tell that commander who they have at their disposal that can execute the mission," Johnson asked. "That's pretty much where we're at now."

NAVIGATING THE VALLEY OF DEATH

Under the traditional acquisition system, the Air Force identifies a requirement it needs to fill a certain gap, and then asks industry to solve that problem. But the process is flipped under the Small Business Innovation Research (SBIR) program.

"We knew the problem. We had already solved the problem," Johnson said. "Now we're kind of going back and cleaning up the paperwork," to re-insert the program back into the traditional acquisition system.

In September, Johnson went to AETC's Requirements Oversight Council (ROC), to validate the requirement for "delivering, analyzing, and reporting on modern training efforts."

Though the ROC typically validates a requirement, not a product, in this case it did both.

Image from USAF video

A user's Augmented Reality view, taken from a 2018 Spark Tank presentation, shows how AR can provide maintainers with prompts to help them learn or complete new tasks.

"In U.S. Code 15, it says that if you use a small business contract to develop a capability, you are legally required to use it, you cannot recompete it under another process," according to Johnson. "So, the ROC, knowing that, said, 'Not only is delivery of analysis and reporting capability validated, MOTAR, as the solution for that delivery analysis reporting capability, is validated, too, because you used a SBIR phase three [contract].'"

Though it's a new requirement, MOTAR is actually the fourth attempt at developing such a capability. The Defense Advanced Research Projects Agency built the first iteration in 2007—the same year Apple introduced the iPad, which quickly shifted the way information is consumed "from being centralized and bundled to modular and mobile," Johnson pointed out. The second and third attempts, both through AETC in 2015 and 2018, respectively, took that into consideration. But none have become an official program of record.

Col. Thomas Wegner, head of AETC's analysis and innovation directorate, says he currently has development dollars for MOTAR, but now that the command has validated the requirement, he needs sustainment funding in order for the program to become operational.

"We have a validated requirement that people want, that's not in the POM [program objective memorandum,]" the Defense Department's five-year budget plan, Wegner said. "So, the only way to keep it alive is for me to go back to [AETC Commander Lt. Gen. Marshall B. "Brad] Webb and ask him for some of his commander's withhold on the year of execution. We're keeping it alive with a year of execution dollars until we can get into the pot."

Wegner said he put MOTAR in the Future Years Defense Program for fiscal 2024, but that's still two years away, and the Air Force still needs to rack and stack MOTAR's capability against everything else included in the POM.

SHOPPING AROUND

That's why the team is shopping MOTAR around to the rest of the Air Force.

Some 300 people from various commands, including AETC, Air Combat Command, Air Force Special Operations Command, and the Air Force Life Cycle Management Center attended the first MOTAR Expo at Joint Base San Antonio's Kelly Field on Nov. 4.

The expo offered Air Force units a chance to share how they are using the platform and showed those considering adopting AR/VR tech in the future ways it might be useful for

Airman Natalie Rubenak

U.S. Air Force Tech. Sgt. Kevin Collins, 366th Maintenance Squadron aircraft metals technology section chief uses a 3D scanner on an aircraft structure, March 2, 2020, at Mountain Home Air Force Base, Idaho. The HandySCAN 3D allows Airmen to scan a structure, eliminating the need to hand draw it on a computer. What used to take anywhere from five to 10 hours of computer time now takes less than an hour.

them. Air Force representatives had a chance to interact with 28 different MOTAR vendors and learn how they are advancing immersive technologies and using the MOTAR platform to rapidly distribute it.

"What we're looking to do here is to get cross communication between all of the different parties … and learn lessons from each other, share progress with each other," Margaret Merkle, AFLCMC'S chief innovation officer for simulators, told Air Force Magazine. "What MOTAR brings to bear on this is the fact that we can share digital assets underneath these various projects to allow each project to build faster toward their end point and not repeat steps early in the development cycle."

Merkle said the service is striving to bring together various digital training assets and capabilities into one platform so Airmen can access them from anywhere, anytime they need it.

"Today, things are stovepiped in certain areas where they are developed, and that's very hard to … reach back into those records from different disparate systems," she said. "This gives us a platform to make that connectivity of all that performance data for those Airmen across the commands," and though training remains with the individual major commands, Merkle said, "We see this as a tool to enable that to be done easier and delivered more quickly."

Merkle offered the example of taking an aircraft offline to make digital scans of it. Those scans can then be shared with different entities looking to build training programs centered around that aircraft. One group may be looking to build a training program to teach the proper way to load weapons on that aircraft, while another will teach how to maintain it, and yet another could use the simulation for pilot training.

"We could take that one digital model and share it with all three of those projects," Merkle said. "And each one of them will progress a little faster because they don't have to do the same things over and over again."

Andrea Hagen, a program analyst with Air Combat Command's Capability Development Engine Room, said that although the command is much earlier in the process than AETC, the platform could one day play into ACC's Reforge fighter pilot training plan. Reforge looks to cut in half the time needed to transform a recently graduated student pilot into a fighter flight lead by pairing the new T-7 Red Hawk's in-jet simulation capability with ground-based virtual reality and artificial intelligence.

"One of the things we are missing is a [Learning Management Sytem] we can use across different FTU schoolhouses," Hagen said. "We have multiple around ACC. They're kind of all doing their own thing, but we're looking for one common platform, and MOTAR kind of fits that bill."

The team held a similar event in Virginia in December, as it touted MOTAR's benefits to those tackling similar challenges inside the Pentagon.

"The Air Force is a busy environment, everybody has job jars that are overflowing, we're extremely busy, and to ask somebody to add innovation to their job jar, when it's overflowing already, is sometimes a bridge too far," Johnson said. "And if there's not an interest and a passion in that person to do it, where they're willing to commit the extra time and hours to that effort, then it gets lost. And this is part of the reason I believe that we haven't innovated so far."

Johnson said senior leadership support is key to "getting over that hump." The Chief of Staff has empowered Airmen to think outside of the box and to be innovative, and that's making its way down through the chain of command.

"What we're doing here, is we're coming back to the folks in the building across the street, where it's their job to solve these things, but they're so overwhelmed, and saying, 'Hey, I solved 50 of your 100 problems. Tell me the other 50 so I can figure out how to solve those, too.'" Johnson said. "So, we're here to … provide support, tell them, 'Hey, somebody is doing this.' But we're also here to provide that pressure on the people standing in the way."

Crider, who's the brainchild behind MOTAR, was also at the December event, now as a member of Det. 23. When asked what it's like to see his idea finally start to get real traction in the Air Force, he said, "It's fantastic. I wanted to go faster, but the problem that we're seeing across the board in the innovation space, and this isn't just this project, it's all over the board, is that the bureaucracy says it's ready for innovation, but it's not. We still have so many layers of bureaucracy that we have to cut through to get things to happen." ✪

Tech. Sgt. James Cason

A U.S. Air Force F-22 Raptor and F-35A Lightning II fly in formation with the XQ-58A Valkyrie low-cost unmanned aerial vehicle over the U.S. Army Yuma Proving Ground testing range, Ariz., during a series of tests in December. The Valkyrie operates autonomously, taking its cues from the manned fighters with which it flies.

Turning Up the Heat on AI

The Pentagon battles its own inertia to make progress in artificial intelligence.

By Amanda Miller

Whenever Lt. Col. Tucker Hamilton encounters skeptics about artificial intellignece, he goes back to a time years ago before the Air Force adopted collision avoidance technology for its F-16 fighters. An Air Force F-35 test pilot, Tucker is familiar with resistance. He's spent the past two years leading the Department of the Air Force's AI Accelerator at MIT, and the parallels with the collision avoidance system are clear in his eyes.

In the 14 years the military waited to require automatic collision signaling in its fighters, at least 17 F-16 pilots "died from collisions that could have been avoidable with this technology." The problem wasn't with the technology. It was just that "people didn't trust it."

Eventually the Automatic Ground Collision Avoidance System became a welcome tool, taking over for pilots who lost consciousness or misjudged terrain.

USAF-MIT AI Accelerator/courtesy

Lt. Col. Tucker Hamilton leads the Department of the Air Force's AI Accelerator at MIT.

Today no one things twice about "It took the ability of someone to trust the autonomy in order to be able to fly with it and feel comfortable with it," Hamilton said of that system, introduced in 2014. Now he wants to apply the same approach with AI. "We want to make sure that we're approaching the technology rightly and that we are making it so that society can trust in the outcomes," he said.

The "accelerator teams the unit's 16 Airmen and Guardians (12 active, plus four reservists) with about 140 MIT researchers and focuses them on 10 projects. The work is "meant to further the science of AI, not just in some military sense," but for a broad array of applications, Hamilton said. "AI is ubiquitous right now. Everything is being influenced by machine learning. So how do we, as a military, approach the technology?"

Investigations include AI amplifying human decision-making, AI-assisted optimization of training schedules, and machine learning-enhanced processes

for sorting and sharing data, among several others others. When the Airmen and Guardians complete their time, they carry what they've learned back to their units.

SEEKING THE EDGE

The National Security Commission on Artificial Intelligence completed its work less than a year ago, citing deepfake videos, drones in the hands of "terrorists and criminals" and a "gathering storm" of "foreign influence and interference" as threats to the United States. In response, the authors said, the U.S. "must prepare to defend against these threats by quickly and responsibly adopting AI for national security purposes." The National Security Commission on Artificial Intelligence concluded that the U.S. "must prepare to defend against these threats by quickly and responsibly adopting AI for national security purposes."

Convened in 2019 with 12 members appointed by Congress and three by the Executive Branch, the commission studied AI and related threats for more than a year and published its final report in March 2021. Chaired by former Google and Alphabet CEO Eric Schmidt, it concluded that the DOD's digital innovation initiatives are "uncoordinated and under-resourced" and said the department should "embrace proven commercial AI applications" as "a critical first step" to building a "modern digital ecosystem" that could serve to "integrate AI across the organization."

The commission brought together senior members of Congress and the U.S. national security establishment—along with leaders from India, Japan, Australia, South Korea, New Zealand, NATO, and the European Union—for a summit in July 2021. All agreed that China presented the greatest competition in AI.

China, for its part, had declared in 2017 that it intended to be globally dominant in AI by 2030.

The commission advised what it called a "modest down payment on future breakthroughs," telling Congress that DOD needed everything from "widespread integration of AI" to "a state of military readiness of AI," all by 2025. And it wanted DOD to spend a lot more on AI, proposing an increase from $1.5 billion a year to $8 billion a year by that time.

"If anything, this report underplays the investments America will need to make," write Schmidt and his vice chair Bob Work, a former deputy secretary of defense, in their letter introducing the final report. Saying the money is to "expand and democratize federal AI research," Schmidt and Work also said they "worry that only a few big companies and powerful states will have the resources to make the biggest AI breakthroughs."

Schmidt was chief executive officer, then executive chairman, at Google and its parent company, Alphabet, from 2001 to 2017, then served as a technical adviser to Alphabet until 2020. Schmidt heads the list of investors in AI startup Rebellion Defense, founded in 2019 and reported to have been valued at $1 billion as of September.

600-PLUS AI PROJECTS

At the commission's summit to accompany the report's release, Secretary of Defense Lloyd J. Austin III proudly noted that the Defense Department has more than 600 AI projects underway across the services and DOD agencies. Some commands are just trying to get a handle on their data—what they have and how to format it for future use, for things as simple as optimizing a schedule.

Other projects are advancing AI for more inherently military uses, such as the Air Force Research Laboratory Sensor Directorate's $88 million contract with the University of Dayton to study AI and machine learning for autonomous systems.

Maj. Kimberly Burke/ANG

Sgt. Shane Keahiolalo tests the new Battle Management Training NEXT system at Joint Base Lewis-McChord, Wash. BMTN uses a video game approach to teach battle management.

Like the DAF's MIT AI Accelerator, DOD's Joint Pathology Center wants to make a wider contribution—in its case, to medical research. The center houses the world's most extensive repository of diseased tissue samples, largely in the form of slides. Its director, pathologist Army Col. Joel T. Moncur, envisions AI algorithms learning to predict a patient's prognosis. AI might help predict whether a cancer patient could get by with just monitoring or would need aggressive treatment.

To train the algorithms, the center is scanning slides at high-power magnification—recording hundreds or thousands of digital images per slide—to link with information such as the person's outcome.

Even while recognizing the potential, Moncur said "privacy, security, and ethics" continue to take priority. Having first figured out how to manage the data, the center is speeding up the rate of scanning from 500,000 slides to more than 1 million slides a year.

Austin, for the Pentagon's part, promised the department wouldn't "cut corners on safety, security, or ethics," not believing "for a minute that we have to sacrifice one for the other." With "some of our competitors" thinking that emerging technologies such as AI represent "an opening," Austin said DOD had requested its "largest ever" budget for research and development.

The Pentagon already received an increase of $3 billion in the fiscal 2022 National Defense Authorization Act for science and technology research such as in AI, and Congress required a new comparison of U.S. and Chinese research and development activities "on certain critical, military-relevant technologies."

But without accepted technical and ethical standards in developing AI, it may not yet be ready for some military uses.

An analysis published in December by the American Enterprise Institute (AEI) found that "the international community faces disarray that stands to cause considerable harm to consumers, companies, and countries." Broad implications include exploitation of individuals' data and bias AI against certain groups of people in the development of AI.

The Washington, D.C., think tank's author, Elisabeth Braw, a former senior fellow of the Atlantic Council who focuses, in part, on nonkinetic threats, describes the approach to standards by U.S. companies and the federal government as "laissez-faire," while noting that "China spends massively on AI and eschews international standards while pushing heavily for de facto international acceptance of its own standards."

Recognizing the problem, NATO chimed in separately in 2021, publishing new principles on appropriate uses of AI while its assistant secretary general for emerging security challenges

went public with a cautionary message.

Adopting already developed AI for military purposes carries risks because most AI to date has been developed for commercial purposes, "then maybe a dual-use case later on in the process," said NATO's David van Weel in a webinar that accompanied the release of the American Enterprise Institute's report.

"If you do not master it, if you are not there when the technology is being developed, and those developing it are not looking at the security impact of their technology," van Weel said, "it means that governments, but also the defense sector, [are] always late to seeing what the potential impact of technology is."

In addition to spending the most on developing AI, the AEI report pointed out that China's researchers publish the most papers in the field of AI and that China files for the most AI patents, calling China and the U.S. "the undisputed leaders in a fast-growing and, so far, little-regulated field."

TRUST LIES IN STANDARDS

Members of DOD and even NATO have acknowledged that without a window into its development, repurposing commercial AI for the military carries risks. "We are not known, at NATO, for publishing a lot," accordinmg to van Weel. "We try to keep secrets a lot."

