JULY 1986/$2

AIR FORCE MAGAZINE

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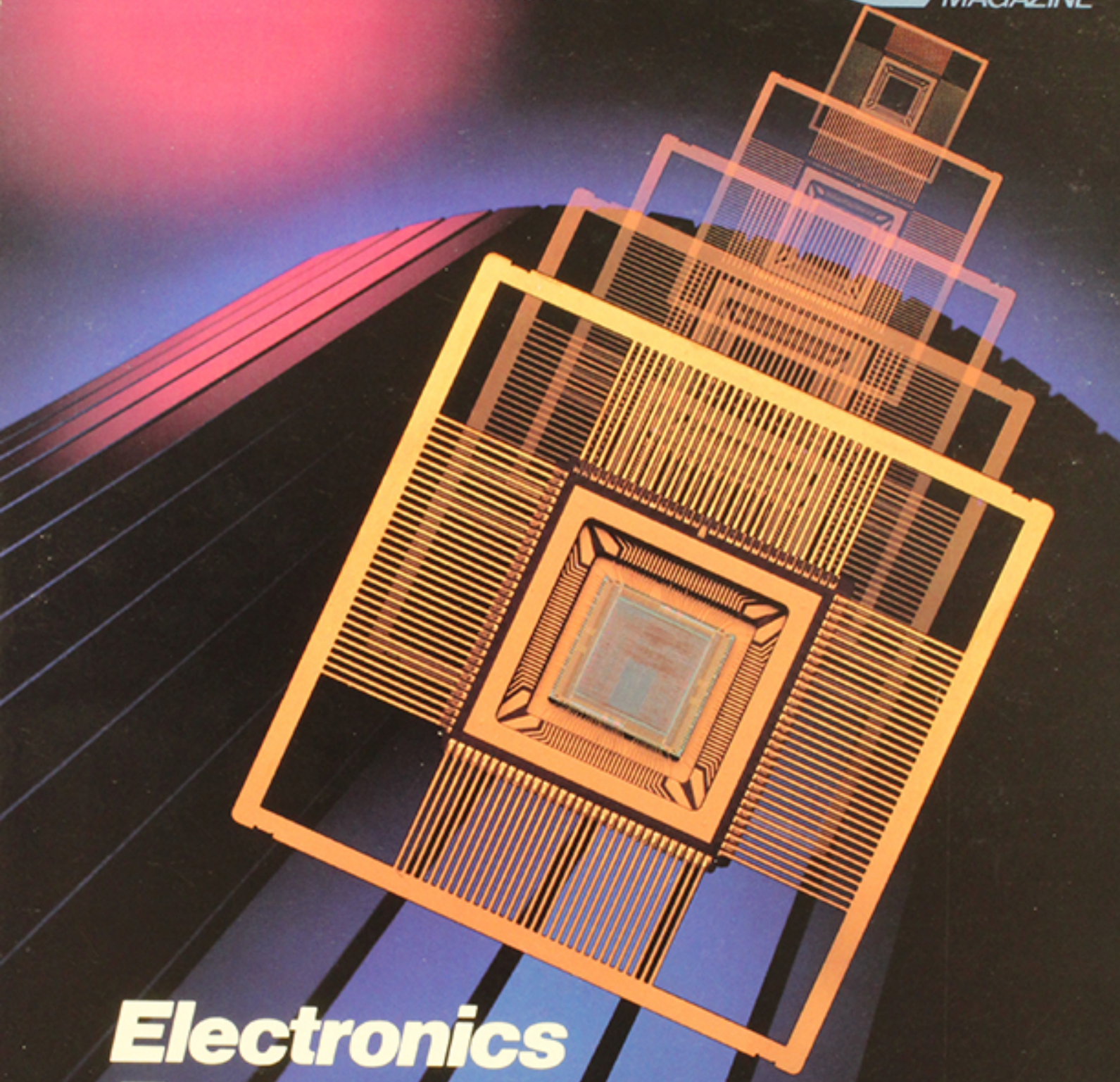

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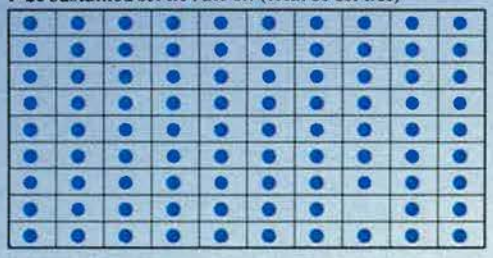
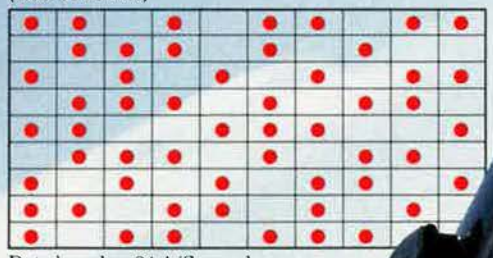


CLOSEST COMPETITOR sustained sortie rate 2.3 (total 55 sorties)



Data based on 24 A/C squadron, USAF environment

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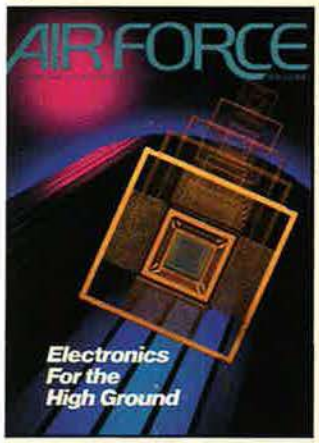

bout the cover: Such VHSIC hips as the Westinghouse 10K onfigurable gate array pic- ured on the rains of the Air Force's force- ultiplying electronic systems. special section on "Electro- ics and the Air Force" begins n p. 44.

Special Section: Electronics and the Air Force

Electronics for the High Ground / By James W. Canan 44
ESD is orchestrating the testing of technologies for strategic defenses.

What's Happening in Electronics at ESD 52
A checklist of major electronics projects at Electronic Systems Division.

A Million Pulses Per Second / By James P. Coyne 60
The electronic warfare environment of the 1990s will be dense and deadly.

Machines That Think / By John T. Correll 70
USAF is moving deliberately to exploit the promise of artificial intelligence.

The Military Use of Light / By Maj. Randal E. Morger, USAF 76
The possibilities are brightening for the development of photonic systems.

Features

On the Shoulders of Giants / Editorial by David L. Gray 4
AFA has inherited a heavy obligation along with its forty years of heritage.

Aldridge on the Issues / By Edgar Ulsamer 84
The new Air Force Secretary signals stability, but suggests new "tendencies."

Our Tech Base Needs Attention / By Gen. Robert T. Marsh, USAF (Ret.) 90
Basic R&D—the bedrock of US defense capability—requires renewed support.

There I Was . . . at the Gathering of Eagles! / By Bob Stevens 96
Our resident cartoonist, pen in hand, tours the happenings in Las Vegas.

Air Full of Eagles / By Jeffrey P. Rhodes 98
Three generations of airmen assemble to celebrate the achievements of airpower.

Partners in Education / By Kenneth A. Goss 104
AEF is the catalyst for a new program to encourage academic excellence.

The P-12 Comes Home / By Steve McElroy 106
An aviation artist paints an affectionate portrait of a genuine "fun machine."

The Reality of the Philippines / By Gen. T. R. Milton, USAF (Ret.) 111
The US has a big stake in helping to resolve the unstable situation there.

Valor: Experiment at Yangdok / By John L. Frisbee 112
Capt. John S. Walmsley zeroed in on the enemy train, searchlight blazing.

Departments

Airmail	8	**Senior Staff Changes**	39	**Intercom**	117
In Focus . . .	20	**Index to Advertisers**	40	**AFA Regional Report**	120
Capitol Hill	28	**There I Was . . .**	96	**Unit Reunions**	123
Aerospace World	30	**Airman's Bookshelf**	114	**Coming Events**	124

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AN EDITORIAL

On the Shoulders of Giants

By David L. Gray, PUBLISHER

IT IS an honor to begin service as Executive Director of AFA and Publisher of AIR FORCE Magazine in this, the fortieth anniversary year of our Association, when the sense of our heritage is especially strong. That heritage—which we celebrated a few months ago when three generations of airmen came together at AFA's Gathering of Eagles—is far more than nostalgia. It reminds us of our purpose and provides us a yardstick against which we can measure our progress.

No one is better qualified to talk about that heritage and purpose than General Jimmy Doolittle, the aviation pioneer and war hero who, in 1946, became AFA's first President. He describes AFA as "an organization founded by veterans who sought nothing for themselves, but rather were dedicated to the pursuit of national security and world peace by supporting the primary means for deterring aggression—airpower." General Doolittle has also charged us to remember that this objective requires work at the national, regional, and local levels. "From the start," he says, "it has been a grass-roots organization, supported by a thoroughly professional and dedicated staff in Washington."

In our fortieth anniversary year, we are well positioned to carry out that charge, and we are doing so actively. Today, AFA has 230,000 members, nearly 25,000 of them Life Members, organized into 310 chapters in the United States and thirty-three overseas. Almost any day of any week, an Air Force Association chapter, state organization, or region somewhere is putting on a program to advance understanding of airpower. AFA has 253 Industrial Associates, and the Community Partner program—growing recently at the rate of fifty enrollments a week—has established ties for support from more than 700 local businesses.

Our national symposia and Aerospace Education Foundation roundtables enable us to present the views of leaders and thinkers in the fields of defense and aerospace. AFA awards recognize and promote contributions to national security. We disseminate reliable information and analysis not only through our monthly journal, AIR FORCE Magazine, but also by production of films, videotapes, legislative reports, and other printed materials. In many instances, we are the source of information that would not be readily available to the public—if available at all—were AFA not here to provide it.

As my predecessor, Russell E. Dougherty, has said, the accomplishments of AFA today are possible because we stand on the shoulders of giants, meaning those farsighted leaders who founded AFA and sustained it as it grew. Throughout our history, each generation of members and leaders has been able to build on the achievements of the generations that went before. Thus, the Association has become an instrument, perhaps without parallel and certainly of unlimited potential, to promote understanding and support for issues vital to national security. We of AFA are a quarter million strong, and we are just as effective as we will ourselves to be.

It is important that we will ourselves to be *very* effective—at the national, regional, and local levels—because we have a huge job of informing and educating on our hands.

Sixteen years into the All-Volunteer Force, five years into the restoration of US military preparedness, and seven months into the Gramm-Rudman-Hollings deficit reduction adventure, signs abound that defense has begun to slip badly as a national priority.

In part, this is because the public either does not understand or does not believe that its security is threatened in an immediate way by the relentless buildup of Soviet military power. There is a vague perception that the risk is exaggerated and that the United States probably has already as much military capability as it needs. It does not weigh heavily on the public's mind that the USAF lacks the number of combat-coded fighter and attack squadrons to meet its taskings, that total airlift available is woefully short of the amount required, or that the balance in strategic nuclear capability is drifting in favor of those who intend us harm. Unaware of the facts or choosing to ignore them, a great many people think that defense spending is largely to blame for the federal deficit. There is a growing mood that we must cut our military coat to fit the budgetary cloth, no matter what such a coat might cover or leave uncovered.

With each passing year, fewer Americans—and fewer decision-makers—have served personally in the armed forces. Accurate, timely information on defense issues is seldom available from the popular media. Along with forty years of heritage, we in AFA inherited an obligation from those giants on whose shoulders we stand. It is not enough that we ourselves be informed and understand. We must also inform others and make them understand, too. If we do not do this, who will?

The program of the Air Force Association serves many constituencies: The general membership, as it goes about learning, teaching, and informing; the active-duty Air Force and the Air Reserve Forces; the education system that prepares the leaders and doers of tomorrow; decision-makers, as they struggle with the difficult issues of our times; veterans and military retirees, to whom we owe so much; the much-maligned but critically important defense industrial base; and above all, the nation we seek to protect and preserve.

As we begin our fifth decade, we are obligated by heritage and purpose to live up to the assessment made by one of our best-known charter members, President Ronald Reagan, in his message to AFA's Gathering of Eagles: "It looks like that association of Air Force supporters we pulled together forty years ago has thrived. It makes me proud to have had a hand in getting AFA started, to see how it has grown and contributed to the security of our nation."

This is our history—and our mandate for the future. ■

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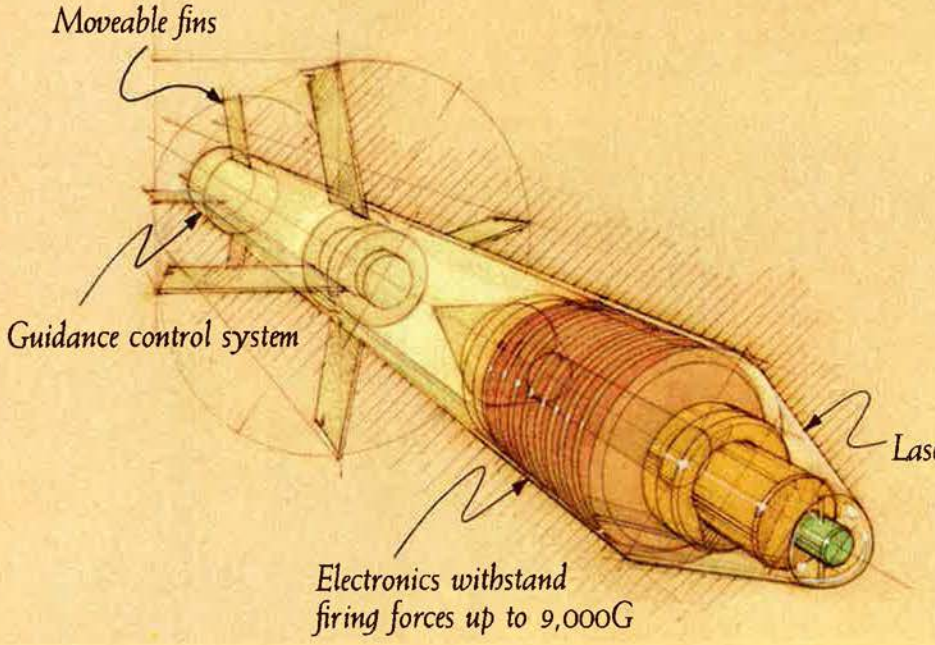

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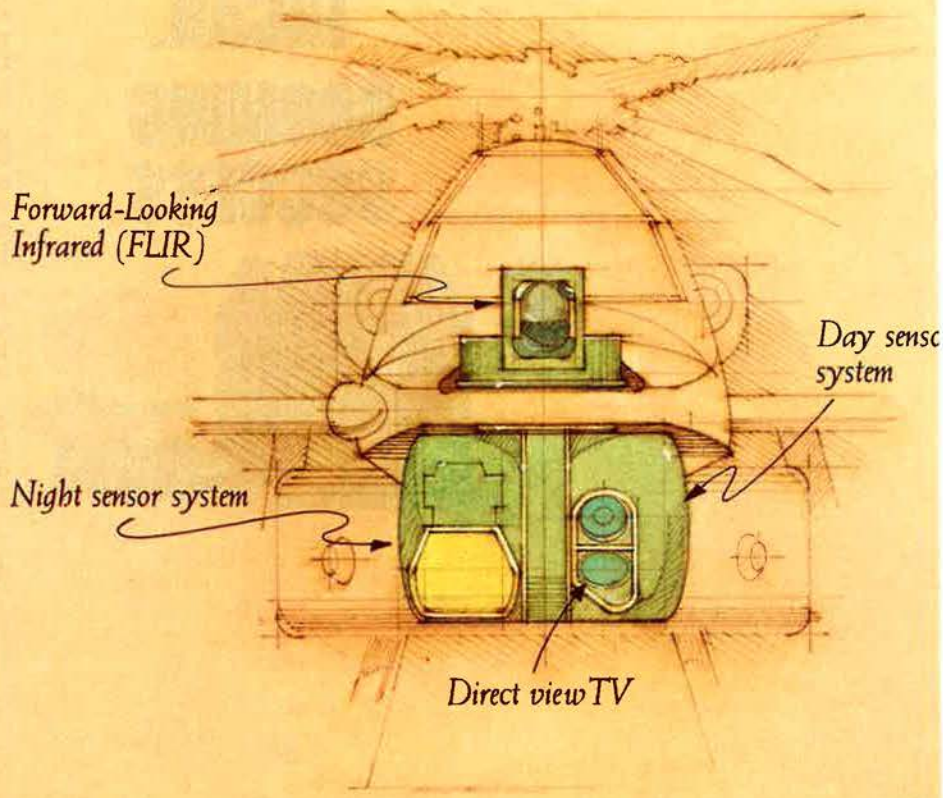

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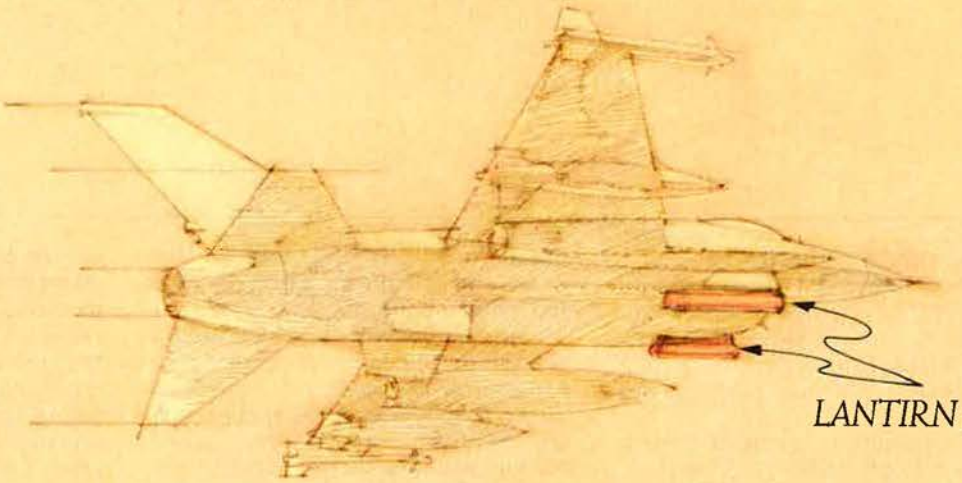

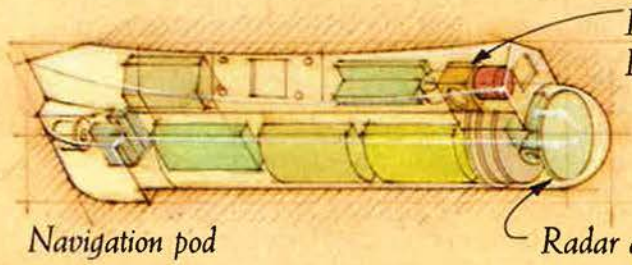

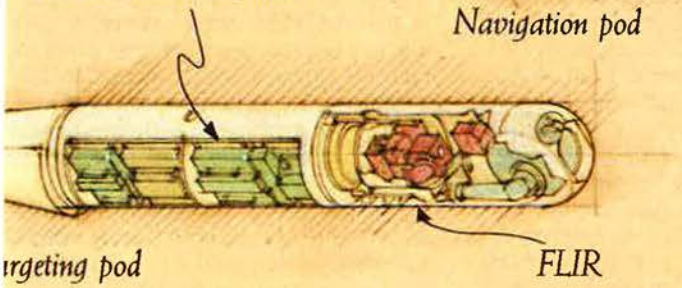

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AIRMAIL

Hard Words for Software

In your May 1986 issue, it was very interesting to read your article entitled "The Software Crisis" *(May '86, p. 46).* It appears to me that a little knowledge is dangerous most of the time.

While the author, James W. Canan, has done a very good job of comparing statistical data on various programs and the lines of code on each of the systems, it doesn't directly reflect what software development is all about and the problems that it faces. It shows in this article that many people in industry and management in general continue looking at software technology as a big taboo. They keep on forgetting that software, as a technology, can be properly "engineered" and that it is not any different from any other product that can be engineered and produced.

Your article keeps on referring to programmers instead of talking about software engineers, and there is a difference. Software technology, just like any other engineering discipline, requires careful analysis, specifications, design implementation, integration, and support. Software development in an engineering environment has a process that parallels the hardware development process.

Your use of the number of lines of code to represent productivity is so irrelevant that it can totally misrepresent the complexities that software-intense systems have. I could take two very good software engineers and provide them with the same specifications to develop a system with limited amount of space in memory and processor load, and both of them could provide different answers but yet meet the requirements. One of them could produce a solution with only, say, 500 lines of code that uses a certain amount of memory and processor load, and this engineer could complete the full development in 500 hours. The other person could develop another solution using twice the amount of lines of code also in 500 hours but using twice the amount of memory and processor load as the other and still meeting the requirements for the development. In this case, who is more productive? Who has done a better job? . . .

Your comparison of productivity in the United States vs. Japan and Europe is irrelevant and cannot be determined based on your information. Are you comparing apples with apples? People measure lines of code in different ways, and there is not a solid standard throughout the industry, let alone the world, as to how to measure lines of code—notwithstanding the problems stated before and whether or not the "delivered" lines of code include lines of code generated to support the actual operational software that is finally included in the product.

I am willing to bet that the productivity of 3,500 lines of code generated per man per month in Japan or Europe vs. the 183 lines of code generated in the United States, as you state in your article, are not equivalent types of systems or have not been measured properly, taking into account all the factors stated above. . . .

Finally, your article fails to point out that in a typical DoD system, the hardware and software are developed simultaneously or in parallel. When hardware/software integration starts to take place, the problems encountered in hardware and software are analyzed, and many times hardware deficiencies are made up by adding "code." In other words, changes are made to the software to compensate for hardware capability that does not meet the requirements.

In many instances, if there is enough memory and processor load available, the software solution is cheaper because it represents nonrecurring cost and also because it is "easy" to change (no need to change the real estate in the board, nor is there any need to add any chips or supporting circuitry). However, it is this flexibility in software that sometimes causes the problem in the development cycle on the software and gives the perception to the customer that the software is late or incomplete or that it doesn't meet the specs.

Victor N. Rios
Director of Software Engineering
ITT Avionics Division
Nutley, N. J.

Do you have a comment about a current issue? Write to "Airmail," Air Force Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Letters should be concise, timely, and legible (preferably typed). We reserve the right to condense letters as necessary. Unsigned letters are not acceptable, and photographs cannot be used or returned.

In his article "The Software Crisis" in the May 1986 issue, James W. Canan makes many points that need to be understood and publicized. Unfortunately, he states as facts some things that were apparently expressed to him as opinions and that are, in fact, errors.

As one of the very early Air Force software professionals, I can speak on some of his subject matter from the perspective of personal knowledge. As a young lieutenant, I attended the SAGE Programmers Course at Keesler AFB, Miss., in 1962. As I recall, ours was the second or third class after Air Training Command took over from IBM, which had taught a few dozen officers at its plant. At the time, very few people knew that the Air Force had a contract with MIT to teach the punch-card people to build computers. In a very real sense, we who learned to program the AN/FSQ-7 were learning on the computer that built IBM.

The bogus claim that "banks and industries, for example, are paying top dollar for [software talent] and are luring military officers" is demonstrably hogwash. My own case is only one of the many I know of in which a dedicated and able military software engineer was involuntarily retired from active duty at exactly twenty years of service. If I had been permitted to continue, even as a twice passed-over regular Air Force major, I would now

ıe approaching my retirement at thir-
y years.

I am shocked that Dr. John H. Man-
ey should state that "the commercial
ector is offering double or triple the
alaries of our software professionals
o hire them away." As a former Air
orce officer and if he is qualified to
ıe the director of the Software Engi-
ıeering Institute, he must know that it
vas the personnel "system" that
lrove us out, not the fabulous salaries
hat lured us out.

I am employed as a software man-
ıger within the defense industrial
:omplex, but my salary is less than
50 percent of what I would be receiv-
ng if I were still on active duty. The
ıad fact is that my contribution (and I
ım proud to be able to claim that it is
:onsiderable) to the national defense
s costing the taxpayer (including me)
nany times what it is worth. But I am
ıot getting it. The headhunters, the
)ld-time managers, and the stock-
ıolders in the defense industry and
he contract administrators on both
ıides are the ones to profit from the
elocation. . . .

Maj. William P. Russell,
USAF (Ret.)
Half Moon Bay, Calif.

Re: "The Software Crisis" by James W. Canan in the May 1986 issue.

It was a shock to see so many errors in so few lines of text. Mr. Canan should do his homework or get a more reliable source of information.

First, the F-111A/E aircraft have not been modified. They will be modified—the preliminary design review will be in July 1986.

Second, the A/E analog computers will not be modified—they will be replaced by the new digital computers currently in the D, F, and FB-111 aircraft.

Third, there are extensive modifications to the cockpit that will parrot the FB-111 Avionics Modernization Program (AMP) systems—updated attack radar and terrain-following radar, radar altimeter and air data computer replaced, many cockpit panels replaced by three CRT displays, extensive reharnessing, etc.

Fourth, the D's and F's software was not modified. These two aircraft are different avionically, except for the digital computers of the weapons-nav system. These were updated from the IBM CP-2 to the Singer CP-2EX. The software was changed to accommodate the architecture of the new computers.

Fifth, the FB-111 is the aircraft that is currently being upgraded via the FB-111 AMP, an offshoot of which is the recently begun F-111A/E and EF-111 AMP. The trial aircraft is not due out until next year.

Sixth, it was stated that the hardware changes (which have not yet even begun) took three times as long to make as the software changes (which have not been done and which are not contemplated).

Philip P. DeCarlo
Lead Engineer
AMP Support
North Highlands, Calif.

● Senior Editor James W. Canan replies:

Mr. Rios makes some interesting points on the software situation as seen from his special vantage point in industry.

However, my article did make the distinction—quite pointedly and repeatedly, in fact—between software programmers and software engineers. It also drew comparisons among lines of code past, present, and future in military system software to show how the demand for and use of software is on the rise.

Trusting my sources, I also stand by the article's comparison of software quantity as a factor of software productivity.

With regard to foreign competition in software, all who supplied information for the article expressed great concern about it, with some emphasis on Japan's productivity.

Finally, the article was at pains to point out, as Mr. Rios does, that software changes are often cheaper and easier to make than hardware changes. The article did not say, as Mr. Rios seems to suggest, that development of a system's hardware and software is not instituted simultaneously or planned in parallel. The thrust of the article, rather, is that software development increasingly lags behind new computer hardware's receptivity to its incorporation.

Mr. Russell, too, provides his special perspective on the military's problems in retaining software professionals. However, his objections to the military "system" serve more to validate Dr. Manley's point about the greater attractions of the commercial world than they do to refute it.

As to Mr. DeCarlo's letter, the information on the F-111 came directly from the report, "Strategy for a DoD Software Initiative," Department of Defense, October 1, 1982.

Page 3 of that report discusses software changes vs. hardware changes and cites "the Air Force experience with the F-111 program" in making its point that "software changes are easier and less costly to make than physical system changes." Clearly, the report was referring to F-111 changes in the past, not to changes currently under way or being contemplated. My article did the same.

Here's the pertinent passage from the DoD report:

"Similar avionics capabilities were implemented in analog electronic hardware on the F-111A/E and in software on the F-111D/F. A number of changes were tracked through both systems. The savings in dollars and deployment lead time in the digital F-111D/F are striking. Hardware changes cost fifty times as much as software changes and took three times as long to make."

The software initiative report was prepared by the Office of the Under Secretary of Defense for Research and Engineering, based on information supplied by the Air Force and the other services.

Flawed History?

There are a number of off-the-mark comments and significant omissions made by Gen. T. R. Milton, USAF (Ret.), in his May 1986 article "Israel's First Line of Defense" *(p. 62)* that call for clarification. The General is clearly in his element when discussing the Israeli Air Force, IAI, and strict defense measures. But his preamble dealing with the historical perspective is somewhat flawed.

First, to the omissions. The British severed their Palestine Mandate into two segments—Palestine, the area west of the Jordan River, and Jordan, the area east of the river—in the early 1920s. Then Britain restricted Jewish immigration into Palestine from the 1930s through the Holocaust and up until Israel's statehood. In 1948, Jordan succeeded in conquering the West Bank and East Jerusalem while failing to destroy Israel and drive the Jews into the sea. Finally, the Arab states kept their brother Arabs festering in refugee-camp poverty rather than admitting them to their countries. At the same time, Israel became a haven for Jewish refugees. Most recently, immigrants have come from the USSR and Ethiopia.

Other points require clarification. The demise of Beirut as a financial center was independent of Israel's Lebanese incursion. The unstable, unsafe conditions in that area predate Israeli actions. The insoluble civil war and strife, which proved to be beyond even the power of the US to end, are not conditions sought by any sane financier.

Israel's actions to combat terrorism should not be dismissed casually as adherence to "the ancient eye-for-an-eye tradition." Judaic tradition inter-

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David L. Gray

Associate Publishers
Charles E. Cruze, Richard M. Skinner

Editor In Chief
John T. Correll

Senior Editor (Policy & Technology)
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Advertising Director
Charles E. Cruze
1501 Lee Highway
Arlington, Va. 22209-1198
Tel: 703/247-5800

Director of Marketing Services
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David Harrison
Overseas Publicity Ltd.
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prets that Biblical phrase as relevant to financial matters solely. To support this view, pre-Christian Jewish rule over the land of Israel that took place after the Greek/Syrian conquest and prior to the Roman conquest lasted about 100 years. During that period under Jewish religious law, only one individual received capital punishment. In the thirty-eight years of modern Israel's existence, only Adolph Eichmann was afforded a similar fate.

Israel's terrorist policy is based on other principles—those of rationality and effectiveness. First, most if not all terrorist acts have been aimed at civilians—usually women and children. A small nation with limited resources cannot let itself get caught up in a one-for-one attrition situation. Further, an ethical society cannot go out and inflict savagery on civilians, even as retribution. Accordingly, Israeli policy is based on surgically isolating and responding against those who commit such atrocities and against those who train, arm, plan with, and aid and abet them. As terrorists recognize that they will receive certain punishment for their actions, they are far less likely to act in the first place.

The relative safety within modern Israel bespeaks the wisdom of such a policy. President Reagan's recent actions show that we are finally learning this lesson.

Lastly, General Milton leaves the reader with the impression that Israel's defense is "up to the faithful in this religious country." The vast majority of Jewish Israelis does not consider itself "religious." The religious parties in the Israeli Knesset are mere splinter parties comparable in size to the Arab parties in this proportional democracy state. The religious parties have, however, exercised considerable influence as coalition partners in various Israeli governments.

Mel Waldgeir
San Antonio, Tex.

Acquisition and Quality

I have just finished reading "Burros, Bureaucrats, and Reformers" and "Packard's Partial Fix" in the May 1986 issue. As a commander of a Defense Contract Administration Services Plant Representative Office, I agree wholeheartedly with the authors' comments regarding streamlining the defense acquisition process.

However, after having read about the results of the Packard Commission *(see "In Focus . . . " April '86 issue, p. 21),* completing a survey for the Commission, and reading the articles cited above, I believe that a vital ingredient is still being missed—quality.

It is a malady of the USA that we assume quality into products and services. The Packard Commission report addresses trade-offs between cost, schedule, and performance, but quality is never mentioned. It appears that no one in a position of influence understands what quality is. We certainly don't assume costs are fair, etc.

Simply, DoD's responsibility for quality is to assure that defense contractors establish systems that design capable processes to prevent delivery of nonconforming hardware, software, and services. Some areas of DoD address this. Many do not. And there are those who want to do away with all quality requirements because they feel (vs. know) that contractors know what to do when it comes to quality.

Another point that demonstrated that the Packard Commission has missed the mark with regard to quality was its Work Force Survey. The writers of the survey called out members of the "acquisition team" as including the program manager, technical/engineering people, the business manager, the purchasing contracting officer, the administrative contracting officer, the contract negotiator, the lawyer, headquarters staff, the DCAA auditor, the contract/price analyst, and the logistics manager. From the definition, one might assume that quality assurance is part of the team. However, the questionnaire addresses cost, schedule, specifications, pay, benefits, bureaucracy, etc., but not quality. You can't assume quality in.

While many may be tired of hearing about it, foreign producers are outstepping the United States drastically in quality. We must change. It isn't a matter of establishing an entirely new system. We must simply take what vast (but diminishing) resources we have and use them properly to obtain the highest quality possible.

Capt. Steven D. Kahne, USAF
Chicopee, Mass.