But lagging behind the private sector has left governments "in a situation where regulation comes after the broad use and misuse of technology," van Weel added. "So we need to be early to the party and make sure that we understand new technologies, not to militarize them—no, but to understand the security and defense implications."

To build confidence in AI, NATO has proposed that governments join with universities to set up test centers "where allies that are thinking about co-developing AI for use in the defense sector can come in and verify, with protocols, with certain standards that we're setting, that this AI is actually verified," van Weel said. "Principles are nice, but they need to be verifiable as well, and they need to be baked in from the moment of the first conception of an idea up until the delivery."

"It's not a world standard yet, but if the 30 nations, Western democracies, start out by shaping industry to adhere by these standards, then I feel that we are making an impact, at least in the development of AI and hopefully also in the larger world," he said.

The Defense Advanced Research Projects Agency hopes its new public toolkit to help developers defend their AI against attacks, such as tricks that can fool a system.

Acknowledging the lack of visibility into the development of commercial AI, "How do you vet that—how do you know if it's safe?" said DARPA's David Draper, program manager for the newly available set of tools called GARD, for Guaranteeing AI Robustness against Deception.

NETWORK LACKING

DOD will have to overcome "insufficient network architecture" and "weak data practices" to get to "a state of military readiness" of AI and machine learning, the national commission said.

Moncur at the Joint Pathology Center, for example, recognizes that DOD needs some "common resources" for AI and that they're being looked at. "Resources" include more than secure data storage: "We need to know whether or not there will be a computing environment that has sufficient power within the military to invite collaborators to operate and to development within our secure environment."

He suspects the solution "will probably be a mixture—sometimes inviting collaborators in; other times exporting data out.

Either way: "To the degree that the military could invest in the high-capacity computing environment that's necessary to process data, to train algorithms—I think that that would be very useful."

The national commission's idea if for a "digital ecosystem" by 2025 made of up of data repositories; prepackaged "environments" with tools for developing AI; a "marketplace" of AI resources, including software; and "pre-negotiated computing and storage services from a pool of vetted cloud providers."

This was, in part, the concept behind the JEDI—the Joint Enterprise Development Initiative—which sought to create a common cloud environment for military operators. While JEDI fell by the wayside amidst protests and legal wrangling, however, a variety of nascent cloud-enabled AI projects began to gain steam. Now DOD is pursuing a multi-cloud solution rather than the one-stop-shop envisioned with JEDI. This Joint Warfighter Cloud Capability will provide the same kind of tools and pre-negotiated security and prices as JEDI, but enable users to work with the technology offerings from a number of cloud service providers. To lead the AI revolution in DOD, the Biden administration is creating a new position at the Pentagon and reorganizing some AI-oriented entities within DOD.

Deputy Secretary of Defense Kathleen H. Hicks announced in December that DOD is replacing its Joint Artificial Intelligence Center (JAIC) with a new office and realigning the Defense Digital Service and chief data officer role.

The new Office of the Chief Digital and AI Officer "will serve as the successor organization" to the JAIC and "intervening supervisor" between the Defense Digital Service and Office of the Secretary of Defense. The chief data officer will continue to report up through the chief information officer but will be "operationally aligned" to the new office.

The chief data and AI officer job is effective Feb. 1, 2022. The person selected will "serve as the Department's senior official responsible for strengthening data, artificial intelligence, and digital solutions in the Department," Hicks said in a Dec. 8, 2021, memo.

Echoing some sentiments of the national commission, Hamilton at MIT said he wasn't worried about the pace of algorithm development but instead the data architecture to develop AI and run it on.

"What you really need the money for is to develop the infrastructure that would allow and empower machine learning solutions," Hamilton said. "The ability to share data securely and effectively across the DOD—across the government." ✪

Tech. Sgt. Amy Picard

Airmen operate cyber systems using an enhanced communications flyaway kit during the Global Information Dominance Experiment 3 (GIDE 3) and Architect Demonstration Evaluation 5.

Hypersonics Defense

How hypersonic weapons maneuver and what to do about it.

Mike Tsukamoto/staff; Christian Hänsel/Pixabay; Lockheed Martin

A Lockheed Martin PAC-3 Missile Segment Enhancement intercepts a hypersonic weapon in this illustration. Hypersonic weapons are destabilizing threats that cannot be countered by existing weapons.

By Abraham Mahshie

Hypersonic weapons do not zig and zag across the sky. The stresses and heat generated by a 10,000-pound glide vehicle travelling at five to 15 times the speed of sound are so great a sharp turn would rip the weapon apart. Yet even a slight adjustment can make these weapons unpredictable and nearly impossible to intercept, given their speed, and both China and Russia have developed weapons that pose significant and destabilizing threats. U.S. military leaders say it will take about a decade to counter those threats with new defenses.

Neither the Missile Defense Agency nor the Space Force have revealed the extent to which they can track hypersonic weapons or how close the United States is to being able to intercept a hypersonic weapon. Unlike ballistic missiles that travel predictable trajectories, hypersonic weapons can fly low, evading radar and can maneuver during the cruise phase. They are intended to quickly destroy high-value targets, such as aircraft carriers.

Experts at MIT and the University of Colorado say current U.S. defense can detect these new weapons, but do not yet have the ability to strike a hypersonic weapon in mid-course. Working in their favor is that maneuvering the super-fast weapons comes with a price: Any change in course generates drag, greatly reducing the weapons' range.

"The long pole of the tent is making faster and more agile interceptors." —David Wright, Massachusetts Institute of Technology

Currently, Overhead Persistent Infrared missile warning satellites, like Space-Based Infrared System (SBIRS) and Defense Support Program (DSP), in a variety of orbits, detect missile and space launches the moment they begin. Ground-based radars detect and track missiles in-flight, within and above the atmosphere, Space Operations Command spokesperson Mike Pierson told Air Force Magazine.

But the threat posed by hypersonic weapons requires new capabilities.

"Hypersonics were absolutely considered as part of our threat-informed analysis," said Pierson. Space Force worked with the National Reconnaissance Office, MDA, private industry, and others to complete an integrated force design analysis and recommendation for missile warning and tracking.

"We're in the process of developing new force designs for future space architectures," he added. "There are some sensitivities behind some of these questions as they get into future space architectures, which are still pre-decisional."

In January 2021, MDA awarded contracts to develop a Hypersonic and Ballistic Tracking Space Sensor (HBTSS) to L3Harris Technologies and Northrop Grumman. These new satellites will integrate with ground radar to track hypersonic missiles anywhere

on the globe. MDA plans on-orbit demonstrations of two prototype satellites by 2023. In November, MDA awarded three new Glide Phase Interceptor (GBI) contracts to develop the ability to intercept a hypersonic weapon in mid-course by the late 2020s.

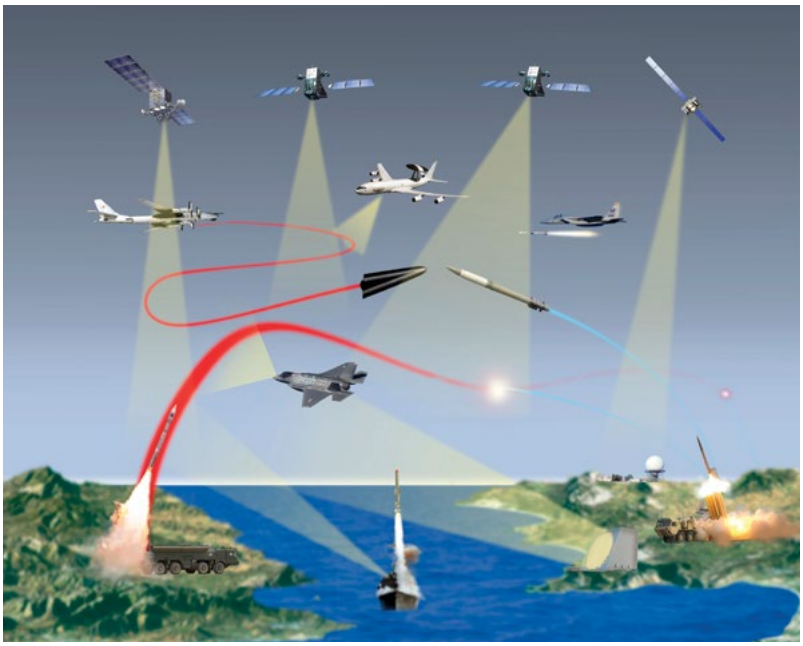
"When you look at defending hypersonics, our focus has been on the regional fight," said MDA Director Vice Adm. John Hill on Dec. 6, following the initial Fielding of the Long Range Discrimination Radar at Clear Space Force Station, Alaska.

Hill said that U.S. aircraft carrier battle groups are now equipped with a Sea-Based Terminal (SBT) missile defense capability.

"They're going to have that destroyer operating to protect the carrier against the end game of a hypersonic," he said.

SBT uses the Aegis Baseline 9C capability, including the SPY-1 radar and SM-6 interceptor to defend "against anti-ship ballistic missiles and some hypersonic threats," the Missile Defense Agency told Air Force Magazine.

But both MDA and experts warn that successfully defeating hypersonics ultimately must start before the terminal phase of a missile's trajectory.



Mike Tsukamoto/staff; DOD; USAF; USN; USA; Northrop Grumman; Lockheed Martin; RT.com

U.S. satellites and aircraft monitor, transmit, and share intelligence in this conceptual illustration of hypersonic missile defense.

"We have a program that we are working toward ... that takes us further back into that trajectory for a layered defense against hypersonic [threats], and that would be in the glide phase," Hill said.

"If you can defeat in the ballistic phase of a hypersonic or when it's launched by an aircraft or launched by a cruise missile, that's, step one, right? Then if you can kill it in the glide phase," he said. "That's great because really all you've got left is terminal capability."

Asked what capability the military now has to track and target hypersonic weapons during the glide phase, Hill said: "We do not have that capability ... today."

MANEUVERABILITY IS 'OVERSOLD'

Maneuverability of a 10,000 to 20,000 pound weapon system traveling at hypersonic velocity is limited, experts say.

"You see these videos, you see where these things are just like cruising around, going around things and stuff," said MIT physicist Dr. David Wright, a research affiliate at the Laboratory for Nuclear Security and Policy. "That just isn't the way it goes. Because the thing is going so damn fast, that to change the direction ... you have to do a heck of a lot of work, and it takes a long time."

Hypersonic weapons can have control rudders and fins, which can be adjusted to change altitude or direction, but at the cost of both speed and range. Hypersonic missiles can maneuver in the mid-part of their flight, dropping to about 50 km altitude and traveling a good distance of their trajectory using lift forces to maneuver. Material strength under the overwhelming heat and pressure created at that speed is a primary limiting factor.

Dr. Iain Boyd, director of the Center for National Security Initiatives at the University of Colorado Boulder, said even small adjustments can make a big difference. "You're not maneuvering so that you're turning very large angles," he said. "You're just doing a little bit. And that's more than enough to make it difficult to track."

Wright explained the challenge. In lower altitudes, both lift and drag are greater due to greater atmospheric density. "The point is that if the vehicle drops to lower altitude, the atmospheric density is larger," Wright said. "That allows it to create more lift force so it can turn more quickly, but it also increases the amount of drag it experiences.

Wright calculated that for a hypersonic glide vehicle traveling at Mach 15, it would take seven minutes to turn 30 degrees, and that if it were flying at an altitude of 40 km, it would have to drop 2.5 km to achieve that objective.

"I have a radius of curvature of like 4,000 kilometers," he said. "It's a very slow turn. And at the same time, I'm losing like 15 percent of my range." Dropping instead by 5 km, the turn can be made in half the time—but the price of that maneuver would be 25 percent of vehicle range.

"People have really gotten this idea that it's like this speed boat, you're just cruising around," he said. "The timing is much slower than that and it's much more costly. So, I think that's been oversold."

MIT Hypersonics Research Laboratory Director Dr. Wesley L. Harris is currently working with a team of seven Ph.D. students to understand the loads, pressure distributions, and heat transfer on hypersonic vehicles.

"Those are enormous loads," he said. "These are usually 20,000 [pounds]no less than 10,000-pound vehicles flying at Mach Five. So, a slight deflection can generate a big, heavy load leading to shockwaves, even leading to separation of fins, control surfaces, on these vehicles, enormous pressure, therefore force loads and shockwave boundary interaction, on these vehicles."

Wright believes the enormous restrictions on vehicles moving that fast has been left out of the debate on hypersonics.

"I think there are all these myths about [hypersonics being] undetectable and maneuvering and all that kind of stuff," he said.

MDA is nonetheless preparing to defend against hypersonic weapons at all phases of its trajectory.

"Hypersonic weapons can travel at exceptional speeds with unpredictable flight paths that challenge existing defensive systems," the Missile Defense Agency said in a statement.

"MDA is developing a systems-level defensive architecture to provide a layered defense to address a growing threat posed by hypersonic weapon systems."

TRACKING HYPERSONICS

The "confounding" aspect of tracking a hypersonic glide vehicle, Boyd explains, is how it differs from a ballistic missile, cruising at an altitude that missile defense systems have never before needed to look.

"These new systems, really, they're flying in a different part of the sky, and they can maneuver all along the trajectory," he said. "They are a much more difficult challenge on the defensive side."

At an altitude between 20 and 60 km, hypersonic weapons operate both far above airplanes and far below satellites in low-Earth orbit.

"One of the things about these hypersonic systems is that they kind of lie at the seams in between things that we have in place," Boyd said. Neither space-based sensors designed to detect ballistic missiles nor ground-based radars are designed to address this threat.

"There's actually a lot of real estate out there, but we're not used to looking," he said. "They're not following a predictable trajectory, and they don't really have to maneuver very much to be lost to us."

The SBIRS can detect rocket launches by identifying their heat signature. Theoretically, they could also track hypersonic weapons by watching heat they generate in flight, Wright said.

"If you're flying something at Mach 10 through the thick atmosphere at 50 kilometers, the thing is so hot that you're creating a red glow that can be seen by these satellites," he said. So the issue is not that an incoming missile is invisible, he added.

"This idea that it's just going to be a surprise ignores the fact that one of the physics properties of these things is they create so much heat [that] they can be seen by early warning satellites."

But Boyd notes that a satellite would have to continuously track such a missile and that as it slows, the heat signature could become too faint to pick up.

"There's almost certainly a need to have higher sensitivity sensors to pick them up," he said.

That's the focus of the Missile Defense Agency's Hypersonic and Ballistic Tracking Space Sensor contract. Phase IIb of the project will build on industry designs and risk-reduction efforts.

MDA will continue to develop HBTSS as a unique Overhead Persistent Infrared (OPIR) sensor providing fire-control quality tracking data on hypersonic threats and ballistic missile defense threats. MDA plans to work with the Space Force to integrate the future system into a unified defense.

"HBTSS is needed, since we cannot populate the earth and the oceans with terrestrial radars to meet this need," the agency read when it announced the contract award.

"If I have a radar on the ground, and the ballistic missile is up at 1,500 kilometers, I can see it," Wright said. But the curvature of the Earth masks weapons at lower altitude until they are within 500 km, or so, providing only about two minutes to respond.

"It's kind of already too late," Boyd said.

GLIDE PHASE INTERCEPTORS

The most advanced missile defense system now in operation is the Patriot Advanced Capability (PAC)-3 system, which can reach hypersonic speeds to hit its target. Hypersonics experts believe current missile defenses could possibly protect high-value assets against hypersonic threats, provided they were placed in the correct location.

MIT's David Wright is currently studying the susceptibility of hypersonic weapons to current generation missile defenses."If you slow a hypersonic weapon down below about Mach 6 ... you could probably have a good chance of intercepting with something like the state-of-the-art Patriot," he said.

But the advantage will always go to the faster weapon. If the interceptor is faster than the incoming missile, it can defeat it. But "if the hypersonic weapon is going about the same speed, then it will always have the advantage," he said.

"If you're worried about hypersonic weapons ... it appears to me that the long pole of the tent is making faster and more agile interceptors," he said. "There's a rule of thumb that the interceptor actually needs two to three times as much lateral acceleration as the target in order to make up for that time lag."

Boyd disagreed. He said MDA must first overcome the tracking problems. "Because we don't have the sensors in place, because they're [hypersonic weapons] flying in a different part of the sky, because of the geometry of the earth, the radar would pick it up, [but] it would likely be too late for an interceptor to get up there and engage with it."

MDA's multi-layered tracking approach would begin with space sensors tracking the launch and cruise phase and carry through until ground-based radars could pick up the target. Tracking data would be fed to a new Glide Phase Interceptor missile defense system deployed aboard Aegis cruisers, which would seek to intercept the hypersonic glide vehicle during the cruise phase; as a backup, in case the hypersonic threat got through, the Aegis SM-6 missile defense system could still engage the target in the terminal phase.

Harris said current interceptors could be effective against a hypersonic weapon as long as they have enough notice and enough knowledge of the weapon's size, weight, and maneuverability.

"All of those things are critically important," he said. The interceptor need not strike the weapon directly; it only needs to be able to explode in the vicinity in order to destroy the incoming weapon. "You have to build faster, more maneuverable and more potent warheads in our defensive interceptors," he said.

Wright is not convinced that the SM-6 would be fast enough to take out an incoming hypersonic threat in the terminal phase, as MDA has suggested.

"My sense is the SM-6 is just too slow," he said. "It's not a matter of sensors that you have to look at, it's a matter of having a faster and more maneuverable interceptor."

Indeed, even if it could strike the incoming weapon in the terminal phase, that might not prove effective. "Stuff is still going to get through," Boyd said. "So, even if you were able to engage it right at the end, that may be too late."

Boyd argues the U.S. needs to ramp up investment—and soon. "There should be a sense of urgency," he said. "I think the current investment is not going to provide a comprehensive solutio. ... The current investments are going to take a long time to get there."

Meanwhile, Russia and China are racing to develop scramjet and ramjet hypersonic engines that could yield smaller, more maneuverable, and harder-to-detect weapons. The threat will not stay static, but like all weaponry, continue to evolve.

"The next generation of interceptors will have to be responsive to certain parameters driven by what we know about the offensive weapons that the bad guys have: How maneuverable are those?" Harris said. "We have to know, we must. We have no choice." ✪

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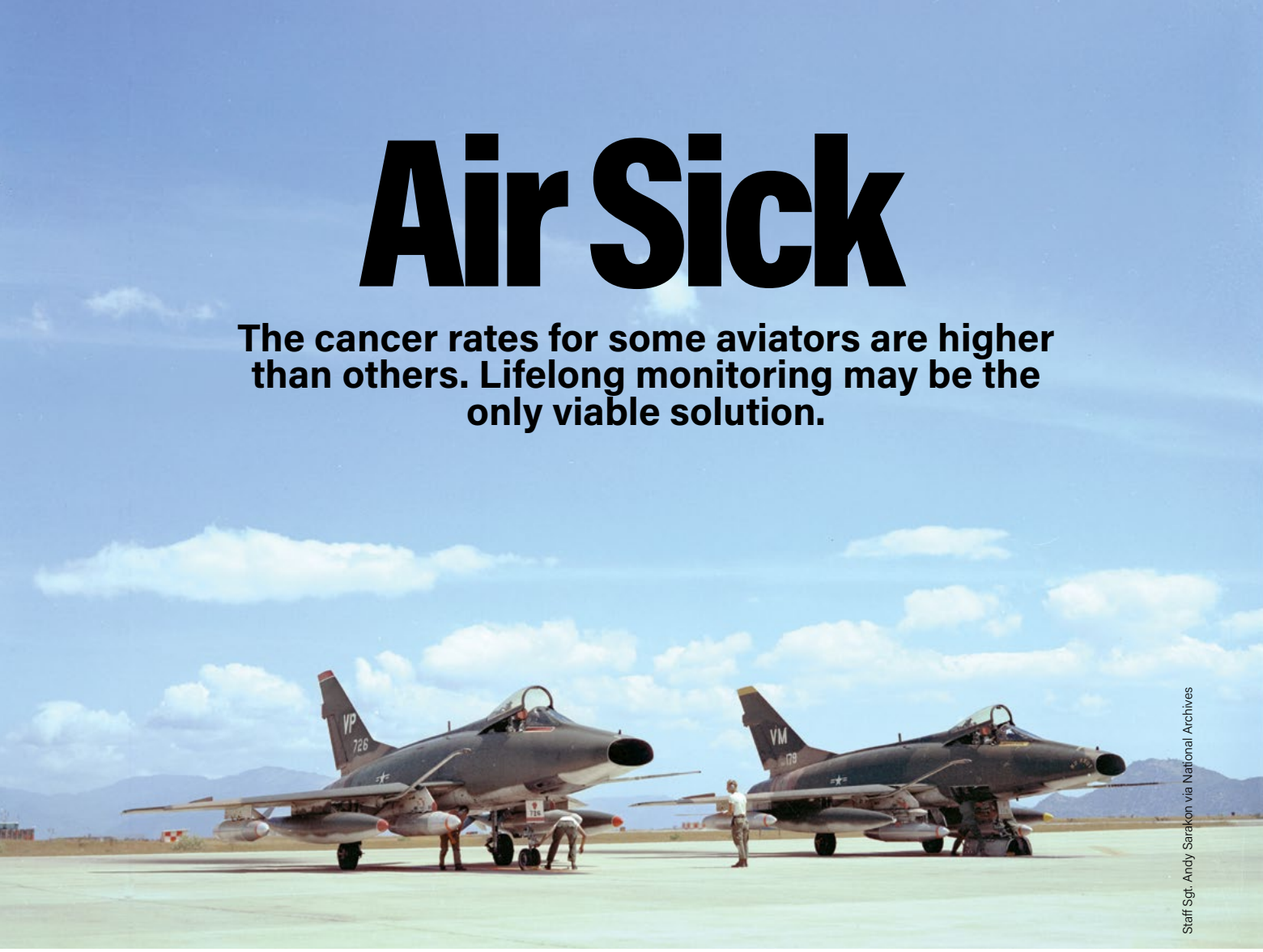
Air Sick

The cancer rates for some aviators are higher than others. Lifelong monitoring may be the only viable solution.



In Vietnam, where Airmen flew F-100s, Airmen were exposed to a variety of risks, ranging from Agent Orange to unknown exposures in their aircraft. The Department of Veterans Affairs presumes certain ailments are the result of Agent Orange exposure.

By Greg Hadley

On May 26, 2021, the U.S. Air Force School of Aerospace Medicine released a study titled, "Cancer Incidence and Mortality Among Fighter Aviators who Served on Active Duty In the U.S. Air Force between 1970 and 2004: A Comparison to Other Officers and the General U.S. Population."

Less than five months later, the man who helped lead the push for that study was gone.

Thomas "Boot" Hill flew F-4s and F-14s in the Navy over the course of a 23-year career, before going on to work with Booz Allen Hamilton and other defense contractors. A decade ago, however, he was diagnosed with esophageal cancer.

Over the next 10 years, Hill dedicated himself to tracking the rates of cancer among military personnel, especially aviators, and advocating on those aviators' behalf. His early work focused on Navy pilots, but over time, he became involved more broadly with the Red River Valley Fighter Pilots Association (RRVFPA) and its Aviator Medical Issues Committee.

"There's nothing like a guy who is fighting cancer to have a conversation with about military aviator cancer," retired Air Force Col. Vince Alcazar, head of the committee, told Air Force Magazine.


Legacy Funeral Home

Navy Cmdr. Thomas "Boot" Burcham Hill, shown as a midshipman, died from esophageal cancer in October.

For months, Alcazar, a former F-15 pilot, and his fellow committee members worked with Hill, even as the former Tomcat pilot went "from 200 pounds down to 120 and just [faded] away." Yet despite his poor health, Hill's passion for the cause never waned.

"Here's Tom, he's going for chemo treatments, [saying] 'Hey, fellas, you know, I gotta knock off the Zoom call, my wife's driving me across town over here to the cancer center over here in Phoenix,'" Alcazar recalled.

On Oct. 15, 2021, former Navy Cmdr. Thomas Hill died peacefully, surrounded by his family. But the issue he championed isn't going away—indeed, the Air Force study he helped push for could be just the start of a sea change, advocates say.

INCREASED RATES

For years, Hill, Alcazar, and others said they noticed a distressing trend: fellow aviators contracting cancer at unusually high rates, many dying from the disease.

Within a few years of retiring, Alcazar said, he started to hear about cancer among his squadron mates. "I heard at the rate of one to two per year," he said. "Half of them died of cancer within two or three years."

Even relatively young pilots and crew members have been diagnosed at high rates, advocates say. It's what brought the issue to the attention of Tom Porter, executive vice president of government affairs at Iraq and Afghanistan Veterans of America.

"We generally hear a lot of input from service members on social media," Porter said. "We've probably got over 600,000 followers across our social media channels. That's how we reach most of our folks. … And we hear lots about toxic exposure. But also pilots—I mean, we've heard enough from those that were affected that it caused us to want to engage."

Nationwide, about 39.5 percent of American adults can expect to be diagnosed with some form of cancer during their lives, according to National Cancer Institute estimates. But even within that context, the trend among aviators stands out.

"Looking at some of the people that we've seen pass away, and also Air Force individuals who have died because of cancer … the rate of cancers in the Air Force period is astounding, astounding," said Chelsey Simoni, an Army veteran and clinical nurse researcher with the HunterSeven Foundation, which specializes in medical research and education for veterans.

In late 2019, an investigative series by journalist Tara Copp, then with McClatchy, found clusters of cancer cases across the country tied to Air Force and Navy aviation bases. Copp's articles brought the issue out of the shadows, but advocates lacked the data or medical expertise to be taken seriously by the research community.

"Medical professionals and nuclear science medicine professionals … would immediately discount them for the same sort of almost paternalistic, 'there, there,' kind of reaction," Alcazar said. "A lot of sermonizing about biases, and you don't know about epidemiological studies, or multi-cohort, or cross-longitudinal [studies]. 'None of you guys are practicing physicians, so you're not board certified, you can't talk. You're no one to be trusted. You're essentially a child running with scissors.'"

But the issue caught the ear of then-Air Force Chief of Staff Gen. David L. Goldfein and then-Surgeon General of the Air Force Lt. Gen. Dororthy A. Hogg. After speaking with members of the Red River Valley Fighter Pilots Association, Goldfein and Hogg authorized an official Air Force study of the issue.

USAF's School of Aerospace Medicine, under the Air Force Research Laboratory, studied fighter pilots and backseat aircrew from 1970 to 2004 who either had at least 100 hours in any seat of any fighter or "a Rated Distribution and Training Management code or a Major Weapon System code consistent with fighter aviation." They then compared those Airmen to other Air Force officers and the general U.S. population, adjusting for race, ethnicity, sex and age, using cancer rates pulled from Pentagon, Veterans Affairs, and National Cancer Institute databases.

In all, the medical records of nearly 35,000 aviators and roughly 316,000 officers were compared over that 34-year time frame. The results were grim:

Male fighter aviators were 29 percent more likely than other officers to be diagnosed with testicular cancer, 24 percent more likely to get melanoma skin cancer, and 23 percent more likely to have prostate cancer. When compared to the general population, those aviators were 25 percent more likely to get melanoma and 19 percent more likely to have prostate cancer, as well as 13 percent more likely to have non-Hodgkin lymphoma.

Airmen were also more likely to die from their cancers. While cancer mortality rates were similar between fighter aviators and other Air Force officers, Airmen were more likely to die than members of the general population as a result of melanoma skin cancer, non-Hodgkin lymphoma, and prostate cancer.

F-100 pilots were particularly afflicted. Researchers found that "male fighter aviators who flew the F-100 had greater odds of being diagnosed and dying from colon and rectum cancer, pancreas cancer, melanoma skin cancer, prostate cancer, and brain cancer" than aviators who never flew that aircraft. "They also had greater odds of dying from thyroid cancer and non-Hodgkin lymphoma, despite similar odds of diagnosis."

"The request by the RRVFPA was to specifically evaluate cancer incidence and mortality among fighter aviators," said Maj. Brian Huggins, chief of disease surveillance and research support in the Air Force Research Laboratory's 711th Human Performance Wing, in a statement to Air Force Magazine. "The

USAF

Men who flew F-100s were more likely to be diagnosed with melanomas and colon, rectal, pancreatic, prostate, and brain cancers than aviators who flew other aircraft, according to one Air Force study.

Cmdr. Ian Anderson/USN

A 2019 investigative report by McClatchy found clusters of cancer tied to Air Force and Navy air bases, including Naval Air Station China Lake, Calif.

RRVFPA also requested emphasis on Vietnam-Era airframes, as this represents a significant portion of their membership."

While the data in the study is neither complete nor comprehensive—the authors acknowledged they were missing birth data for some officers and that cancer diagnoses for some were likely missed—advocates say the study validated their concerns.

"No one was paying attention" before, Alcazar said. "It wasn't getting a warm reception, or it was not embraced." Now the issue is being taken more seriously, he said.