The Importance of Safety

I read Samuel McGowan's letter on safety vs. aircrew accomplishment with some dismay *(see "Airmail," May '86 issue, p. 13).* Mr. McGowan's career must have been vividly marked at some point by a disappointing en-

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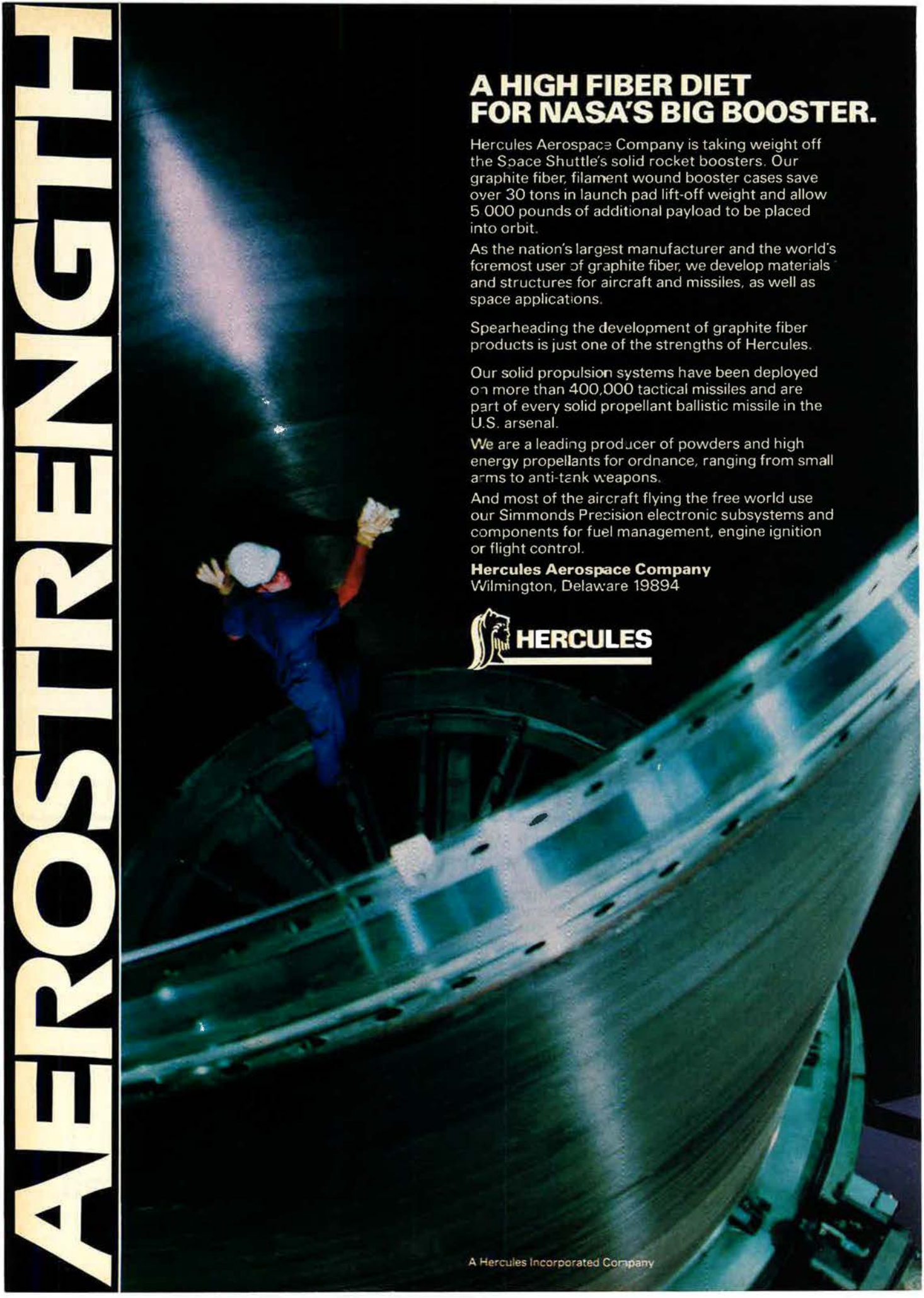

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Hercules Aerospace Company
Wilmington, Delaware 19894

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counter with a particularly bad flying safety officer. I *hope* that's the explanation for his unfortunate view of the proper role of safety in the aircrew business. If this is not true, we should both be even more worried than he already is. Safety is *not* an impediment to mission accomplishment. A "press on" attitude does *not* facilitate the mission.

An example: A tanker crew is a man spare for an important operational mission. It's minus fifty degrees outside. Because of a combination of "you'll be airborne shortly" and "the primary will be fixed any minute now," they sit, without heat, for two hours and two minutes. For some reason, the landing gear does not retract on initial takeoff. The cold-numbed crew rolls into a thirty-degree bank, trims full nose up, and stalls the airplane too low to recover, killing all on board.

So it was an important mission. The receiver really needed the gas. Tough. He didn't get it; the gas burned in the crash.

Another example: The crew starts takeoff roll more than fourteen hours into their duty day for a seven-hour flight. The crew is not augmented, but the pilot incorrectly believes waivers for the deviation have been obtained. In base ops, they had mentioned to another crew that they were tired, did not get much sleep in the tents the night before, and were not looking forward to the all-night flight.

These guys were all dead before they even took off. In their fatigue, they made some serious errors in their takeoff data. The airplane was physically unable to clear the nearby mountains. The hills were simply too high, too close in, for the bird to get over them. No survivors.

Did "safety" impede these missions? Sure the receiver needed the gas. Of course time on orbit station was important. However, no gas was transferred, and station time turned out to be zero. Why does the book have to go out the window?

Rules and procedures are not written to delay the mission. Pulling out the "go home" flag does not mean that you can't cope, have no flexibility, or don't want to place yourself in a position of some risk.

My prime task in flight safety is the preservation of assets (read tail numbers) for combat capability. If you hit a mountain, the mission goes wanting. Perhaps one man's flagrant disregard looks different from someone else's cool calculation.

Let's keep in mind that neither flexibility, as in "I can handle anything," nor strict adherence are magic bullets to bring us victory. Everybody can tell when that elusive morale is gone, and we all have our own ideas about how to foster it. However, for my money, checking the book, weighing the risk, and wearing a shining plastic spoon are not omens of doom.

If you don't survive the takeoff roll, then no amount of knowledge, courage, or judgment will get you to the drop zone.

Maj. Kelly M. Haggar, USAF
Edmond, Okla.

Aardvark Echoes

We, the flyers of the strategic Aardvark, insist on echoing the words of the "Airmail" letter "Aardvark Indignation" in the May 1986 issue *(p. 13)*.

We have endured and prospered under a philosophy of B-52 heavies for the last fifteen years. SAC is synonymous with heavy metal—always has been. The philosophy that "bigger is better" has a lot of credibility; however, there are many strategic contingencies requiring penetration capability that currently cannot be handled by the big guys. The role of the BUFF is changing to be more of a standoff vehicle. The B-1B is in its infancy and will hopefully grow to maturity as a viable weapon system. ATB is somewhere out there. But in the meantime, let's not forget the FB-111, which has performed accurately and consistently.

It has had its share of problems, partly because of its radical, then state-of-the-art technology, partly because of inadequate spares provisioning, and partly because of political realities. Luckily, the F/FB-111 Avionics Modernization Program (AMP), with the first FB-111 due in the field by late 1986, should greatly increase the reliability of the -111's avionics systems, provide innovative spares support concepts, and make the Aardvark a viable system well into the future.

Despite the naysayers, the 'Vark Guiders in both SAC and the tactical air forces have a deep love and respect for this rarely heralded bastion of freedom. The Libyan incident provided a picture to the American public of the finer points of the F-111 that hopefully will not be soon forgotten.

The -111 has endured many nicknames throughout its life, from

"McNamara's Folly" to "Mini-BUFF." It has been reluctantly acknowledged by SAC and TAC, yet never fully accepted by our fellow aviators. In SAC, it's thought to be too small for a real bomber; in TAC, it's thought to be too big for a fighter. But still it performs unique roles, both strategic and tactical, and should be remembered for its myriad of capabilities and not as a General Dynamics vestige that never got an official Air Force moniker.

To those who fly and have flown it—long live the Aardvark!

Maj. Terry A. Ross, USAF
Plattsburgh AFB, N. Y.

Air Force Art

My compliments on your May 1986 cover, as the elements in the photograph indeed convey the image of our high-tech Air Force. However, the artwork in the background depicting a KC-10 refueling an F-15 is part of the Air Force Art Collection and should be recognized as such.

The US Air Force Documentary Art Program was established in the early 1950s to capture on canvas significant moments in Air Force history and to portray Air Force life through the eyes of this nation's finest artists. Administered by the Art and Museum Branch, Secretary of the Air Force Office of Public Affairs, the collection now holds more than 6,000 paintings donated by more than 900 artists from the Societies of Illustrators of New York, Los Angeles, and San Francisco and the Artists' Guild of Chicago.

This artwork is displayed in the Pentagon, Air Force and National Air and Space Museums, Air Force Academy, command headquarters, and Air Force facilities worldwide. The paintings also travel on tour and have been viewed by nearly 20,000,000 people.

I would hope that if such artwork is used in the future, it will be credited to the Art Collection. I know my fellow Air Force artists consider it a privilege to participate in this fine program, and we are proud to serve our country in this manner.

Mike Machat
Woodland Hills, Calif.

Hats Off to the Highlight

The May Almanac issue is always the highlight of the year, so far as my subscription is concerned. This year is the best so far. One addition that I particularly enjoyed was the inclusion of "USAF Aircraft Tail Markings" and "Air Defense Unit Fin Flashes" on page 192 of the May '86 issue. Please don't forget to continue running them in future Almanac issues.

I have one comment that I believe deserves consideration. The section on "Some Famous Fighter Firsts" on page 197 has an omission that I believe should be corrected in future Almanacs. The first kill of the Korean War is credited there to 1st Lt. William G. Hudson, who was flying an F-82. The Twin Mustang included a radar observer, who in this case was Lt. Carl Frazer.

As established in the criteria during World War II for awarding claims for enemy aircraft destroyed, victory credits were awarded to the entire crew on night fighters. Back during the inception of the F-82, when it was known as the P-82, it was also known as a night fighter, later being redesignated as "all weather."

Thus, I believe that Frazer's name should be placed with Hudson's on that "famous first." I should mention that USAF Historical Study No. 81, which covers the Korean War, does not credit any of the radar observers,

THE F-16 SET A NEW SURGE RECORD IN TH

While deployed at a remote air base, 18 U.S. Air Force F-16 Fighting Falcons engaged in a training exercise that set a new standard in combat fighter readiness.

Over the course of 16 flying days, the planes and their pilots flew an average of 48 sorties. Then on the last day, in one 12-hour period, they flew 144 sorties. Sortie effectiveness was 100 percent. Turnaround reliability was 97 percent.

In fact, if it weren't for regulations that limit a

regardless of the type of aircraft involved. A tad unjust!

David R. McLaren
Springfield, Ill.

Hats off and a salute to the editors, publishers, and writers who produced the "Reports from the Major Commands" section in the May 1986 issue of AIR FORCE Magazine.

Having served in TAC from 1953–54, USAFE from 1954–58, and SAC from 1958–73, after which I retired, I found the reports very, very interesting and informative.

Thomas W. Young
Denison, Tex.

"Valor" Update

The "Valor" story "Marauders at Midway" *(April '86 issue, p. 140)* gives the impression that all four B-26s that attacked a Japanese carrier with torpedoes were from the 38th Bomb Group. Walt Gaylor, President of the 22d Bomb Group Association, has pointed out that two of the B-26s, flown by Lts. James P. Muri and Herbert C. Mayes, were from the 22d Group. My apologies to the 22d's Association for the omission.

The story also states that "the AAF never again sent torpedo-armed bombers into combat." Readers have called to my attention some later, limited use of torpedo-armed bombers in the Pacific and the Mediterranean.

John Frisbee
Leesburg, Va.

The C-17 Controversy Continues

After reading Gen. T. R. Milton's article "The Airlift Shortage Continues" in the March 1986 issue of AIR FORCE Magazine, I couldn't agree with him more.

General Milton makes a valid point about the C-17, which I assume he is referring to when he says that intercontinental air transports need not be designed to land behind the front lines. Who in their right mind would risk losing an airplane that some have said will cost $176 million apiece in 1984 dollars to small-arms fire in a small-scale war? No one, that's who.

I am from the home of tactical airlift—Pope AFB, N. C. Many people here at Pope claim that the C-17, once operational, will be used in roles no more demanding than those of the C-5 or C-141. So let's just buy more C-5Bs for approximately $100 million per plane.

So far as the Army is concerned, the Air Force should tell them that if they plan to build any larger (and more expensive) vehicles, then they should plan on shipping them by sea. As General Milton implies, if the Air Force doesn't put its foot down, the Army will continue to require more airlift than we can supply.

I think that MAC feels left out of the new high-tech airplane arena that SAC and TAC have jumped into. MAC wants a new high-tech airplane, no matter what it costs, because the other guys are getting them.

MAC might sometimes forget that we are all on the same side and that our job is to airlift "fustest with the mostest"—and for the cheapest for the US taxpayers.

1st Lt. Glenn D. Butler, USAF
Pope AFB, N. C.

My column "The Airlift Shortage Continues" in the March 1986 issue of AIR FORCE Magazine was not intended as an attack on the C-17 but rather as a question about its place on the list of priorities, given a shrinking military budget.

In all honesty, however, I remain an unbeliever in a concept that would take transport airplanes into the combat zone. We have, I fear, forgotten that—one of these days—the enemy might have an air force.

Gen. T. R. Milton, USAF (Ret.)
Colorado Springs, Colo.

AIRMAIL

Most Informative

My brother Bob, a retired chief master sergeant from the US Air Force, enrolled me as a patron in the Air Force Association, and I must say in all sincerity that AIR FORCE Magazine has to be one of the most informative publications that I have ever had access to. I have always been a staunch supporter of the US military, and after I have finished reading each issue of AIR FORCE Magazine, I certainly can understand the reason why.

Keep up the excellent work. I am looking forward to the next issue.

Don F. Hughes
Charlo, New Brunswick
Canada

Defense Attaché Duty

The Directorate of Attaché Affairs, Air Force Intelligence Service, is soliciting volunteers for Defense Attaché duty. Positions are available worldwide for those in the following grades and AFSCs: staff sergeant to master sergeant/70270, senior master sergeant/70290, chief master sergeant/70200, and staff sergeant to master sergeant/A43174 (turboprop experience for duty with C-12 aircraft). Also required are language-qualified personnel to serve in SDI 99606 in Yugoslavia and the USSR only. The duty is challenging, interesting, and rewarding and offers eligible personnel an opportunity to observe and work with the United States diplomatic corps.

Only active-duty regular Air Force personnel assigned in the CONUS are eligible to apply for Defense Attaché duty. All assignments have automatic concurrent travel for married personnel and a civilian clothing allowance authorization. Those selected for language-qualified positions will receive necessary language training along with approximately three months of training at the Defense Intelligence College (DIC) in Washington, D. C. Training will take place under a PCS status prior to reporting to station. All other selectees will receive DIC training in a TDY status.

Interested personnel are encouraged to contact Hq. AFIS at Fort Belvoir, Va. 22060-5788, or to contact Sgt. Terry Jones or MSgt. Robert Becker at AUTOVON 354-6036 or commercial (703) 664-6036. Eligible NCOs will be mailed an information letter regarding the selection process, housing, availability of schooling, and a brief description of duties. Applications will remain active for a one-year period.

Lt. Col. James P. Mannix, USAF
Hq. AFIS
Fort Belvoir, Va.

33d Fighter Squadron

The 33d Fighter Squadron was reactivated at Shaw AFB, S. C., on January 1, 1985, becoming the first operational squadron in USAF to equip with the F-16C Fighting Falcon. The 33d has a long and illustrious history, dating back to 1917. . . .

We in the 33d have beautiful new facilities at Shaw AFB, but lack tangible ties to our past. We do not have a single photo or item of memorabilia. We are interested in hearing from anyone who has served in the 33d and would deeply appreciate any photographs, newspaper clippings, maps, or personal memorabilia that could be donated for permanent display at the squadron.

We would be happy to make copies of photographic material and to return originals. Any assistance in our search for our "roots" would be greatly appreciated.

Lt. Col. Wayne A. Ivan, USAF
23 Rushmore Ct.
Sumter, S. C. 29154

REDCOM Anniversary

On October 9, 1986, the United States Readiness Command (formerly Strike Command) will observe its twenty-fifth anniversary with a ceremony and other activities at MacDill AFB, Fla. To help prepare for this event, we are seeking contact with any individuals who could provide photographs, diaries, or other memorabilia relating to any operations conducted by this command.

We are especially interested in documents and items relating to contingency operations, disaster relief, and joint exercises, particularly JTF Leo and Operation Dragon Rouge/Noir in 1964 and disaster relief operations in Central America, the Caribbean, and Africa.

These items will be used in developing displays and articles relating to this anniversary. All photos will be copied and originals returned. Anyone who can provide information or items should contact the address below.

Hq. USREDCOM/HO
MacDill AFB, Fla.
33608-6001
Phone: (813) 830-2105

AFHF Proposals

Proposals for papers and complete sessions are invited for the 1987 annual meeting of the Air Force Historical Foundation, to be held April 1987 in Richmond, Va. The AFHF will be meeting in conjunction with the annual meeting of the American Military Institute.

The tentative topic for the AFHF session is "Historical Perspectives on Aircraft Structures," but other suggestions are invited. Proposals, including an abstract of proposed papers and curriculum vitae for each proposed participant, should be sent to the address below. The Program Committee will select the most promising and appropriate papers and notify those selected as early as possible.

Prof. I. B. Holley
Chairman
AFHF Program Committee
Department of History
Duke University
Durham, N. C. 27706

31st TES

The 31st Test and Evaluation Squadron will be reactivated on July 1, 1986, at Edwards AFB, Calif. It will assume the mission of SAC's 4200th TES.

A ceremony will be held in July to commemorate the changeover, and we hope to hear from former squadron members who are interested in attending. Also, we are seeking photos and other memorabilia in order to create a permanent heritage room dedicated to the men and women of the 31st.

Former members and friends of the 31st are invited to contact us at the address below.

Capt. Rex E. Brinker, USAF
4200th TES/TEAO
Edwards AFB, Calif. 93523
Phone: (805) 277-2430

Glenn Miller Stamp

A group of fans is attempting to get a commemorative stamp issued honoring Maj. Glenn Miller. We feel that his example of patriotism and self-sacrifice has been overlooked and that this recognition is deserved. We have already received support from such political figures as Virginia Gov. Gerald Baliles and Sen. John Warner (R-Va.).

Our effort is just beginning, and we could use your help. If you would like to be a part of this effort, please write your senator or congressman, or write directly to Mr. Bill Halstead, Philatelic Programs Specialist, Stamp Information Branch, US Postal Service, Customer Service Department, 475 L'Enfant Plaza, S. W., Washington, D. C. 20260-6300.

Air Force Association Balance Sheets

Assets	December 31, 1985 General Fund	December 31, 1985 Life Membership Fund	December 31, 1985 Total	December 31, 1984 General Fund	December 31, 1984 Life Membership Fund	December 31, 1984 Total
Current Assets						
Cash plus marketable securities at cost	$ 6,963,777	$4,374,240	$11,338,017	$ 6,326,884	$3,256,561	$ 9,583,445
Receivables, inventories, and prepaid expenses	2,965,996	949,029	3,915,025	2,355,859	706,662	3,062,521
Other assets (including fixed assets, funds on deposit, etc.)	8,061,433		8,061,433	7,357,413		7,357,413
Total Assets	$17,991,206	$5,323,269	$23,314,475	$16,040,156	$3,963,223	$20,003,379
Liabilities and Fund Balances						
Current Liabilities (including payables, accrued expenses, etc.)	$ 2,932,284		$ 2,932,284	$ 2,675,759		$ 2,675,759
Deferred Revenue (including advance membership dues and magazine subscriptions)	2,775,145		2,775,145	1,241,098		1,241,098
Long-Term Debt	4,884,750		4,884,750	5,016,375		5,016,375
Fund Balance	7,399,027	$5,323,269	12,722,296	7,106,924	$3,963,223	11,070,147
Total Liabilities and Fund Balance	$17,991,206	$5,323,269	$23,314,475	$16,040,156	$3,963,223	$20,003,379

If we can demonstrate enough interest, we just may succeed. Thank you for your support.

Fred T. Wickis, Jr.
Lynchburg, Va.

Roll Call

I am trying to locate some crew members who served with me during World War II in the 370th Bomb Squadron, 307th Bomb Group, Thirteenth Air Force. We crewed a B-24, #787, named *Pistol Packin' Mama.*

The crew members are Albert J. Towns, Sherwood Griffith, A. J. Galleus, George White, Robert Bowers, and John Hill.

Anyone having any information concerning these men is asked to contact me at the address below.

William F. Seery
167 Pond Lily Ave.
New Haven, Conn. 06515-1107

I am interested in hearing from any former "Black Knights" of the 526th Fighter Interceptor Squadron based at Ramstein AB, Germany, during the time that the unit was equipped with the F-86D Sabre. I was a crew chief in the 526th from 1956–59 and would especially like to hear from other members of the 1958 team that represented USAFE for the first time at the William Tell competition. (We were beat out of first place by a scant 800 points!)

If there is enough response, perhaps we could work out a squadron reunion at a later date. Please contact me at the address below.

Jerome P. Burton
2712 W. 176th St.
Torrance, Calif. 90504

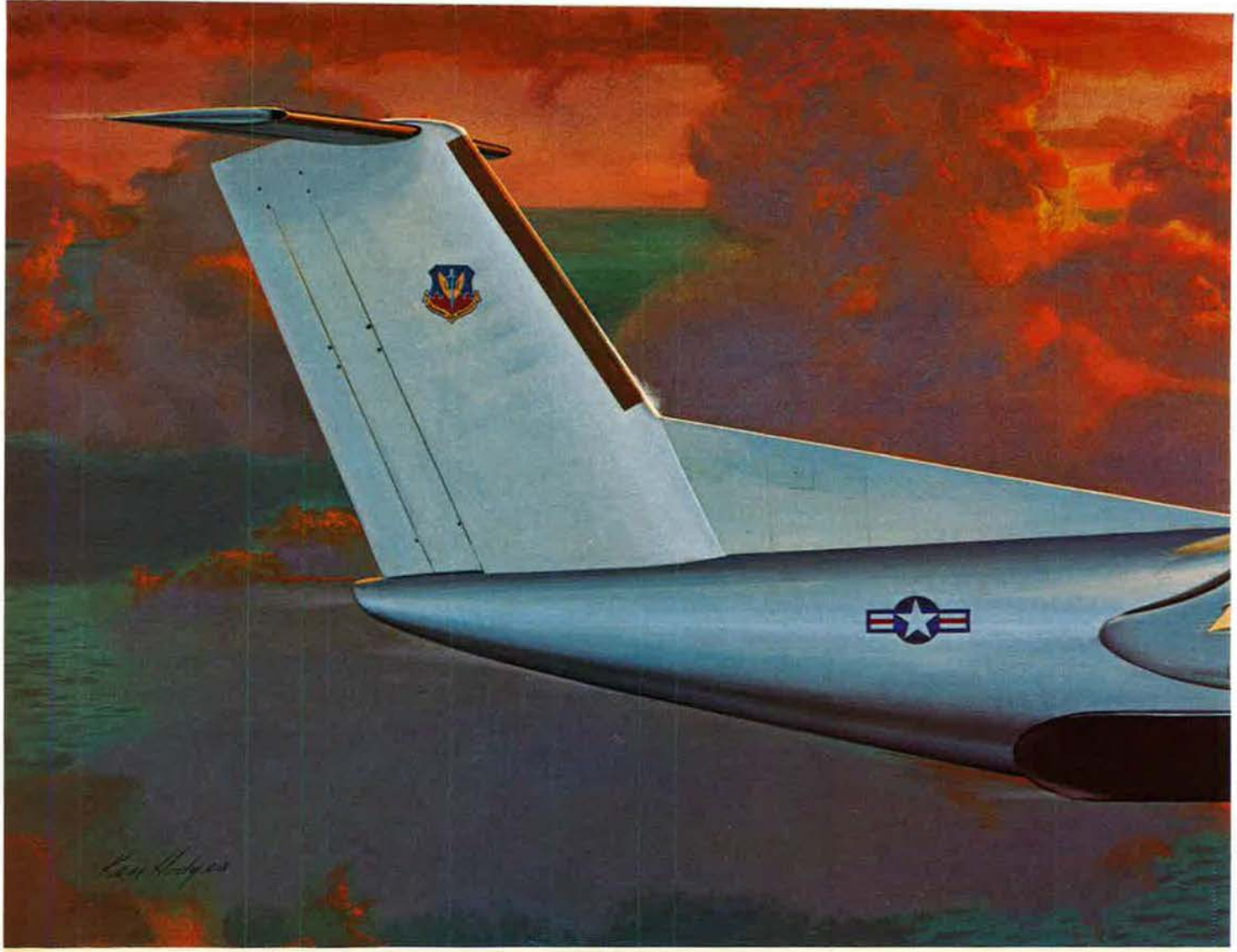
Air Force Association Statements of Revenues and Expenses

	Year Ended December 31 1985	1984
General Fund		
Revenues		
Membership	$2,849,104	$2,452,128
Patronship	254,074	216,793
Magazine	3,095,775	2,988,096
Industrial Associates Program	153,750	129,818
Data Processing Services	99,319	104,706
Insurance Programs—Administration	1,834,601	1,745,534
Annual Convention	428,767	375,095
Aerospace Development Briefings	873,724	803,873
Other Income and (Expenses)—Net	152,495	(7,953)
Total Revenues	9,741,609	8,808,090
Expenses		
Membership	3,890,035	3,143,354
Patronship	276,947	224,348
Magazine	2,774,597	2,453,576
Industrial Associates Program	138,141	110,973
Data Processing Services	292,080	357,865
Insurance Programs—Administration	2,883,741	2,604,532
Annual Convention	543,668	482,665
Aerospace Development Briefings	444,663	418,819
Total Expenses	11,243,872	9,796,132
Net (Loss) from Operations	(1,502,263)	(988,042)
Non-Operating Revenues		
Investment Income	707,219	916,186
Insurance Programs—experience credits and interest on reserves	1,081,897	873,493
Net Income—General Fund	$ 286,853	$ 801,637

Expenses include chapter commissions, state commissions, and other direct support for field units totaling $623,174 in 1985 and $577,921 in 1984.

Life Membership Fund		
Revenues from Investments	$313,426	$279,274
Less: Transfer to General Fund for annual dues	288,722	222,432
Net Income—Life Membership Fund	$ 24,704	$ 56,842

Treasurer's Note: The figures reflected herein have been extracted from audited financial statements submitted previously to the Board of Directors of the Air Force Association.



Sierra Research to produce new

AIRBORNE PLATFORM SYSTEM

Systems integration key to critical Air Force requirement

The Airborne Platform System, operating out of Tyndall AFB in Florida, will be an integral and critical part of the Gulf Range Instrumentation System. The platform is a flying data link that will relay telemetry, voice communications and drone tracking data while simultaneously performing radar surveillance functions. It will extend the Gulf Range to 200 miles offshore, enabling critical tests and training to be safely conducted without impacting the valuable commercial and recreational uses of the Gulf.

Meeting the challenge

Under contract to the Air Force Systems Command, Armament Division, the Sierra Research Division of LTV Aerospace and Defense Company has developed a complete Airborne Platform package that offers superior performance from

the aircraft to the antenna, from mission through maintenance.

The careful integration of the right aircraft with proven hardware will provide the USAF with a cost-effective combination offering the needed capabilities at the lowest possible risk and cost.

Where new developments were required, risk has been minimized by designing, building and testing all key elements. The antenna, for example, is a modern, modular and maintainable design based on mature tested technology. It's one of the largest electronically steerable phased-array antennas ever mounted on an aircraft. It is mounted low, along the side of the high-wing de Havilland Dash 8, for unobstructed "look down" performance and easy ground-level maintenance.

The Dash 8, too, is an integral component of the total system design. It offers superior mission flexibility, the desired payload reserve and room for growth—all with no compromise in risk, desired performance, cost or reliability.

Systems integration is key

The critical nature of the Gulf Range Instrumentation Upgrade demands total dedication to quality, performance, schedule and cost management. The careful selection, design and integration of aircraft, antenna and avionics as a total system—providing maintainable performance at absolute minimum cost—is an essential element of this dedication. The USAF and Sierra Research Division of LTV Aerospace and Defense have met this challenge. The result will be satisfaction of a critical defense requirement at absolute minimum cost to the taxpayer.

Proven performance

Sierra Research isn't new to systems like the Airborne Platform. Since 1957, we've been designing, integrating and manufacturing precision guidance and tracking systems, tactical data links, stationkeeping, flight inspection and airborne surveillance systems for military and commercial applications. As LTV's electronics division, we're backed by the full capability and commitment of one of America's premier aerospace and defense companies.

LTV Aerospace and Defense Company, Sierra Research Division, P.O. Box 222, Buffalo, New York 14225. Telephone (716) 631-6200.

LTV Aerospace and Defense
Sierra Research Division

L T V : L O O K I N G A H E A D

IN FOCUS...

Joint Chiefs Oppose CTBT

By Edgar Ulsamer, SENIOR EDITOR (POLICY & TECHNOLOGY)

JCS Chairman Crowe cautions Congress that the Soviets continue to stall on effective treaty verification techniques and that Gorbachev's proposals are rife with risks for the US.

Washington, D. C., May 21

In contrast with the somewhat aloof, ambivalent positions on the military consequences of a comprehensive test-ban treaty (CTBT) taken by that body in the past, the current Joint Chiefs of Staff recently warned firmly and unequivocally against entering into such an accord with the Soviets. Testifying on behalf of the JCS before the Senate Foreign Relations Committee, Adm. William J. Crowe, Jr., Chairman of the Joint Chiefs, cautioned that such an accord would not "eliminate a single nuclear weapon" and chided Congress for wanting to "suspend testing on one of the most critical and sophisticated elements of our nuclear deterrent—namely, the warhead."

A key factor militating against a CTBT is that even the high yield levels—up to 150 kilotons—of the currently-in-force Threshold Test-Ban Treaty can't be measured precisely by remotely located sensors, Admiral Crowe told the Senate Foreign Relations Committee. By comparison, the difficulties associated with detecting and gauging the much lower yields covered by a CTBT go up exponentially. Seismic techniques, he emphasized, appear to be "inadequate to ensure effective verification and compliance."

The US verification means, he suggested, can be duped by "testing in cavities, thereby decoupling the energy of an explosion from the surrounding medium, [or] by testing in outer space, in remote areas, or in the atmosphere above [certain] parts of the world . . . where attributing the test to a particular country would be extremely difficult."

The verification problem could be ameliorated significantly by a "direct yield measurement technique known as CORRTEX, which US scientists believe could enable both the US and USSR to improve verification and ensure compliance with the current Threshold Test-Ban Treaty," according to the JCS Chairman. But the USSR, so far, has shrugged off US proposals to implement the CORRTEX verification method on a voluntary, mutual basis.

President Reagan offered to demonstrate the efficacy of this new detection and measurement technique to the Soviets in the third week of April 1986, but found no takers. While Admiral Crowe's testimony excluded specific details of the new technique, he explained that CORRTEX "does not replace remote sensing by seismic detectors; rather, it would eliminate some of the uncertainties associated with remote sensing by on-site measurement of specific nuclear tests." He stressed that "the US government does not intend that such measuring be accomplished by a third party." US personnel would monitor Soviet tests, and "citizens of the Soviet Union would monitor our tests."

But this approach was turned down by the Soviet government on grounds that, in Moscow's view, current verification methods are adequate and should be coupled to a comprehensive moratorium on nuclear testing. This, the JCS Chairman suggested, constitutes a maneuver "that would completely ignore effective verification concerns in a regime where these factors are even more critical and demanding." The Joint Chiefs of Staff have "trouble" with such a "good faith" approach, "particularly when other aspects of the Soviet nuclear disarmament package envision a continuing military struggle for world power and influence." He added, "I doubt the Soviet Union will ever be able to square this circle."

The Joint Chiefs are also concerned about the political legerdemain associated with Moscow's recent, moralistically couched proposals on nuclear testing halts: "The Soviet Union has been reaching for the high ground in political and social rhetoric, condemning in particular the US program. In reality, however, the official proposals [announced with great fanfare by General Secretary Mikhail Gorbachev at the beginning of this year] do not contemplate a worldwide ban on nuclear testing until the late 1990s—more than a decade from now," Admiral Crowe complained.

Gorbachev's proposals are rife with risks to the US, according to the JCS Chairman. Mutual arrangements to delay or halt nuclear testing "can be broken and, in fact, worked very much to our disadvantage in 1961 when the Soviets broke out of a three-year moratorium with the most intensive nuclear test program in history." Moscow's recent suspension of nuclear testing, he suggested, was a "temporary expedient" that did not slow down Soviet preparations for the resumption of such tests.

In his testimony, Admiral Crowe pointed out also that "the Soviet proposals of mid-January weave the whole issue of nuclear testing into a much broader package that, through the year 2000, would enhance their security and flexibility while undermining the foundations of US and allied security." Comprehensive Soviet efforts to bolster the survivability, reliability, and effectiveness of their strategic forces by offensive and defensive means include "but certainly [are] not limited to an earth and space shield for many of their nuclear strike forces, national command structure, and communications assets," he explained. It follows, he suggested, that US deterrent forces must be given the tools to place such protected targets at risk. Concomitantly, US nuclear weapons must be upgraded for this task, and "that, in turn, requires continuity within the nuclear testing program."

Predicting that the nuclear disarmament process will lead to major un-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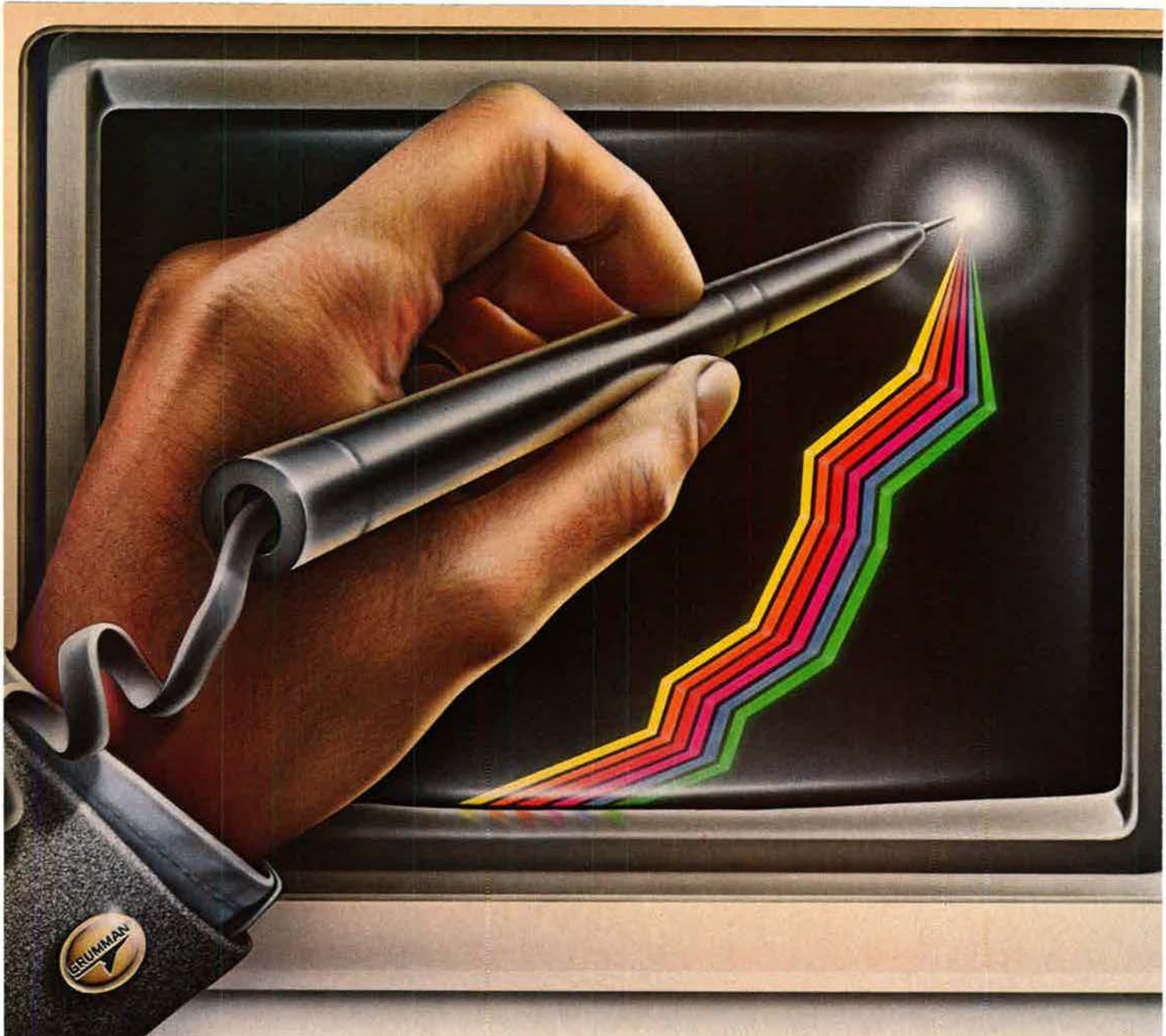

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certainties about the mix and performance characteristics of the US strategic arsenal in the years to come, Admiral Crowe warned that "we don't know whether the Soviets will emphasize mobile or hardened ICBMs, more dispersed and sheltered bombers, or ballistic missile submarines, some of which may be berthed in coastal tunnels." What is certain, on the other hand, is that the US will have to address uncertainties surrounding the evolving mix and location of Soviet offensive forces with a range of new, flexible weapon systems whose effectiveness will have to be validated through thorough testing, the JCS Chairman asserted. So long as this country's national security depends on nuclear deterrence, "we want that deterrent to be as effective and credible as possible. Nuclear testing is required to guarantee this," he stressed.