POSSIBLE CAUSES

Having identified that fighter aviators suffer statistically greater rates of certain cancers, the Air Force must now try to decipher what the cause may be. Researchers have highlighted six potential exposures associated with fighter aviation—galactic cosmic radiation, radium and other isotopes, ultraviolet radiation, radar radiation, jet fuel, and mechanical forces—as potential factors, but it has not measured or compared these exposures or measured other lifestyle or behavioral risks.

"We are therefore unable to draw any conclusions about possible causes for the increased rates identified in the study," Huggins said in a statement.

Theories, however, abound. Simoni pointed to studies that show jet fuel and jet fumes to be potentially toxic—as well as the Air Force's firefighting foam that had PFAS [polyfluoroalkyl substances]—chemicals linked to a variety of health problems.

"Those fumes alone, right? … Just being exposed to the fuels, you know, it seeps into your skin, into your blood," said Simoni. Future studies could expand the research to include ground and aircrew who are likewise exposed.

Alcazar and his committee are developing a hypothesis document, in consultation with medical experts, that will posit that higher cancer rates are the result of a combination of "not entirely understood, nor fully researched chronic occupational exposures to ionizing radiation (IoR) and non-ionizing radiation (NIoR)" along with "factors potentially unique to military operating environments."

The working hypothesis views non-ionizing radiation exposure as potentially "another causal path for DNA damage at the cellular level that elevates cancer risk."

Non-ionizing radiation includes "visible, infrared, and ultraviolet light; microwaves; radio waves; and radio frequency energy from cell phones," according to the National Cancer Institute, along with emissions from such technologies as radars and jamming equipment. There is little research data available about how much non-ionizing radiation such equipment emits, indicating the need for more study, the working hypothesis document states.

Alcazar is calling for "vertically designed studies cohorted over time that look at chemicals, agents, environmental causation factors in military operating environments, because military operating environments in Southeast Asia, Southwest Asia, Iraq, Afghanistan, … they're not all the same, they're not monolithic," he said.

ANOTHER STUDY COMING

Copp's investigative series also got the attention of Sen. Dianne Feinstein (D-Calif.), who represents Naval Air Weapons Station China Lake, where one of the cancer clusters was located. Her office got a provision into the 2021 National Defense Authorization Act, Section 750, which requires the Defense Department to conduct another study, similar to the Air Force's, to determine if aviators have a higher incidence of cancer. Instead of just fighter pilots, however, this study covers "any air crew member of fixed-wing aircraft and personnel supporting generation of the aircraft" across all the military services, and it must reach back to include anyone who served from Feb. 28, 1961, to the present.

The provision had bipartisan support from Sen. John Cornyn (R-Texas) and was backed by more than 30 veteran service organizations, many of them part of the Toxic Exposures in the American Military (TEAM) Coalition.

In November, Feinstein released a statement saying the results of the Air Force study "while limited in scope, are striking and provide further evidence of the need for a careful study and evaluation of all military flight and ground crews across all services to understand why so many are getting cancer and, importantly, how to prevent it."

An aide to Feinstein confirmed to Air Force Magazine that her office was aware of the study when the 2021 NDAA provision was being drafted, and a subsection in that provision

allows the overarching study to draw upon previous studies and data. Results of the study are expected in May. If the Secretary of Defense determines that there are higher rates of cancer among aviators, a second phase must be launched to identify carcinogens based on exposures, locations, operating environments, and other factors.

But even if the Pentagon doesn't reach that conclusion, advocates say they won't let the matter die. "We are fully, fully ready to go to Congress and … ask them to use public law to direct DOD to conduct nexus studies," Alcazar said.

END GAME

Exposure to toxins during military service has a long history, dating back to radiation exposure during nuclear tests in the 1950s, Agent Orange in the 1960s and '70s, oil fires in the first Gulf War, and burn pits in the Iraq and Afghanistan wars.

"I've been through all of the evolution of awareness. I've seen it all happen in real time," Porter said. "I've always known that toxic exposure and burn pits affect probably more veterans and service members than any other health impact. That's not scientific, that's just from hearing from people. … I mean, I got asthma. I was diagnosed when I got back from Afghanistan, but it hit my lungs as soon as I got there. I was on medications ever since week one of the year in Afghanistan. And I can't breathe normally without my medications."

Now it's time to focus on other factors related to aircraft, Alcazar said.

"We've got one study, and it's a very well-done study," said Alcazar. "This is a hinge moment in time. … And until we get more work done, we certainly can't go to Congress and ask for benefits for military aviators that are different than what they're getting today."

That, veteran advocates say, is the end goal—better care for veterans. Military aviation is a part of modern life; the issue isn't trying to stop it, but trying to understand what effects it might have and how to manage that.

"We're not on a campaign to kill aviation in the military. Nobody is going to stop raising their hands to go fly Hornets and F-35A models in the Air Force and F-15 Eagles and F-22 Raptors and KC-135s and B-2s and B-21s. No one's gonna stop doing that," Alcazar noted. "But what they want and what they will ask for is lifetime tracking. … Military health care providers will start mapping, talking to you about cancer. And if you get diagnosed, immediately we're going to rally around you and even if you separate or you retire, you've got tracking in the VA. People just want to be taken care of."

The issue, Simoni added, is primarily about preventative care; veterans are often unaware of their potential exposures, and hospitals often don't know or think to screen them for cancer until it has spread. "These younger people do not look like they meet the age requirements for someone who has cancer," she said. "And I say that as a healthcare provider myself. When somebody comes into my ER, I'm going to look at them, and that's going to be my first assessment: They're walking, talking, breathing and they look young. They're fit. What's the problem with this person?"

If doctors don't ask the right questions of someone complaining of back pain, the patient will just get a pain killer. No one wonders if they're a veteran and if they might have some other underlying issue that needs to be investigated. That's why the phase 2 study, if it's called for, would be directed to "determine the appropriate age to begin screening covered individuals for cancer."

Those so diagnosed should have access to "the best oncology care that is possible in America," Alcazar said.

To deal with things like Agent Orange exposure and the health issues that it causes, the Department of Veterans Affairs has a presumptive disabilities program under which the VA "presumes that certain disabilities were caused by military service," such as Agent Orange in Vietnam. There is currently legislation pending in Congress that would extend more presumptive benefits to Iraq and Afghanistan veterans who had toxic exposures. No moves have been made—so far, anyway—to offer presumptive benefits to aviators.

"Everyone needs to understand that these people [should not be] off in a hospital ward all by themselves, wondering how they got here," Alcazar said. No one should ask, "Who cares? Who will care for me?" ✪

Tech. Sgt. Joseph Swafford

Non-ionizing radiation includes "visible, infrared, and ultraviolet light; microwaves; radio waves; and radio frequency energy from cell phones," according to the National Cancer Institute, along with emissions from such technologies as radars and jamming equipment. There are many such emitters in fighter jets.

Welcome to the NEW Space Race

Growing threats raise the stakes for why the U.S. must prevail in this essential domain.

Joshua Conti/ USSF

A United Launch Alliance Atlas V rocket lifts off Dec. 7, 2021, from Space Launch Complex 41 at Cape Canaveral Space Force Station, Fla. The rocket propelled two Department of Defense Space Test Program satellites into space.

By Thomas "Tav" Taverney

Space today enables nearly every facet of society and is central to our way of life: From commerce to weather forecasting to global communications, society not only relies on space capabilities, but also expects those capabilities to be available on demand. Space enables everything from email and Internet service to global trade, scientific research, and national security, where it is essential to achieving U.S. goals and maintaining U.S. leadership.

The ideological and geopolitical struggle between the United States and the Soviet Union that followed World War II fueled a space race that began in the 1950s and stretched into the 1970s. Beginning with the successful launch of Sputnik on Oct. 4, 1957, that Cold War race was on. Both countries were battling for power, prestige, and control of the new "high ground." The nation that mastered getting to or operating in and through space would have a huge advantage.

From the beginning, the United States promoted the free and open use of space for the entire world, and organizations and policy approaches designed to support that view. The very goal of the "freedom of space," rather than "domination of space," was uniquely American.

Two key milestones in establishing this approach were the formation by the Air Force of the Western Development Division under Brig. Gen. Bernard A. Schriever in 1954, to drive the development of intercontinental ballistic missiles, and the establishment of the National Aeronautics and Space Administration (NASA) in 1958, led by Thomas Glennan, to develop scientific exploration of space. The U.S. also created organizations to develop overhead intelligence to better understand our adversaries so that war would not break out accidentally. Both the National Reconnaissance Office, led by Dr. Joseph Charyk, and the Central Intelligence Agency worked with industry to create amazingly complex and capable intelligence satellites. Yet Russia continued to lead the way in many areas, becoming the first to:

- Launch an ICBM;
- Put a satellite on orbit;
- Put a living animal in space;
- Put a man in space;
- Put a woman in space;
- Successfully launch interplanetary probes;
- Land a spacecraft on the moon—and also on Mars and Venus; and
- Put a manned space station on orbit.

Even so, the United States prevailed. It built superior rockets, missiles, satellites, and space-based intelligence assets, and on July 20, 1969, NASA won the public space race when Apollo 11 astronauts Neil Armstrong and Buzz Aldrin set foot on the Moon, achieving what only decades earlier had seemed an impossible dream. By winning those bragging rights, as well as the missile race and the overhead intelligence race, the United States set the foundation for the free and open use of space by all the nations of the world. Rather than becoming weaponized, space instead became a uniquely peaceful sanctuary, beyond what the Airman-poet John Gillespie Magee Jr. called "the surly bonds of Earth."

America's gift to the world enabled a nascent commercial space economy that has grown by leaps and bounds, especially in the past decade, and which now encompasses governments and independent companies representing some 80 nations who now have assets on orbit, enhancing the lives of everyone in the world.

Arguably, America's superiority in space and its heavy investment in space-based missile defense helped win the Cold War and bankrupt the Soviet Union. By 1989, the Berlin Wall had fallen and

within two years the Soviet flag had been lowered for the last time over the Kremlin in Moscow. Both the United States and Russia cut back on nuclear weapons spending and reduced their arsenals.

THE HONEYMOON PERIOD

With the dissolution of the Soviet empire, the U.S. became the world's sole superpower and the dominant player in outer space. It would hold that leading position through 2015, using the power of its example to ensure the free and open use of space. By successfully maintaining strict separation between scientific exploration, commercial exploitation and military space, the U.S. nurtured a flourishing international space industry in which competition fueled innovation.

Over the course of the past decade, however, both Russia and China have emerged as counterweights to the U.S. strategy to keep space peaceful and benign. While each has sought to gain parallel military capabilities to those the U.S. has demonstrated over this stretch of time, each has also demonstrated threats and actions that on an almost daily basis challenge the safety and security of the space operating environment. We are entering a new era and a new space race, one in which the very freedom to leverage space is at risk.

SPACE RACE 2.0

Space Race 2.0 started on Jan. 11, 2007, when China launched a ballistic missile from Xichang Space Launch Center. Its payload, a kinetic kill vehicle (KKV), collided with an inoperable Chinese weather satellite, the Fengyun-1C (FY-1C), 863 km (534 mi) above the Earth's surface, instantly destroying the satellite and creating a debris field that threatened every satellite in low-Earth orbit (LEO). Even now, 15 years later, more than 2,300 pieces of debris from that collision remain in space and must be tracked as threats. The launch and strike were condemned almost universally, and for the next 14 years no one else took a similar risk. That is, until Nov. 15, 2021, when Russia—testing its LUCH anti-satellite (ASAT) system—launched the weapon against a long defunct Tselina-D electronic signals intelligence (ELINT) satellite. The resulting cloud of at least 1,500 pieces of trackable debris—and many thousands more smaller objects—now circles the globe, threatening everything in its path.

These are just the best-known events. Other dangerous and provocative offensive counterspace demonstrations by both Russia and China came in between. In 2008, China's BanZing (BX-1) imaging satellite travelled within 45 kilometers of the International Space Station without providing prior notification. Because of the relative speeds of objects in orbit—the ISS flies at 4.76 miles/second, for example—that qualifies as a near miss. The combination of orbital speed and the latency of maneuver orders in space is such that a 45 kilometers distance could be closed in just three to six seconds. In 2010, after China launched its SJ-12 satellite, it maneuvered the asset and successfully bumped it into China's own SJ-6F satellite, demonstrating the ability to intentionally impact other satellites including those owned and operated by the United States. In 2013 China demonstrated the capability to grab and disrupt satellites, using its Tiangong robotic arm aboard a Chinese satellite.

In 2021, the Center for Strategic International Studies Aerospace Security project reported that: "Unlike most objects in the geostationary belt, [the Russian satellite] Luch (Olymp-K) made a series of orbital maneuvers after it reached its destination orbital regime, varying its position relative to the Earth and neighboring satellites and spurring several accusations of Russian misbehavior by other satellite operators."

From July 2017 to December 2020, the report noted, "Luch (Olymp-K) occupied at least 16 distinct orbital positions." Among those expressing concern about Luch (Olymp-K) over the past

Changing Course in GEO: Russia's Luch (Olymp-K)

Satellites in geosynchronous orbit (GEO) maintain their position above a single spot on Earth because they orbit the Earth at the same rate as the Earth's rotation. But Russia's Luch (Olymp-K) has changed its location frequently, at times appearing to surveil other satellites.

CSIS Aerospace Security

23 Orbital Changes

Between December 2014 and October 2020, Russia's Luch (Olymp-K) satellite changed its location 23 times.