Testing is paramount also because it provides information essential to the effective deployment of nuclear weapons, such as the "confidence that the right weapon is applied to the right target. The lethality of nuclear weapons—theirs and ours—against hardened targets is one of our major concerns. So too is the expected survival and performance of such weapons in a nuclear environment." A nuclear environment would include extreme overpressures and highly intense radiation as well as electromagnetic pulse.

Nuclear testing provides the only reliable means for determining critical nuclear effects on surveillance and command and control systems and is indispensable for validating the performance of new weapons tailored to such new delivery systems as the MX Peacekeeper, cruise missiles, or the D-5 SLBM, Admiral Crowe told Congress. In this context, he pointed out that, at one time, "we had to recall all of our Polaris [SLBM] warheads because of reliability problems, which degraded inventory effectiveness by as much as seventy-five percent. Only nuclear testing allowed us to verify that Polaris modifications had solved this problem."

Lastly, nuclear testing is essential in designing new weapons of smaller size and lower weight for a given yield: "For years, the US has led the world in this aspect of nuclear technology, with considerable savings in the size and cost of delivery systems." But each new delivery system and associated weapon requires thorough testing before it can be counted on as part of the US strategic or tactical nuclear deterrent, the JCS Chairman emphasized in his testimony.

IN FOCUS...

Nuclear Testing Needed in Perpetuity?

In an elaboration of Admiral Crowe's testimony on CTBT, the Defense Department's Assistant Secretary for Nuclear Forces and Arms Control Policy, Frank J. Gaffney, Jr., told AIR FORCE Magazine that the Administration's position on nuclear weapons testing is that so long as the US relies on nuclear weapons for its deterrence, "we have to have confidence that they work and, therefore, [must] test." He added that even with the deployment of comprehensive strategic defenses derived from the SDI (strategic defense initiative) program, the need for some nuclear weapons would not go away. In turn, the US, therefore, will have to continue to test its nuclear stockpile.

The OSD arms-control expert expressed cautious optimism about congressional awareness of the importance of nuclear testing to national security. He pointed out that last year's joint resolution (HJ Res. 3) in favor of halting US nuclear weapons tests was—as were previous "nuclear freeze" resolutions—nonbinding and merely expressed congressional sentiments at one point in time. The vote would have gone the other way, he speculated, if the resolution had called for an unequivocal halt to all nuclear testing.

Currently pending before the House is a resolution that would ban US nuclear testing in a binding fashion. But this legislation, offered by Rep. Patricia Schroeder (D-Colo.), does not stand any realistic chance of passage, in his view: "I don't think Congress wants to impose an uninspected moratorium that in the [early 1960s] had such disastrous consequences" and that culminated in the detonation of a fifty-six-megaton device by the Soviets. This was the largest yield recorded since the start of the nuclear age.

Turning to a different category of ambiguity and uncertainty that attends arms-control verification, he pointed out that the US national technical means of verification did not detect in timely fashion the recent explosion of the nuclear reactor at Chernobyl in the Ukraine. "Our much vaunted eyes in the sky . . . don't see all of the USSR all of the time under all circumstances with the level of accuracy and real-time data return that is" popularly ascribed to the US intelligence collection capability, he asserted. Chernobyl, he added, was not considered a military "intelligence target."

Over time, the US overhead sensors probably would have spotted the extreme nuclear emissions emanating from that facility, just as they eventually detected the construction of the giant "illegal" ABM radar site at Krasnoyarsk and the out-of-control biological warfare experiments at Sverdlovsk, according to Secretary Gaffney. The US, in fact, first learned of the Chernobyl nuclear disaster through the contamination measurements taken by Sweden and other neighbors of the Soviet Union. The implications to the verifiability of arms-control accords that result from this experience, he suggested, are far-reaching and "reinforce the need for on-site inspection."

Asked about the Administration's perplexing arms-control proposal to ban all mobile ICBMs, the Pentagon's arms-control expert cited a range of reasons, including the Administration's recognition of the difficulties associated with establishing the actual number of fielded Soviet mobile ICBMs: "If [huge] radars are hard to find and if nuclear reactors that blow up can't be seen immediately," then pinpointing the number of mobile missiles that the Soviets would have every incentive to hide is a no-win proposition, he suggested.

Another consideration that caused the Administration to propose at the Geneva arms-reduction talks that all mobile ICBMs be banned was the question of whether or not Congress would actually okay the fielding of the Midgetman or any other mobile ICBM. There were profound reservations, Secretary Gaffney said, about congressional willingness to provide "a home for that missile" after the country might have invested billions of dollars in one mobile missile type or another.

The fundamental question that fostered the Administration's proposal to ban mobile ICBMs boiled down to this: "How, in the context of vastly reduced strategic forces [as sought by this country's arms-control policy], can we justify a treaty that would in effect provide an open invitation to the Soviets to circumvent" the limitations that are its *raison d'être*? With a sharply reduced US inventory of nuclear weapons, the consequences of Soviet breaches of such an accord's numerical ceilings could entail intolerable consequences to this country's deterrent capability, he said.

The value of the proposed ban of mobile ICBMs in practical military terms—as opposed to negotiation leverage—appears problematical. Secretary Gaffney readily acknowledged that the Soviets seem bent on continuing the development and deployment of such mobile ICBMs as the SS-24 and SS-25: "I personally believe that we will see the worst of both worlds, [with the Soviets continuing] to improve their silo-based [ICBMs] and [to bring] mobile systems on line." The Soviets, he added, don't seem to treat the issue of fixed and mobile systems as a "zero-sum game," where one type replaces the other, but as an opportunity for force expansion and diversification: "I don't think we have driven them out of their silos."

In the field of ballistic missile defense capabilities, he denied congressional allegations that the Administration was "stonewalling" ATBM (antitactical ballistic missile) defenses because of concerns that such weapons might detract from and dilute the SDI (strategic defense initiative) program: "Most people in the Administration consider ATBM a very significant issue . . . that complements and augments SDI. We welcome Capitol Hill and allied interest in ATBM." Under Secretary of Defense Donald Hicks, in similar fashion, told this writer that the Pentagon firmly supports development of ATBM as an extension of SDI.

Washington Observations

★ NATO's FOFA (Follow-on Forces Attack) concept for interdiction of attacking Warsaw Pact forces in their staging areas hundreds of miles behind the FLOT (first line of troops) suffered a setback when the US Army dramatically revised its FY '88 budget plan, or POM (program objective memorandum). Most of the funding initially proposed for the "Conventional Defense Initiatives," the budget account encompassing FOFA-related programs, was reportedly excised from the US Army's POM just prior to that document's submission to OSD. The overall, long-term investment in the conventional defense initiatives has been pegged at about $30 billion.

★ The Air Force eliminated the Precision Location Strike System (PLSS) from its FY '88 POM, putatively on grounds of technical difficulties, and opted instead to consider a substitute program that is expected to cost less and be of worldwide application. PLSS was optimized for use in Europe to pinpoint hostile radars from standoff positions several hundred miles away. PLSS sensors were to be carried by TR-1 aircraft and possibly also by stealthy platforms.

IN FOCUS...

★ The Air Force's recent decision to change the ATF (Advanced Tactical Fighter) program to a fly-before-you-buy prototype format will entail "down-selection" to two competitors by October of this year. At the same time, the decision to "prototype" the ATF will speed up first flight of actual hardware by about one year compared to the original schedule. As a result, ATF is likely to enter flight test by about 1989—ahead of the US Navy's Advanced Tactical Aircraft (ATA). Both aircraft are candidates for joint-service use.

★ Seemingly inevitable, sizable cuts of the defense budget by Congress have caused the Administration to stake out nonnegotiable priorities. The two "don't-touch" areas are reportedly strategic force modernization and a combination of forces and weapon systems needed for sophisticated, low-margin-of-error punitive operations similar to but more refined than the recent strikes against Libya. The Pentagon, so far, has not been able to come up with an official term for such operations, which are related to low-intensity conflict and SOF (special operations forces) missions, but which transcend both in terms of requirements for high-tech weaponry.

★ The Air Force this spring launched a special, comprehensive planning effort code-named "Constant Green" that is aimed at revitalizing its Special Operations Forces. A forty-five-member task force formed at the direction of the then Assistant Vice Chief of Staff, Lt. Gen. Robert Reed, will define programmatic and budget objectives for the revitalization of the SOF.

Under the current overall Air Force five-year plan, SOF is to be beefed up with the acquisition of twenty-one MC-130H Combat Talon IIs for long-range infiltration, exfiltration, and supply, twelve AC-130 gunships, and eighty CV-22A tilt-rotor aircraft. In addition, a number of HH-53s are to be retrofitted with the Pave Low sensor system, and several HC-130s will be modified as tankers. At present, fifty-two Air Force aircraft are dedicated to SOF missions.

Among the topics under review by Constant Green are integration of SOF and combat search-and-rescue missions within MAC's Twenty-third Air Force, airlift support of SOF, SOF threats and requirements, and support of congressionally mandated drug-interdiction efforts. The upshot of Constant Green is to be a unified plan that backs up USAF Special Operations Forces requirements with a realistic budget.

★ The Administration recently formed a high-level interagency technology assessment group to search for and evaluate high-leverage, advanced technologies that can boost the ability of NATO forces to repel Warsaw Pact aggression without resorting to the early use of nuclear weapons. The assessment group is made up largely of senior civilian and military Pentagon officials, but also includes representatives of the White House and the Central Intelligence Agency.

Candidate technologies to be evaluated include "supersmart" ordnance, advanced ground-based and airborne sensors, stealthy and conventional remotely piloted vehicles (RPVs) and cruise missiles, the advanced sensors associated with the national technical means (NTM) of verification of Soviet compliance with arms accords, and spinoffs from the SDI research effort.

★ Defense Secretary Caspar Weinberger, in a detailed report to Congress on "Allied Contributions to the Common Defense," disclosed that "the US is expending between six and seven percent of its gross domestic product on defense, while the NATO allies are spending about 3.5 percent on a weighted average basis, and Japan is spending about one percent. Also, the US is increasing its real defense expenditures at a higher rate than most of its allies."

These statistical factors notwithstanding, he warned Congress however that "achieving US security goals would cost much more if the NATO alliance and our partnership with Japan were permitted to become weak as a result of divisive arguments over defense burden-sharing." Secretary Weinberger's report stressed that "unilateral pronouncements by the US on the extent to which our allies are or are not sharing [the defense burden] are not an effective formula for encouraging improved allied efforts. Our positive leadership has always been, and will remain, a better means to ensure the adequacy of our common defense effort." ■

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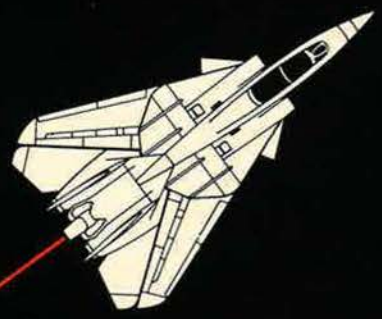

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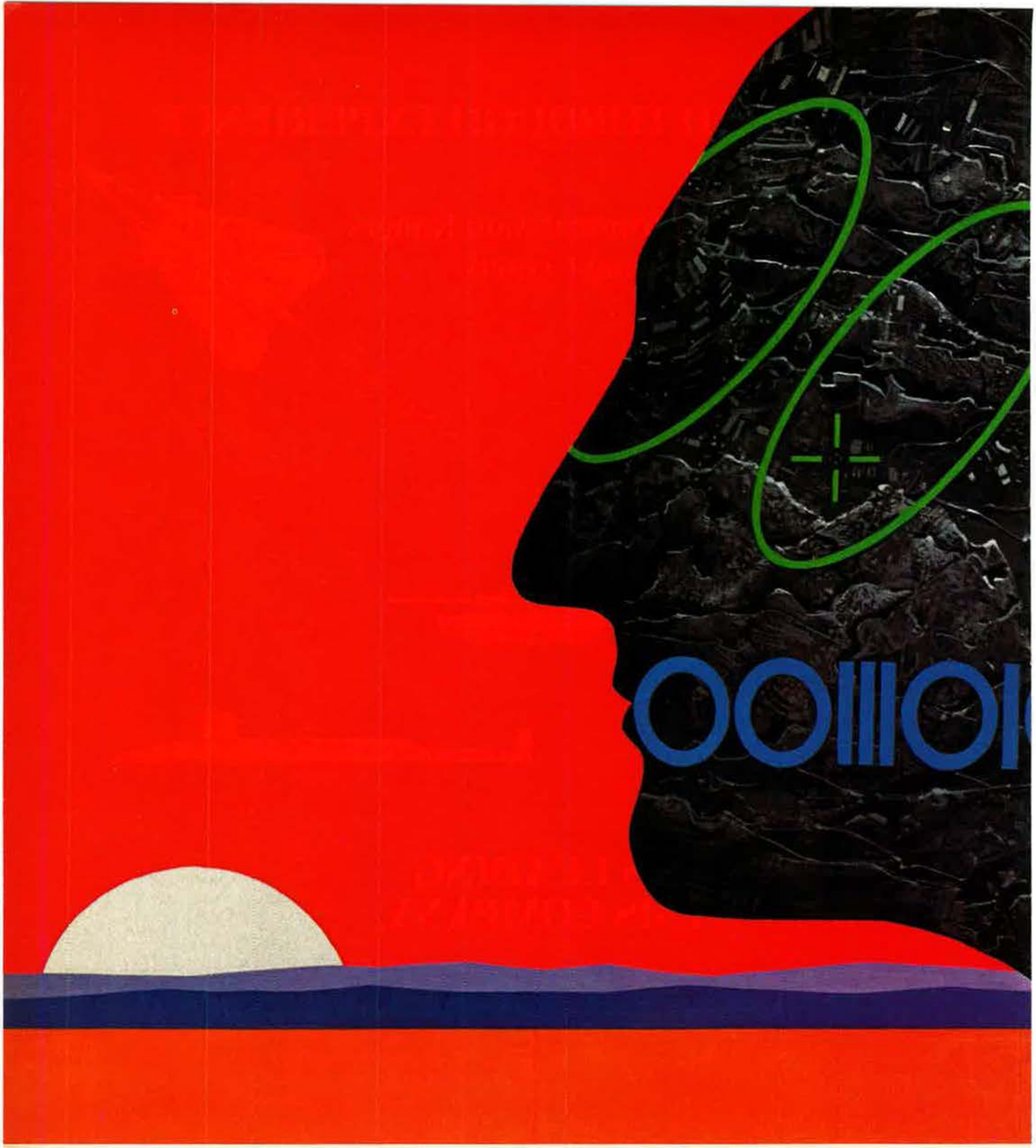

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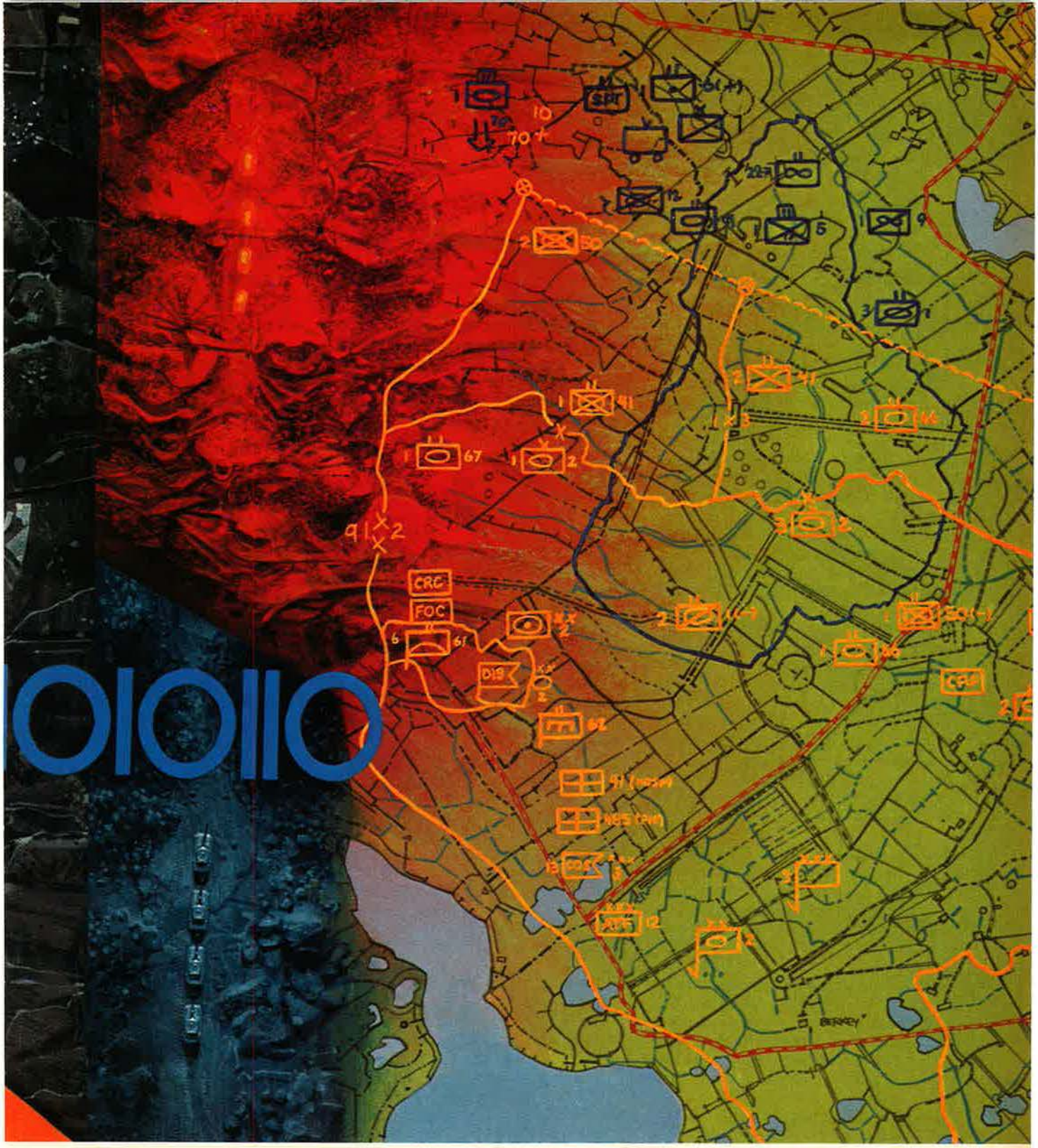

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CAPITOL HILL

By Brian Green, AFA DIRECTOR OF LEGISLATIVE RESEARCH

Washington, D. C., May 27

Senate Approves Budget

The Senate, by a vote of 70–25, approved an FY '87 budget that authorizes $301 billion for defense (including Department of Energy military programs), a $19 billion reduction from the Reagan Administration request of $320.3 billion. It amounts to a real, inflation-adjusted increase of about 1.5 percent over the final FY '86 spending level. Actual defense spending (outlays) in FY '87 for the Senate package is projected at $282 billion. The Congressional Budget Office predicts outlays of $297 billion for the Reagan budget.

The Senate-approved defense budget is $6 billion higher in spending authority and $2 billion higher in outlays than the levels approved by the Senate Budget Committee. The higher defense figure resulted from a compromise engineered by Senate Majority Leader Sen. Robert Dole (R-Kan.), who was concerned by a lack of support among Republican senators for the Committee package.

House Also Approves Budget

The House, by a 245–179 vote, approved its budget resolution, which calls for $285 billion in budget authority (with a $3 billion set-aside, subject to a review of unspent DoD funds) and $276.2 billion in outlays for defense. The House budget reduces the Reagan request by $35 billion and is about $2 billion less, in nominal dollars, than the amount finally approved for FY '86—an inflation-adjusted decrease in defense authority of four to six percent.

Administration reaction to the budget resolutions has been markedly negative, particularly toward that of the House. The White House characterized the House spending package as a "radical antidefense budget" that would "cripple the combat readiness of our conventional forces and take unacceptable risks with our national security."

The Pentagon also released a statement detailing potential effects of the proposed reductions. These include the cancellation of the C-17 airlifter, the Joint Surveillance and Target Attack Radar System (Joint STARS), the Air Defense Competition, and all new R&D starts; stretch-outs of F-16 and F-15 procurement and a one-year delay in the Small ICBM program; and deactivation of one F-4E wing. Large reductions would also have to be imposed in munitions acquisition and real property and depot maintenance, according to the DoD statement.

The differences between the budget resolutions must now be reconciled in a House-Senate conference. Some critics of the House resolution believe that the bargaining position of the Republican-dominated Senate has been undermined by an alternative budget offered by the House Republican leadership that included $293 billion for defense, amounting to $8 billion less than the Senate figure. That proposal was soundly defeated.

Chairman of the House Armed Services Committee (HASC) Rep. Les Aspin (D-Wis.) has also expressed reservations about the low level of defense funding in the House package. He further contends that the way the budget authority and outlay cuts were made in both the House and Senate resolutions dictates that readiness and manpower will be cut more deeply than weapons programs.

Senate Passes Defense Reorganization

The Senate, by an overwhelming 95–0 margin, passed the defense reorganization bill approved last March by the Senate Armed Services Committee *(see also "Capitol Hill," p. 30, May '86 issue).* The bill is intended primarily to improve "jointness" by strengthening the Organization of the Joint Chiefs of Staff and enhancing the authority of the CINCs and unified commanders.

A major amendment to create the post of Under Secretary of Defense for Acquisition was approved on the floor of the Senate. Sections delineating the experience and duties of the new Under Secretary were considered, but did not receive final approval.

The House approved a JCS reform bill in November. Approval of other defense reorganization measures by the HASC is expected this summer.

Aspin Clarifies SICBM Position

Rep. Les Aspin (D-Wis.), one of the key congressional supporters of the SICBM, has backtracked on his philosophical opposition to a multiwarhead (MIRVed) SICBM, but continues, on political grounds, to support strongly a single-warhead version of the missile.

In a statement attached to a February study of the SICBM by the HASC, Representative Aspin argued then that a single-warhead missile is desirable because, if two warheads were used to destroy an enemy missile, "[W]e would have to expend 200 Midgetmen in order to knock out only 100 Soviet missiles. . . . Midgetman, in other words, provides real stability."

In a recent hearing before the HASC Policy Panel, however, he argued that mobility is the key to SICBM survivability and, thus, to stability, regardless of MIRVing: "I've got no problem with more warheads on it." But he expressed deep concern that the ICBM issue was "so sensitive, so volatile" that he would not make the trade between the money saved by MIRVing and the delay incurred by changing the missile design. Significant changes and delay could cause the program to "lose focus," and, he contended, "We could end up with no missile at all."

Under Secretary of Defense for Research and Engineering Donald Hicks, at the same hearing, suggested that one alternative being explored would not delay the missile's initial operating capability at all. That option involves placing two lightweight warheads on a 37,000-pound SICBM, the missile weight currently favored by Representative Aspin and most others in Congress. Secretary Hicks also stated his belief that the full force of small missiles would be deployed on schedule, regardless of the missile configuration eventually chosen. ■

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Compiled by Jeffrey P. Rhodes, DEFENSE EDITOR

Washington, D. C., June 2 ★ On May 2, the Naval Air Systems Command (NAVAIR) awarded a $1.714 billion fixed-price incentive contract to Bell Helicopter Textron of Fort Worth, Tex., and Boeing Vertol Co. of Philadelphia, Pa., for full-scale development (FSD) of the V-22 Osprey tilt-rotor aircraft. The FSD program for the multimission, multiservice, vertical takeoff and landing aircraft will last seven years.

FSD plans call for the building of three structural- and ground-test examples and six flying prototype aircraft. Boeing Vertol has overall responsibility for the aircraft's empennage, overwing fairings, and the fuselage, while Bell will build the wing, nacelles, transmissions, and rotor and hub assemblies and will integrate the two Allison 501-M80C 6,000-shp-class engines. After a swap of components, each of the two companies will build three of the prototypes.

The contract is unusual in that the Defense Systems Acquisition Review Council (DSARC) and the Navy (the lead service) will perform incremental reviews on the program in the first quarter of FY '87. The results of the reviews will determine the continued development of the V-22.

First flight is planned for June 1988, and production deliveries will begin in December 1991 to the Marine Corps, which plans to buy 552 MV-22s for combat assault and assault support. Deliveries to the Navy (fifty HV-22s for search and rescue, with a possible later order for 300 aircraft for antisubmarine warfare duties) and the Air Force (eighty CV-22s for special operations) will begin in late 1992. The Army will start receiving its complement of 231 aircraft for multimission duties in mid-1993.

The V-22 program also has a number of "firsts" associated with it. The Osprey is the:

- First weapon system to be developed from the start to meet the needs of all four services.
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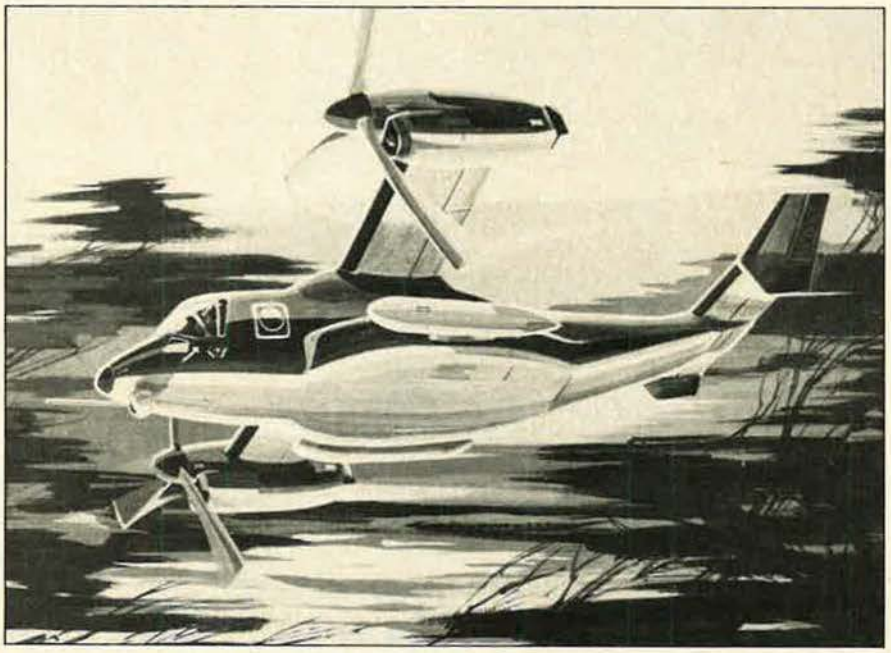


A $1.7 billion contract has been awarded to Bell Helicopter Textron and Boeing Vertol to begin full-scale development of the V-22 Osprey. The Air Force has an order for eighty CV-22s. The CV-22 will be used for special operations.

Welch Nominated as Chief of Staff

Gen. Larry D. Welch has been nominated by President Reagan to become the twelfth Air Force Chief of Staff. He will succeed retiring Gen. Charles A. Gabriel, who has held the post since 1982. The current Commander in Chief of Strategic Air Command, General Welch started his career as an enlisted man in the Kansas National Guard. He later enlisted in the Air Force and entered the aviation cadet program. Receiving his wings in 1955, he flew combat missions over Laos and Vietnam during 1966–67. He has also served as Chief of the Fighter Division at the Pentagon, Commander of the 1st Tactical Fighter Wing, Commander of Ninth Air Force, and Deputy Chief of Staff of USAF. General Welch is married to the former Eunice Ellis, and the Welchs have three children, one of whom, Paul, enters the Air Force Academy this summer.

designed by computer, rather than by engineering drawings.

- First full-scale tilt-rotor development program ever undertaken.
- First production aircraft whose airframe will be fabricated almost entirely of composites. Only about 1,000 pounds of metal will be used.
- First weapon program where the contractor will finance most of the tooling costs.
- First aircraft whose wing can be rotated ninety degrees to allow shipboard storage.
- First fixed-wing aircraft to use cross-connected propulsion systems, which provide balance even when one engine is not operating; and
- First program where two US helicopter manufacturers have agreed to build a new airplane.

The flyaway cost of the V-22 is expected to be around $16 million each.

★ As this is being written, Congress is on the verge of making major changes to the military retirement system. Both the Senate and the House of Representatives have passed retirement reform bills, but there are considerable differences in the two pieces of legislation, and the prospect was that a conference committee would be set up to work out a compromise.

The major differences lie in the retirement multiplier and the way the average base pay is figured. On the multiplier, the Senate version (which is the plan put forth by the Department of Defense) would pay forty-four percent of base pay at twenty years, while the House version would pay forty percent at twenty years. While both chambers' programs will pay seventy-five percent of base pay upon retirement at thirty years, the annual percentage increases between the two bills also varies.

The House version averages its payments on the five highest-earning years a member served upon retirement at twenty years, while the Senate version bases its payments on the three highest-earning years.

President Reagan presented one of aviation's highest honors, the Harmon Trophy, to Sen. Barry Goldwater (R-Ariz.), right, and XV-15 test pilot Dorman Cannon (behind President Reagan) on May 29 for their lifetime support of aviation and for their achievements as pilots. (Photo by Mary Anne Fackelman-Miner)

As passed, the House interpretation will result in a savings of $3.1 billion per year, while the Senate solution will produce a yearly savings of $2.9 billion. An individual's lifetime earnings will be fifteen percent less under the Senate's plan, while the House's definition will result in twenty percent less in lifetime earnings.

It must be emphasized, however, that once a compromise is reached and the law enacted, the reform will affect *only* those people who join the services after that date. Current members of the armed forces and current retirees are "grandfathered" under the old system and are not affected by the new legislation.

Any major change to the retirement system, however, is expected to affect retention.

★ "The most destabilizing part of our balance [of power] with the Soviets in the NATO area is chemical weapons," said Gen. Charles A. Gabriel, Air Force Chief of Staff, at the Global Aerospace Symposium at AFA's recent Gathering of Eagles in Las Vegas, Nev.

General Gabriel went on to say that binary weapons, or ones that consist of two chemicals that become toxic only when they are mixed upon release, are the best way to modernize the US chemical arsenal. "It's not a question of adding to what we've got," noted the General. "We don't have a credible retaliatory capability today. It's as simple as that.

"The Soviets look on chemical weapons as part of conventional war-

The Northrop F-20 Tigershark, one of the two aircraft involved in the Air Force's Air Defense Fighter Competition, recently passed the 1,500-flight milestone at the Air Force Flight Test Center at Edwards AFB, Calif. In more than three and a half years of flying, the F-20 has met or bettered all of its performance goals. The Air Force will decide the winner of the competition later this year.

fare. They train that way. They would not, I think, find it persuasive if we had . . . a policy of nuclear response. We do need the binary weapons to replace one for one, or less than that, to give us an offensive retaliatory capability," General Gabriel concluded.

In late May, the NATO defense ministers, despite strong reservations from Denmark, the Netherlands, and Norway, endorsed a set of Alliance military plans that would allow the US to produce the binary weapons.

★ Also at the Global Aerospace Symposium, Adm. Wesley L. McDonald, who recently retired as the Commander in Chief of the US Atlantic Fleet (CINCLANT), described what the Navy's submarine attack plans for the opening rounds of a conflict would be.

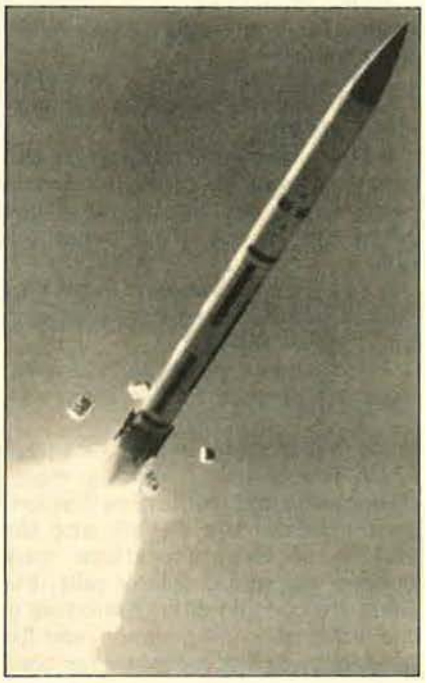
AEROSPACE WORLD

Admiral McDonald, who has also served as Deputy Chief of Naval Operations, said, "As soon as there are indications that we're getting close to conflict, the whole US submarine force is going to be put to sea. We are going to be forward deployed, and we will, at the first indication that conflict has started, start sinking Soviet [attack and ballistic missile] submarines. We're going to get anything that's underwater, and it's going to go as soon as we can get a hold of it. . . . They will try to do the same to us—but they are behind in ASW [antisubmarine warfare] capability. [We] will strive to improve [in this area]. NATO and allied subs will be out looking, too. We think we will do mortal damage to their submarine force early on and, of course, their surface force."