1 December 2014	53.0 degrees East	**9 February 2018**	42.6 degrees East	**17 October 2019**	68.5 degrees East
2 February 2015	96.4 degrees East	**10 April 2018**	47.5 degrees East	**18 November 2019**	70.6 degrees East
3 September 2015	23.6 degrees West	**11 June 2018**	48.1 degrees East	**19 February 2020**	10.0 degrees East
4 January 2016	0.9 degrees West	**12 July 2018**	49.9 degrees East	**20 March 2020**	21.5 degrees East
5 August 2016	9.9 degrees East	**13 October 2018**	57.0 degrees East	**21 April 2020**	1.1 degrees West
6 July 2017	32.7 degrees East	**14 February 2019**	60.0 degrees East	**22 September 2020**	4.9 degrees West
7 October 2017	38.1 degrees East	**15 June 2019**	64.1 degrees East	**23 October 2020**	3.0 degrees West
8 January 2018	41.9 degrees East	**16 August 2019**	66.0 degrees East		

Dash Parham and Mike Tsukamoto/staff; European Space Agency

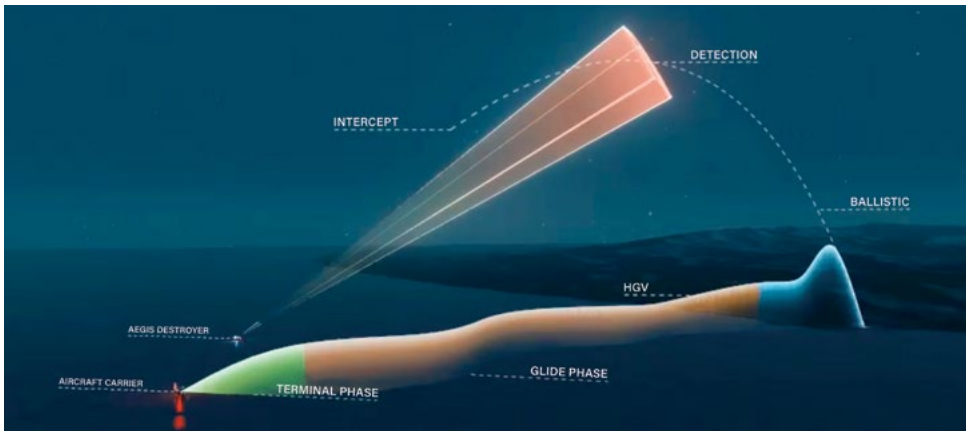
decade: France and Italy, which in 2014 accused Russia of maneuvering the satellite to spy on their Athena-Fidus military communication satellite, and Intelsat, the commercial communications satellite operator, which raised similar concerns in 2015.

In 2019, Russia deployed a small satellite into an orbit so close to a U.S. national security satellite that the U.S. government was unsure whether it was attacking or simply observing. The Russian satellite then backed away and conducted a weapons test, releasing a small target before shooting it with a projectile.

"There really are no norms of behavior in space," said Gen. John W. "Jay" Raymond, Chief of Space Operations, at a National Press Club event in March 2021. "It's the Wild, Wild West."

Missile Defense and Hypersonics

The Aegis missile defense system is designed to intercept ballistic missiles, which fly at a predictable trajectory. But hypersonic glide vehicles are faster and more maneuverable, flying lower and evading conventional defenses. Future space-based defenses are needed to rapidly identify and track hypersonic missiles to enable defensive countermeasures.



MDA

The United States has long known and long recognized that access to and freedom to maneuver in space is a vital national—and indeed global—interest," he said. "It underpins our national security, it underpins our intelligence efforts, it underpins our treaty verification, it underpins our economy, and it underpins every instrument of national power. The challenge is that the access to space and the freedom to maneuver in space can no longer be treated as a given. There are threats that exist today. … With high relative velocities, even a tiny fragment can cause significant damage should it collide with another spacecraft, especially vulnerable commercial spacecraft."

The establishment of U.S. Space Command and the U.S. Space Force in 2019 demonstrates recognition that the current space environment needed a coherent response to ensure space remains a free and open environment enabling all to enjoy the economic and social benefits. The mission of the U.S. Space Force is to deter conflict in space and avoid a costly conflict that could have worldwide implications. The world has changed and external threats have emerged that drive a need for the U.S. to respond. Space is becoming a dangerous place in which to operate—not just for us, but for the commercial and civil markets across the world.

Gen. David D. Thompson, USSF Vice Chief of Space Operations, makes this clear: "The threats are really growing and expanding every single day. And it's really an evolution of activity that's been happening for a long time, we're really at a point now where there's a whole host of ways that our space systems can be threatened. Both China and Russia are regularly attacking U.S. satellites with nonkinetic means, including lasers, radio frequency jammers, and cyberattacks"

Most reasonable people wish weaponizing space never occurred, but Russia and China have already passed that threshold, demonstrating offensive space capabilities with the stated and demonstrated intent to use those capabilities. Additionally, they are both building hypersonic weapons systems to put our nation and our people at risk. The truth is that our adversaries now pose a clear and present threat to our national security, making the case for a strong defensive posture in space.

SPACE RACE 2.1

Speaking at the Halifax International Security Forum in November 2021, Thompson acknowledged that in some ways—as it did in the 1950s and 1960s—the United States has again fallen behind. "We're not as advanced as the Chinese or the Russians in terms of hypersonic programs," Thompson said.

New advanced threats include hypersonic cruise missiles (HCMs) and hypersonic glide vehicles (HGVs), which place a maneuverable projectile atop a ballistic missile or rocket booster, and can be utilized as a fractional orbital bombardment system. This could also take multiple orbits becoming the world's worst nightmare—offensive weapons in space.

HCMs travel about six times faster than conventional cruise missiles, powered by supersonic combustion ramjets, or scramjets, a technology first conceived in the late 1950s but not fully demonstrated until 2013.

HGVs resemble ballistic missiles, but fly at lower altitudes and are more maneuverable, making them far less predictable. HGVs do not require any new engine technology development, instead they leverage conventional rockets to gain speed, then bleed off in an unpowered glide. In addition to being able to be used like a standard strategic or tactical missile, HGVs can launch from mobile platforms, ships, submarines and aircraft. They also can also go into space, go into orbit, then re-enter the atmosphere to release the kinetic energy gained in orbit while maneuvering to the target at immense speed on unpredictable trajectories deep into the Earth's clutter.

Both HCM and HGV weapons are maneuverable and operate below the classical ballistic missile trajectory and above typical low-speed cruise missile operating altitudes. They are difficult to detect both from the ground, because of limited viewing angle, and from space because of background clutter caused by reflections from other objects on the ground; in effect, they can hide as if in fog. They maintain significant maneuverability with precision even in the terminal phase, putting even moving targets at risk. For example, consider a Navy ship underway. If the ship can detect such a missile at 100 miles, it would have only about a minute to change its course before it hits. An Aegis weapon system requires eight to 10 seconds to intercept an incoming threat, enough time for a hypersonic missile to travel 15 to 20 miles.

Both HVMs and HGVs can carry conventional or nuclear weapons, further complicating strategic decision-making and operational identification, response, and engagement. In addition to nuclear and conventional warheads, hypersonic missiles can also carry Electro Magnetic Pulse (EMP) weapons. Both Russia and China already possess EMP capabilities, which could be

launched on a hypersonic glide vehicle. EMP could be used in conjunction with cyberattacks early in a conflict to try to destroy information and communication systems. While there are known active protection measures, they are not currently deployed across the U.S., which leaves vulnerable civilian systems such as electric grids, telecom networks, transportation systems, water and sewer services, and other critical infrastructure.

Finally, Hypersonic threats encompass intercontinental- range, medium-range, and short-range/tactical missile threats. Both HCM and HGV weapons can be ground based, mobile launcher based, ship based, or air based, resulting in short flight that adds to their complexity.

To protect and defend against such threats the U.S. must be able to find, fix, track, and then intercept incoming threats. Hypersonic threats have four features that make them challenging.

1. They are very fast, which makes them very difficult to intercept prior to almost being on the target.

2. They rapidly enter the atmosphere in an area of high clutter, making them difficult to find and fix.

3. They maneuver, which makes it very challenging to fix and track.

4. They are virtually invisible to radar. Hypersonic weapons fly so fast that the air pressure in front forms a plasma cloud as it moves absorbing radio waves, making it virtually invisible to radar.

Russia has conducted research on hypersonic weapons technology since the 1980s and became more serious in 2001. Today, Russia is pursuing multiple hypersonic weapons programs, including the Avangard (a hypersonic glide vehicle), the Tsirkon (a ship-launched hypersonic cruise missile), and the Kinzhal ("Dagger"), a maneuvering air-launched ballistic missile that is reportedly already fielded.

China has conducted flight-tests of an HGV and some analysts believe it may be planning to mate conventionally armed HGVs with its DF-21 and DF-26 ballistic missiles in support of an anti-access/area-denial strategy. They have already conducted several successful tests of the DF-17, a medium-range ballistic missile specifically designed to launch HGVs and threaten the U.S. fleet. The DF-41 intercontinental ballistic missile, which was tested could be modified to carry a conventional or nuclear HGV, and the highly maneuverable DF-ZF HGV (previously referred to as the WU-14) at least nine times since 2014. China has also tested the Starry Sky-2 (or Xing Kong2), a nuclear-capable hypersonic vehicle prototype—a "wave rider" that uses powered flight after launch and derives lift from its own shockwaves. Finally, in August 2021, China tested a nuclear-capable HGV-Fractional Orbital Bombardment System (FOBS), which could provide the People's Republic Army with a space-based global strike capability, further reducing warning time prior to a strike.

CONCLUSION

"Today, we are at war every day in space," wrote former Rep. Robert S. Walker, who once chaired the House Science, Space and Technology Committee and the President's Commission on the Future of the United States Aerospace Industry. In an article published in May 2019, months before the Space Force was established, he continued: "We have satellites chasing satellites. We have adversaries developing and deploying offensive and defensive space weapons. Our $19 trillion economy is at grave risk that a space attack could significantly cripple us. Today, the potential of a space attack is as dangerous to us as a nation as the threat of a nuclear attack was in the 20th century. And we now have the USSF on the JCS with a focus of looking at and responding to these very real threats, every second of every day."

The Chinese and Russians have been both provocative and sometimes reckless in their development and demonstration of offensive space capabilities. The demonstrated capabilities now range from direct ascent to co-orbital systems and ground-based lasers, weapons that can produce both reversible and permanent effects. They threaten both national security assets in space, as well as civil and commercial space systems. Having demonstrated their hypersonic attack capabilities, Russia openly brags that the U.S. has no response.

In the first space race the ability to escalate was minimal, focusing only on the numbers of nuclear missiles fired. The biggest inhibitor to their use was the catastrophic nature of that step. Any use of nuclear forces pointed toward Mutually Assured Destruction, an untenable choice for either party. In the Space Race 2.0, however, there appear to be options for a more gradual escalation, which suggests a greater likelihood of miscalculations leading to a disastrous ending. Because escalation actions are not catastrophic, they are inherently more likely to occur.

The risk of a space Pearl Harbor—in which an adversary launches an unprovoked, unpredicted surprise attack on U.S. space assets—is growing every day. Such a war would not last years, but rather would be over the day it started. Without satellites to guide our weapons and our warriors, to communicate globally and to gather intelligence, the U.S. would be hard-pressed to fight back. Indeed, America might not even know who attacked, only that it was suddenly deaf, dumb, blind, and impotent. Then-Defense Secretary Donald H. Rumsfeld warned of such a threat in 2001, but the Defense Department did little since to reduce this existential risk. The 2008 Allard Report warned that "no one is in charge" of U.S. space strategy.

The December 2019 establishment of the U.S. Space Force, to join US Space Command, was a crucial step in reconciling this shortfall. Since then, DOD's dependence on space has only grown, as has commercial space systems that depend on the free and open use of the space regime.

America and, indeed, the free world, cannot afford to lose that freedom. As Raymond said in June, "We cannot afford to lose space. Both China and Russia are developing space capabilities of their own, narrowing the gap with the U.S. in this area. At the same time, these countries are developing weapons systems that could target U.S. satellites. We have long understood that our nation is stronger—economically, diplomatically, and militarily—when we have access to and freedom to maneuver in space. America's predominant position in space might come under threat from more aggressive rivals. For three decades, we have been able to take that access and that freedom for granted. Unfortunately ... this is no longer the case."

The Space Force and U.S. Space Command were formed just in time. The risks of adversaries moving from demonstrations to action, from Cold War to hot war, are increasingly possible. The world needs the U.S. to be the world leader in space, to preserve their freedom to build and prosper in that domain. To achieve that, the U.S. must prevail in this new "Space Race." This "Space Race" is every bit as crucial as was the first "Space Race." It must have resilient, lean, and agile Space capabilities which can absorb losses without loss of capability. It must have the ability to rapidly and affordably reconstitute space capabilities. And these systems must be acquired inside the acquisition speed of our allies, to deter conflict and, if necessary, to fight and win in the heavens. ✪

Maj. Gen. Thomas "Tav" Taverney, USAF (Ret.) *is a former vice commander of Air Force Space Command. His last article for Air Force Magazine appeared in the December 2020 issue.*

Crisis in the Fighter Force

USAF is ill-prepared to absorb combat losses in a peer fight.

Tech Sgt. Nestor Cruz

The F-35A will be the backbone of the USAF fighter force for years to come, but the Air Force is not acquiring new Lightning IIs as fast as it is retiring legacy aircraft.

By David A. Deptula and **Heather Penney**

The U.S. Air Force fighter force is in crisis. Three decades of canceled, curtailed, and delayed investment in aircraft modernization has left the nation with far too few advanced fighters to meet demand. The Fiscal 2023 budget will be submitted to Congress in February 2022, and all indications are that the fighter crisis will only deepen.

Most of Air Force's fighters—F-15C/Ds, F-15Es, F-16C/Ds, and A-10Cs—were designed in the late 1960s and early '70s and acquired in the 1980s. They were flown hard in multiple wars. Today, they are structurally fatigued and technologically obsolete compared to advanced Chinese and Russian air defenses and next-generation fighters. Yet the nation has not allocated the necessary funds to replace its aging fighters with more capable aircraft, and certainly not in the numbers that are needed.

Despite dramatic cuts to the Air Force in the face of known operational demand, defense leaders continue to promote the idea that the introduction of advanced capabilities can enable and/or justify an even smaller force structure. While that concept once had merit, the truth is those force structure cuts happened decades ago. Today's small fleet dynamics fail to meet peacetime demand, let alone the reality that in peer combat, additional fighters are needed to absorb and compensate for losses over time. This dynamic also results in running down air and ground crews, exacerbating morale and retention issues.

We are rapidly approaching the point in time that, no matter how capable it may be, the Air Force will be too small to meet our national security commitments. How did we get here? For 27 years in a row, the Department of Defense has invested less in its Department of the Air Force than in the Departments of the Army or Navy. Since 9/11, in fact, the nation has invested more than $1 trillion more in our Army than our Air Force—an average of more than $53 billion a year. It is time to rebalance the DOD budget to recapitalize and grow our nation's Air Force.

Lt. Gen. David Deptula, *USAF (Ret.), is the Dean of AFA's Mitchell Institute for Aerospace Studies and* ***Heather Penney*** *is a senior fellow. This article is adapted from a study, "The Future Fighter Force Our Nation Requires." You can download the full report at www.MitchellAerospacePower.org.*

WHY AIR FORCE FIGHTERS MATTER

When addressing U.S. military fighter force structure issues, it is very important to understand first principals. The United States possesses only one air force—USAF—whose purpose is to organize, train, and equip forces to exploit the third dimension to achieve U.S. security objectives directly or in conjunction with other service components. The Army, Navy and Marine Corps possess air arms that exist to support their core competencies in their respective domains—land, sea, and the littorals. Navy and Marine Corps fighters are doctrinally dedicated to supporting their service mission-sets first. They do not exist to execute a broader theater-wide air campaign. While naval aircraft can and have supported theater-wide campaigns, the re-emergence of potential naval conflict will likely refocus these fighters on naval defense and other sea-focused operations. Similarly, the purpose of Marine Corps fighters is to provide close air support to Marines on the ground. Marine combat air power is scaled to support Marine operations.

Accordingly, fighter aircraft from each of the services are not equivalent. This is true whether comparing effects realized, mission availability, or functions executed to fulfill combatant command requirements. Marine aircraft force structure exists to support Marine Air-Ground Task Forces and most Navy aircraft are associated with carrier strike groups, which dramatically limits their availability to meet combatant command requests, given their deployment cycles and associated tiered readiness. Air Force squadrons, therefore, are the only aviation units that deploy primarily to fill combatant command requirements. Their rotational structure also means they are available for front line operations for a far greater percentage of their lives. Because Air Force aircraft carry the predominant operational load for joint operations, modernizing the USAF fighter force is crucial to all joint force operations. Other service contributions are helpful, but additive, not core.

Analysts and leaders inside the Office of the Secretary of Defense (OSD), the General Accountability Office, and Congress err, therefore, when they view all fighter aircraft as interchangeable to meet national defense and contingency requirements. This erroneous assumption happens all too often, however; thus, false assumptions yield high-risk conclusions.

Only the Air Force is designed to deliver fighter aircraft in the volume, readiness, and availability necessary to execute theater-wide combat operations at scale. Over 20 years of land-dominated operations, DOD accepted growing risk by not fully funding Air Force modernization. Now the bill is due: The Air Force fighter force is too old and too small to meet the challenges posed by potential peer conflict. Gapping the Air Force's fighter inventory even further over the next decade, as has been proposed, places the entire joint force at risk.

A FIGHTER FORCE UNDER STRESS

The Air Force's fighter force is now insufficient to match, much less dominate, the global threats challenging U.S. security interests. The service has supported over three decades of continuous combat operations with an aircraft inventory predominantly procured before most of its pilots were born. These legacy aircraft are stressed to their extremes every time they fly. That wear and tear adds up and takes its toll. Eventually, physics wins. Already, the F-15C fleet is prohibited from flying at maximum airspeed and G-loading due to airframe fatigue.

Another exacerbating factor is a smaller number of aircraft carrying a larger mission load. Defense cuts in the 1990s culled 40 percent of the Air Force's fighter inventory, leaving fewer aircraft and aircrews to meet an unsustainably high operational tempo. Remaining fighters flew continuously for over a decade, including Operations Northern and Southern Watch missions over Iraq, wars over Bosnia and Kosovo, and ultimately over Iraq, Afghanistan, Libya, and Syria in the post-9/11 period. At the same time, leaders cut the Air Force's total inventory another 20 percent—even in the face of higher demand for air power. As a result, over 80 percent of today's USAF fighter fleet is flying beyond its design service life.

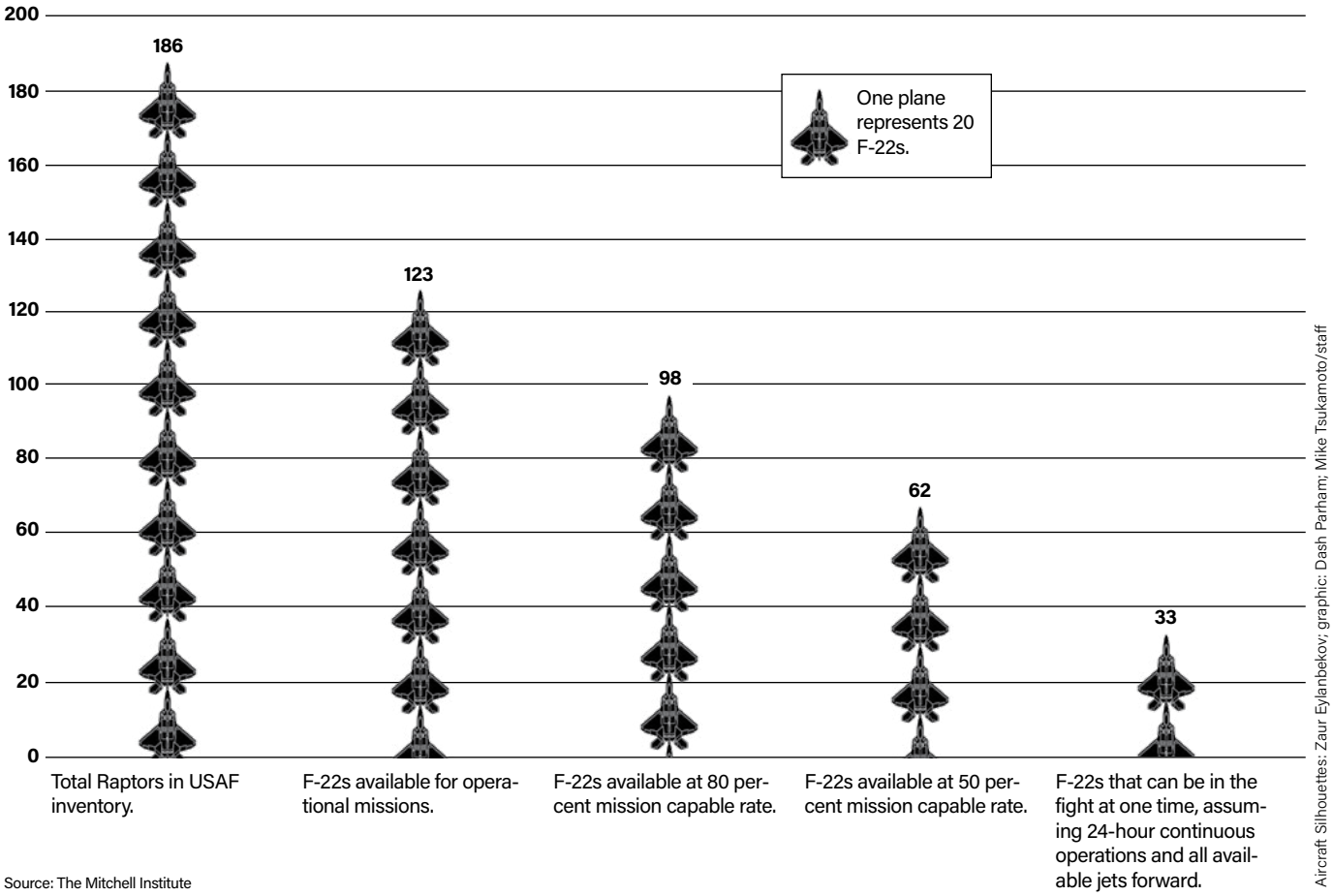
Aged aircraft drive up weapon system sustainment costs, like old cars whose maintenance bills and service calls continue to grow with time. Breaking this cycle by procuring new aircraft is crucial, but without the budget bandwidth to both sustain the legacy fleet and develop and buy new aircraft, Air Force leaders must seek to retire older aircraft to free up budget space to acquire "peer-capable" aircraft. Yet because it takes multiple aircraft divestitures to generate the savings to pay for just one new aircraft, the Air Force is unable to replace its fighters on a one-for-one rate. Thus, the number of jets on the ramp gets smaller and smaller. This fuels the downward spiral where remaining aircraft and crews are pushed even harder, so that the aircraft that remain fly more, break more, and ultimately cost more to sustain.

Tech Sgt. Nestor Cruz

Today's fighter force is led by the fifth-generation, low-observable F-35A (left), but the bulk of the force remains fourth-generation aircraft, including F-16s, F-15s, and A-10s. Those aircraft are highly vulnerable to modern Chinese and Russian air defenses.

Inventory vs. Availability

The Air Force has 186 F-22 Raptors in its inventory, but training, testing, and availability mean far fewer are available at any given time.



Source: The Mitchell Institute

Aircraft Silhouettes: Zaur Eylanbekov; graphic: Dash Parham; Mike Tsukamoto/staff

Consider that the Air Force today has only five squadrons of F-22s, which are shared by five Active-duty and five associated Air National Guard and Air Force Reserve units. Using Air Force data and considering those F-22s assigned for primary training, development, and backup aircraft inventory, only about 123 F-22s make up the primary mission aircraft inventory. Factor in 50 percent mission capable rates, the current norm for the F-22, and that leaves just 62 mission capable F-22s on any given day. Of course, a surge with adequate preparation could certainly increase this number; so, if mission capable rates increase to 80 percent, available F-22s increase to 98 mission capable aircraft available. If mission planning assumes 1/3 of the available airframes are in the fight; 1/3 preparing to launch or enroute; and 1/3 recovering, refueling and rearming, then 33 F-22s can be in a fight at any one time—using the entire USAF F-22 inventory. This simple analysis does not even include the impact of combat losses and battle damage.

When it comes to facing advanced threats and peer adversaries that are growing in both capability and capacity, the U.S. Air Force fighter inventory is woefully undersized and increasingly at risk of defeat in high-intensity conflict.

RISK IN THE NEAR-TERM

America finds itself in a period of growing international tension, with rising concern over territorial aggression from both Russia and China. Having extricated itself from combat operations in Afghanistan and Iraq, the U.S. faces a world where perceived U.S. weakness appears to have incentivized adversaries to push the bounds of acceptable global behavior. Russian activity on the borders of Ukraine and China's stepped up military "combat drills" around Taiwan both raise alarms.

U.S. global leadership depends on credible military strength, especially the asymmetric advantage afforded by superior American air power. Without the capacity and capability to project strength and counter multiple threats simultaneously, adversaries could engage in opportunistic aggression. Without a capable USAF fighter force to back up U.S. diplomacy, forward deterrence, and joint military operations, the U.S. has fewer options to rapidly respond to aggression, altering global norms and enforcement of the rule of law.

THE NEED FOR A PLANNING FORCE

Responding to threats in a credible, sustainable fashion demands an honest recognition of actual mission demand. The 2018 National Defense Strategy focused on these sorts of threats, but three decades of delayed investment cannot be undone in an instant. Investments that should have been paced over time must now be surged. Indeed, in its quest to free up funds for future buys, the Air Force is on course to shrink its fighter inventory through the 2020s and early 2030s; plans call for retiring 421 fighters through 2026, while only acquiring 304. Divestments will continue to exceed procurement through the end of the decade.

Solutions to these problems are illusive because it is budget shortfalls, not mission requirements, that are driving DOD decision making. Air Force officials say they would need to procure 72 new aircraft per year to replace existing inventory; if the refresh cycle was 20 years, rather than 30 or more, that rises to

97 fighters, just to sustain the legislated minimum fighter force of 1,950 fighter aircraft. Even this rate will fall short, however, if ongoing strategic competition requires more growth. Current funding affords only about 60 fighters per year—too few to meet the demands of the national defense strategy. While Air Force plans for fiscal 2023 are not yet public, it is clear budget pressure risks eroding these totals even more.

The divide between real-world requirements and budget allocations represents the differences between a "planning force"—defined as the requisite capacity and capabilities the Air Force needs to fulfill the National Defense Strategy at a reasonable level of risk—and the programmed force—defined as the assets for which the service is actually funded. The gap between the planning force and the programmed force represents risk. In the past, budget documents conveyed this risk to Congress and the American public, but that practice was terminated in the late 1990s. It is time to resume this practice. Problems cannot be solved unless they are acknowledged and quantified. Just because the service cannot afford to meet a requirement does not invalidate the existence of the requirement. Congress deserves to understand the risks their budgets are causing.

USAF presently lacks the capacity to fulfill the full range of combatant commander demands, and pressures are not likely to ease in future years. Meanwhile, investment in Air Force fighter procurement faces competition from other near-term, high-cost requirements: nuclear command, control, and communications systems; the Ground-Based Strategic Deterrent to replace USAF's 400 Minuteman III nuclear missiles; the KC-46 aerial refueling tanker; the B-21 bomber; the MH-139 nuclear missile security and airlift helicopter; the Next Generation Air Dominance (NGAD) fighter; the T-7 trainer, the Advanced Battle Management System enterprise, AWACS replacement, next-generation unmanned aerial vehicle acquisition, and more. Every one of these programs is essential.

Today's Air Force budget is too small to keep even today's undersized fighter force inventory. Instead of cannibalizing the fighter force to accommodate budget constraints, Air Force plans and force structure should be based on—and resourced to—strategy and threats.

INADEQUATE BUDGET

A key factor driving this shortfall is that the Air Force does not have as much actual budget authority—real buying power—as generally believed.

Approximately 20 percent of the Air Force's budget is "pass-through" funding—money that literally passes through Air Force accounts, but that funds national security programs the Air Force neither controls nor influences. In the Air Force's fiscal 2020 budget, over 40 percent of procurement funds were pass-through, an impact of more than $22 billion dollars. Collectively, over the past 30 years, such pass-through funds amounted to $932 billion.

With an insufficient budget topline, the Air Force is now driven to cannibalize its fighter force in order to free up funds to recapitalize that geriatric force. Infrastructure, end strength, and personnel benefits are untouchable accounts, the Space Force is an underfunded mandate, and pass-through accounting further diminishes the Air Force's real buying power. Other priorities are rightfully considered "no-fail," like the nuclear enterprise: replacing the 1960s-era Minuteman III ICBM and the nation's archaic nuclear command and control enterprise, the B-21 bomber, NGAD, and KC-46 aerial refueling tanker are other strategic imperatives that must be protected for the future. That leaves the fighter procurement portfolio as one of the only places left for the Air Force to make trade-offs for modernization funds.

FY23 BUDGET CHALLENGES

The Air Force therefore faces impossible choices as very nearly all Air Force core mission capabilities must be reset. There is simply not enough budget to sustain the old, buy the new, and invest in the future. The Fiscal '23 Program Budget Review (PBR) will be a key indicator as to how seriously the Pentagon takes the Air Force's fiscal crisis—and its consequences. Questions that should inform the FY23 PBR:

■ **Is the Air Force aggressively replacing legacy aircraft at a one-for-one rate, targeting whole fleets for retirement?** The service has long sought to retire legacy platforms but has not matched procurement to its divestment rate. Congress has mandated that the Air Force maintain a floor of 1,950 fighter aircraft. Fighter procurement should, at a minimum, replace retiring fighters at a one-for-one rate to prevent the force from shrinking any further. Allowing Air Force fighter divestments to outpace procurement is a strong indicator that OSD is continuing to under-resource the Air Force enterprise.