There will be a complete report on the Global Aerospace Symposium in next month's AIR FORCE Magazine.

During twenty-one years of operation, this Armament Division F-4 accumulated more than 2,600 hours of flight time before being retired on May 16 to the Air Force Armament Museum. The pilot for the last flight was Col. Jimmy Sharp, Vice Commander of the 3246th Test Wing. Maj. Joe Boyles flew as WSO.

On April 5, a storage tank partially filled with JP-4 aviation fuel exploded at Osan AB, South Korea, killing sixteen people and injuring eleven more. The blaze was brought under control in eighteen hours. Units from ten military installations and the Songtan City Fire Department were called in to fight the fire. Swirling winds blew chemical foam over these firemen. (USAF photo by SrA. Tony Lambert)



On April 20, the Army's Flexible Lightweight Agile Guided (FLAG) Experiment Program hypersonic test vehicle, shown above at launch, destroyed an aluminum sphere suspended below a balloon at 15,000 feet. The FLAG program is part of the SDI effort.

★ "It was a great team effort," said Vice Adm. Henry Mustin, Commander of the Second Fleet, after a joint Navy and Air Force Harpoon missile firing exercise recorded a perfect six-for-six score. The April 20 exercise, a part of FLEETEX 2-86, featured launches of the AGM-84 from air, surface, and underwater platforms.

A B-52G from the 42d Bomb Wing at Loring AFB, Me., led off the exercise by firing a Harpoon into a target hulk at extended range. The bomber re-

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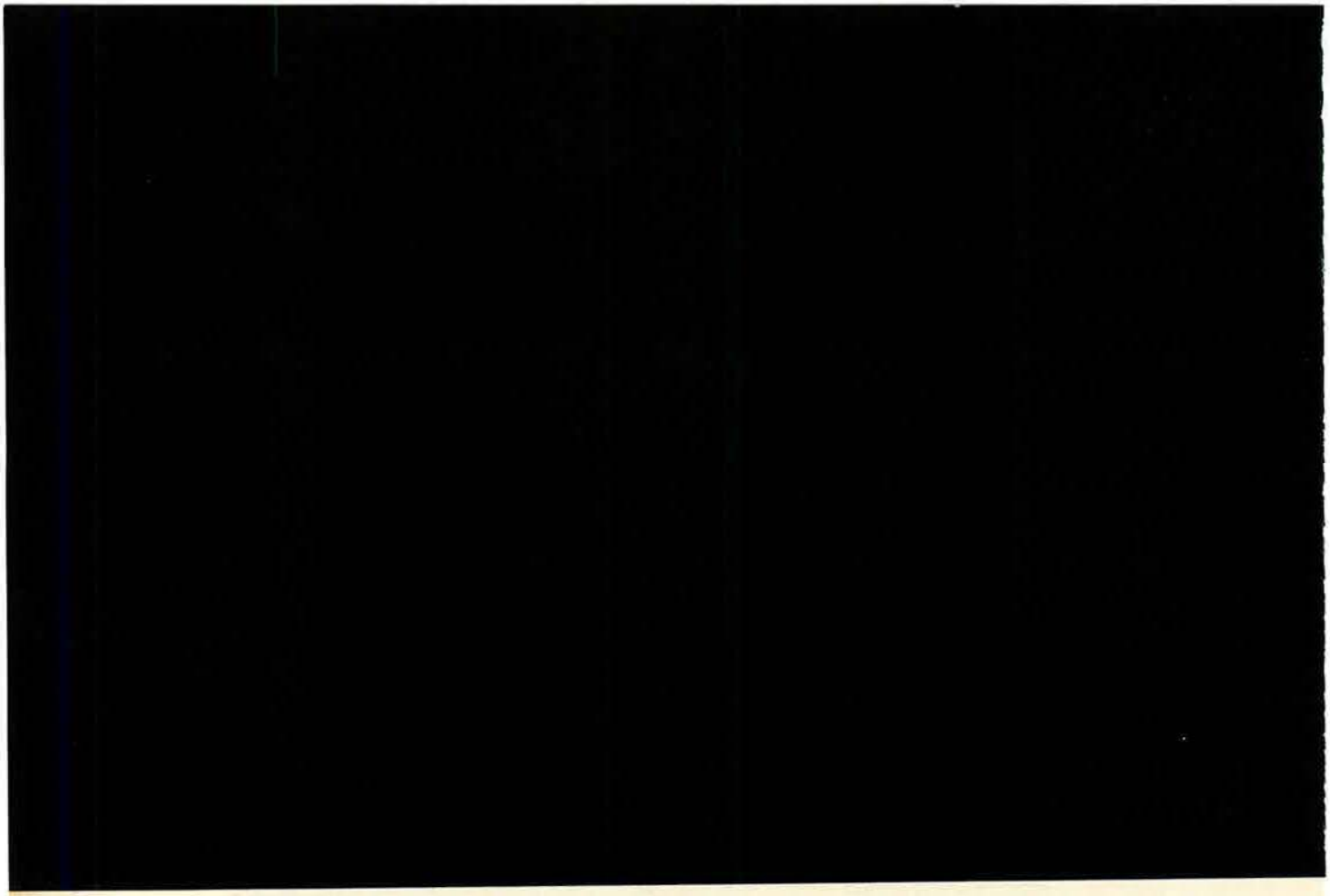

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L T V : L O O K I N G A H E A D

ceived targeting data from Navy units before the launch. This was also the first B-52 launch of the nearly thirteen-foot-long missile in a Navy fleet exercise.

Two submarines, the battleship USS *Iowa* (BB-61), the cruiser USS *Josephus Daniels* (CG-27), and an A-6E from VA-176 aboard the USS *Forrestal* (CV-59) recorded the other hits.

★ Over the past twenty-five years, 109 of the most famous people in the history of aviation and space have been inducted into the National Aviation Hall of Fame in Dayton, Ohio. This July 26, the Hall will mark its silver anniversary with the induction of two prominent Army Air Forces figures, Lt. Gen. Frank M. Andrews and Maj. Richard I. Bong; two who made significant contributions to aviation, Gerhard Neumann and Allan H. Loughhead; and one former astronaut, Capt. Walter M. Schirra, USN (Ret.).

AEROSPACE WORLD

Lt. Gen. Frank M. Andrews (1884–1943) came into aviation late in his career, having earned his wings at age thirty-four. He was instrumental in the reorganization of the Army Air Corps and in the planning for the establishment of a consolidated General Headquarters Air Force. General Andrews became commanding general of the US forces in the ETO in 1943. He was killed later that same year in a crash in Iceland. Camp Springs Army Air Field, Md., was renamed Andrews AFB in his honor.

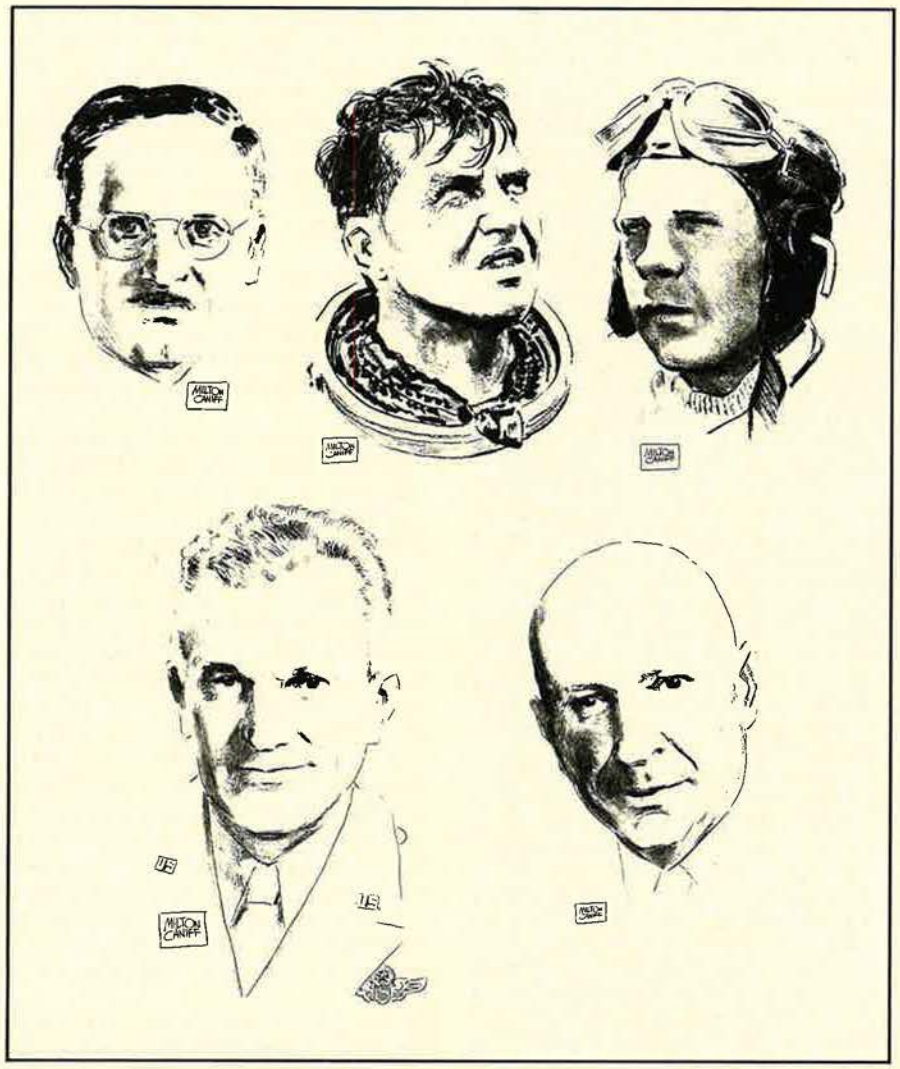
Maj. Richard I. Bong (1923–1945), America's ace of aces, with forty enemy aircraft to his credit, was the first World War II fighter pilot to break Capt. Eddie Rickenbacker's World War I record of twenty-six victories. During the war, Major Bong requested permission to go to gunnery school, and upon his return to the South Pacific, he upped his tally to thirty-six kills. He was then awarded the Medal of Honor. He recorded his last four victories and was sent back to the US. Ironically, Major Bong was killed in a P-80 accident on August 6, 1945, the day the atomic bomb was dropped on Hiroshima.

Gerhard Neumann (born 1917), an engineer with the Flying Tigers in China, was permitted to join the Army Air Corps in 1942 by permission of the Secretary of War, even though he was a German citizen. Made a US citizen by an Act of Congress, Mr. Neumann went on to develop the variable stator compressor system for jet engines and was instrumental in the development of General Electric's reliable J79 engine. Now living in Massachusetts, Mr. Neumann holds eight patents and has won the Collier Trophy, the Goddard Award, and the Daniel Guggenheim Medal.

Allan H. Loughhead (1889–1969) had a number of ups and downs during his varied aviation career. In 1910, Mr. Loughhead, along with George Gates, made the first dual-pilot controlled flight. Mr. Loughhead (who endured many years of mispronunciation before having his name legally changed to Lockheed in 1934) started Lockheed Aircraft Corp. in 1926 after one earlier effort went bankrupt. Unhappy with a stock buyout, he resigned in 1929. His third company, Alcor Aircraft, was ruined by a disastrous test flight in the late 1930s. Mr. Lockheed died in 1969 after serving as a consultant to his namesake company.

Capt. Walter M. "Wally" Schirra, USN (born 1923), was the only astronaut to fly on Mercury, Gemini, and Apollo missions. A naval aviator, he flew more than ninety missions in Korea in an F-84E as an exchange pilot with the Air Force's 154th Fighter-Bomber Squadron. While participating in the development of the Sidewinder missile, he nearly shot himself down when an errant missile started tracking his own aircraft. He flew on the Mercury-Atlas 8 mission in 1962, commanded the Gemini VI-A mission in 1965, and commanded the Apollo-7 mission, the first successful manned launch of the Apollo spacecraft, in 1968. Mr. Schirra is now in private business.

Past inductees who have service



The 1986 inductees into the Aviation Hall of Fame in Dayton, Ohio, are (from left, top row) Allen H. Loughhead (Lockheed), Navy Capt. Walter M. "Wally" Schirra, and Maj. Richard I. Bong. Bottom row: Lt. Gen. Frank M. Andrews and Gerhard Neumann.

connections to the Air Force include H. H. "Hap" Arnold, Frank Borman, Albert Boyd, George S. Brown, Claire Lee Chennault, Michael Collins, James H. Doolittle, Ira C. Eaker, Carl B. Eielson, Benjamin D. Foulois, Francis S. Gabreski, Barry M. Goldwater, Albert F. Hegenberger, George C. Kenney, Frank P. Lahm, Curtis E. LeMay, Charles A. Lindbergh, Frank Luke, Jr., John A. Macready, William Mitchell, Edward V. Rickenbacker, B. A. Schriever, Thomas E. Selfridge, Carl A. Spaatz, John Paul Stapp, Nathan F. Twining, Leigh Wade, and Charles E. Yeager.

Senator Gore Advocates "Deutchman"

Sen. Albert Gore, Jr. (D-Tenn.), has come out in support of a mobile, 37,000-pound, single-warhead Small ICBM, which the Senator has dubbed the "Deutchman" (after John Deutch, the chairman of the Defense Science Board study recommending the larger SICBM). The new missile would be "an extremely potent weapon, with stunning accuracy and devastating destructive power," and, because of its mobility, would force the Soviets to expend vast resources—in some cases, their entire strategic arsenal—in any attack against US nuclear forces.

The Senator made his remarks in a recent interview with AIR FORCE Magazine after spotting Sen. Pete Wilson (R-Calif.) making "The Case for a Bigger Midgetman" in the April '86 issue of this magazine. Senator Wilson believes the SICBM should carry multiple warheads.

Senator Gore shares Senator Wilson's view that the vulnerability of the land-based missile leg of the triad must be rectified. "The advantages of the ICBM force cannot be so easily discounted," he said. "If . . . we find our national security resting on a small number of very large submarines, and if . . . the ocean is painted transparent by some now unforeseen technology, we will rue the day we gave up on the triad, which served us so well for so long." He sees the SICBM as the key to ICBM modernization and believes that the consensus that has developed in support of the SICBM is important: "In a democracy, a consensus is itself a strategic asset. If we thoughtlessly destroy a domestic consensus . . . we are to that extent unilaterally disarming ourselves."

He disagrees strongly, however, with the efforts by Senator Wilson and others to make the missile bigger. Senator Gore accepts modest growth, from the 30,000 pounds now approved by Congress to 37,000 pounds, to accommodate penetration aids, though he avers that the need for penaids is based on "speculation . . . that future Soviet defensive environments might require enhanced penetrability." He is opposed to putting multiple warheads (MIRVs) on the SICBM, however. With its currently intended warhead and penetration aids, a MIRVed SICBM might weigh 50,000–75,000 pounds, and Senator Gore believes that the mobility, and thus survivability, of any missile larger than 37,000 pounds would be significantly reduced. Moreover, MIRVing, he says, complicates the pursuit of strategic stability.

Senator Gore is critical of the Administration's offer to ban all mobile missiles. He claims that the US has verified the number of deployed mobile systems in the past, including ballistic missile submarines and the Soviet SS-20 intermediate-range missile. Furthermore, "There are cooperative measures upon which we should seek agreement with the Soviet Union that would make verification of mobile missiles much easier." He also suggests that the real motivation behind the proposed ban is not a concern for adequate verification, but rather an inability to locate Soviet missiles on a real-time basis for purposes of targeting.

The Senator evinces much less enthusiasm for two other elements of the strategic modernization program that are strongly supported by Senator Wilson: MX and SDI. While he supports "robust studies" to determine whether or not MX can be deployed in a survivable basing mode (he sees "carry hard" as a promising alternative), he says we are "years away from answering that question." He also supports a "reasonably robust" SDI research program to determine whether a "nearly perfect" strategic defense is technologically feasible. Senator Gore says, however, that many SDI proponents reject the goal of near-perfect defense and see SDI as a means of developing defenses to protect offensive retaliatory forces. That, he believes, reduces strategic defense to one of a number of alternatives that must be judged on the basis of the consequences of deployment and cost-to-attack—calculations that lead Senator Gore to his strong support of the Small ICBM.

—By Brian Green
AFA Director of Legislative Research

AEROSPACE WORLD

★ On June 1, the Air Force began testing all active-duty members worldwide for the antibodies associated with acquired immune deficiency syndrome (AIDS). The testing program is expected to last two years.

Testing of all medical personnel and airmen subject to rapid deployment began in February. Approximately 7,000 people have been screened so far for the human T-cell lymphotrophic virus (HTLV) type III, which is found in people who have been exposed to AIDS.

Initial testing was conducted by the Epidemiology Division of the Air Force School of Aerospace Medicine at Brooks AFB, Tex. A private contractor, operating under the aegis of the Epidemiology Division, will take over the testing later this year. Roughly 200 specimens are being tested daily.

The Air Force initiated the tests for two primary reasons. The first is to identify anyone whose health would be jeopardized by continued military service. This includes persons who, if they were sent to a country where they might be exposed to malaria or other diseases, could die from such exposure because of a compromised immune system. The second reason is to identify people who should not be allowed to donate blood.

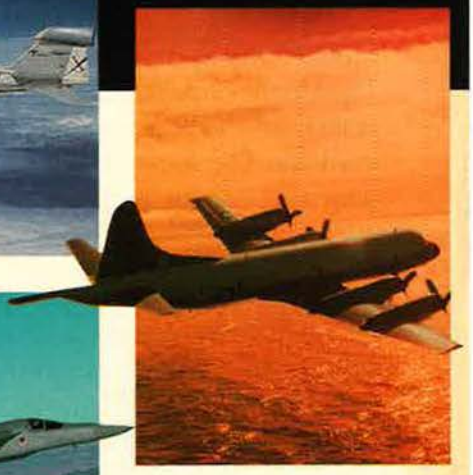
Those people considered unfit for continued service after medical examinations may be medically retired or placed on a temporary disabled retirement list. Members will be separated if they are medically unfit to serve. Those who have the virus but are otherwise healthy will remain on active duty.

★ In a recent Air Force Policy Letter for Commanders, Gen. Robert T. Herres, Commander in Chief of US Space Command, wrote on the relationship between research and deterrence.

General Herres, who is also the CINC of North American Aerospace Defense Command (NORAD), explained that "the policy of deterrence and our national interests demand that we investigate new technologies that might shift existing weapons platforms and strategies toward defensive systems. A very modest investment, roughly one percent of the DoD budget each year, may be sufficient to determine if such technological opportunities will enable a breakthrough. Making such a determination should be the goal of all those concerned with the defense of our nation. No one can be expected to know precisely how much we should spend on defense, but we all know what the ultimate and inevitable outcome would be if we spent too little."

★ On July 1, the National Air and Space Museum (NASM) will celebrate its tenth anniversary. Over the past decade, "America's birthday gift to itself," as President Gerald Ford called

The Threats Are There



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A head-up display (HUD) that provides a wide field of view can be retrofitted on fighter aircraft to give pilots vital sensor and steering data, even in low-altitude flights at night and under poor visibility. The display allows pilots to read key instrument symbology without looking into the cockpit. Information such as airspeed, heading, and target data is superimposed on a diffractions optics combiner mounted at the pilot's eye level. Compared with conventional displays of mirrored glass, the HUD has a wider field of view, is more transparent, has brighter symbology, and reduces glare and sunballs. Hughes Aircraft Company pioneered the technology used in diffraction optics displays, which incorporate holographic techniques and lasers.

With the new laser-guided Maverick missile, U.S. Marine Corps pilots can acquire targets more quickly with less risk than with currently available weapons. The weapon improves the Marine Corps' ability to conduct close air support by striking targets near friendly troops with pinpoint accuracy. It can be fired from safe stand-off distances to minimize a pilot's exposure to enemy fire. Laser Maverick locks on to the reflection of a coded laser beam aimed at a target by ground troops or an aircraft crew. If the missile's seeker loses the illuminated spot, as when a designator is turned off, the warhead is automatically disarmed. The missile then guides itself beyond the target and front-line area. Laser Maverick, in production at Hughes, will be carried by AV-8B, F/A-18 Hornet Strike Fighter, A-6E, and A-4M aircraft.

Acting as a kind of design and manufacturing prompter, a new artificial intelligence network increases productivity by automatically generating instructions for assembling complex electro-optical devices. The Hughes Integrated Classification System (HICLASS™) analyzes product design information to determine the best assembly techniques. It then selects the most efficient manufacturing processes available. Operators, on demand, are able to call up appropriate graphical and text instructions in color as they interact step by step with the system. As a result, workmanship improves substantially and products are made better.

Military commanders at separate headquarters can share up-to-the-minute information, thanks to a new automated message processing system for Command and Control Information Systems (CCIS). The system, developed by Hughes, handles a wide range of formatted and unformatted messages as specified in the Joint US/NATO military reporting system. It will dramatically lessen the time needed to update planning, intelligence, and force status information in command and control systems. The system can receive messages over a variety of digital links. Messages can be drawn automatically from complex relational databases, or be used to update information automatically. Information can be displayed on screens in a variety of formats, and be modified by commanders.

A new processing technique eliminates impurities in an optical fiber that has promising uses in the mid-infrared region of 1 to 5 micrometers. Zirconium fluoride glass fibers, which are typically prepared in an atmosphere of inert gases, contain defects that scatter light transmissions and preclude their use in long fiber links. Scientists at Hughes Research Laboratories, however, have prepared molten glass at 850°C using a novel reactive atmosphere process. This special process completely eliminates the chemical interaction with impurities, which yield light-scattering defects.

For more information write to: P.O. Box 45068, Los Angeles, CA 90045-0068

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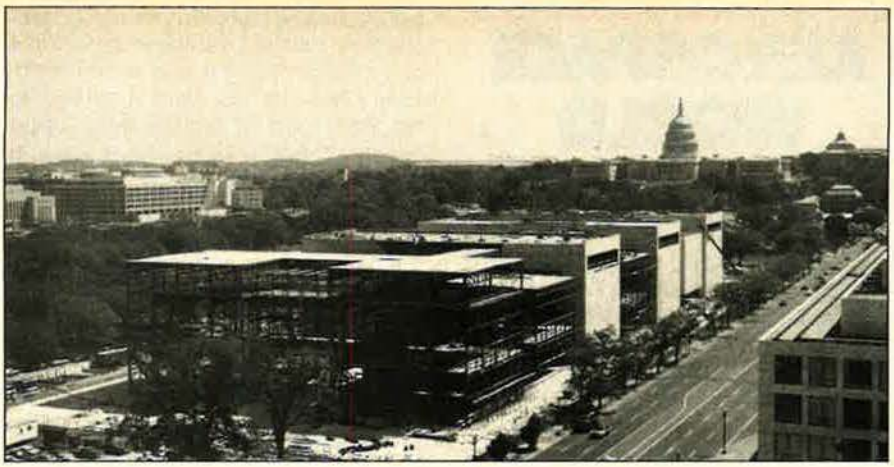


This month will mark the tenth anniversary of the National Air and Space Museum. Construction of the building was started in 1972. As this 1974 photo shows, the museum exterior was only partially covered by the eventual 280,000 square feet of Tennessee pink cedar marble, and it still had some of the 5,600 tons of structural steel exposed. Since its opening in 1976, NASM has played host to more than 105,000,000 visitors.

the museum, has played host to more than 105,000,000 people, making NASM the most visited museum in the world.

Although the building is celebrating its tenth anniversary, the collection of aviation and space artifacts dates to 1876, when a group of Chinese kites was given to the Smithsonian Institution. The National Air Museum was chartered in 1946, and it displayed the collection in a Quonset hut and in the Arts and Industries building. In 1966, the charter was amended to add the words "and Space" to the title. Construction of the new building was also authorized that year.

Construction began in 1972 and was completed four years later, on time and under budget. The $40 million, 635-foot-long, 225-foot-wide, and eighty-three-foot-high building contains 5,600 tons of steel and is covered by 280,000 square feet of Tennessee pink cedar marble.

Over the past ten years, seven of the twenty-three major galleries have been replaced, and the Samuel P. Langley Theater has added four new IMAX films. The Air and Space Museum now has a collection of some 320 aircraft and more than 100 spacecraft, including one on another planet. The Viking lander on Mars, which sent a signal to its duplicate on earth to cut the ribbon that marked the opening of the museum in 1976, was ceded to NASM in 1984.

SENIOR STAFF CHANGES

RETIREMENTS: B/G Christian F. **Dreyer,** Jr.; M/G Donald W. **Henderson;** B/G Robert L. **Kirtley;** M/G Stuart H. **Sherman,** Jr.

CHANGES: B/G John A. Corder, from Dir., Electronic Combat, DCS/P&O, Hq. USAF, Washington, D. C., to Dir., Electronic Combat, DCS/RD&A, Hq. USAF, Washington, D. C. . . . **M/G Donald L. Cromer,** from Vice Cmdr., SD, AFSC, Los Angeles AFS, Calif., to Cmdr., SAMTO, and Dep. Cmdr. for Launch Ops., AFSC, Vandenberg AFB, Calif., replacing retired M/G Donald W. Henderson . . . **M/G Thomas G. Darling,** from Vice Cmdr., 15th AF, SAC, March AFB, Calif., to C/S, Hq. USLANTCOM, Norfolk, Va.

B/G John M. Davey, from Cmdr., 832d AD, TAC, Luke AFB, Ariz., to Cmdr., 26th AD/NORAD Region, TAC, March AFB, Calif., replacing retiring B/G Christian F. Dreyer, Jr. . . . **M/G Jack K. Farris,** from DCS/Op. Plans, and Dep. Dir. for SIOP, JSTPS, Hq. SAC, Offutt AFB, Neb., to Vice Cmdr., 15th AF, SAC, March AFB, Calif., replacing M/G Thomas G. Darling . . . **B/G (M/G selectee) Richard B. Goetze, Jr.,** from Dir., C^2, Hq. SAC, Offutt AFB, Neb., to DCS/Op. Plans, and Dep. Dir. for SIOP, JSTPS, Hq. SAC, Offutt AFB, Neb., replacing M/G Jack K. Farris.

Col. (B/G selectee) Thomas W. Honeywill, from C/S, Hq. AFSC, Andrews AFB, Md., to Spec. Asst. for SDI, DCS/RD&A and AFSC, Washington, D. C., replacing B/G Robert R. Rankine, Jr. . . . **Col. (B/G selectee) Arlen D. Jameson,** from Cmdr., 90th SMW, SAC, F. E. Warren AFB, Wyo., to Dir., C^2, Hq. SAC, Offutt AFB, Neb., replacing B/G (M/G selectee) Richard B. Goetze, Jr. . . . **M/G Donald J. Kutyna,** from Dir. of Space Systems and C^3, DCS/RD&A, Hq. USAF, Washington, D. C., to Vice Cmdr., SD, AFSC, Los Angeles AFS, Calif., replacing M/G Donald L. Cromer.

B/G (M/G selectee) Donald L. Marks, from Asst. DCS/Ops., Hq. SAC, Offutt AFB, Neb., to Cmdr., 3d AD, SAC, Andersen AFB, Guam, replacing M/G Ellie G. Shuler, Jr. . . . **Col. (B/G selectee) Billy G. McCoy,** from Cmdr., 1st TFW, Hq. TAC, Langley AFB, Va., to Cmdr., 832d AD, TAC, Luke AFB, Ariz., replacing B/G John M. Davey . . . **B/G Robert R. Rankine, Jr.,** from Spec. Asst. for SDI, DCS/RD&A and AFSC, Washington, D. C., to Dir. of Space Systems and C^3, DCS/RD&A, Hq. USAF, Washington, D. C., replacing M/G Donald J. Kutyna . . . **M/G Ellie G. Shuler, Jr.,** from Cmdr., 3d AD, SAC, Andersen AFB, Guam, to Asst. DCS/Ops., Hq. SAC, Offutt AFB, Neb., replacing B/G (M/G selectee) Donald L. Marks.

SENIOR ENLISTED ADVISOR CHANGES: CMSgt. Robert L. Lucero, to SEA, Hq. AFOTEC, Kirtland AFB, N. M., replacing retired CMSgt. Raymond F. Enright . . . **CMSgt. Robert L. Schenk,** to SEA, Hq. AFISC, Norton AFB, Calif., replacing retired CMSgt. Ronald L. Rude. ■

★ Taking a cue from the helmet-mounted displays (HMDs) used with successful FLIR (forward-looking infrared) systems in helicopters, Texas Instruments is undertaking a FLIR technology and hardware program for F-16s that will involve internally installed components and an HMD. Unlike the heavy and drag-inducing Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN) system, the only external part of this project is the five-inch-diameter dome mounted near the canopy.

Named Falcon Eye, this company-sponsored program is expected to perform such diverse night functions as low-altitude navigation, infrared search and track (IRST), air-to-ground targeting (including a continuously computed impact point [CCIP] bombing capability), and integrated fire control.

The system will consist of three line-replaceable units (LRUs) defined functionally as a sensor receiver unit, an ancillary electronics unit, and a power supply unit. Additionally, the system has a magnetic head tracker, so that all the pilot has to do is to look at the target in order to move the FLIR sensor toward the same line of sight. It also has the HMD, which features a two-field-of-vision capability. The unit flyaway cost is expected to run under $1 million.

Honeywell and GEC Electronics are subcontractors on the Falcon Eye

project. Flight tests of the system are currently scheduled for mid-1987.

★ Competition is alive and well in Air Force weapon procurements. Fully half of the $24.7 billion spent since October 1, 1985 (the start of FY '86), has been a result of competition. The $12.3 billion that has been put out on competitive contract in the past six months equals the total amount that the Air Force competed in FY '84.

Of the remaining fifty percent of funds spent, 41.5 percent went to follow-on production programs, or those major programs that were originally competed but are now in long-term production. The balance, 8.5 percent, went to single-source procurements.

The Air Force's goal for competitive contracts for FY '86 is forty-two percent.

★ Air Force Systems Command's Aeronautical Systems Division (ASD) at Wright-Patterson AFB, Ohio, issued requests for proposals (RFPs) on April 23 to three aerospace firms for development and initial production of a new short-range attack missile (SRAM II). The new missiles will replace the AGM-69A SRAM, which entered service in 1972.

Boeing Aerospace Co., McDonnell Douglas Astronautics Co., and Martin Marietta Corp., Orlando Aerospace Div., were the three companies receiving the proposal requests for the new nuclear-tipped missiles.

A contract will be awarded late this year for full-scale development during the period of FY '87 through FY '92, and it will include twenty-five test flights. Two firm-price production options for low-rate initial production in FY '90 for 200 missiles and 200 to 400 missiles in Lot 1 full production in FY '92 will also be included in the contract.

Second-source contractors will be selected for all major subsystems during Lot 1 production, and competitive procurement is contemplated for all subsequent lots. Initial operational capability for the new missiles on the B-1B is required by early 1992. Total production of 1,633 missiles is currently planned.

★ **NEWS NOTES**—One of the last of the "firsts" was marked on May 28, as **Terrie Ann McLaughlin,** twenty-one, of Naperville, Ill., became the **first woman to be named the Air Force Academy's outstanding cadet.** A member of a 948-cadet graduating class, Lieutenant McLaughlin was also named the outstanding cadet in engineering and electrical engineering. She will attend Stanford University on a National Science Foundation Fellowship, working toward her master's degree in electrical engineering. Lt. Richard Scobee, son of Space Shuttle *Challenger* commander Francis R. Scobee, was also a member of this year's graduating class.

AEROSPACE WORLD

The **1st Special Operations Wing** at Hurlburt Field, Fla., recently received **two HH-53H Pave Low III helicopters** that are replacements for a pair of helicopters lost in accidents in 1984. Two CH-53s were modified to the Pave Low III configuration after roughly 2,000 man-hours of work at the Naval Air Rework Facility (NARF) at NAS Pensacola, Fla. As a cost-saving measure, the NARF used many of the components and metal parts from a crash-damaged HH-53H that could not be repaired.

Air Training Command will start reaching for the stars in October. That's when **a new undergraduate space training program** is scheduled to begin. Newly commissioned officers from all services will be trained for a range of command and staff as-

INDEX TO ADVERTISERS

Aerospace Historian	128
Amex Systems, Inc.	25
AT&T Technologies, Inc.	94 and 95
Avco Systems Div.	79
BDM International	126
Confederate Air Force	103
Cubic Corp.	66
Data General Corp.	11
Datametrics Corp.	115
Dayton/Montgomery Co. Convention & Visitors Bureau	128
Delco Systems Operations, GMC	82 and 83
Eaton Corp., AIL Div.	37
Electronic Data Systems Corp.	69
Elbit Computers Ltd.	41
E-Systems, Inc., ECI Div.	88
General Dynamics Corp.	14 and 15
Goodyear Aerospace	26 and 27
Grumman Corp.	33
Grumman Data Systems Corp.	22
Harris Corp., Government Support Systems Div.	29
Hercules Aerospace Co.	12
Hughes Aircraft Co.	38
Interstate Electronics Corp.	2
Kollsman Instrument Co., Div. of Sun Chemical Corp.	113
Litton, Itek Optical Systems	63
Lockheed Electronics Co., Inc.	73
LTV Aerospace and Defense, Sierra Research Div.	18 and 19
LTV Aerospace and Defense, Vought Aero Products	34
LTV Aerospace and Defense, Vought Missiles and Advanced Programs Div.	93
Magnavox Electronic Systems Co.	21
Martin Marietta Aerospace	6 and 7
MBB Messerschmitt-Bölkow-Blohm	116
McDonnell Douglas Corp.	42, 43, and Cover IV
National Car Rental	87
Northrop Corp.	Cover II and 122
Rockwell International	64 and 65
Rockwell International, Autonetics Strategic Systems Div.	74
Rockwell International, Collins Defense Communications Div.	Cover III
Rockwell International, Collins Government Avionics Div.	5
Shreveport-Bossier Convention and Tourist Bureau	125
Sperry Corp.	80
TEAC Corporation of America	13
United Technologies Corp., Chemical Systems	110
United Technologies Corp., Pratt & Whitney	1

AFA Convention	127
AFA Member Supplies	124

signments in such space-related fields as Shuttle and satellite operations, sensors, and surveillance.

The **Advanced Medium-Range Air-to-Air Missile** (AMRAAM) recorded its **eighth successful test firing** on May 8 over the White Sands Missile Range in New Mexico. This latest test, the sixth consecutive guided launch, proved the missile can shoot down a target flying at a higher altitude than the launching aircraft. The launch of the unarmed AIM-120A was a front-aspect midrange shot from an F-16C flying at Mach 0.85 at approximately 11,000 feet. The missile passed within lethal range of the QF-100 target drone, which was flying at Mach 1.1 at 26,000 feet.