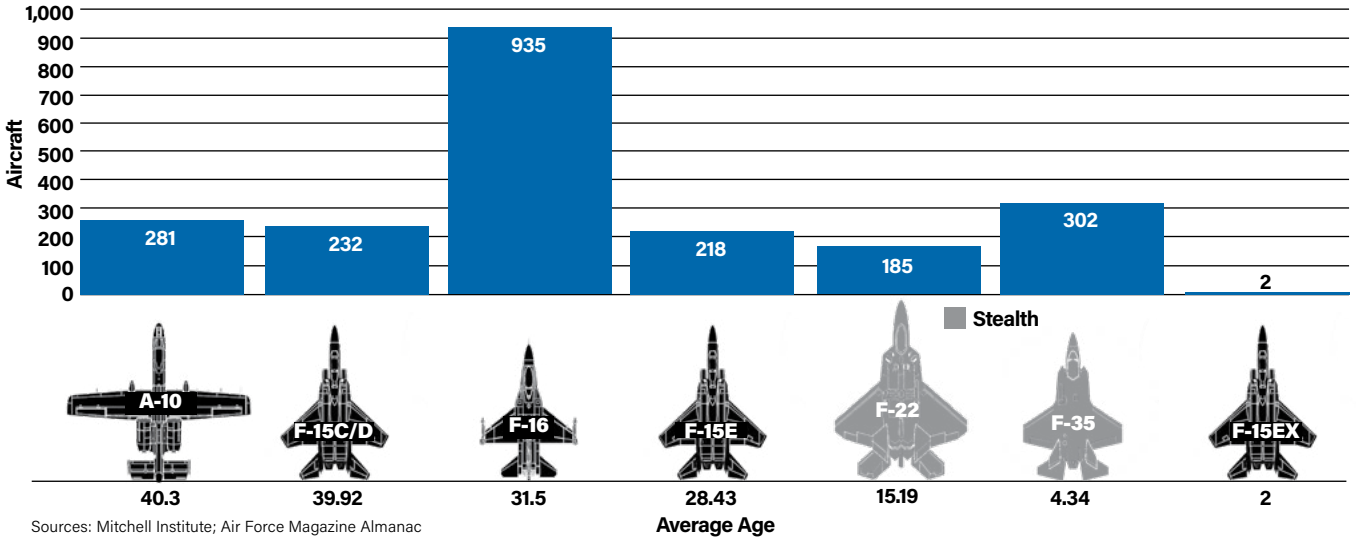
■ **Is the Air Force procuring F-35s at meaningful and**

Staff Sgt. Sarah M. McClanahan/ANG

The Air Force has long sought to retire its A-10 Thunderbolts in order to free up funds to buy and develop new systems. But lawmakers in Congress, fearing the loss of jobs on bases in their districts, have balked.

USAF's Magnificent Seven Fighter Jets

Average age and inventory of USAF's fighter fleet.



Sources: Mitchell Institute; Air Force Magazine Almanac

Aircraft Silhouettes: Zaur Eylanbekov; graphic: Dash Parham/staff

economic rates? The fewer aircraft the Air Force buys, the more expensive each aircraft gets, as fixed overhead costs must be spread across fewer jets, which causes the service to decrease buy rates, further driving up costs. This is known in the defense community as the "death spiral," and was a contributing factor in the premature termination of the F-22. Now DOD is on the verge of inducing the death spiral on the F-35, dropping procurement from 62 USAF aircraft in '21 to 49 in fiscal '22, and possibly fewer in '23. While the other services, partners, and foreign military sales (FMS) can mitigate this effect, the Air Force cannot rely on those orders to keep the F-35A line healthy for the long run. The Air Force must accelerate F-35 production to credibly hedge risk in the next decade. Given the number of competing Air Force modernization efforts, steady F-35A buys year after year are the only way to realistically accrue mass. Budget room will not exist throughout the rest of the 2020s and 2030s to spike production.

■ **What is the optimum way to fill the USAF fighter force bathtub of the 2020s?** In 2026 the USAF fighter force structure is projected to reach an all-time low. Part of the solution to correct that deficiency may be to accelerate available production lines, which realistically includes the F-35 and F-15EX. However, that takes money. When OSD imposed the F-15EX decision on the Air Force, it committed to providing additive funding for the F-15EX to the Air Force's topline. That funding commitment eroded, however, leaving the Air Force trying to fund two production lines from a budget originally planned for one. Evidence of insufficient resourcing is that F-35 production volume declines as F-15EX numbers increase. When the Air Force committed to the F-15EX, then-Chief of Staff Gen. David Goldfein stipulated that it must not come at the expense of F-35 production. Without additional budget from OSD, the risk of a death spiral for both the F-35 and the F-15EX grows, as does pressure to raid money from important future development efforts, like the Next Generation Air Dominance (NGAD) program. None of these options are acceptable.

■ **Does RDT&E funding exceed procurement accounts?** In 2022, the Air Force requested $28.8B for its research, development, test, and engineering accounts compared to just $22.9B for procurement. Investing in the future is crucial to maintaining the competitive edge our warfighters need and deserve, but given the Air Force recapitalization crisis, it cannot afford to neglect immediate fighter requirements. The 2020s were long planned to be the decade to reset geriatric aircraft inventories; modernization cannot be punted again. The ratio between RDT&E and procurement must be balanced to deliver capability now. Transitioning technology into programs of record has long been a challenge for the Air Force, and over-prioritizing RDT&E now at the expense of procurement poses the real danger of continuing the service's modernization crisis.

■ **Should more attention be focused on the Air Force strategy-resource mismatch?** All military members are required to support the President's budget, but service leaders also have an obligation to provide their best professional military advice to Congress. Air Force leaders have steadfastly supported budgets issued to them for the past 20 years. It is time now to be candid about the state of the Air Force.

Previous decisions to skip a generation of technology may have appeared visionary at the time, but ultimately widened the Air Force's capability and capacity gaps. Cancelßing or even slowing present fighter production to chase future generations of unproven and immature technology is not prudent. Cannibalizing the force is a budget strategy that risks seeing legacy fighters run out of life before sixth-generation aircraft can replace them. This approach also assumes that developmental programs will miraculously meet schedule, performance, and budget targets better than current production—a dubious hope that invites failure.

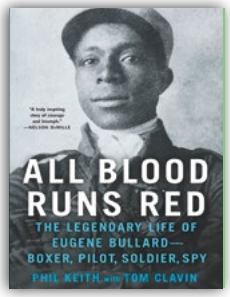
CONCLUSION

Current Air Force plans risk gapping America's fighter capability and capacity until the late 2030s. Assuming this near- to mid-term risk presents a window of opportunity to rivals and may incentivize opportunistic adversary behavior, potentially inviting outright peer conflict. The Air Force is assuming great risk because it lacks the resources to do otherwise. DOD must resource the Air Force so that it can procure a fighter force that can credibly bridge to the future.

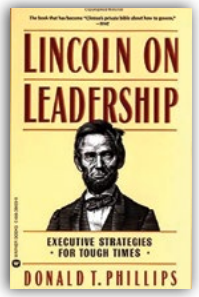
Past generations of Air Force leaders deferred to OSD leadership, which neglected crucial opportunities to modernize the Air Force fighter force. "Kicking the can down the road" again today risks irreparable harm to America's ability to fight and win. As former Air Combat Command Commander, retired Gen. John D. W. Corley, recently remarked, "If it's always about 'program next,' you'll never have a program at all." ✪

CSAF READING LIST

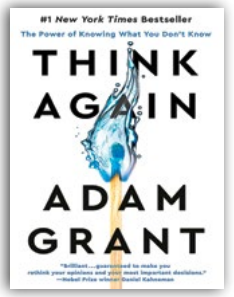
Gen. Ronald R. Fogleman created the CSAF Professional Reading Program in 1996 to develop a common frame of reference among Airmen, including officers, the enlisted force, and civilians. Each Air Force Chief of Staff since then has enhanced and continued the reading program. Featuring books, podcasts, documentaries, movies, and more, this list is added to on a regular basis and can be found at https://www.af.mil/About-Us/CSAF-Leadership-Library.



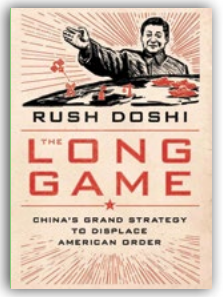
All Blood Runs Red: The Legendary Life of Eugene Bullard—Boxer, Pilot, Soldier, Spy
by Phil Keith, Tom Clavin
A thought-provoking chronicle of the 20th century and a portrait of a man who came from nothing and by courage, determination, gumption, intelligence and luck forged a legendary life.



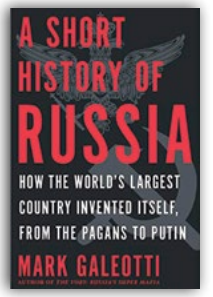
Lincoln on Leadership: Executive Strategies for Tough Times
by Donald T. Phillips
The first book to examine Abraham Lincoln's diverse leadership abilities and how they can be applied to today's complex world.



Think Again
by Adam Grant
We don't have to believe everything we think or internalize everything we feel. An invitation to let go of views that are no longer serving us well and prize mental flexibility, humility, and curiosity over foolish consistency.



The Long Game
by Rush Doshi
What does China want, does it have a grand strategy to achieve it, and what should the U.S. do about it? An analysis of China's conduct, to provide a history of China's grand strategy since the end of the Cold War.



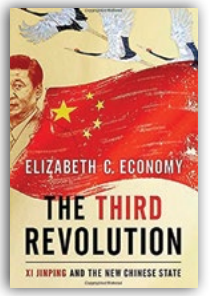
A Short History of Russia: How the World's Largest Country Invented Itself, from the Pagans to Putin
by Mark Galeotti
Russian history through two intertwined issues: influences from beyond its borders and how Russians came to terms with this influence, writing and rewriting their past to understand their present and future.

Message From the Chief

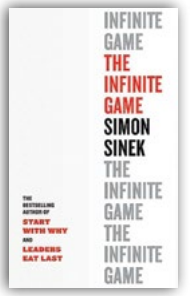
Welcome to the CSAF Leadership Library. This is a new way of looking at the traditional reading list—a fluid set of media that I have personally explored—that changes and evolves as novel ideas are published, recorded, and debated. The Leadership Library will have periodic additions as I come across media and ideas I'd like to share to generate dialogue. My aim is that this Leadership Library sparks conversations for you with fellow Airmen, with your family, and with your friends.

Charles Q. Brown Jr.
General, USAF
Chief of Staff

Trey Ward/USAF



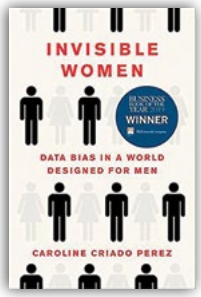
The Third Revolution: Xi Jinping and the New Chinese State
by Elizabeth C. Economy
A look at the transformative changes underway in China today. A wide-ranging exploration of Xi Jinping's top political, economic, and foreign policy priorities.



The Infinite Game
by Simon Sinek
Leaders who embrace an infinite mindset, in stark contrast, build stronger, more innovative, more inspiring organizations. They have the resilience to thrive in an ever-changing world, while their competitors fall by the wayside.

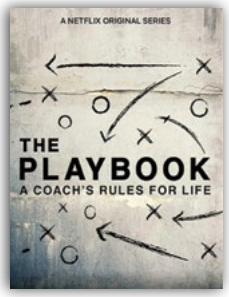
CMSAF READING

Documentary

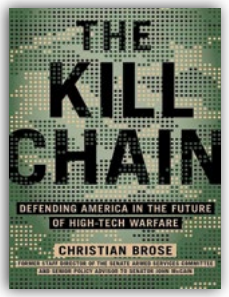


Invisible Women: Data Bias in a World Designed for Men
by Caroline Criado Perez
Built on hundreds of studies in the U.S., the U.K., and around the world, this is a groundbreaking, unforgettable exposé that will change the way you look at the world.

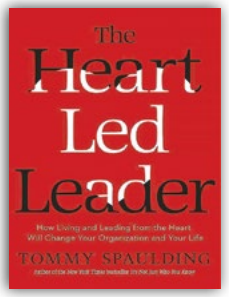
Red Tail Angels: The Story & Legacy of the Tuskegee Airmen
Produced by Air Force Television Pentagon
A three-part documentary series on the formation, early years, contributions, and legacy of the Tuskegee Airmen. Featuring interviews with historians, pilots, and many of the Tuskegee Airmen.



The Playbook: A Coach's Rules for Life
A Netflix original series
Profiles of legendary coaches as they share the rules they live by to achieve success in sports and in life.



The Kill Chain: Defending America in the Future of High-Tech Warfare
by Christian Brose
America's traditional sources of power are eroding amid the emergence of new technologies and the growing military threat posed by rivals such as China. America is at grave risk of losing a future war.



The Heart-Led Leader: How Living and Leading from the Heart Will Change your Organization and Your Life
by Tommy Spaulding
Authentic leaders, Spaulding says, live and lead from the heart. To effect true transformational change, heart-led leaders draw on the qualities of humility, vulnerability, transparency, empathy and love.

Video

Competition with China: Laying the Foundation
videos by A1C Anthony Clingerman
A series of videos that explore China's interests at home and abroad and relationship with the United States, Asia, and international institutions in the area of strategic competition.

Challenger: The Final Flight
A Netflix original documentary series
Engineers, officials and the crew members' families provide their perspective on the 1986 Space Shuttle Challenger disaster and its aftermath.

The Social Dilemma
A Netflix video documentary
How social media is deliberately designed to nurture addiction, manipulate people and governments, and spread conspiracy theories.

Podcasts

Cautionary Tales: How Britain Invented, Then Ignored, Blitzkrieg
by Tim Harford
It was not a German invention. In 1917 a brilliant English officer developed a revolutionary way to use the latest development in military technology—the tank. The British army squandered the idea, but two decades later later Hitler's tanks thundered across Europe, achieving the kind of rapid victories that had been predicted back in 1917.

Choiceology: Knew it All Along
Host Katy Milkman shares stories of irrational decision-making—from historical blunders to the kinds of everyday errors that could affect your future.

Message From the Chief Master Sergeant

Airman 1st Class Alexandria Fulton

It is no secret that we are at an inflection point in our Air Force. As Air Force Chief of Staff, Gen. Charles Q. Brown, says, "Good enough today will fail tomorrow."

We need leaders at all levels who can think strategically, and execute tactically. To that end, I'm bringing you a reading list that will flex and evolve as we build the Air Force we need to compete, deter, and win across all domains.