Assistant Secretary of Defense for Force Management **Chapman Cox** said in congressional testimony recently that **"education levels and enlistment test scores** of recruits are considerably higher than those of the general youth population, and ninety-three percent of last year's recruits had earned a high school diploma. This compares to about seventy-five percent of today's general youth population and sixty-eight percent of recruits in FY '80."

After World War II, Gen. H. H. "Hap" Arnold wanted a way to preserve the strong links between the nation's military leaders and the scientific and technical communities that had been forged during the war. Thus, in May 1946, **Project Air Force,** the division of the Rand Corp. that is the Air Force Federal Contract Research Center for policy-related research and analysis, officially came into being. Project Air Force (or Project Rand as it was originally known) provides a place where civilian scientists can devote their efforts during peacetime to national security issues of interest to the Air Force. Over the last forty years, Project Air Force has shown the operational practicality of aerial refueling, helped to develop modern computers, and laid the foundation for the continental air defense system of the mid-1950s and 1960s.

In early May, the 91st Tactical Fighter Squadron of the 81st Tactical Fighter Wing became the first USAFE unit to achieve **initial operational capability (IOC) with the AGM-65D IR Maverick** air-to-ground missile. The 91st TFS is an A-10 unit stationed at RAF Woodbridge in the United Kingdom. The IR Maverick is capable of attacking in day, night, adverse weather, and battlefield smoke conditions. IR Mavericks are also in use at the Fighter Weapons School at Nellis AFB, Nev., at George AFB, Calif., and at Suwon AB, South Korea. ■

C-17

"C" as in computerized

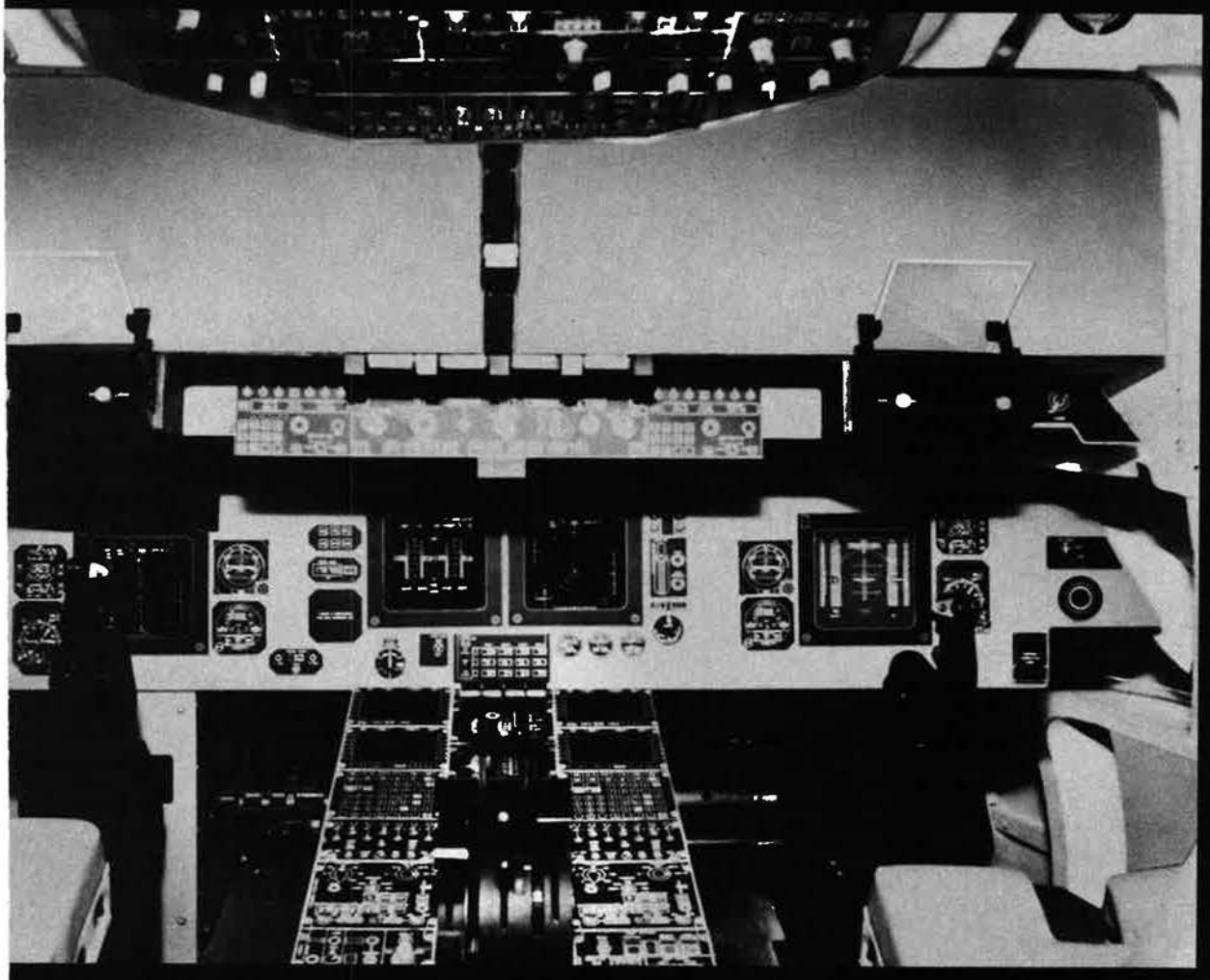
MODERN AIRLIFTER'S SYSTEMS CUT AIRCREW TO THREE.

Advanced avionics including head-up displays, combined communication/navigation controls, and multi-function CRT displays will reduce markedly C-17 pilot workload, compared with existing airlifters.

Equally important: With a basic crew of two pilots and one loadmaster, Air Force crew costs will drop dramatically compared with other airlift aircraft. And because ease of maintenance is engineered into the C-17, operations and support costs will also be reduced. The USAF Airlift Master Plan estimates a $16 billion savings over the life of the fleet compared to other airlift options.

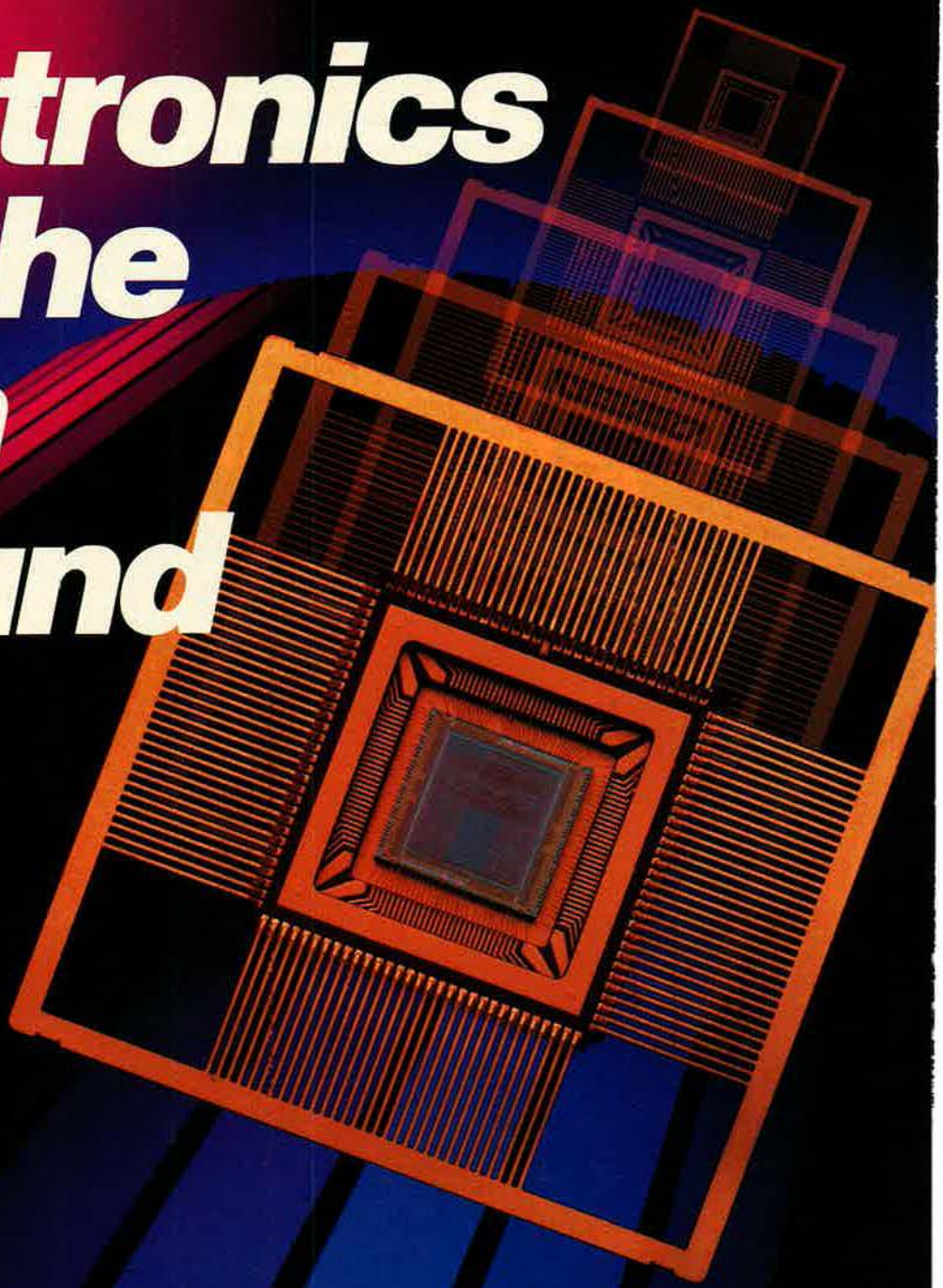
The C-17 is now in development for first flight in 1990, when it will reach new highs for operational utility and new lows for cost of ownership.

MCDONNELL DOUGLAS



At Hanscom and Rome, the pace picks up with work on a "National Test-Bed" for SDI and a new "Air Defense Initiative."

Electronics For the High Ground



Densely layered VHSIC chips such as this Westinghouse "10K configurable gate array" device will enhance the reliability and performance of USAF's electronic systems.

BY JAMES W. CANAN
SENIOR EDITOR

THE fate of the Defense Department's daring Strategic Defense Initiative (SDI) research program will be determined in great measure by USAF's Electronic Systems Division at Hanscom AFB, Mass.

ESD has become pivotal to the accomplishment of the SDI program's toughest task, that of demonstrating that a nonnuclear, layered system of weapons and sensors for defending against ballistic missiles can really work. All along, ESD has been in charge of USAF's major share of SDI research on battle-management command control and communications (C^3), the segment of the many-sided SDI program that is central to all others.

Now ESD's role in the SDI program has been greatly expanded. The Strategic Defense Initiative Organization (SDIO) and the Air Force have put ESD in charge of designing and building the geographically dispersed, electronically coordinated SDI National Test-Bed to simulate and validate SDI system concepts and technologies in "engagement" scenarios.

The National Test-Bed will be the means of determining how well those concepts and technologies work without actually developing or deploying an SDI system in space or on earth. It is also expected to disarm critics who charge that SDI is fatally flawed for the lack of any means of testing it, short of building and deploying systems in contradiction of the ABM treaty.

ESD is also moving out smartly on a newly organized Air Force program that is intended to supplement SDI. Called Air Defense Initiative (ADI), it has been set up to develop surveillance, battle-management, and weapons technologies for in-depth defense of North America against the growing threats of bombers and air-launched and submarine-launched cruise missiles.

As ESD's arm for advanced research and technology development and transition, Rome Air Development Center (RADC) at Griffiss AFB, N. Y., is the wellspring of the division's SDI and ADI programs.

Eye-catching as they are, those endeavors are matched in importance by many others in ESD's kit bag of programs to enhance the C^3I capabilities of USAF's strategic, tactical, and security forces.

Notable among these on the tactical side are the Joint Surveillance Target Attack Radar System (Joint STARS) program now in full-scale development, the AWACS upgrading program, and the Joint Tactical Information Distribution System (JTIDS) program now settling into stride.

On the strategic side, ESD has begun installing the Ground Wave Emergency Network (GWEN), which will communicate low-frequency emergency action messages to Strategic Air Command bases and launch control centers.

ESD is also well along in its work on new antijam (AJ) radio receivers for bombers and on high-power transmitters for the World-Wide Airborne National Command Post (WWANCP) fleet of EC-135 aircraft.

ESD's development of terminals for military aircraft and for some USAF ground stations to receive signals from vital Milstar communications satellites had fallen behind schedule. It now seems to be back on track, however, in anticipation of initial Milstar deployment scheduled for 1988.

The SAC Digital Information Network (SACDIN) is being installed, the World-Wide Military Command and Control Information System (WIS) is taking shape, the Ballistic Missile Early Warning System (BMEWS) is being refurbished, and the North Warning System—a US/Canada project to replace the technologically outdated Distant Early Warning (DEW) Line in North America—is heading for completion in 1992.

Meanwhile, the east coast segment of ESD's Over-the-Horizon Backscatter (OTH-B) radar system is in production, and the west coast segment is scheduled to be put under contract about the time this issue goes to press.

In a time of terrorism, ESD's development of sensors and automated communications and alarm systems for safeguarding Air Force bases and deployed weapon systems assumes all the more importance.

This work is directed by Thomas O'Mahony, ESD's Deputy Commander for Intelligence, C^3 Countermeasures, and Support Systems. His shop also handles such pro-

grams as C^3 upgrades for Military Airlift Command and automated management systems for Air Force Logistics Command and ESD's parent Air Force Systems Command.

The order of the day at ESD is to push all programs through development and into production in strict adherence to stringent timetables.

A Trimmer, Tighter Look

Lt. Gen. Melvin F. Chubb, Jr., ESD's Commander, is a stickler for getting things done on time and at or under cost. General Chubb also assigns high priority to a variety of ESD programs to induce contractors to increase productivity and improve the reliability and cut the costs of hardware and software.

Consequently, ESD's programs have a trimmer look these days. There is also a sense of ESD reasserting its role in the company of other AFSC product divisions that deal in aeronautical, weapons, and space systems of seemingly greater glamor but of no greater importance than ESD's "silent" systems for C^3I.

ESD's leadership in establishing and running the SDI National Test-Bed joint program office adds to its luster and confronts it with a difficult challenge.

As presently envisioned, the National Test-Bed will be made up of several simulation sites electronically linked to a central test facility where SDI battle-management simulations and weapons-engagement simulations will be run.

The central test facility may take up as much as 300,000 square feet and employ up to 1,000 people. At this writing, its location had not been chosen, but Colorado Springs is considered a likely prospect.

Some officials predict that the SDI National Test-Bed program will become a multibillion-dollar operation.

ESD officials involved in the program say that it is too early to get specific about such matters. National Test-Bed contractors have only begun investigating concepts.

Selected late last March by SDIO, those contractors are TRW, Rockwell, Martin Marietta, and Boeing. Each heads a large team of subsidiary contractors. All are competing for National Test-Bed design and implementation contracts.

The Battle Management Laboratory (BML) at Rome Air Development Center, Griffiss AFB, N. Y., is the heart of Electronic Systems Division's BM/C^3I research for USAF and SDIO.

SDIO has budgeted $462 million for the test-bed program in FY '87, which will begin October 1. It plans to have the central test facility in operation no later than 1989.

Col. William F. Flanagan, ESD's Deputy for Development Plans, describes the National Test-Bed as "the wind tunnel for SDI."

Colonel Flanagan explains that the military services and other agencies in the SDI program will fashion the software and the simulations for their individual concepts and systems.

"They'll debug the simulations," he says, "and then submit them, in data form, to the central test-bed, which will be the vehicle for testing them all together."

ESD was not tapped out of the blue to take the lead in the National Test-Bed program. It came naturally to the task by virtue of its work, much of which has been done at RADC, on battle-management C^3—described by Colonel Flanagan as "the glue that holds everything together"—for the Air Force's space-oriented role in SDI.

Such work has involved the simulation of the C^3 that would be necessary should US kinetic energy weapons in space be called on to intercept incoming Soviet ICBMs.

"We put the formulas and the scenarios into a computer and did runup exercises," Colonel Flanagan explains. "The process involved some unique software that we developed fairly cheaply, with three to four people working nine months to a year."

The National Test-Bed will size up SDI technologies and concepts with a view to trade-offs among them, measure the "leakage" of reentry vehicles into US airspace in various scenarios, and test defensive systems concepts, via simulation, for their survivability as well as for their lethality.

"In our own in-house [ESD] simulations, we're starting small," Colonel Flanagan says. "We don't know yet what computing power we would need to simulate a full-up [SDI] system. It's going to be a gradual learning process for us while we increase the number of scenarios and vehicles involved."

"Our first cut," he explains, "was with six [Soviet] missile fields and one [US] 'kill' satellite interacting. We've come a long way. We're getting better now at answering such questions as how long would it take after a missile comes out of a silo for a [space-based] kinetic energy weapon to fire at it and kill it before [its] burnout."

ESD has also simulated warheads impacting on the US, singly at first and then in multiples. Moving up to multiple reentry vehicles in the simulations taxed computers and software but was manageable.

"We can ask [the computer] questions," Colonel Flanagan explains, "such as, 'What happens if the velocity of the [SDI] kill vehicles is increased? What difference would that make?' "

Man in the Loop

ESD's research on SDI battle-management C^3 has been done "with man in the loop," Colonel Flanagan emphasizes. This should allay the fear expressed by some SDI critics that a deployed SDI system would be wholly automated and that a decision to open fire would be left to computers, not to people.

The decision-making role of humans in SDI battle management (ESD calls this "the SDI man-machine interface") is being analyzed by an ESD contractor, Bolt, Beranek & Newman.

Other ESD battle-management C^3 contracts involve architecture studies by IBM, Ford Aerospace, and McDonnell Douglas; a study by GTE of "intelligence impacts" on such battle-management architectures, with funding shared by the Army; and "software simulation support" by H. H. Aerospace Design Co. MITRE Corp., ESD's allied Federal Contract Research Center, has a hand in all such work, with emphasis on the sometimes daunting problems of software quality and quantity.

"We believe battle management is one of the toughest parts of SDI," says Colonel Flanagan. "All other parts—weapons and sensors—are influenced by battle-management C^3."

ESD's battle-management C^3 work has primed it for its leadership role in the SDI National Test-Bed program. The test-bed will be a creature of the computers and the communications that ESD is all about. Interconnecting the central

test facility with others run by the services and by other DoD agencies and integrating the simulations of all of them will be a sophisticated sort of "battle management" in itself.

The SDI National Test-Bed could well be the means of deciding a major question that ESD is pondering: Should a deployed SDI system embody satellites that are dedicated to battle management, or should each sensory satellite and each weapon satellite have its own battle-management microprocessors and software?

"Those are the options," Colonel Flanagan asserts.

The National Test-Bed will have to tackle a great many such crucial questions.

"If we do our job right, we'll be able to handle the whole range of SDI battle-management concepts and technologies," Colonel Flanagan declares.

He emphasizes that the National Test-Bed, like all other SDI programs, comes under the heading of "research," not of "development." ABM treaty considerations make this distinction imperative.

Rome Air Development Center gets great credit for ESD's exemplary status in the SDI program.

Among other achievements, RADC's communications researchers have come up with a multinet "gateway" device that checks the security classification status of data coming out of computers and makes sure that it is routed only to authorized recipients. RADC has built a development model and will select a contractor to build an operational model roughly the size of a refrigerator and stuffed with electronics. The device is a godsend to SDI research operations and could play a key role in the functioning of the SDI test-bed.

RADC's participation in the SDI program goes well beyond battle-management C^3 work. Its scientists and engineers are also involved in SDI's Surveillance, Acquisition, Tracking, and Kill Assessment (SATKA) research and directed-energy weapons (DEW) research, with emphasis on large optics, information and signal processing, surveillance radars, and software.

"Our work in SDI represents our emphasis in areas where RADC has been and will continue to be dominant," explains RADC Vice Commander Col. William E. O'Brien.

RADC has conducted several SDI experiments. Late last year, for example, it ran the show when the Air Force beamed a low-power laser at a Space Shuttle orbiting above a test range on Maui in the Hawaiian Islands. The laser hit the bull's-eye, illuminating a reflecting device on the Shuttle.

That test, says Colonel O'Brien, "gave us a better understanding of how to overcome the atmospheric effects on optical systems and enabled us to demonstrate advanced optical tracking technology." It also had great significance for SDI research on using mirrors in space to deflect the beams of big, powerful lasers on US soil to ICBMs booming skyward from the Soviet Union or anywhere else.

RADC's increasing involvement in SDI research is the major reason for the recently sharp upswing of its budget, from $300 million two years ago to $500 million this year.

Now RADC is applying its resources and its know-how to USAF's new Air Defense Initiative as well.

"I see our role increasing in ADI," says Colonel O'Brien, "because many of the technologies that apply to SDI ripple right into the ADI area. That's our main focus—the synergism of SDI and ADI in those areas where we have the technical expertise."

USAF reasons that the SDI program for defense against ballistic missiles must be augmented by the ADI program for defense against bombers and cruise missiles.

At the heart of the ADI endeavor is ESD's Atmospheric Surveillance Technology (AST) program. It seeks to develop new sensors to go along with ESD's OTH-B radars and others in providing "wide-area surveillance" of all air approaches to North America. The AST program is considering the entire architecture of sensors and C^3I that will be needed for such surveillance. It is in partnership with complementary work being carried out at AFSC's Space Division.

An example of such work is the Teal Ruby mosaic infrared sensor that had been scheduled for a Space Shuttle tryout this year. That test was delayed when the *Challenger* disaster put the Shuttle program on hold.

Air defense is clearly in the ascendance among DoD and USAF priorities. At this writing, discussions of how to improve C^3 connectivity for the air defense mission were taking place at Hq. AFSC, Andrews AFB, Md., and in the Air Staff at the Pentagon.

Tactical Air Command is eyeing modern fighters for the air defense mission and is said to be increasingly interested in ESD's C^3 and surveillance research programs of potential import for that mission.

Enthusiasm About Joint STARS

TAC does a lot of business with ESD and should be heartened by developments on the tactical front there.

The Joint STARS program is a prime example. It is a joint Air Force/Army program to provide real-time battle surveillance and attack management for air and land combat. It embodies air and ground segments, each with a weapons-targeting capability.

The heart of the airborne segment is the EC-18 (converted Boeing 707) aircraft with the Joint STARS radar, an operations and control system, and communications equipment aboard.

The EC-18's radar antenna, which will be twenty-four feet long and more than two feet top to bottom, will be carried inside a canoe-shaped radome slung underneath the forward section of the fuselage.

Boeing will produce the aircraft and build the radome. Grumman Melbourne Systems Division is the airborne system contractor. Norden will build the side-looking radar.

Grumman and Norden had teamed up in USAF's Pave Mover program, which led to Joint STARS.

The EC-18 will collect radar information on such moving targets as tanks, trucks, and personnel carriers over a deep, wide area behind enemy lines, all the while dispatching this data to air and ground commanders.

The purpose of the whole setup is accurate and timely air and artillery interdiction of enemy second-echelon ground targets wherever they move en route to reinforcing units at the battlefront.

Col. Charles E. Franklin, ESD's

Deputy Commander for Joint STARS, is convinced that the system "will revolutionize battlefield management."

"With the ability to see in real time across the battlefield at the level of detail that the EC-18 provides, air commanders, corps commanders, and division commanders will get a far better picture of the whole scene than they've ever had before," Colonel Franklin declares. "Their ability to see the movements of enemy forces will be tremendous."

Colonel Franklin's enthusiasm seems well-founded. ESD has worked long and hard on Joint STARS technologies and knows what the system can do.

In the Joint STARS full-scale development program that began earlier this year, ESD will acquire two developmental aircraft. The first aircraft is scheduled for delivery to USAF in January 1989 and will be demonstrated in Europe later that year. Production of the Joint STARS operational EC-18 aircraft is scheduled to begin in 1990.

Inside each EC-18 will be as many as fifteen operations and control consoles. They will display terrain features and vehicles in a variety of colors.

They will also store their data as they go, thus enabling their operators to call up "historical replays" of enemy whereabouts and movements in time gone by. This will enable air and ground commanders to discern the patterns and speeds of such movements as well as their paths and intended points of confluence in attack-susceptible staging areas.

"Every EC-18 console will be 'smart,' with its own processor inside," Colonel Franklin explains. "Each will be able to store up to an hour's worth of data."

Joint STARS aircraft will also be capable of assessing damage caused by attacks against targets that they had spotted and tracked.

Presently, there are no plans to give the Joint STARS aircraft a lock-on linkup with air and ground weapon systems. Such a mode would be possible, however.

The Army's segment of the Joint STARS program is its Ground Station Module (GSM) now being developed by Motorola. The GSM is a

ESD is improving the sensitivity of radars atop AWACS aircraft such as this one by upgrading their associated computers.

truck-mounted operations and control system full of computers and communications gear. It will receive data from the EC-18s and distribute it to ground commanders.

A Joint STARS data hookup with a wide range of combat aircraft is in the offing through the Joint Tactical Information Distribution System (JTIDS) now in full swing at ESD. The Navy and the Marine Corps have joined the Air Force and the Army four-square in the JTIDS program, which will provide antijam digital communications for all.

At the same time, USAF has shelved its plan for an enhanced JTIDS (EJS), which would have provided substantial voice communications capability as well. TAC supported the EJS program, but the Navy's fighter force, primarily dependent on data communications, did not. With EJS no longer complicating the scene, "JTIDS is really in business here now," declares Brig. Gen. Charles P. Winters, ESD's Deputy Commander for Tactical Systems, JTIDS, and AWACS.

The contractor team of Singer Kearfott/Rockwell Collins is developing JTIDS Class II terminals to replace Class I varieties now in relatively limited usage. The team is evaluating Class II terminals for application to Navy-unique communications requirements.

The Class II terminals have been put through developmental flight testing at Eglin AFB, Fla., and are expected to be ready for operational test and evaluation this summer. Meanwhile, ESD is making preparations for their production.

The success of ESD's Have Quick II program for upgrading the original Have Quick ultrahigh-frequency (UHF) voice radios now aboard all USAF fighters had much to do with the Air Force's willingness to end the EJS program while continuing to develop EJS technology.

Have Quick II radios feature additional frequencies, software improvements, increased memory, more power, and faster frequency hopping, the better to escape jamming. Their software is also compatible with that of the E-3A AWACS aircraft.

USAF swears by its AWACS aircraft. It has no plans to add to its inventory of thirty-four E-3As. However, ESD is making them more capable of spotting and tracking airborne targets for the US fighter force.

The goal of ESD's AWACS upgrading program is to increase the sensitivity of the huge radar atop the aircraft.

The radar itself will remain unchanged. However, the computers that receive and correlate its sensory data will be made much faster and more reliable.

"This will significantly improve the ability of AWACS to see smaller targets," General Winters declares. Notable among such targets are cruise missiles, which are ever more abundant in Soviet bomber and submarine forces.

AWACS improvements could become all the more necessary if the Soviets turn to low-observable aircraft and cruise missiles in the US manner.

"The IBM computer in AWACS is a super one," says Col. John Colligan, ESD's Director for AWACS, "but it was designed more than twenty-five years ago. We can get a fair amount of advantage in radar sensitivity just by giving the computer more capability."

In remodeling the computer, ESD is giving thought to applying VHSIC (very-high-speed integrated circuits) chips that are coming into production. The computer's software is being enhanced as well.

Changes in the AWACS radar data correlator are being made by Westinghouse, which built it way back when. Most internal wiring is being eliminated, and computational capacity is being increased. Westinghouse is expected to finish validating its new model later this year.

Colonel Colligan expects that the new radar data correlator will have a mean time between failures of more than 400 hours and will be capable of conducting 2,000,000 operations per second. This will quadruple the MTBF of the existing correlator and double its speed.

In the meantime, ESD has asked Boeing to come up with a new antenna to augment the AWACS radar.

"We've felt for a long time that we need some ancillary sensors in case the radar gets jammed or isn't seeing as far as we'd like it to see under certain conditions," Colonel Colligan explains. "The new antenna won't be terribly precise, but it will signal that there's something out there, moving in this or that direction, that needs to be looked at. Having it will be comforting."

This is also true of the many systems being developed, acquired, and installed by the strategic side of the house at ESD.

With a billion-dollar-plus budget and thirty-five programs, ESD's Deputy Commander for Strategic Systems manages a great deal of the work in the top-priority C^3 segment of President Reagan's strategic modernization program.

The going has been difficult in some instances, mainly because levels of funding have not always kept pace with levels of ambition. Even so, progress has been steady.

GWEN Thin Line

The Ground Wave Emergency Network (GWEN) is a prime example of this. A "thin line" of fifty-six GWEN antenna-tower sites will have been completed by RCA on federal, state, and leased private properties in the US by next April. Thirty-eight radio terminals will also have been installed at military facilities.

This is a solid start toward the construction of more than 200 sites, or nodes, that will make up the full-bodied GWEN system.

The GWEN program was begun five years ago as the means of assuring that the National Command Authorities (NCA) and SAC will be able to communicate with data via low-frequency ground waves should a nuclear attack disrupt other channels for emergency-action messages.

Each of the fenced-in GWEN sites around the country will feature a transmitter tower about 300 feet tall and three compact shelters containing communications equipment and a powerplant.

GWEN's equipment and broadcast signals would be unsullied by electromagnetic pulse (EMP) emanating from a high-altitude nuclear detonation, which could very well be the first thing to happen in a nuclear attack.

Anthony D. Salvucci, ESD's Assistant Deputy Commander for Strategic Systems, is convinced

PAVE PAWS radar at Otis ANGB, Mass., stands guard against sea-launched ballistic missiles. Another is operating on the west coast. Two more are in the works for Georgia and Texas.

that GWEN's widely proliferated nodes and message-routing versatility will be enough to discourage a would-be attacker.

"We plan to have enough nodes in the system to make the enemy pay a significant penalty to cut enough of them to put the system out of action," Mr. Salvucci declares.

SAC has had the use of a nine-tower GWEN prototype that RDA Associates built for starters. Seven of the towers are part of the existing thin-line network and will be incorporated into the full-up network as well.

Many other ESD strategic programs also have to do with guaranteeing the connectivity of communications during a nuclear war.

High among such programs are those for a Miniature Receive Terminal (MRT) for B-1B and B-52 bombers. The MRTs will be nuclear-hardened and extremely difficult to jam. Their developmental testing is expected to begin next February. First production deliveries are scheduled for 1990.

ESD is also pushing ahead with development of high-power transmitters for the EC-135 aircraft making up the World-Wide Airborne National Command Post (WWABNCP) fleet.

At this writing, the Navy was moving to join the program. It needs to improve its capability for VLF/LF transmission of emergency-action messages to ballistic missile submarines from the TACAMO (Take Charge and Move Out) aircraft over the oceans.

ESD expects to award a contract for full-scale development of the high-power transmitter next year and production early in 1990.

ESD's program for developing and acquiring all airborne Milstar terminals "is now settled and prioritized," Mr. Salvucci says, and will culminate in a production program that "will guarantee good competition."

Raytheon, the prime contractor for the terminals, is teamed with Bell Aerospace and Rockwell in a leader-follower arrangement. At least two of these contractors will be capable of building an entire Milstar terminal embodying fifteen black boxes and a variety of antenna systems. Production of the terminals is scheduled to begin in 1990. ■

What's Happening in Electronics at ESD

A CHECKLIST OF MAJOR ELECTRONICS PROJECTS

(As of May 1, 1986)

NAME AND MISSION	STATUS	CONTRACTOR
Deputy Commander for International Programs (FA)		
Japanese BADGE Engineering technical support to the Japan Air Self-Defense Force for the Base Air Defense Ground Environment (BADGE) upgrade.	Ongoing	MITRE Corp.
Royal Saudi Air Force Alternate Command Operations Center (ACOC) Acquisition of a Royal Saudi Air Force Alternate Command Operations Center. The Center will use commercially available equipment and software.	Installation and Checkout	Hughes Aircraft Co.
Royal Saudi Air Force C³ System Acquisition of a ground command control and communications system for the Royal Saudi Air Force. The system includes equipment, facilities, and support elements to interface existing tactical radars, the Saudi E-3A AWACS, and elements of other Saudi military organizations.	Acquisition	Boeing; General Electric
Royal Thai Air Defense System (RTADS) Automation and upgrading of the existing Royal Thai Air Force (RTAF) Air Defense System and upgrading and expansion of its supporting long-haul communications network.	Acquisition	None
Somali Command Control and Communications Programs (PEACE CUBE) Activation of the Somali Ministry of Defense Command Center; installation of large-screen-display as well as local and long-haul communications subsystems.	Acquisition	None
Sudan Air Defense System Repair or replacement of air defense radars, communications equipment, and support equipment.	Acquisition	EG&G
Deputy Commander for Joint Surveillance Target Attack Radar System (JS)		
Joint Surveillance Target Attack Radar System (Joint STARS) An Air Force/Army program to acquire an airborne sensor and ground elements that will satisfy the services' needs to detect, track, and direct weapons against moving and stationary ground targets. The airborne system consists of an electronic-scan, multimode radar, an operations and control subsystem, and a communications subsystem on board an EC-18 aircraft. The ground elements are composed of ground station modules, which will be distributed across a corps front. Radar information is transmitted directly to the ground stations and other C³I elements through secure data links.	Full-Scale Development	Grumman (prime); Norden; Boeing; Cubic
Deputy Commander for Intelligence, Countermeasures, and Support Systems (OC)		
Air Force SAFE Program Procurement and deployment of DoD BISS program-developed and commercially available physical security equipment to approximately seventy USAF bases and 210 sites worldwide. These systems will protect such mission-critical/high-value resources as stored weapons, strategic/tactical alert aircraft, open- and closed-sheltered alert aircraft, special mission aircraft located on parking areas, specified command posts, and other specifically identified strategic resources.	Procurement/Deployment	RACON: Morse Products; Aritech Corp.; Vindicator Corp.; Stellar Systems; Support Systems Associates; Sygnatron Protection Services; TERA Advanced Services; Analytical Systems Engineering Corp; Canadian Commercial Co.
Air Traffic Control (ATC) Survivability The ATC program includes quick restoral equipment for control towers, survivability radar, and an ECCM capability to ASR radars to improve AFCC's ability to continue air traffic control services at USAF combat operating bases during a conventional war.	Predevelopment	None
Assured Logistics Communications This will improve the probability of logistics information transfer within areas of conflict and between areas of conflict and AFLC. The system will access redundant modes of communication (DDN, Public Data Network Radio Satcom, etc.) and will exploit message/packet-switching and protocol-transfer technologies with applicable equipment in order to meet wartime or other stressed logistics information requirements.	Development	None
Automated Weather Distribution System (AWDS) AWDS will enhance Air Weather Service's meteorological support for the Army and the Air Force. The system will reduce labor-intensive tasks by using advanced computer technology, color graphic displays, and sophisticated meteorological and graphic presentation software. A total of 165 automated Base Weather Stations worldwide and twenty transportable versions will interface with two communications networks for distribution of global alphanumeric and graphic meteorological data.	Development	MacDonald Dettwiler and Associates Ltd.
Avionics Intermediate Maintenance Shop Program manager for developing and acquiring shelter systems to support F-15, F-16, A-10, and F/EF-111 avionics maintenance. Support includes design, integration engineering, and acquisition of all systems.	Development and Acquisition	Medley Tool and Model Co.
C³ Countermeasures Support Data Base A C³CM Support Data Base under construction to support Compass Call. The data base will also be used for studies and simulation. It will be made generally available to DoD users involved with electronic combat.	Continuing	PRC; ISN Corp.; BETAC Corp.
COBRA DANE Upgrade COBRA DANE, a land-based phased-array radar at Shemya AFB, Alaska, provides intelligence and space-track data to a variety of users and has a tertiary early warning mission. This upgrade will replace the aging computers and software in the system as well as improve data collection and processing capabilities.	Concept Definition	None
COBRA JUDY X-Band COBRA JUDY is a USAF shipborne phased-array radar system to collect data on foreign strategic ballistic missile tests. This modification will extend the capabilities of the basic system to allow it to gather higher-resolution data.	Production	Raytheon Co.

COMFY SWORD A ground-based jamming and deception system for training friendly aircrews to operate in a hostile electronic environment.	Production	Flight Systems, Inc.
Digital BRITE (D-BRITE) The D-BRITE program will replace existing Air Force BRITE II display systems with new, more reliable equipment that can display alphanumeric beacon data, including Mode C altitude information.	Acquisition	None
DoD Base and Installation Security Systems (BISS) An evolutionary RDT&E program to provide a DoD-standard electronic exterior physical security system for protecting DoD resources worldwide. The system's components include detection, assessment, entry control, and command and control equipments. The system concept emphasizes maximum commonality of major items and a variety of supporting subsystems. It offers a flexible choice of equipment (USAF developed/commercially available) that must be tailored to the unique physical characteristics of the location and to the threat.	Development	Teledyne; ASEC; Canadian Commercial Corp.; TERA Advanced Services; Sygnatron Protection Services
Eifel The Eifel follow-on is a binational development program to improve the operational capabilities of operations centers, wings, and squadrons for offensive air command and control in central Europe.	Definition	None
HQ Air Force Local Area Network (LAN) The HQ Air Force LAN program will provide a local area network to allow reliable, efficient, unclassified data, voice, and video communications between Air Staff offices in the Pentagon and the computer that supports them.	Production/Implementation	Clarence B. McCullough; Booz-Allen & Hamilton
Intelligence Analysis Center (IAC) Automated assistance to the Marine Air/Ground Task Force Intelligence organizations to store data, correlate information with a master file, perform analyses on collected information, and prepare and disseminate intelligence reports to appropriate organizations. The IAC segment is to be contained in standard 8′ × 8′ × 20′ mobile shelters capable of worldwide deployment.	Production	ADCOR
Intelligence Work Station (IWS) Intelligence Work Station (IWS) is a joint ESD/RADC project designed to replace the present standard intelligence terminal, the OJ-389. The modular, upgradable, standalone IWS will perform message handling, data base update, and mapping for intelligence users worldwide.	Definition	None
Intra-Theater Imagery Transmission System (IITS) This is a hardcopy imagery dissemination system using the tactical digital facsimile equipment being developed by ESD under the TRI-TAC program. The IITS program allows the tactical air forces to transmit photographs and other intelligence information rapidly to high-priority users via electronic means.	Development/Production	Litton Amecom
Local On-Line Network System (LONS) The objective of LONS is to provide a system for AFSC product divisions, laboratories, and SOAs to communicate command-directed information over the DDN by using standardized office automation hardware, software, and base communications facilities.	Development/Acquisition	Computer Sciences Corp.
Logistics C³I System This system is a complete AFLC command and control system, designed for battle staff crisis operations but capable of operating in peacetime. It will support the AFLC missions from readiness through reconstitution and serve as the command-unique subsystem of the WWMCCS Information System.	Conceptual	Booz-Allen & Hamilton
MAC C² Upgrade Four of the more than fifteen programs to upgrade the MAC C² system are being prosecuted at ESD. The elements to be acquired are UHF SATCOM Terminals (UST), Tactical Data Stations (TDS) for digital data entry and receipt, Automated Communications Processors (ACP) to modernize HF frequency selection and communications, and the Information Processing System (IPS), which consists of hardware and software to automate airlift planning, execution, and control. These elements will significantly improve MAC's command and control of aircraft in peace and wartime.	Development and Acquisition	Rockwell Collins
Manual Radar Reconnaissance Exploitation System (MARRES) The exploitation element of the AN/UPD-8 Side-Looking Airborne Radar System, MARRES uses equipment similar to the Imagery Interpretation System to provide automated aids that help the radar imagery interpreter to perform target identification and location.	Production/Deployment	Texas Instruments
Operations System Network (OPSNET) OPSNET is a proposed multilevel secure information management system for DCS/Plans and Operations, Hq. USAF. It will consist of a network of automated systems and equipment that will link together the entire DCS and provide for easier information flow and access. The purpose of the system is to increase the productivity of and reduce the work load on action officers.	Development	Booz-Allen & Hamilton
PACER Acquire (AFLC Local Area Network) Development, installation, testing, and integration of a full-capability Local Area Network (LAN) communications system that utilizes multiple-coaxial-cable, broadband technology for terminal-to-host connectivity for existing and new Logistics Management Systems (LMS) at the five Air Logistics Centers. Installation of a LAN in the two headquarters buildings at Hq. AFLC is currently under way; the initial buy is 168 bus insurface units. The system has the growth capability to service 1,000 users.	Production and Deployment	TRW
Security Police Communications System (SCOPE SHIELD) SCOPE SHIELD addresses requirements to replace radios currently used by the USAF security police forces in the mission areas of air base defense, weapon system security, and law enforcement. These areas utilize fixed-base station, vehicular, and hand-held radios. SCOPE SHIELD will effect their replacement through implementation of a combined state-of-the-art acquisition/preplanned product improvement approach.	Development/Production	None
SEEK SCORE This radar bomb scoring system consists of a ground radar that tracks aircraft and a computer that, upon termination of a simulated bomb release tone, computes the bomb impact point. The score is automatically calculated and relayed to the aircraft.	Production	Sierra Research
Sentinel Aspen (Phase I) This program will provide a General Imagery Intelligence Training System (GIITS) to Air Training Command. This generic trainer incorporates computer-aided instruction to prepare imagery analysts for operational hardcopy and softcopy exploitation systems.	Development	Goodyear Aerospace
Sentinel Aspen (Phase II) Modernization of air intelligence targeting indications and warning and fusion training conducted by the Goodfellow Technical Training Center at Goodfellow AFB, Tex.	Requirement Definition	None

NAME AND MISSION	STATUS	CONTRACTOR
Sentinel Bright I This program is to design, develop, and acquire a voice processing training system that features 460 workstations for the training of cryptologic linguists.	Development and Acquisition	Logicon Inc.
Sentinel Bright II This effort will design, develop, and acquire a classified training system that will use 275 workstations and an unclassified training system that will use 113 workstations. These will be used to train operators, analysts, and maintenance technicians for modern operational cryptologic systems.	Definition	None
Shelter Management Office (SMO) USAF focal point for all USAF mission systems requiring mobility and transportability. It gives initial acquisition and integration engineering support to all USAF program offices that employ mobile tactical shelters (currently forty-six Air Force development programs) and serves as overall USAF manager for research and development for new tactical shelters.	Development and Acquisition	B and M Technologies Services
SPACENET The SPACENET program will design and deliver a command-wide office information system for Hq. Space Command. The office information system is to grow in an evolutionary manner into a management information system and, ultimately, a decision support system.	Development	Booz-Allen & Hamilton
Tactical Decision Aids (TDA) A new capability for Air Weather Service to support mission planning and execution. TDA will process target/background information along with associated weather information to provide forecasts of such smart weapon performance parameters as the lock-on range for infrared, laser, and TV-guided munitions.	Predevelopment	None
Warrior Preparation Center (WPC) This program will enhance our tactical warfighting capability through better training of our battle commanders.	Incremental Development	Computer Engineering Associates
Weapons Storage and Security System RDT&E and production planning to provide dispersed, unattended, tactical nuclear weapons storage. Weapons will be collocated with tactical aircraft in hardened vaults beneath the floors of closed aircraft shelters.	Development	Analytical Systems Engineering Corp.
Deputy for Product Assurance and Acquisition Logistics (PL)		
Computer Resource Management Technology A continuing engineering development program to support the transition of software technology to USAF weapon systems programs. The program's goal is to apply technology in the system acquisition and support process to reduce software life-cycle cost and to improve the quality of weapon system software acquisition and support process, to reduce software life-cycle cost, and to improve the quality of weapon system software. This program provides for the transition of computer systems development in laboratories, industry, and academia to active Air Force systems; develops and applies software acquisition tools and techniques to reduce life-cycle costs; serves as the only research and development area of the Air Force for computer security; and develops an information network that links existing and planned logistics engineering systems into an integrated architecture. In addition, this program has been designated by the Office of the Under Secretary of Defense for Research and Engineering (USDRE) as a special-interest program to support the transition of software technology.	Engineering Development	University of Texas; DIGICOMP; Massachusetts Computer Ass'n; Computer Corp. of America; General Dynamics; Denver Research Institute; Input-Output Computer Services
DoD Software Engineering Institute The objective of the Software Engineering Institute is to provide the technology and means to improve the quality and cost of software in DoD mission-critical systems. The Institute will reduce state-of-the-art software engineering technology to practical methods and will encourage the use of modern techniques and methods throughout the mission-critical computer systems community.	Ongoing	Carnegie-Mellon Institute
GET PRICE A program to reduce the production cost of Air Force electronic command control and communications systems by encouraging contractor capital investment in modern technology. Increased productivity and improved product quality are key objectives. Contractor direct and indirect manufacturing areas are analyzed; specific, required manufacturing technologies are demonstrated; and capital investment incentives for new technology acquisition are negotiated.	Continuing	Hazeltine; Rockwell Collins; Singer Kearfott; Westinghouse Electric Co., Defense & Electronic Systems Center; General Electric Co., Electronic Systems Div.
Logistics Information Management Support System (LIMSS) This program will provide a logistics command control and communications system to network logistics information at all required logistic levels.	Validation	None
Pursuit 2000 (Electronics Sector Analysis) A continuing analysis project intended to identify projected needs for Air Force actions regarding the electronics sector of the US industrial base. Electronic Systems Division is pursuing this effort under assigned responsibilities as the AFSC electronics sector manager. The full project title is "Pursuit 2000: Electronics—The Key to Deterrence."	Continuing	DHR, Inc.
Deputy Commander for Strategic Systems (SC)		
Aircraft Alerting Communications EMP (AACE) Upgrade Program The AACE Upgrade Program is to provide assured, electromagnetic pulse (EMP) hardened, end-to-end communications from the Commander in Chief of Strategic Air Command (CINCSAC) to his alert aircraft forces. It will also provide CINCSAC and the SAC Main Operating Base (MOB) Commanders with indications of an EMP event so that appropriate actions may be taken.	Full-Scale Development	BDM Corp.
Alternate Space Defense Operations Center The Alternate SPADOC will perform a critical portion of the functions of the SPADOC in the event that a natural disaster or emergency causes a SPADOC failure. Alternate SPADOC will be an austere facility.	Conceptual	None
Attack Warning Processing and Display System (AWPDS) The AWPDS, a small, intelligent processing and display system, will receive fused data directly from the NORAD Fusion Centers (Cheyenne Mountain Complex and NORAD-Offutt) and data, both discrete and summary messages, direct from selected ballistic missile sensor systems via the Survivable Communications Integration System (SCIS). There will be fixed, ground-mobile, and airborne versions of the AWPDS.	Conceptual	None

Berlin Radar System This program will modernize the Berlin Air Route Traffic Control System by consolidating air traffic control operations at Tempelhof Central Airport, by replacing the current long-range radar system with a modern 3-D AN/FPS-117 radar, and by automating the associated operations center.	Deployment	Sanders Associates
BMEWS Modernization Program Upgrade of the two operational sites (Greenland, England) operated by Space Command and the Royal Air Force. The existing BMEWS radar in Greenland is being replaced with a modern, solid-state phased-array radar. Replacement of the radar in England with a solid-state phased array is scheduled to begin in 1986. The modernization of the radar in Alaska is being planned. These new radars will meet the threat in the 1990s.	Acquisition	Raytheon Co.
C-Band Imaging The C-Band Imaging program will acquire a radar-imaging capability at four existing spacetrack radar sites. Imaging will assist in meeting the Space Defense Program mission.	Conceptual	None
Command Center Processing and Display System Replacement (CCPDS-R) As part of the ballistic missile warning network, CCPDS-R will receive warning information from ballistic missile sensors and determine if a threat to national resources exists. This system will produce integrated warning and attack assessment displays for the Cheyenne Mountain Complex, Hq. SAC, and other strategic military command centers.	Acquisition	Booz-Allen & Hamilton
Communications System Segment Replacement (CSSR) Improvement of the reliability, capacity, maintainability, and flexibility of the Cheyenne Mountain Complex communications processing function by replacement of the Communications System Segment (CSS) acquired through Program 427M. The CSS handles message processing, formatting, technical control, line code conversion, and routing of internal and external messages.	Full-Scale Engineering Development	GTE
Deep Space Warning Radar (DSWR) DSWR will provide surveillance and warning information on our critical synchronous-altitude space assets. DSWR will be a standalone radar system with an interface directly to the NMCC.	Conceptual	None
Diversity Reception Equipment (DRE) The Diversity Reception Equipment will provide improved low-frequency communications capability for the Worldwide Airborne Command Post fleet. Improvements will include a new transmit processor and new receivers. Resulting improvements in operational capability will include reduced message delivery time, enhanced survivability, and interoperability with the Navy's low-frequency network.	Full-Scale Development	Sonicraft
E-4 Airborne Command Post A survivable Airborne Command and Control System that will operate under the direction of the National Command Authorities and the Commander in Chief, Strategic Air Command, during the pre-, trans-, and postattack phases of a nuclear war. Used by OJCS/NEACP with Offutt AFB as the main operating base, the E-4B is a survivable emergency extension of NMCS and SAC ground command and control centers and provides high confidence in US ability to execute and control SIOP forces in a nuclear environment. ESD's current effort is directed toward upgrading the SHF communications to ensure aircraft compatibility with the existing and evolving Worldwide Military Command and Control System (WWMCCS).	Full-Scale Development, Production/Operational	Boeing Aircraft Co.
FAA/Air Force Radar Replacement (FARR) This program is a joint FAA and USAF effort to replace 1950s' technology, two-dimensional surveillance and height-finding radars with forty-seven modern, highly reliable, unattended three-dimensional radars. Forty-four radars will be located in CONUS, one will be used for training at the FAA Academy, and one each will be located on Guam and Hawaii. Once fully operational, the FAA will operate and maintain all sites, thus relieving TAC of 1,000 manpower requirements.	Conceptual/Development	None
Granite Sentry Granite Sentry is a program to acquire certain elements of the NORAD Command and Control System (NCCS) not included in other ongoing acquisition programs. Granite Sentry will replace the current NORAD Computer System (NCS) and Modular Display System (MDS) and upgrade the Command Post in the Cheyenne Mountain Complex (CMC) to increase its operational capability to meet multiple mission attack warning and defensive needs.	Conceptual	None
Ground-based Electro-Optical Deep Space Surveillance System (GEODSS) The GEODSS system will extend Space Command's spacetrack capabilities for detecting and cataloging space objects in the 3,000–20,000-nautical-mile range. This will be a global network of five sites to detect optically, track, and identify satellites in earth orbit. Three sites are operational; two sites are being deployed.	Deployment	TRW Inc.
Ground Wave Emergency Network (GWEN) GWEN will provide US strategic forces with the ability to maintain critical CONUS long-range command and control communications connectivity despite atmospheric disturbances present in both the trans- and postattack phases. Survivability for this system is achieved primarily by proliferated relay nodes using unmanned, ground wave radio equipment. Strategic forces units, equipped with compatible radio equipment, will interface with nearby nodes for participation in the overall network.	Fabrication/Deployment	RCA; R&D Associates
High-Power Transmitter The High-Power Transmitter program will replace the existing twenty-kilowatt low-frequency transmitter on the EC-135 Airborne Command Post with a new 100-kilowatt transmitter. This new solid-state transmitter will greatly improve the reliability and range of the existing system. A new dual trailing-wire antenna will also be developed to accommodate the increased power. A joint effort for a combined Air Force/Navy development is being explored.	Conceptual/Validation	None
Milstar SATCOM System (USAF Terminals) Reliable, jam-resistant, survivable EHF satellite communications for the three services' tactical and strategic users is being developed. A common transmission format will be employed to provide for interoperability among the services. ESD is responsible for developing communications terminals for airborne platforms. As part of this development, the current AFSATCOM system is being upgraded to provide a transition for the SIOP forces from UHF to the EHF frequencies of Milstar.	Full-Scale Development	Raytheon Co.
Miniature Receive Terminal (MRT) The MRT will provide highly survivable low-frequency communications from CINCSAC and the National Command Authorities (NCA) to the SAC bomber force. The MRT will employ diversity combining, jammer nulling, and advanced message-processing techniques to assure Emergency Action Message (EAM) connectivity in a hostile environment. Technical challenges include hardware miniaturization and implementation of embedded software using the Ada language.	Full-Scale Development	Rockwell Collins

NAME AND MISSION	STATUS	CONTRACTOR
NORAD-Offutt NORAD-Offutt will provide a geographically separated command center as a backup to the existing NORAD command center at the Cheyenne Mountain Complex. The NORAD-Offutt command center will be capable of performing all critical wartime attack warning/attack assessment C^3I functions necessary for CINCNORAD to complete the AW/AA mission in a high-altitude-EMP-stressed environment.	Conceptual	None
North Atlantic Defense System This provides Air Forces Iceland with a modern surveillance and command control communications system that will enhance its ability to carry out its NATO mission of Icelandic air defense. An interim, stopgap system is now being installed to be operational in 1988. In 1989–90, modern, minimally attended, three-dimensional radars will be replacing aging radars. In 1992–93, a state-of-the-art, automated command control system will be operational.	Development/ Deployment	Hughes Aircraft; Techdyn Systems
North Warning System The North Warning program will replace the current DEW Line with a combination of long- and short-range radars for contiguous coverage from the northern slopes of Alaska across Canada and down the east coast of Labrador. Thirteen long-range radars and thirty-nine unattended gapfiller radars will be required. A new communications network will link the North Warning sensors with the Canadian and Alaskan JSS ROCCs.	Full-Scale Engineering Development/Production	General Electric; Sperry
Over-the-Horizon Backscatter (OTH-B) Radar A series of four radar systems to provide long-range tactical early warning and attack assessment of air threats approaching North America. The 180-degree-coverage East Coast Radar System is in final production. The 180-degree West Coast Radar System will be in production in mid-1986. The environmental impact analysis process and site selection for the 240-degree-coverage Central Radar System and the 120-degree-coverage Alaskan Radar System will be completed this year to support production beginning in FY '88.	Full-Scale Engineering Development/Production	General Electric Co.; SRI
PAVE PAWS Primary mission of PAVE PAWS is credible warning and attack characterization of sea-launched ballistic missiles penetrating the PAVE PAWS coverage. The warning and attack characterization data includes estimations of launch and impact points and times. Radars are operational at Otis ANGB, Mass., and Beale AFB, Calif. Others are under construction at Robins AFB, Ga., and near Goodfellow AFB, Tex.	Operational/Full-Scale Engineering Development	Raytheon Co.
SEEK IGLOO Replacement of all thirteen Air Force long-range radar sites in Alaska with solid-state, highly reliable radars that provide range, azimuth, height, and beacon data on all detected targets. Implements a minimally attended radar concept: maintenance by not more than three medium-skill radar technicians and no on-site radar operators. A major objective is a large-scale reduction in the life-cycle cost of Alaskan radar surveillance systems.	Deployment	General Electric Co.
Space Defense Operations Center (SPADOC) SPADOC, to be located in the Cheyenne Mountain Complex, is the central command control communications and intelligence element of the Space Defense Command and Control System. It will consist of new ADPE, displays, interface equipment, software, and communications upgrades. It will act as the focal point for higher-echelon command and control and disseminate space-related information to other US commands. SPADOC will collect and disseminate real-time information on space status, warning, and operations direction.	Development	Ford Aerospace
Strategic Air Command Digital Network (SACDIN) A program to modernize Strategic Air Command's control and communications systems from both the operational and maintenance standpoints. SACDIN will provide two-way, direct, secure data communications with enhanced survivability from the National Command Authorities to the nuclear strike forces through the Commander in Chief, SAC. It will replace parts of the SAC Automated Command and Control System.	Production	ITT, Defense Communications Div.
Survivable Communications Integration System (SCIS) The Survivable Communications Integration System (SCIS) is a multimedia management and control system for missile warning data passing between sensor sites and the command authorities. The SCIS will receive and transmit critical message traffic simultaneously over all availabie communications media, thus ensuring that the most effective communications media is transmitting in any operational environment.	Development/Acquisition	None
WWMCCS Information System (WIS) This total information system planned for the post-1985 time frame will replace, modernize, and enhance the current WWMCCS Automatic Data Processing. WIS encompasses the information collection, processing, and display system that includes WWMCCS ADP and related software systems, procedures, and supporting telecommunications. The modernization focus is on the backbone of standard WWMCCS ADP, which supports command and control functions on Honeywell H6000-based systems.	Acquisition/Development	GTE
Deputy Commander for Tactical Systems, JTIDS, and AWACS (TC)		
AF Joint Interoperability of Tactical Command and Control Systems (JINTACCS) JINTACCS is a JCS-directed joint program to improve the operational effectiveness of the services' tactical C^2 systems used in support of joint tactical operations through the 1980s. JINTACCS is developing and testing the interoperable system architectures and is standardizing message structure, message language, and operation procedures employed in both computer-to-computer and person-to-person systems. The USAF program ensures that Air Force requirements are reflected in the developed and tested standards.	Acquisition/Development	None
Airborne Battlefield Command and Control Center (ABCCC) III The ABCCC III will give the tactical air forces an automated airborne command and control system in the forward battle areas for offensive air support operations and an on-scene command center for special operations. The system will include an automated tactical battle management and display system, a communications switching system for internal/external voice and data distribution, recording, and playback, teletype systems, and cryptographic equipment.	Development	None
Antiradiation Missile (ARM) Alarm Sensor The ARM Alarm Sensor is a special-purpose, small, solid-state, pulse-Doppler radar used to detect approaching antiradiation missiles as part of the ground radar Electronic Counter-Countermeasures program. This radar will continuously monitor the threat environment of the AN/TPS-43 radar.	Development	Sanders Associates, Federal Systems Group
Caribbean Basin Radar Network A new program to upgrade US air surveillance and communications capability in the Caribbean basin. Data from a variety of geographically separated radar sites will be transmitted via land/satellite-based communi-	Definition	None

cations links to US-owned C³ centers. These enhancements will improve, at a minimum, USSOUTHCOM's ability to perform air traffic management and search-and-rescue missions.

Central Command and MAC Imagery Transmission System (CITS/MITS) A hardcopy imagery dissemination capability for US Central Command and Military Airlift Command for rapid transmission and receipt of reconnaissance and intelligence material via electronically secure communications networks.	Production	No commerical contractor (Tobyhanna Army Depot)
Combat Grande II Assistance to the Spanish Air Force for development and modernization of Spain's air defense system. This includes improvements in the areas of command and control, surveillance, communications, and operations and maintenance. Interoperability with NATO air forces will also be provided.	Acquisition	Hughes Aircraft Co.
Combat Identification System—Indirect Subsystem (CIS-ISS) A joint program to develop and deploy a worldwide, NATO-compatible system for accurate and timely target identification for battle commanders and weapons controllers. The program objective is to develop automated correlation and fusion of information from multiple ID sources and to develop a tactical electronic support measures (ESM) sensor to serve as a high-quality source of aircraft identification information.	Definition	None
Communications Nodal Control Element (CNCE) The CNCE is a segment of the TRI-TAC family of ground-based tactical digital communications equipment. The CNCE is a technical control facility used at communications nodes to provide performance monitoring of communications equipment, rapid restoral capability for essential communications in the event of failure or battle damage, and the capability when deployed to reconfigure communications assets rapidly to meet changing user requirements.	Production	Martin Marietta Aerospace
Digital European Backbone Incremental upgrade of portions of the European Defense Communications System (DCS) from a frequency-division multiplex (FDM) analog system to a time-division multiplex (TDM) digital system with higher-reliability components. This will provide modern, wideband digital communications with encryption capability and increased channel capacity over the current analog system.	Acquisition and Deployment	None
Digital Nonsecure Voice Terminal (DNVT) The DNVT is a low-cost, nonsecure digital telephone instrument that will interface directly with the TRI-TAC Army circuit switches to satisfy a variety of user needs and TRI-TAC system architectural requirements. The TA-954-( )-TT DNVT is a "ruggedized" model designed for field use.	Production	General Atronics Corp.
E-3 Airborne Warning and Control System (AWACS) This system provides survivable airborne air surveillance capability and command control and communications functions. Its distinguishing technical feature is the capability to detect and track aircraft operating at high and low altitudes over both land and water. Used by Tactical Air Command, with Tinker AFB, Okla., as the main operating base, these aircraft may deploy throughout the United States and overseas to provide surveillance, warning, and control in a variety of peacetime and wartime situations. Major upgrades now under way or being planned include additional sensors, antijam communications, radar system upgrades, and mission and flight simulator system advances.	Acquisition and Operational	Boeing; Westinghouse
Ground Attack Control Center (GACC) The Ground Attack Control Center will provide the TACS with a capability to control air attacks against time-sensitive (moving and stationary) ground targets. The GACC will use the MCE operations module as the hardware equipment baseline.	Development	None
Ground Mobile Forces Satellite Communications (GMFSC) Terminal Program The GMFSC program provides the tactical air forces with highly mobile satellite communications terminals. The program will also provide equipment to Air Force Communications Command for support of rapid deployment forces and Air Force contingency missions. The GMF program is multiservice, with the Army as lead service. The GMFSC terminals operate through the Defense Satellite Communications System (DSCS) satellites located in synchronous orbits for continuous worldwide coverage.	Development, Acquisition, and Production	RCA; Lincoln Laboratory; Raytheon Co.
HAVE QUICK Provides an improved near-term air-air and air-ground-air jam-resistant UHF voice communications capability that will allow TAF mission accomplishment against the current threat.	Development and Production	Magnavox; Rockwell Collins
HAVE QUICK II A follow-on improvement to the HAVE QUICK modification program, HAVE QUICK II will improve the jam-resistance of HAVE QUICK against the evolving threat and will also improve the operational utility of the radio.	Development/Production	Magnavox
JINTACCS Automated Message Preparation System (JAMPS) JAMPS is a program that will improve the generation and transmission of text messages through the use of stored templates, for which only a minimum number of variable entries need to be provided. The templates consist of a large number of specific action messages covering the many different kinds of actions that can only be interpreted by human operators. The variable entries identify particular agents, times, objectives, and the like. JAMPS is scheduled for initial operation in 1986.	Development	None
Joint Tactical Communications (TRI-TAC) Acquisition of ground-based tactical digital communications equipment for the multiservice area under the auspices of the DoD Joint Tactical Communications (TRI-TAC) program. This includes all trunking, access transmission, and switching equipment for mobile and transportable tactical multichannel systems, associated systems control and technical control facilities, local distribution equipment, and voice, record, data, and ancillary terminal and COMSEC devices.	Definition, Acquisition, Production, and Deployment	Martin Marietta; Raytheon Co; General Atronics Corp.
Joint Tactical Information Distribution System (JTIDS) A program to develop a high-capacity, reliable, jam-protected, secure digital information distribution system that will enable a high degree of interoperability among data collection elements, combat elements, and command and control centers within a military theater of operations.	Full-Scale Development/Production	Hughes Aircraft Co.; Singer Kearfott; IBM, Federal Systems Div.
Microwave Landing System (MLS) This four-part DoD program will develop, test, and produce landing systems to replace the existing Instrument Landing System (ILS) and Precision Approach Radars (PARs). Mobile MLS will provide tactical ground systems to support MAC/AFCC wartime missions. Fixed-Base MLS will procure FAA-developed ground systems for DoD bases worldwide. ESD will obtain modified civil avionics for cargo, tanker, and transport aircraft and a militarized version for most other aircraft types.	Development	None
Modular Control Equipment (MCE) The MCE is a transportable, modularized, software-intensive automated air command and control system. It will interface with the AN/TPS-43E radar for local-area air surveillance and other TACS elements via tactical	Development	Litton Data Systems

NAME AND MISSION	STATUS	CONTRACTOR
data links for remote sensor data. The MCE will replace elements of the 407L system located at the combat reporting center and forward air control posts. The system will dramatically improve operational capability and provide reliable and survivable operations into the twenty-first century.		
NATO Air Base SATCOM (NABS) Terminal Program The NABS terminals will enhance the survivability of critical wartime communications between and among NATO Air Operations Centers (AOCs) and allied airfields where USAF elements would deploy in their NATO wartime role.	Acquisition and Production	None
NATO E-3A Acquisition of E-3A Sentry aircraft for the North Atlantic Treaty Organization (NATO), with special modifications to meet NATO requirements. Currently planned upgrades include additional sensor techniques undertaken in a unique cooperative R&D program with the United States.	Acquisition and Operational	Boeing; Westinghouse
Salty Net '82 The Salty Net '82 program provides a digital data link between the US Army Air Defense Command Center (AN/TSQ-73) and the German Air Defense Ground Environment (GEADGE) system on a short-term basis. The Buffer was developed in 1976 to accept, translate, and transmit air surveillance messages automatically between the US Tactical Air Control System (407L) in Germany and the European Command and Control Centers, which used the NATO 412L and NADGE systems.	Deployment	None
Saudi Arabia E-3A/Tanker This effort involves development and acquisition of five modified E-3As and eight derivative tankers to fulfill United States government commitments to the Saudi Arabian government.	Development and Acquisition	Boeing; Westinghouse
SINCGARS This program is to develop airborne SINCGARS systems for jam-resistant, secure, tactical VHF/FM/AM voice communications that will interoperate with the US Army-developed equipment and be a direct form, fit, and functional replacement of the AN/ARC-186 radio. Also, ground SINCGARS systems for jam-resistant, secure, tactical VHF/FM voice communications will be acquired from the US Army.	Development	ITT, Aerospace Optical Div.
Speakeasy Secure Voice Terminal Secure voice terminals for triservice use over normal AUTOVON or commercial circuits. These terminals have excellent voice quality and can be used in the normal office environment. The terminals will expand the number of users having access to the Defense Automatic Secure Voice System. The secure voice terminals will be used by selected C^2 and other high-priority agencies that have not had this service in the past. Enhancement units are being installed to upgrade the existing terminals in order to expand their capabilities.	Production	Harris Corp.
System Trainer and Exercise Module (STEM) The STEM is a deployable trainer and exerciser utilized to train CRC/CRP AN/TSQ-91(v) operations personnel in various mission functions. The STEM will provide capability to prepare exercise scenarios containing simulated flights of aircraft performing various types of tactical missions.	Production	GTE Communications Systems Div.
Tactical Digital Facsimile (TDF) The TDF system, which is compatible with standard modems, provides transmission, receipt, and reproduction of photographs, maps, fingerprints, and other types of hardcopy. Colored material can be processed in black and white or up to sixteen shades of gray. TEMPEST/COMSEC secure, the TDF is interoperable with all other facsimiles, including those of NATO.	Production	Litton Amecom
Tactical Digital Troposcatter Radio Terminal A family of tactical digital troposcatter radio terminals to provide secure transmission and reception of analog and digital voice and digital data by means of line-of-sight and tropospheric modes of propagation over distances up to 200 miles.	Production	Raytheon Co.
Ultra Low Sidelobe Antenna (ULSA) The ULSA is an electronic counter-countermeasures improvement to the AN/TPS-43E Tactical Radar System. It is designed to minimize the vulnerability of the radar to jamming and to maximize the survivability of the transmitter system in the presence of an antiradiation missile (ARM) attack. The low transmitting sidelobes not only offer jamming resistance but also permit the use of low-power decoys to misdirect the ARM.	Production	Westinghouse Defense and Electronics Center
Deputy for Development Plans (XR)		
Adaptive Planning This effort analyzes certain strategic planning functions for the applicability of artificial intelligence techniques. It will provide a system specification for development and acquisition of an "expert system."	Planning	MITRE Corp.
Advanced Tactical Battle Management System Advanced Tactical Battle Management System planning identifies alternatives to satisfy future tactical command control and communications needs as identified by the users—the tactical air forces. The program will assist in controlling tactical C^3 acquisitions by focusing the expenditures on a system solution rather than on a piecemeal approach. The resultant increased capability will be incorporated through an evolutionary systems upgrade. The program uses as its baseline the architecture developed by the 21st Century Tactical C^2 Study Group.	Planning	MITRE Corp.
AFCC Base Support Communications Planning Development of a comprehensive Air Force base communications architecture for the 1990s, with general guidance and specific implementation plans for an evolutionary upgrading of base communications facilities. It will cover telephone service, local area networks, land mobile radios, video, graphics, sensor/alarm systems, and interfaces to such external long-haul systems as DDN.	Planning	MITRE Corp.
Air Defense Battle Management Technology (ADBMT) A new program element under the Air Defense Initiative (ADI) that will perform battle management/C^3 technology development and system planning. This system will enable the air defense battle staff to collect sensor data, make engagement decisions, and communicate those decisions to field units.	FY '87 New Start	MITRE Corp.
Air Defense Initiative (ADI) ADI is an Air Force initiative to define, develop, and demonstrate the enabling technologies for in-depth North American defense. The ADI program is built around four program elements: Atmospheric Surveillance Technology (AST), Cruise Missile Surveillance Technology (CMST), Air Defense Battle Management Technology (ADBMT), and Cruise Missile Engagement System Technology (CMEST). The AST and ADBMT programs will be managed by ESD/XR.	Planning	MITRE Corp.