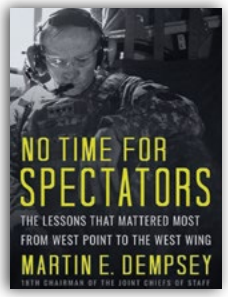
As a lifelong learner, I am constantly adding to my reading list—looking for new ideas that can challenge my assumptions and help me grow beyond my own limitations. As your 19th Chief Master Sergeant of the Air Force, I am committed to sharing this information with you, in the hope that you will apply it and eventually grow beyond us all.

We are the best Air Force in the world because of our people. I encourage each of you to take up the mantle of a learning leader, who continues to challenge the status quo and take us to new heights.

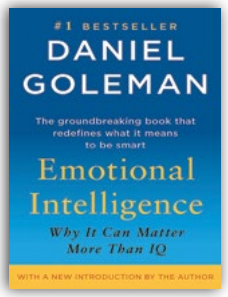
I am honored to serve alongside you, and I look forward to seeing you all out in our Air Force.

JoAnne S. Bass
Chief Master Sergeant of the Air Force

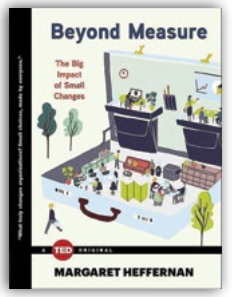
LIST



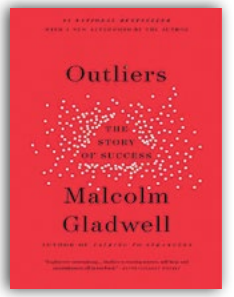
No Time For Spectators: The Lessons That Mattered Most From West Point To The West Wing
by Martin E. Dempsey
The limits of loyalty, the necessity of sensible skepticism, and the value of responsible rebelliousness, … why we actually should sweat the small stuff.



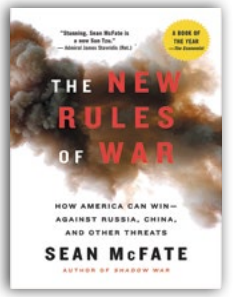
Emotional Intelligence: Why it Can Matter More Than IQ
by Daniel Goleman
Startling new insight into our "two minds"—the rational and the emotional—and how they together shape our destiny.



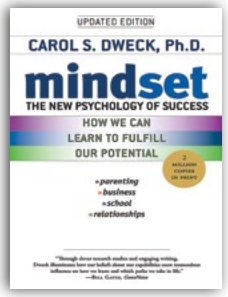
Beyond Measure: The Big Impact of Small Changes
by Margaret Heffernan
How organizations can build ideal workplace cultures and create seismic shifts by making deceptively small changes.



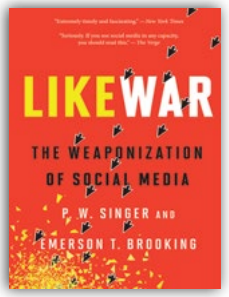
Outliers: The Story of Success
by Malcolm Gladwell
An journey through the world of "outliers"—the best and the brightest, the most famous, and the most successful. What makes high-achievers different? Do we pay too much attention to what successful people are like, and too little attention to where they are from: that is, their culture, their family, their generation, and upbringing?



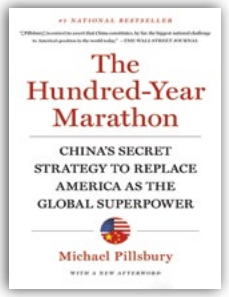
The New Rules of War Victory in the Age of Durable Disorder
by Sean McFate
Some of the principles of warfare are ancient, others are new, but all will permanently shape war now and in the future. If we do not follow them, terrorists, rogue states, and others who do not fight conventionally will succeed—and rule the world.



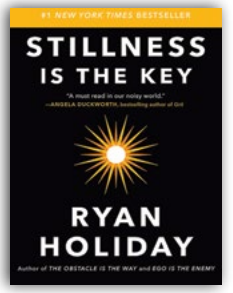
Mindset: The New Psychology of Success
by Carol S. Dweck
People with a fixed mindset—those who believe that abilities are fixed—are less likely to flourish than those with a growth mindset—those who believe that abilities can be developed. How great parents, teachers, managers, and athletes can put this idea to use to foster outstanding accomplishment.



LikeWar: The Weaponization of Social Media
by P.W. Singer and Emerson T. Brooking
Two defense experts explore the collision of war, politics, and social media where the most important battles are only a click away. Through the weaponization of social media, the internet is changing war and politics, just as war and politics are changing the internet.



The Hundred-Year Marathon: China's Secret Strategy to Replace America as the Global Superpower
by Michael Pillsbury
One of the U.S. Government's leading China experts reveals the hidden strategy fueling that country's rise—and how Americans have been seduced into helping China overtake us as the world's leading superpower.



Stillness Is the Key
by Ryan Holiday
This book draws on timeless Stoic and Buddhist philosophy to show why slowing down is the secret weapon for those charging ahead.

Podcasts

A Bit of Optimism
Podcast by Simon Sinek
So many politicians say our children are our future, so why do so few nations have a Cabinet-level position to represent their youth? Insights about fostering a nation's youth, the power of listening, and how hope empowers.

Simple Life Habits
Podcast by Jonathan Milligan
Work Less. Do More. Live with Greater Focus. How to develop habits that will enrich your life, focus your mind, and make you more successful.

Kwik Brain
Podcast by Jim Kwik
The world's top brain coach says knowing "your dominant question," and gives lessons on how to expand your mind, find your inner genius, and unleash your mental superpowers.

70th Annual Operation Christmas Drop Delivers Supplies to Remote Pacific Islands

Airman 1st Class Kaitlyn Preston

U.S. Air Force Airmen wave to island locals after dropping bundles of supplies during Operation Christmas Drop hosted by Andersen Air Force Base, Guam, Dec. 9, 2021. Christmas Drop is an annual operation that gives supplies to more than 55 small islands in the Pacific during the holiday season.

By Greg Hadley

The Pentagon's longest-running humanitarian mission hit a new milestone this month as Pacific Air Forces kicked off the 70th annual Operation Christmas Drop on Dec. 5, 2021.

Operation Christmas Drop involved Airmen from the 36th Wing, 515th Air Mobility Operations Wing, and 374th Airlift Wing gathering, packing, and dropping pallets of supplies from C-130s to more than 55 remote islands in the southeastern Pacific, including the Federated States of Micronesia and Palau.

The operation first began in 1952 when a B-29 aircrew flying over the island of Kapingamarangi, 3,500 miles southwest of Hawaii, saw islanders waving at them, according to a PACAF release. The crew dropped supplies attached to a parachute to them, starting an annual tradition.

In 2021, the Air Force and partner nations dropped some 25,000 kilograms worth of supplies, including school supplies, clothing, rice, fishing equipment, and toys impacting about 20,000 people, said Capt. Dan Mumford, one of the C-130J pilots flying the mission, in an interview released by the 36th Wing.

"These islands are some of the most remote in the world. They may get a boat of supplies every four to five months, but there are no airports and little to no visitors," Mumford said in the interview. "However, we do communicate with the islands through a system of ham radios, and although many do not speak English, the stories of excitement and gratitude that are sent back to us are touching. The thing that really got me was when I was told the children on these islands don't believe Santa Claus flies a magical sleigh—he flies a C-130."

Speaking at a ceremony to commemorate the start of Operation Christmas Drop at Andersen Air Force Base, Guam, on Dec. 5, 2021, Larry Raigetal recalled his childhood on one such island.

"I was curious where the toys were coming from, much less being fascinated with the Air Force guys standing in the C-130 and tossing down those boxes," Raigetal said. "I wanted to find out where they came from. I wanted to know what the source was."

Donated supplies are gathered from private donors, charitable organizations, and the University of Guam and sorted by volunteers before being packed into pallets, Mumford said. From there, crews execute low-cost, low-altitude airdrops over the course of a week. And it's not just a humanitarian mission.

"This training mission is not only a tradition but provides relevant and real training necessary for our Airmen and partner nations in the Indo-Pacific region," Pacific Air Forces Commander Gen. Kenneth S. Wilsbach, said in a release.

Similar to last year, precautions were taken to lessen the risk of COVID-19. All pilots and aircrew were fully vaccinated; all volunteers handling donations wore face masks and gloves; and pallets were left untouched for hours before being closed. ✪

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For more information on the Air Force Association, visit afa.org or call the AFA representative in your area.

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011-82-106-657-1523 (Pacific.SA@afa.org)

1 1st Lt. Frank Patterson
2 The F-15EX program at Wright-Patterson AFB in 2021
3 Wright Field in 1945

USAF (1,3); Jaima Fogg/USAF

WRIGHT-PATTERSON

Three Legends

The "Wright" in Wright-Patterson Air Force Base, Ohio, honors Wilbur and Orville, the famous aviation gods, but who was "Patterson?"

First Lt. Frank Stuart Patterson was a World War I Army Air Service pilot. He and the Wrights lived in Dayton, knew each other, and are buried in the same cemetery. Patterson was not famous, but worthy of the honor.

Stu Patterson was born into a prominent Dayton family. His father and uncle owned National Cash Register, then one of the most technologically advanced firms in the world. They were tycoons of the late 1800s and early 1900s. (The father died in 1901.)

Stu moved in high social circles. Many male relatives were Yale men. After prep school, he himself entered Yale in the fall of 1914, expecting to graduate in June 1918.

Stu was tall—6 feet 4 inches. One friend said he was "devoted to sports and pathetically afraid of girls," but that, for all his wealth, he "never heard Stu … play the bigot or snob."

The World War was a campus preoccupation. Patterson "longed to go," said a classmate. He even took private flying lessons to ready himself for military pilot duty in Europe.

When the U.S. entered the war in April 1917, Stu was among the first at Yale to go. He was 20 and only a year from graduation, but he was determined to serve, so he packed and left.

Patterson entered the Air Service, completed ground school at MIT, and took pilot training at the Flying School, Mineola, N.Y. In August 1917, he received wings and stepped onto a fast military track.

Patterson breezed through Observer School at Fort Sill, Okla., on his way to test pilot school at Hicks Field, Texas. His next stop: Wilbur Wright Field, opened a year earlier in his hometown.

Units there tested machine guns issued to the Air Service. A major focus was testing of newly installed synchronizers that made it possible for a pilot to fire through blades of a spinning propeller. The testing was dangerous work, requiring steep dives.

On the last day of his life, Lieutenant Patterson and his back-seater, 2nd Lt. LeRoy Swan, took off in an Airco DH.4 biplane and initiated a series of tests. On the third firing cycle, with the bomber diving from 15,000 feet, a tie rod snapped, causing the wings to collapse. The crash killed both Patterson and Swan.

The day was June 19, 1918. In New Haven, it was commencement day for the Yale Class of 1918—Patterson's class.

In 1927, Wilbur Wright Field was rededicated as Wright Field to honor not just one but both brothers. On July 6, 1931, however, Wright Field was subdivided. The eastern portion was designated as "Patterson Field" in honor of Lieutenant Patterson.

The new United State Air Force later merged the bases into what is today Wright-Patterson Air Force Base. It is one of USAF's largest and busiest installations. It is a center for technical research and development of all types of Air Force aircraft, and it houses the headquarters of Air Force Materiel Command. Area A of the base is still known to many as "Patterson Field." ✪

FRANK STUART PATTERSON

Born: Nov. 6, 1896, Dayton, Ohio
Died: June 19, 1918, Riverside, Ohio
College: Yale University
Occupation: U.S. military officer
Services: U.S. Army—Signal Corps, Air Service
Main Era: World War I
Years Active: 1917-18
Final Grade: First lieutenant
Interred: Woodland Cemetery, Dayton

WRIGHT BROTHERS

Wilbur Wright: 1867-1912
Orville Wright: 1871-1948
Occupation: Inventors
Interred: Woodland Cemetery, Dayton

WRIGHT-PATTERSON AIR FORCE BASE

State: Ohio
Nearest City: Dayton
Area: 12.7 sq mi / 8,145 acres
Status: Open, operational
Wilbur Wright Field opened: June 6, 1917
Patterson Field opened: July 6, 1931
Wright-Patterson AFB dedicated: Jan. 13, 1948
Current owner: Air Force Materiel Command
Former owners: (Army) Engineering Division, Materiel Division, Materiel Command, Technical Services Command; (Army/USAF) Air Materiel Command; (USAF) Research and Development Command, Air Research and Development Command, Air Force Systems Command
Home of: Hq Air Force Materiel Command

Life doesn't follow a plan.

Therefore, you need to be prepared.

AFA offers its eligible members, under age 70, **Group Accidental Death & Dismemberment (AD&D) Insurance,** with guaranteed acceptance regardless of health. This coverage pays your beneficiary a lump-sum, cash benefit of up to $500,000 if your death is due to a covered accident. Whether that accident occurred at work or at play, at home or while traveling anywhere in the world, 24/7.

These benefits are paid in addition to any other coverage you may have and can help supplement a life or medical policy, allowing you to lessen the impact on your family from a sudden loss. And once insured, you'll have 30 DAYS, RISK FREE, to look over the policy and decide if you wish to continue coverage.

Learn more about AFA AD&D Insurance*.

AFA AD&D Insurance offers:

- **Guaranteed acceptance.** As an eligible member, you cannot be turned down, regardless of health conditions.
- **Select the Principal Sum right for you:** $50,000 to $500,000 (in increments of $50,000).
- **Benefits for military air travel** up to $150,000.
- **Additional benefits paid** for common carrier, common disaster, and use of seat belt and airbag.
- **Additional benefits paid** to help cover expenses such as education, rehabilitation, elderly care, day care and more.
- **Member-Only rates.**

Call 1-800-291-8480
or visit www.afainsure.com

*Information includes costs, exclusions, eligibility, renewability, limitations and terms of coverage. Coverage is not available in some states.

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[1]**Potential average annual savings, rounded to the nearest $25 increment, based on countrywide survey of new customers who switched to USAA and self-reported savings from March 11, 2019 to March 18, 2021. Individual savings may vary and isn't guaranteed.** Use of the term "member" or "membership" refers to membership in USAA Membership Services and does not convey any legal or ownership rights in USAA. Restrictions apply and are subject to change. Automobile insurance provided by United Services Automobile Association, USAA Casualty Insurance Company, USAA General Indemnity Company, Garrison Property and Casualty Insurance Company, based in San Antonio, TX; USAA Limited (UK) and USAA S.A. (Europe), and is available only to persons eligible for P&C group membership. Each company has sole financial responsibility for its own products. Air Force Association receives financial support from USAA for this sponsorship. 275125-1121-AFA