ELECTRONICS might well be the deciding factor in the outcome of modern aerial combat. If so, the winning margin would be slim. The United States has made impressive improvements in its electronic warfare (EW) capabilities over the past decade, but so has the Soviet Union. The electronic battle environment is dense and dangerous.

"Virtually everything we do in the aerial combat arena today takes place in an electronic, electro-optical, or infrared environment," Col. Noah E. Loy told AIR FORCE Magazine. (Colonel Loy was recently replaced by Brig. Gen. John A. Corder as Special Assistant for Electronic Combat in the Office of the USAF Deputy Chief of Staff for Research, Development, and Acquisition. This new position was established to provide more centralized direction and coordination of Air Force electronic warfare programs.)

The EW threat, as well as the US capability to counter it and present its own threat, has grown exponentially since the Vietnam War. "In Vietnam, we started out countering two very specific threats, the SA-2 surface-to-air missile (SAM) and antiaircraft fire," said Col. Edward G. Fincher, Air Force Systems Command Director of Electronic Combat, Reconnaissance, and Intelligence. "We ended up contending with some slightly more sophisticated systems and the shoulder-mounted, heat-seeking SA-7 low-altitude SAM. Today, we are equipped to fight a spectrum of threats that has increased spectacularly." The airborne threat has also grown dramatically, he added, as potential enemies have equipped their aircraft with a wide variety of air-to-air electronic fighting systems.

The Expanding Threat

"In NATO," Colonel Fincher said, "we face a multitude of SAM systems for low, intermediate, and high altitudes, a plethora of AAA systems, and several different types of Warsaw Pact aircraft." He noted that the US faces an EW threat even in the Third World, though not to the same extent as in Europe.

In Vietnam, the US relied on both standoff and self-protection electronic warfare capabilities. F-100 and F-105G Wild Weasel and EB-66 jamming aircraft provided standoff capabilities. The Weasels sought out SAM and radar sites and then attacked them, initially by using iron bombs and later by relying on more sophisticated radar-homing bombs and missiles. The EB-66 provided standoff jamming against early warning and ground intercept radars. For self-protection, strike aircraft were equipped with their own threat warning system, the APS-107 Radar Homing and Warning (RHAW) pod, and with either the APR-25/26 or the APR-36/37 Radar Warning Receivers (RWRs) and with Electronic Countermeasures (ECM) pods. While podded systems worked well, each pod occupied a weapons station on the aircraft carrying it, reducing its surface attack capability. These pods could be employed only against radar.

For infrared countermeasures, EB-66 electronic support aircraft were equipped with the AAQ-4 active infrared jammer. This system was developed to counter such air-to-air infrared-seeking missiles as Atoll. The capability for fighters and support aircraft to eject decoy flares to counter the SA-7 infrared ground-to-air missile was also developed later in the war after the introduction of that missile. Signal and illumination flares were modified for that purpose. But only the RF-4 had an internal flare deployment system—other aircraft in the theater carried other systems.

The original RWR and RHAW systems were based on analog technology and were relatively slow in processing information. They were good enough then, because the density (number) of enemy radio frequency (RF) signals was low. "The biggest challenge for these systems today," Colonel Fincher said, "is the explosion in the number of signals a particular system must process, especially in a European scenario. More than a million pulses per second are expected to be the norm in the 1990s. The threat density has increased by an order of magnitude since the Vietnam era."

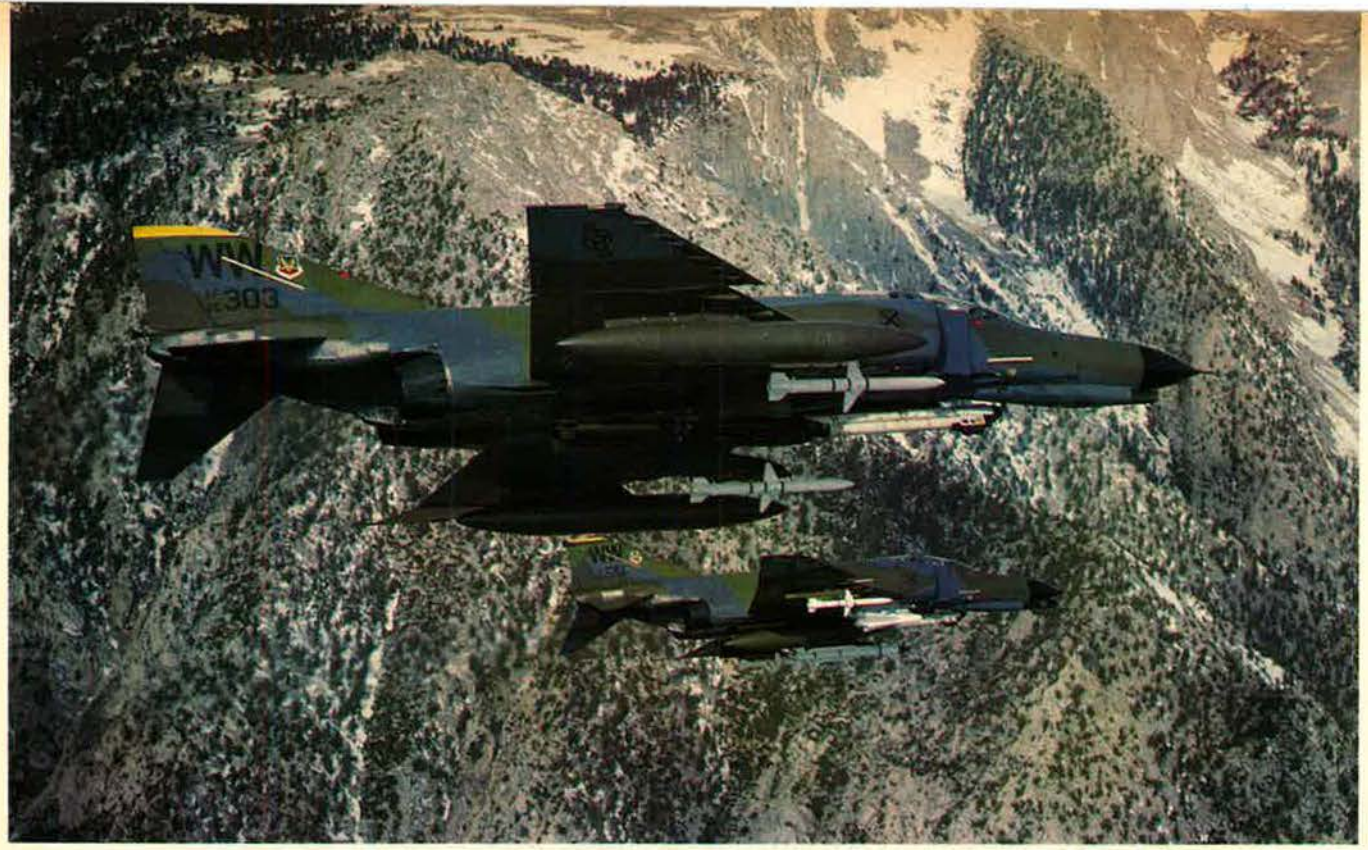
Threat density is not the only new problem. "Besides the increase in the number of pulses, there is a big change in sophistication of the threat—there were no pulse Doppler or monopulse radars in Vietnam, for example," he said. The increase in signal density and threat sophistication has driven the US to use digital, high-speed computer processors in the new generation of RWRs.

Self-Protection Systems

"The primary Air Force focus of the electronic combat effort today," Colonel Fincher said, "is to provide internal self-protection electronic countermeasures systems. The source of this focus, Tactical Air Command, has ranked self-protection 'Number One' on its electronic combat priority list."

Such strategic aircraft as the B-52 and the B-1 already have internal self-protection systems, but those planes have the cubage (space) to accommodate them. They are thus easier to design and install in such aircraft. Additionally, strategic aircraft must have self-contained systems because they operate alone, deep in enemy territory, and seek to remain undetected until initiating an attack. Their bigger systems are capable of defeating numerous threats simultaneously or in a prioritized order.

Fighters are smaller and present a different challenge. Such aircraft not only have less space available for the self-protection systems but



F-4G Wild Weasels of the 561st Tactical Fighter Squadron fly over the snow-capped mountains of California en route to an electronic warfare training exercise. Weasel aircraft seek out and attack enemy radar emitters.

also lack the electrical power resources of larger aircraft. For now, the F-15's internal electronic warfare suite includes an ALR-56 RWR, which interfaces with an internal jamming system, the ALQ-135, and with the ALE-45, a dispenser for deploying chaff or flare decoys. More work is under way on developing new systems for countering the infrared/electro-optical (IR/EO) threat. F-16s and A-10s also carry self-protection systems. These include the ALR-69 and ALR-45 RWRs and ALQ-119 and ALQ-131 ECM pods.

In a "strike package," these aircraft would be accompanied by other aircraft providing standoff protection from enemy defenses. These standoff platforms include EF-111s, which jam enemy radar defenses along the route of the strike force; F-4G Wild Weasels, which attack radar installations; EC-130H Compass Call aircraft, which are specially equipped to jam the enemy's command control and communications network; and the Precision Location Strike System (PLSS)—if it survives.

Finding the Targets

PLSS, which is in major technical as well as budgetary trouble *(see "In Focus . . ." p. 24)*, was originally designed for missile attack of radar installations deep in the enemy rear. In its present form, each PLSS utilizes three high-flying TR-1 reconnaissance aircraft to detect enemy radar emitters. Information is transmitted instantly to a ground station that, using triangulation, accurately locates each emitter. The ground station then transmits the location information through one of the TR-1s to an airborne F-16 equipped with an Adaptive Target Data Link (ATDL). Guided precisely to the target, the F-16 then attacks it with iron bombs. The Air Force will eventually equip strike F-16s with a radar-homing weapon, such as the High-speed Anti-Radiation Missile (HARM).

"While it would appear that PLSS does the same thing as the Wild Weasel, the systems are complementary," Colonel Fincher said. The Weasel accompanies a strike force and attacks radar emitters as they are encountered, enabling the force to accomplish its mission. PLSS directs F-16s to do this as well. But the large number of such targets in the Warsaw Pact area means there will be more than enough work for Weasels and F-16 PLSS strike aircraft, which will always be limited in number.

This would be especially true during the expected intensive thirty-day initial phase of a Central European war, when F-16s might well be required at that time for other, more time-sensitive missions. Then, too, Weasels on the scene during an attack could probably hit radar targets in less time than could F-16s dispatched by PLSS. Conversely, PLSS can detect targets beyond the range of the Weasels' on-board equipment.

"Another target-finding system is the Joint Surveillance Target Attack Radar System (Joint STARS)," said Col. Harold E. Thompson, Director of Electronic Systems in AFSC's Office of the Deputy Chief of Staff for Systems. "Joint STARS is a cooperative Army-Air Force program to detect, precisely locate, track, and attack moving and stationary ground targets behind enemy lines." (PLSS locates only enemy radars.) The Air Force provides the airborne system, which is a multimode side-looking radar sensor mounted in a EC-18. The EC-18, a militarized version of the Boeing 707 transport, is also equipped with on-board data-processing and display terminals

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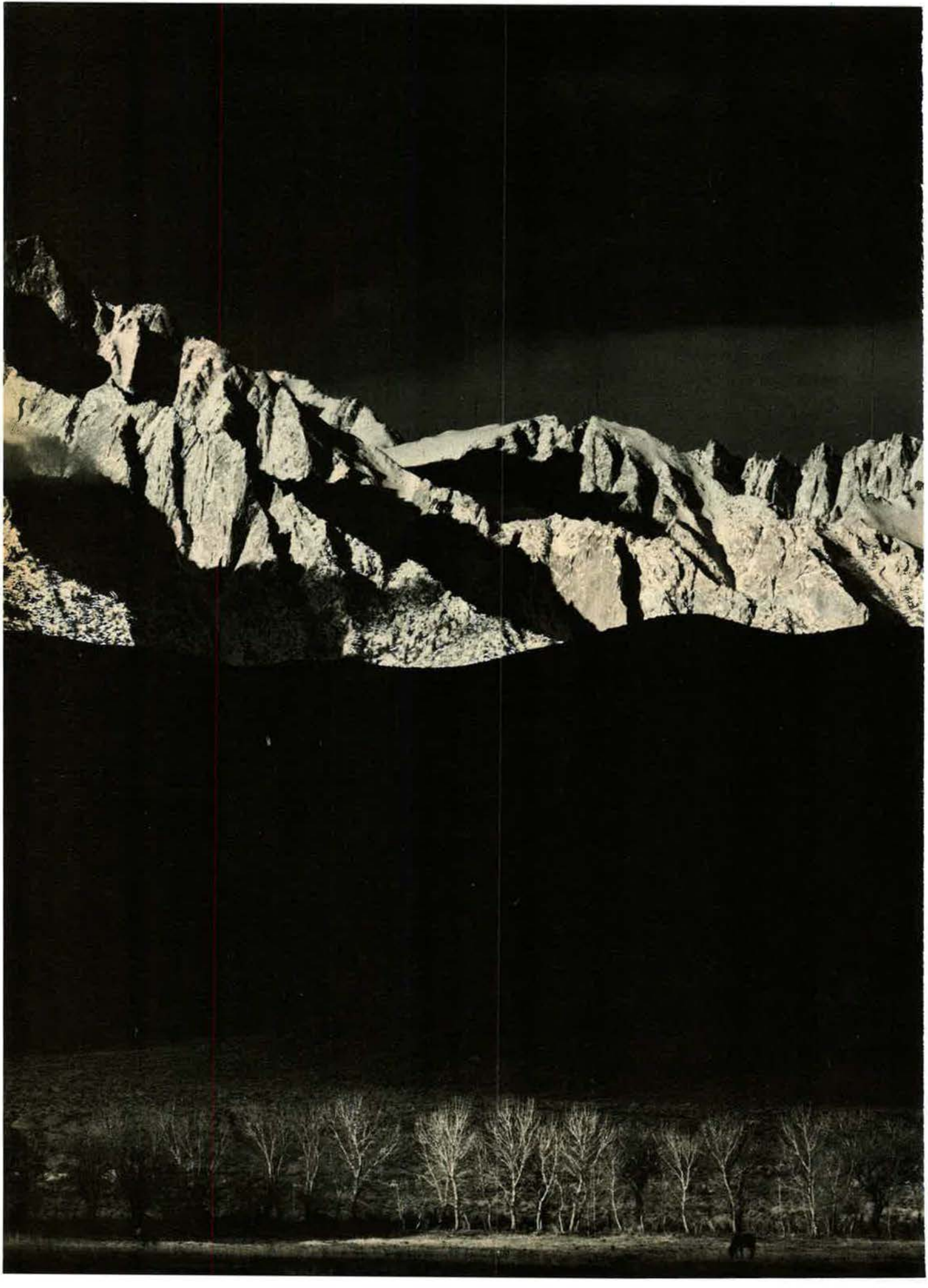

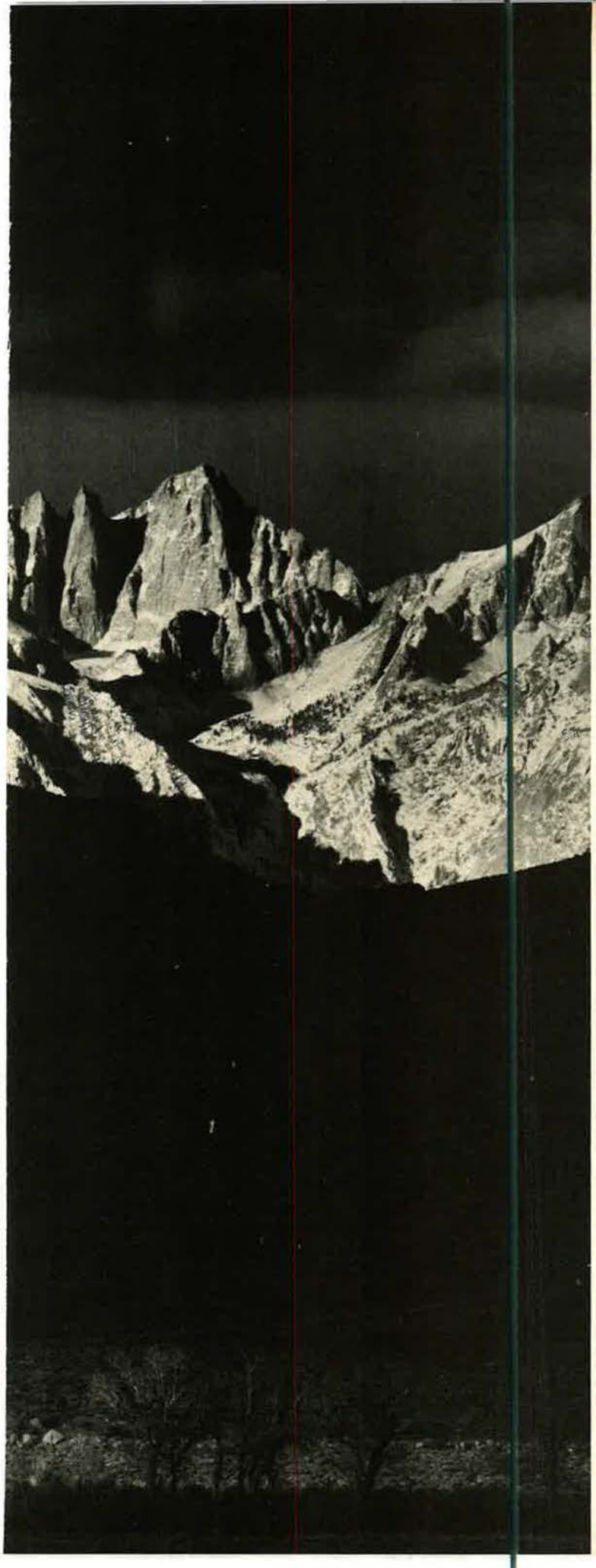

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and secure voice and data communications to both ground stations and attack aircraft. The Army provides Ground Station Modules (GSMs), which are mobile data-processing and display stations.

Antijam Communications

Critical to management of the battle and to survival of USAF aircraft in today's electronic warfare environment is antijam communications. "Without antijam systems," Colonel Thompson said, "we have no communications and thus no command and control. With our antijam communications systems, we can provide reliable voice and data information in the areas where the war is fought—in close proximity to jamming threats in the enemy's rear as well as along the forward edge of the battle area [FEBA]."

A principal part of the antijam capability is the Joint Tactical Information Distribution System (JTIDS) installed in E-3 Airborne Warning and Control System (AWACS) aircraft. This equipment transmits data to properly equipped friendly aircraft. Using it, controllers on the big AWACS aircraft can direct large formations of friendly fighters against enemy air forces, even though the enemy is trying to jam communications. A new variant of this system, Enhanced JTIDS (EJS), would have permitted transmittal of voice, but Congress has zeroed out funding for EJS. Colonel Thompson pointed out that AWACS controllers can communicate by voice with the fighters, even in a jammed environment.

For fighters, Have Quick is the basic USAF antijamming radio system. It works by frequency hopping. All transmitters and receivers on a particular frequency hop to a new frequency every tenth of a second. The enemy can't jam Have Quick transmissions because he doesn't know the sequence of frequency changes. A precise timing hack is provided for the radios in the system by satellite or by a local ground station if a satellite is not available. "Have Quick has been tested in a wide variety of combat environments," Colonel Thompson said. "It works. Aircrews using it say that they are unaware of the frequency hopping or that the jammers are having any effect at all."

Colonel Fincher estimates that about eighty percent of the electronic warfare development budget is being spent to increase fighter self-protection capabilities. This is buying, for example, a major update in the F-15's internal jammer, the ALQ-135, and the ALR-56C RWR. A new chaff and flare dispenser for fighters, the ALE-47, is coming into the inventory. The F-111 is undergoing a major ECM update and improvement program. A new radar warning receiver for the F-16, either the ALR-74 or the ALR-56M, will soon be selected. The new Airborne Self-Protection Jammer (ASPJ), which will fit the F-16 and several Navy aircraft, is in the final design stage.

Still on the production line, with an expected delivery date this December, is the F-15E deep penetration fighter. It will be equipped with the ALR-56C RWR, an upgraded version of the ALQ-135 internal jammer, and the ALE-45 countermeasures dispenser, now carried on earlier models of the F-15.

Compared to the state of electronic warfare in the Vietnam era, Colonel Fincher said, we are "light-years improved." But because of the increased complexity and density of enemy electronics, "we are only marginally better by comparison."

In a Reaction Mode

One reason for this, he said, is that the electronic warfare community, at least in the tactical world, has always been in a reactive mode. As soon as a threat is detected, a specific action is initiated to neutralize or, at least, combat it. Colonel Fincher pointed out that the Soviet development and test cycle is eight to twelve years. "We usually do not detect the threat or get adequate data on it until the new weapon reaches the test phase. Then we start to develop a countermeasure, which takes another eight years. Thus, fifteen to twenty years pass between the time of the threat and the operational response." More often than not, he said, we have developed specific systems for specific threats. This leads to a large number of specialized EW systems.

Getting the Air Force out of this reaction mode, Colonel Loy said, is the main reason why the new office of USAF R&D Special Assistant for Electronic Combat was created. "One big problem," he explained, "is the development of the same combat capability in two different Air Force commands." When a new operational requirement is identified, Air Force Systems Command has the responsibility for developing a new system to fill it. But if the need develops from a new Soviet threat (as many needs do), Air Force Logistics Command may be tasked, at the same time, to upgrade an existing system to meet it. The result is two different systems of similar capability being developed simultaneously. They will start with different basic technologies, but must fit a wide range of aircraft. The Office of the Special Assistant will help coordinate these development efforts.

Establishment of the new office took place simultaneously with the creation of a new organization, the Inter-Command Electronic Warfare Management Directorate, at Wright-Patterson AFB, Ohio. This group is staffed with scientists and engineers from both Systems Command and Logistics Command. "By combining people from AFSC and AFLC, we will be able to utilize the expertise of both commands in a coordinated approach that will reduce duplication of effort and produce needed systems on a more timely basis than in the past," Colonel Loy said. His office will provide the focal point for Air Force efforts in electronic combat and will work closely with the existing Electronic Combat directorate in the DCS/Plans and Operations.

The Special Assistant's job is difficult because he will be trying to develop common EW systems for the entire fleet of Air Force aircraft. These vary in technological complexity from the F-111 and the F-4 (late 1950s and early 1960s technology) up through the F-15 and F-16, which are still coming off the assembly line. Key to success will be development of an Air Force Total Electronic Combat Acquisition Plan for acquiring all the electronic warfare systems needed for all aircraft in the future.

Right now, there is a plan that lists all the requirements. "But what is needed," he explained, "is an in-being acquisition strategy, in-

cluding prioritization, that shows when new systems should come in and old ones go out of the inventory." The plan must take into consideration combat requirements and respond to force structure needs, including both tactical and strategic forces.

"This will be tough," he said. "Strategic Air Command must have systems that enable an aircraft to survive alone. TAC, on the other hand, uses composite deployment plans, so its forces in battle must cope with and benefit from the synergism of all systems present in massed air battles."

The Software Tax

A critical part of the effort will be finding a way to attain commonality so that equipment components are interchangeable among different systems. When systems are built under a Quick Reaction Capability (QRC) contract to meet a newly identified specific threat, they are seldom usable across the aircraft fleet. Very-high-speed integrated circuits (VHSICs) show great promise for solving these commonality problems, Colonel Loy said. With smaller components, equipment will fit more easily into more aircraft. Higher computer speeds and capacities will mean greater EW capability.

The advancement of computer technology and its deeper integration into such systems as the Advanced Tactical Fighter will also help enormously. Changing software is easier to accomplish than changing components. But there is a penalty for computerization.

"Software is the big problem," Colonel Loy said. "The software tax is time. It takes a long time to write and integrate it, and there are not enough software people available. This problem becomes more critical each day," he pointed out. "The original F-16 had 32,000 bits of computer information in its systems. Today, it is moving to more than 500,000. The F-15 originally had a 32,000-bit system, and it's now a 256,000-bit system. Eventually, the F-15E will have a 3,000,000-bit system.

"We don't yet know how to handle the software tax," he said. "And we're not able to calculate accurately the time involved to produce all the integrated software we need." The ASPJ, for example, is highly software-dependent. One potential avenue for improvement, according to Colonel Loy, is software standardization. He believes new development programs must call for manufacturers of computerized aircraft, weapons, and avionics equipment to use standardized software language and avionics architecture.

On a similar track, Colonel Fincher expects to see big improvements once Integrated Electronic Warfare Systems (INEWSs) come into general use. Still on the horizon, INEWS will integrate electronic warfare systems design into the basic design of any new aircraft's avionics system. In the past, EW systems were designed separately, responding to designated requirements. They were then—after the design phase—fitted into the aircraft. Many times, complicated interfaces were required. "What we're talking about is an integrated system capability," he said. "We are past the time when an EW system in an aircraft is self-contained—the system must be a part of the overall avionics system."

He foresees the use of the standard computer architectures that Colonel Loy wants—all the computers in an aircraft and its EW systems using the same language and able to talk to each other without translation from one computer language to another.

Artificial intelligence will play a key role in this new electronic warfare world. Enormous increases in computational power will be put to good use in EW-equipped aircraft. As computers begin to work with much larger data bases and pass data at faster rates than they do today, the electronic warfare arena will grow steadily in sophistication and, inexorably, will become more deadly. ■

A-10 aircraft can carry the Westinghouse AN/ALQ-131 electronic countermeasures pod. The newest version of the pod, the Block II, has posted an excellent reliability and availability record during operational tests.

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Artificial intelligence has moved out of the laboratory and into the world of applications and practice.

Machines That Think

BY JOHN T. CORRELL
EDITOR IN CHIEF

WHEN automated computers first appeared thirty-five years ago, the public greeted them as "electronic brains." While these devices turned out to be enormously useful, time and familiarity soon taught us that they were really no more than very fast adding machines. They performed all of their marvels by manipulating numbers.

But even as the low-cost pocket calculator was evolving from the room-sized UNIVAC, a handful of researchers was plugging away at the notion that computers could do more than common arithmetic.

That field of research—now known as artificial intelligence (AI)—has become one of the hottest technologies of the 1980s, and it is moving rapidly out of the laboratory and into the world of applications and practice.

By using a higher order of abstract symbols, AI seeks to manipulate bits and pieces of information rather than individual numbers. This allows machines to mimic human behavior and carry out tasks that humans accomplish by means of perception, knowledge, reasoning, and learning. Some 500 "knowledge-based" AI systems are already in use by business, industry, and government, and the momentum is still gathering.

AI is the single most pervasive technology underlying the vision of the future as seen by Air Force Systems Command in its recently completed Project Forecast II, according to Brig. Gen. Charles F. Stebbins, AFSC Deputy Chief of Staff for Science and Technology. Such programs as the National Aerospace Plane and the Strategic Defense Initiative are prime candidates for artificial intelligence.

"The applications of AI are likely to be as extensive as the applications of the digital computer," said Dr. Bernard Kulp, AFSC's Chief Scientist, in his opening remarks April 15 for an Aerospace Education Center roundtable on artificial intelligence. "In fact, AI will greatly extend the utility of the computer, allowing it to address many applications that are not practical with conventional computer software and hardware today."

An AI-based maintenance diagnostics system now being tested for the B-1B bomber provides a small preview of what the technology has to offer. This system will monitor and troubleshoot all of the aircraft's subsystems continuously, locate problems precisely, and report them immediately. It promises to save $160 million in maintenance costs over the life of the aircraft. *(See "Bringing on the B-1B," p. 63, June '86 issue.)* Much headier stuff is percolating in laboratory prototypes.

By 1989, AFSC hopes to demonstrate advanced versions of two such systems. The first is the Tactical Experimental Mission Planner (TEMPLAR), which promises to reduce production time for a 1,000-sortie air tasking order from twenty-four hours to two. The second is the "Pilot's Associate," which the Air Force is developing in cooperation with the Defense Advanced Research Projects Agency (DARPA).

It will monitor aircraft systems and battlefield data to help a human pilot maintain full awareness of his situation. *(See "Air Combat and Artificial Intelligence," p. 90, October '85 issue.)*

Despite all this, responsible AI advocates in the Air Force are holding down the ballyhoo. In the past, extravagant claims for amazing automation projects have been followed by failure to deliver. The AI developers, keenly aware that credibility is vital to their success, warn decision-makers not to expect too much too soon. AI still has a long, long way to go.

Expert Systems

Artificial intelligence isn't always easy to distinguish from its more advanced relatives in the computer science family.

One widely accepted definition, Dr. Kulp told the roundtable, is that AI "is the science which enables computers to do things that, if performed by humans, would be called *intelligent*." Dr. Floyd H. Hollister of Texas Instruments, also on the panel, said that an identifying feature of AI is that it goes beyond the alphanumerics of conventional computing to process symbolic data at high levels of abstraction.

The heart of artificial intelligence is symbolic processing. AI programs manipulate chunks of heterogeneous information, with results that resemble rudimentary intelligent behavior in humans. Inference and deduction are possible. Unlike traditional computing, which pushes strings of numbers through a structured sequence in a relatively inflexible process, AI systems are seldom fussy about format. For example, AI systems easily recognize the compatibility of a numerical "4" and a spelled-out "three" and do the desired calculation directly.

Almost everyone agrees that there is a gray area in which a piece of programming could be called either AI or simply clever software. In many systems—the Pilot's Associate being one of them—AI and conventional computing technologies will work side by side.

There are, Dr. Kulp said, four major areas of emphasis in AI research:

- Natural language processing, which gives machines human-like communications skills, including the ability to read and understand text and translate it from one language to another.
- Robotics, allowing machines to manipulate their environment intelligently, navigate over rough terrain, and assemble complex parts without human intervention.
- Vision and speech recognition, in which machines are able to sense their environment, understand it, and respond to it.
- "Expert" systems, which use combinations of rules and facts to solve problems in tightly defined domains by mimicking the steps a human expert would follow.

Most of the AI action, military and otherwise, is in the area of these expert or "knowledge-based" systems. They can take many burdens of manual data collection and compilation off the hands of humans. Or they can be used as skill-extending tools by nonspecialists who lack expertise in a particular area. The objective is to assist humans, not replace them with machines, which is a fear often expressed about artificial intelligence applications.

The Knowledge-Based Planning System (KNOBS), the prototype for the TEMPLAR system that builds an air tasking order, illustrates what a typical expert system has to offer. The user sits at a console, typing questions or instructions in natural language for the machine.

If the question should be, "What fighters are available?" the system knows what a fighter is and what constitutes availability. It answers quickly in natural language on a console screen. It can relate fighters to other parts of the mission package, including targets, weapons, ingress and egress routes, refueling, and more.

When an air tasking order is done in the traditional way, twenty-four hours elapse between the time planning begins and the time the mission is flown. A lot can change in that interval. A big benefit of KNOBS and TEMPLAR is that the air tasking order can be updated rapidly.

Expert systems are built by discovering from human experts what information they use—and how they use it—to perform some well-defined task. This body of specialized knowledge and procedure must then be reduced to a software computer program. In AI jargon, this is called "knowledge acquisition/knowledge representation," and it isn't easy.

"We're finding that humans are like fingerprints in the way they solve problems," says Capt. Gregory Swietek of AFSC's Mission-Critical Computer Resources Division. "No two people use the same pieces of information in the same order. What we have to do is get a number of people together and look for overlap in the way they go through the process. This is a cognitive science area, where our understanding is not as good as it needs to be."

Some elements in human thought continue to elude the AI designers. Among these is analogy, which has long been of great value to scientists. Benjamin Franklin's work with electricity was enhanced by the realization that a cloud is nothing but a floating Leyden jar, Dr. Barry G. Silverman of George Washington University told the roundtable. "I've been working for five, almost six years now to develop some tools that solve analogy problems. We don't have any."

The number of successful expert systems reaching the marketplace is attributable mainly to work done by creative researchers working individually or in small pockets of AI virtuosity.

"Today, expert system applications can be characterized, for the most part, as independent, artistic efforts," Captain Swietek says. The designers custom-build their own tools, there is little standardization, and the results are not as mutually reinforcing as they might otherwise be. Moreover, custom work is costly. It's time, Captain Swietek believes, "to introduce an engineering approach to the development of expert systems."

The emerging technology of artificial intelligence shows brilliant potential. At the moment, though, there are still questions about the software, the hardware, and the human factors. There is also a certain amount of groping for what constitutes the central nature of the process itself.

Computers and Humans

There is disagreement about whether AI programming logic should be modeled after human

thought patterns or merely after the intelligent behavior of humans.

Our school of thought, Dr. Silverman said, holds that AI "is simply trying to get the machine to do what the human does—without regard to how the human does it." On the other hand, he said, the wonder of the human brain is that it deals with large-scale situations, relating one piece of information to another easily. "If we could better understand that through cognitive science research and translate it into some representations we could put on a machine, we could improve our AI programs."

Dr. James Hendler of the University of Maryland agreed that it's important to understand what people are doing when they think. "Then," he said, "as we get better understanding of what's going on, we can start abstracting the machine away from that exact model."

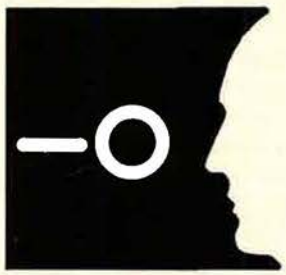
In either case, programmers soon run up against a fundamental truth of AI: Human beings carry an incredible amount of information around in their heads, and trying to match even small amounts of it in the memory of a computer is awesome.

As a recent issue of the Texas Instruments *Artificial Intelligence Letter* observed, computers aren't stupid. Anything that can do differential calculus in seconds can't be called stupid. Computers are, however, *ignorant*.

"Computers do not know how to read newspapers," Dr. Patrick L. Corbin of the Sperry Corp. said at the roundtable. "They do not go through grade school and high school, learning geography and all the other things a person picks up without thinking about it. When a human being is called upon to solve a problem, all these apparently unrelated things that he's learned throughout his entire life are lying there, waiting for some connection to be exercised where they're brought up and used to solve a problem. It's easy to say, 'Everyone knows it's cold in Alaska,' but that's wrong. The computer will not know until it is specifically told."

Dr. George T. Hummert of Westinghouse described what might be involved in imposing a degree of intelligence on a seemingly simple pick-and-place robotic function. To program a robot to find a glass on a countertop and move it elsewhere, Dr. Hummert said, a vast amount of data must first be provided just to enable the robot to recognize what is—and isn't—a glass.

Thus the feasibility of an AI application depends not only on whether the logic of the process is captured



but also on the amount of new data the machine will need and on how well the operation and its surroundings—the "domain"—can be structured and bounded.

Bounding the Domain

When these obvious-sounding principles are applied to actual cases, they sometimes lead to unobvious conclusions.

Take the matter of autonomous vehicles. DARPA's Strategic Computing Program calls for technology demonstration of an autonomous land vehicle that operates in complex terrain intelligently and independent of humans.

Dr. Hummert pointed out that an enormous data base will be needed if an autonomous vehicle is to cope with fallen trees, slippery surfaces, mud, and other things that are difficult to anticipate.

"Mobility on land is a terrible problem because the things that [autonomous vehicles] can sense aren't the things you need to sense to be able to determine where to go," Dr. Hollister said. "You can't sense very well where the swamp is on the other side of the hill."

Autonomous vehicles swimming in the sea would face a different problem, he said: "They have a very hard time seeing anything." While developing an autonomous aircraft would be tough, Dr. Hollister said it would take less computing power than land or sea vehicles because it would operate in a more predictable domain with fewer obstructions. In the sky, there are not many random barriers like logs and mud, visibility is generally good, and the craft has room to maneuver around any obstacles it might encounter.

The Air Force has no plans to buy an autonomous aircraft anytime soon, but Dr. Corbin reported that NASA and DARPA are circulating a draft Request for Proposals (RFPs) to industry for an "Automated Wingman."

"They're talking about the second airplane in a two-aircraft formation," he said. "It would not have a pilot in it. It would have an AI machine. It would maintain station on its leader's wing, and at the slightest threat, it would rush off and do battle while its leader waits to see what happens."

Software, Hardware, and People

The standard computer languages—including DoD's cherished "Ada"—are poorly suited to the symbolic processes of artificial intelligence. The preferred language for AI designers is LISP (a contraction of List Processing), which is configured around lists of various kinds. LISP itself is not new, but symbolic processing machines on which it could be used were not generally available until 1980.

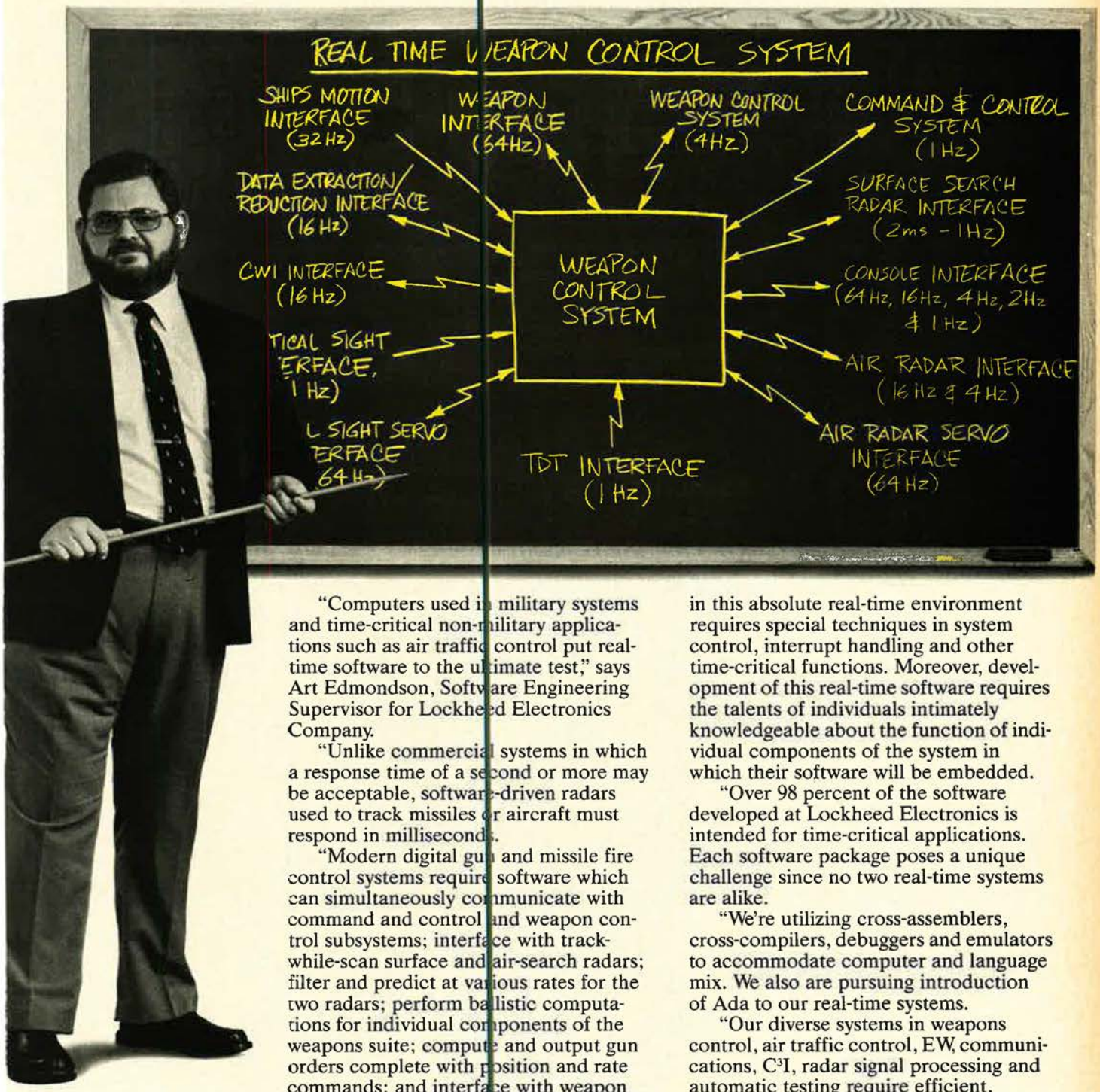
Those first LISP machines were man-sized affairs, but technology is shrinking them. Desktop models are current state of the art. Texas Instruments is on contract to deliver a LISP-on-a-chip machine to DARPA later this year.

"We've reached a point now where we can put a LISP machine in a shoe box, and in the next few years we'll be able to do more of that," Dr. Hollister said. The consequence of such downsizing is that "we can now put LISP machines into tactical air force applications."

The prospect is that Air Force AI projects will be developed in LISP and implemented in Ada, according to Captain Swietek. But beyond that lie some hardware problems.

"Right now," Captain Swietek says, "one of the limiting factors in AI is that even if you can write the

Art Edmondson on advances in real-time software technology.



"Computers used in military systems and time-critical non-military applications such as air traffic control put real-time software to the ultimate test," says Art Edmondson, Software Engineering Supervisor for Lockheed Electronics Company.

"Unlike commercial systems in which a response time of a second or more may be acceptable, software-driven radars used to track missiles or aircraft must respond in milliseconds.

"Modern digital gun and missile fire control systems require software which can simultaneously communicate with command and control and weapon control subsystems; interface with track-while-scan surface and air-search radars; filter and predict at various rates for the two radars; perform ballistic computations for individual components of the weapons suite; compute and output gun orders complete with position and rate commands; and interface with weapon control consoles and operator displays.

"To develop software for application in this absolute real-time environment requires special techniques in system control, interrupt handling and other time-critical functions. Moreover, development of this real-time software requires the talents of individuals intimately knowledgeable about the function of individual components of the system in which their software will be embedded.

"Over 98 percent of the software developed at Lockheed Electronics is intended for time-critical applications. Each software package poses a unique challenge since no two real-time systems are alike.

"We're utilizing cross-assemblers, cross-compilers, debuggers and emulators to accommodate computer and language mix. We also are pursuing introduction of Ada to our real-time systems.

"Our diverse systems in weapons control, air traffic control, EW, communications, C³I, radar signal processing and automatic testing require efficient, reliable real-time software to meet their specific performance requirements."

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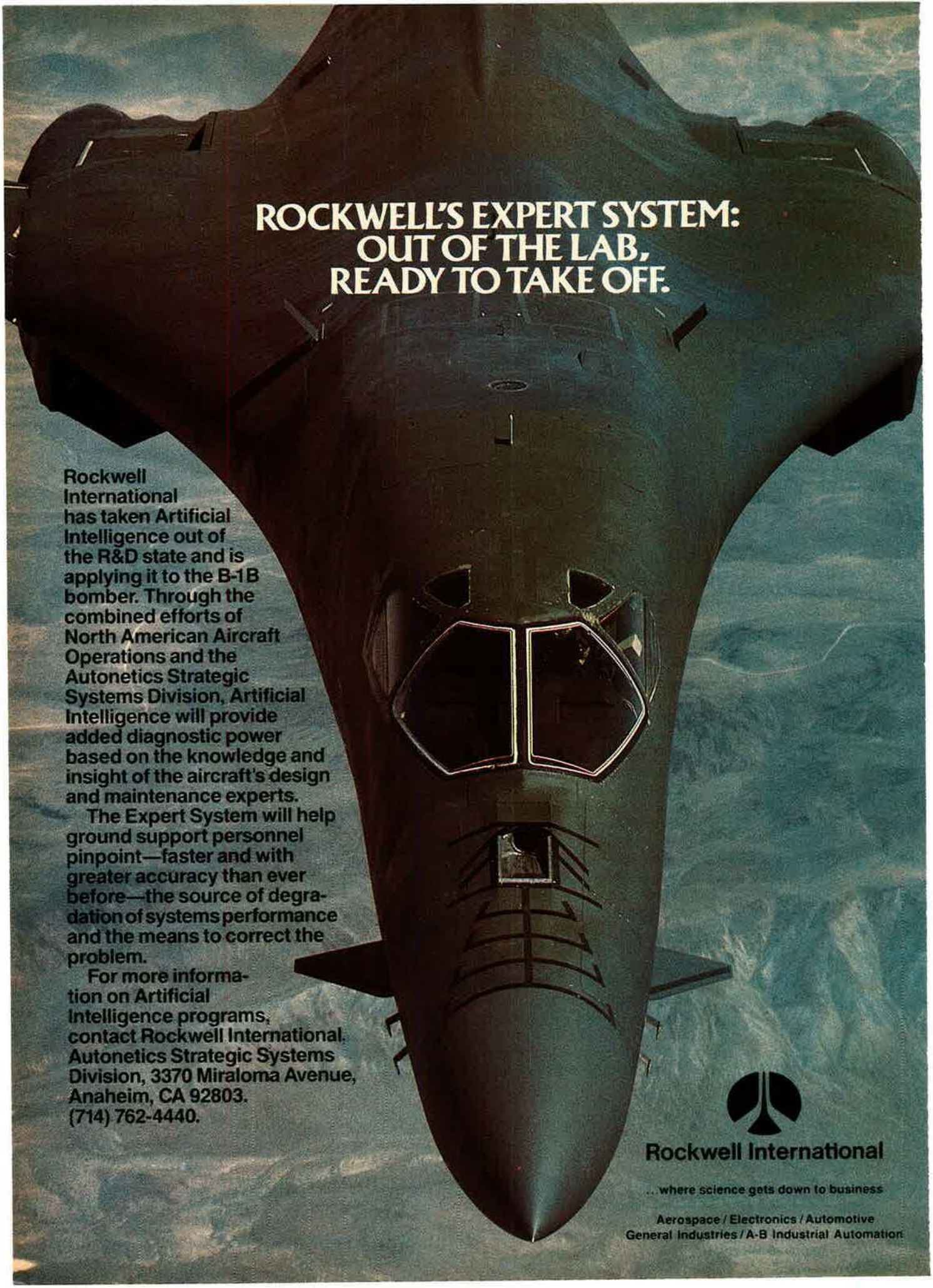
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software, the execution speed isn't there to support real-time applications. There are many military applications that we're interested in that have real-time requirements. Currently, we don't have the hardware to do the truly ambitious AI projects that are of military importance."

The Air Force is looking for leverage to DARPA's Strategic Computing Initiative, a five-year, $600 million program that will field a new generation of swift supercomputers. The supercomputer will employ massively parallel architectures, with tens of thousands of microprocessors working on different parts of a job concurrently.

That may well solve one set of problems while introducing a new set.

"We have to take the sequential processes approach we use today to write software and then break the software up into many parallel pieces," Captain Swietek says, adding that the Air Force and DARPA are doing extensive research "on how to slice and splice."

There is optimism that the big parallel processors can exhibit the characteristics of a team instead of a committee.

The most pressing problem in AI, however, is a shortage of technically prepared people. "Last year, about 300 computer science Ph.D.s graduated," Captain Swietek says. "Probably twenty-five to thirty of them were strong Ph.D.s in AI. There are maybe 100 true AI experts out there, with a growing number of others working their way up to that level."

The government cannot match the pay that AI experts can command from industry. Neither can the universities, upon whose faculty talent the future supply of top-rung AI people depends.

In his roundtable presentation, Dr. Hendler acknowledged the danger of luring people from the schools, but said he thinks the basic manpower shortage is temporary. Until recently, there was no demand for AI people.

"We've just admitted eighty students to our graduate program at the University of Maryland, and about seventy-five of them listed AI among their interests," he said. He cautioned, however, against expectations that an AI work force can be had quickly or cheaply.

To illustrate, he posed a hypothetical solution to an Air Force pilot shortage. His example began with the assumption that traditional sources of trainees and lengthy training programs could be dispensed with. Instead, mechanics and secretaries would be run through a week of ground school and one or two rides in a simulator. The best of them might be taken up in a Piper Cub to get the feel of it. After that, the class would be awarded its wings and turned loose to fly.

"When you say that about pilot training, it sounds silly," he said. "But when you say it about AI, people sit and nod." A week of LISP, a bit of Prolog, and a little experience with small versions of AI programs may enable some workers to function in limited roles, but that is not sufficient to build the corps of AI professionals that will also be required.

Centers of Action

DARPA is big in artificial intelligence. So are defense and consumer industries, a growing number of universities, and all of the military services. Air Force activity is concentrated at Systems Command headquarters and two AFSC labs, the Rome Air Development Center (RADC) and the Wright Aeronautical Laboratories (AFWAL).

Rome, which reports to the Electronic Systems Division, is responsible for generic AI technology research and applications in the field of command control communications and intelligence (C^3I). TEMPLAR is a Rome project.

So is the Artificial Intelligence University Consortium, a loose confederation of academic institutions exploring AI in general, with special concern for RADC's basic technology needs. Schools participating, along with the Air Force Institute of Technology, are the University of Massachusetts, Rensselaer Polytechnic Institute, Clarkson University, Colgate University, Rochester Institute of Technology, the University of Rochester, Syracuse University, and SUNY-Buffalo.

AFWAL reports to the Aeronautical Systems Division. Its responsibility is for AI applications in avionics, flight controls, and manufacturing. So far, its best-known artificial intelligence program is the Pilot's Associate, but in a new initiative, AFWAL is establishing an Institute for Artificial Intelligence in Manufacturing.

Seventy percent of the manufacturing done in the United States—and most of that which is done on contract for the Air Force—is batch manufacturing, Captain Swietek says. A plant produces a limited run of a certain product, then reconfigures to make something else. Only about thirty percent of the cost of batch manufacturing is related directly to the assembly line, though. "Seventy percent is in planning, tracking, warehousing, and expediting the process—areas where AI has tremendous application potential," Captain Swietek says.

Wright Labs is pursuing a cooperative agreement with industry and academia to set up the AI Manufacturing Institute. A university or a group of universities would provide 100 man-years of work annually to advance AI improvements to manufacturing. A board of directors, with industry membership and Air Force chairmanship, would control the effort. Twenty-five percent of the funding would be Air Force money, with the rest coming from industrial members on the board.

Building and Testing

The nearest-term Air Force applications for AI, according to Dr. Kulp, are diagnosing and interpreting the diagnosis of automatic test equipment. The use of artificial intelligence in training will probably come next.

Farther into the future lie operational versions of more complex expert systems, such as TEMPLAR and the Pilot's Associate. And after that, the list of possibilities goes on and on.

It includes systems for photo interpretation, threat recognition, and rapid fusing and interpreting of battlefield intelligence. And perhaps machines that can write software. Or smart robots to work in space or in hazardous areas on earth.

The approach is to build a little, test a little, and keep a handle on the exciting technology of artificial intelligence as it grows up. ■

The field of photonics isn't ready to leapfrog silicon technology yet, but it's coming on strong.

The Milita

BY MAJ. RANDAL E. MORGER, USAF
CONTRIBUTING EDITOR

A hair-thin glass fiber is the transmission medium for high-quality, jam-resistant communication by light waves. Fiber optics is integral to many USAF photonic systems.

ry Use of Light

THE Roman Navy was in for a surprise that fine, sunny day in 213 B.C. The empire's warships blockaded the harbor at Syracuse, supporting the siege of the Sicilian city by the Roman general Marcellus. Greek defenders busied themselves around a contraption on a nearby hillside. The great mathematician Archimedes directed their work. At his signal, hundreds of small mirrors were adjusted to reflect the sun's rays onto a larger hexagonal mirror overlooking the port. The focused light lanced into the rigging of one advancing ship; cloth sails and wooden spars smoldered, then burst into flame. Archimedes gave the word to aim the device at the next hapless vessel. At least that's the way it's told in the legend.

The military use of light is nothing new, as Archimedes purportedly demonstrated twenty-two centuries ago. Today, military applications of optics, photography, and electro-optics are very real and found in a wide variety of combat systems. In government, industry, and academia, scientists are studying dazzling new ways to exploit that portion of the electromagnetic spectrum comprising infrared, visible, ultraviolet, and X-ray frequencies. Other countries, notably the USSR, are also conducting research. It could mean an important combat edge for whoever moves ahead in light-related technologies.

Air Force Systems Command may play a key role in keeping the US in the lead. Command officials use the term "integrated photonics" to describe a collection of the hottest "revolutionary and pervasive" technologies that could lead to major increases in US military capability. Brig. Gen. Charles F. Stebbins, AFSC Deputy Chief of Staff for Science and Technology, has said, "We are at a place today in photonics that is comparable to where we were with the transistor and electronics in the 1950s—on the verge of a technological revolution."

"Photons are to light what electrons are to electricity," explained Capt. Gregg Swietek, program manager for advanced computer technology at Hq. AFSC, located at Andrews AFB, Md. In its purest sense, working with photons "requires a complete rethinking of the way we do things in the electronic world." Optical or "photonic" systems offer so much promise that integrated photonics was one of several areas flagged by AFSC's Project Forecast II study group last February for priority in further research funding.

Captain Swietek said the long-term goal of the program "is to achieve a total system based entirely on optical technology." The components of such a system, he envisioned, could include "optically based sensors and data buses, optical data and signal processing, as well as optical memory and communications." He acknowledged, though, that today's state of the art, particularly in optical computing, is still so rudimentary that a totally integrated system may be decades away.

The advantages appear to be worth the investment. Dr. Bruno Beek, technical director for the Communications Division at the Rome Air Development Center at Griffiss AFB, N. Y., chaired Forecast II's communications panel. He noted that microelectronics faces problems in a combat environment, such as susceptibility to jamming, interference, and electromagnetic pulse (EMP). With photonic communications systems, he said, "many of these drawbacks would go away." Additional benefits could be realized in component size and

weight reductions, improved bandwidths, and smaller power requirements.

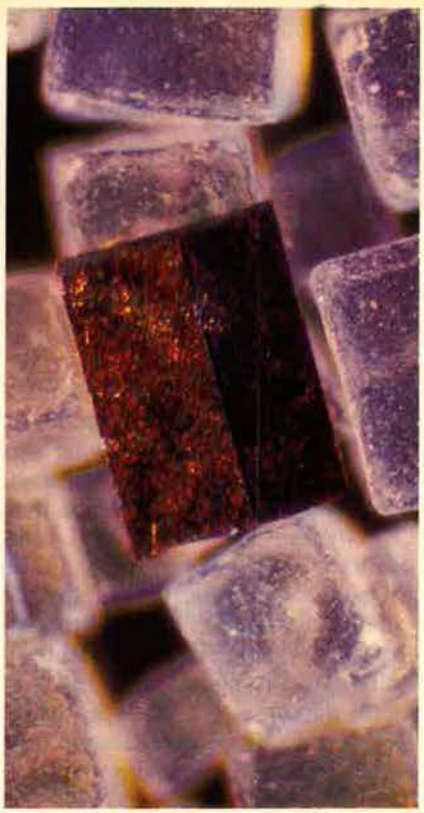
Optical communications and computers also outperform their microelectronic cousins—at least theoretically. "Superiority of lightwave communication," Captain Swietek said, "can be measured by an increase of four orders of magnitude in information-carrying capacity, reduced noise loss during signal transmission by two orders of magnitude, and a one order-of-magnitude reduction in error rate." Optical computers could be from one hundred to a thousand times faster and more efficient than microchip machines and would have "inherent parallelism" based on their ability to interconnect easily with large numbers of other optical processing elements. Parallelism in a computer is a trait for which electronic engineers have searched for years, with limited success.

The ability of a computer to compare information, characterize what sensors "see," generalize data, and come to logical conclusions are all hallmarks of true artificial intelligence (AI). Some scientists theorize that optical computers could better assimilate analog information in at least a crude imitation of the human brain, which readily analyzes shapes, forms, and pictures. Silicon-chip computers, on the other hand, must rely on digital information—strings of zeroes and ones in an "off-on" pattern—to come to mathematical conclusions.

Leapfrogging Silicon

In an April 15 Aerospace Education Foundation Roundtable discussion on Artificial Intelligence, Dr. Bernard A. Kulp, AFSC Chief Scientist, noted the potential advantages of optical processing while probing other panelists' opinions about "jumping right to optical computers . . . as we move to the more sophisticated AI systems."

Reaction was mixed. Dr. Floyd Hollister, Director of the Computer Science Center for Texas Instruments, reported that industrial and academic researchers are studying that possibility, but indicated that "at least twenty-five years of experience has shown that no one has leapfrogged [silicon technology] yet." Dr. James Hendler, assistant professor of computer science at the University of Maryland, added, "Just having a faster computer doesn't mean you can then do it all." The problem, he believes, is more fundamental. "We just don't know how to take our problems and map them onto any of these technologies," he said, no matter how the technology is based. His comments echo those of scientists who see the lack of major AI breakthroughs to date as a problem with the underpinning mathematical structure of microelectronics rather than a mere state-of-the-art holdback.



Grains of salt surround a semiconductor laser. The device, developed by Bell Labs, can be tuned to emit a range of ultrapure light frequencies.

So major mathematical, technological, and even social hurdles may all have to be overcome before a comprehensive optical processor—sometimes termed a "sixth-generation computer"—is built. One big problem is simply finding the right materials to do the job. Scientists are searching in three basic areas for a "bistable" material that would react quickly to light stimulus, hold its new polarity, or charge, for long periods, and require only small energy inputs to make the switch. Certain types of inorganic ferroelectrics, organic polymers, and multiple quantum well materials exhibit these characteristics to some degree. The ideal one has yet to be found.

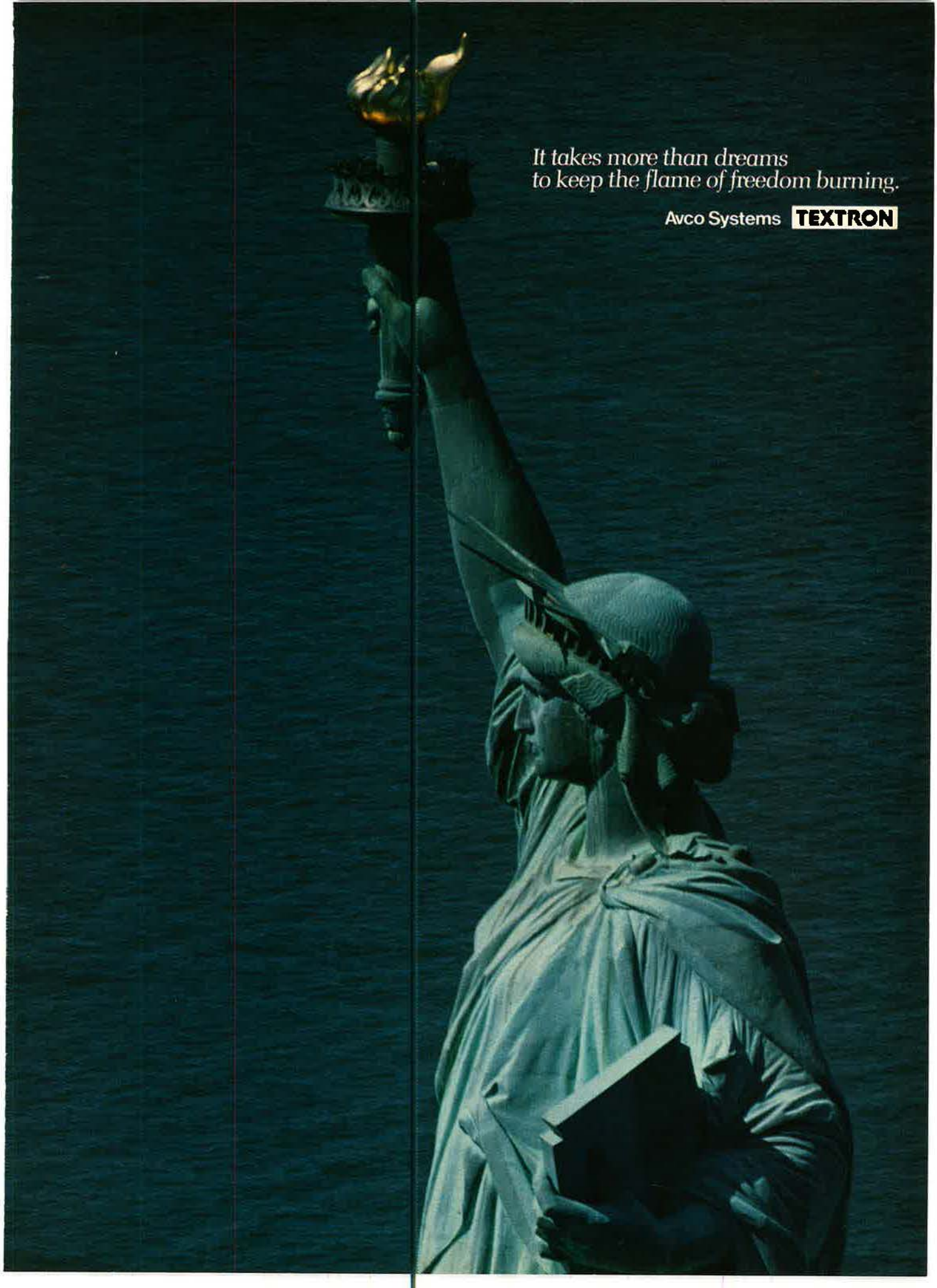
The social problem is equally thorny. Electronics engineers argue that they can already do, or are on the verge of doing, most of the functions that optics seeks to accomplish. "The trouble with optics is that electronics is a juggernaut," Dr. Ravi Athale, an optical computer researcher for the BDM Corp., McLean, Va., told AIR FORCE Magazine. "We constantly have to justify our existence" against the proven capabilities of the electronic community.

Specialties and Hybrids

For the near term, the biggest advances in optics applications will probably be in specialized areas where the technology is already superior and in "hybridization" of optics and electrical systems. Electro-optic countermeasure (EOCM) devices are a good example of specialization—small, lightweight, rugged packages that help defend against optical threats by an enemy. Guidance systems using ring laser gyros offer similar packaging advantages. Lasers for inspection and quality control of items as diverse as circuit boards and hypodermic needles are increasingly commonplace.

An optical image processor is one kind of hybrid system that was outlined for AI Roundtable participants by Dr. George Hummert, manager of Advanced Projects at the Westinghouse Research and Development Center. Optical technology, he said, might be used to scan large numbers of images and select for further analysis "only those of interest." For detailed analysis, silicon technology would take over. One obvious military application for the hybrid processor is in reconnaissance.

Further advances for computing and communication should come fast. After a false start in the early 1960s, US industry has developed a sound technological base. Most major corporations, and many smaller ones, have in-house optical science departments of some form. Scores of universities conduct thriving programs at the leading edge of photonic research.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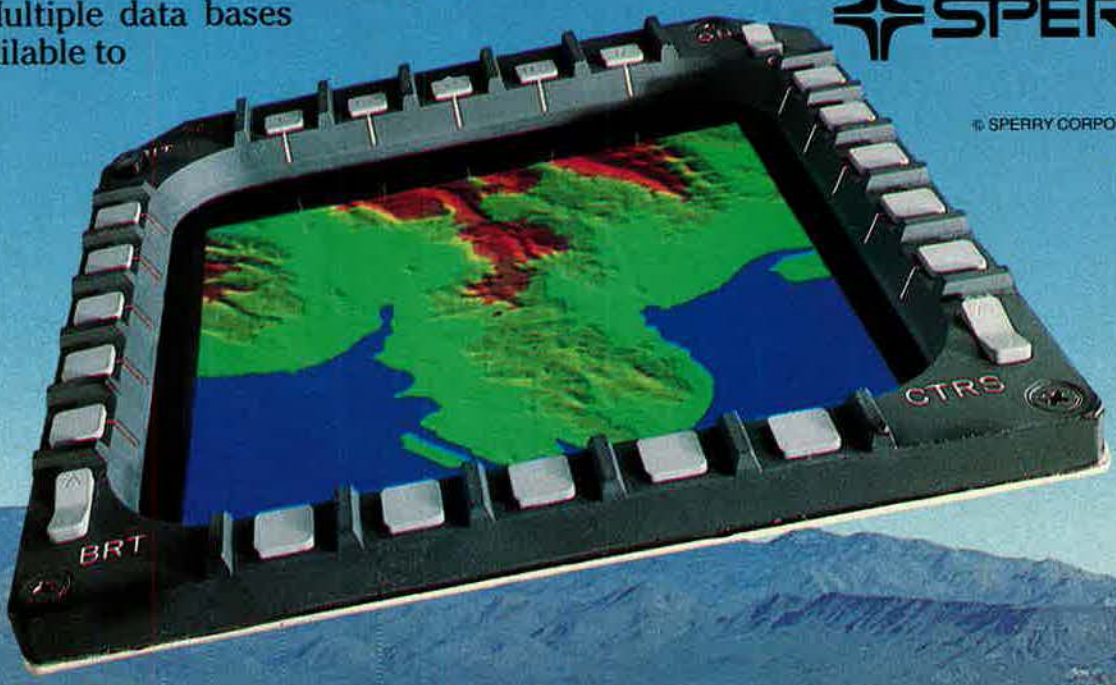

The Pentagon capitalizes handsomely on this independent research when resulting "off-the-shelf" products match military needs. But technological shortfalls are still evident for those defense requirements that go beyond commercial sector spinoffs. In optical fiber communications, for instance, Air Force research and development officials point to the need for tactical fiber optics cable connectors as one area where commercially available products just won't do the job.

In other photonic-related fields, such as weaponry and sensors, DoD sets the pace. The Strategic Defense Initiative clearly drives the bulk of laser weaponry research, and the technology could be at the point of paying off. Lt. Gen. James A. Abrahamson, director of the SDI Organization, said in the January edition of DoD's *Defense 86* magazine that "the potential for large, effective ground-based lasers is very real." Under Secretary of Defense for Research and Engineering Donald A. Hicks reported to Congress earlier this year on "significant progress [being made] in laser technology developments . . . that could have near-term military applications."

In the field of sensors, the Defense Advanced Research Projects Agency (DARPA) hopes to conduct the space-based Teal Ruby experiment next year as a precursor to operational infrared space systems "capable of detecting aircraft and other low-threshold targets against the earth's clutter background." AFSC's Armament Division is working with laser holograms for improved battlefield target identification. Some laser radars are also operational—their extremely short wavelengths offer huge advances over microwave radars in tracking accuracy and resolution.

No Longer Insurmountable

Some of the seemingly insurmountable problems of only a few years ago are beginning to crumble under the onslaught of new theories, materials, money, and research man-hours. In the fields of laser weapons, radar, and communications, such terms as "nonlinear optics," "adaptive optics," and "phase conjugation" describe just a few different avenues that scientists are exploring in order to be able to propagate a laser beam through the atmosphere without significant diffusion or power loss.

General Abrahamson also singled out research into the free-electron laser as one area where "genuine breakthroughs beyond those expected" have been made. Along with its potential for generating powerful beams at deadly high frequencies, the free-electron laser can be "tuned" to produce light at varying wavelengths. That's particularly important, since adjustable-frequency lasers might overcome the vagaries of weather conditions and atmosphere.

Much of this work is not directly within AFSC's purview, but eventually could be applied to the "total optical system" mentioned by Captain Swietek with what he calls "a synergistic effect." And if that day is still a long way off, photonic research is far from cresting. As Dr. Beek commented, "I'd love for my child to be an optical engineer" rather than an electrical engineer.

At the same time, the unifying attitude among the photonic community is still one of cautious optimism. Stung by earlier setbacks and mindful that both microelectronics and electro-optics proponents have often bragged beyond their ability to deliver, Dr. Athale summed up by saying: "We have to be very careful in what we promise and where we put our efforts."

Whether or not Archimedes actually built a "burning mirror" is questionable. Detractors say he couldn't have done it—that mirrors of that age would have been too crude and aiming too difficult to produce a light ray with any military utility. In any event, after a two-year siege, Roman soldiers reportedly breached the walls of Syracuse in 212 B.C. and fought their way to the harbor, where they destroyed whatever devices Archimedes had constructed. Archimedes, by the way, was killed in the battle. ■

Dr. Steve Butler of AFSC's Armament Division produces a target-seeking hologram. Future missiles may carry a small lightweight optical computer on board that can compare holographic imagery of preselected targets to objects on a battlefield. The autonomous missile will home in on and destroy only the specified target. The system is being tested now at Eglin AFB, Fla. (US Air Force photo)

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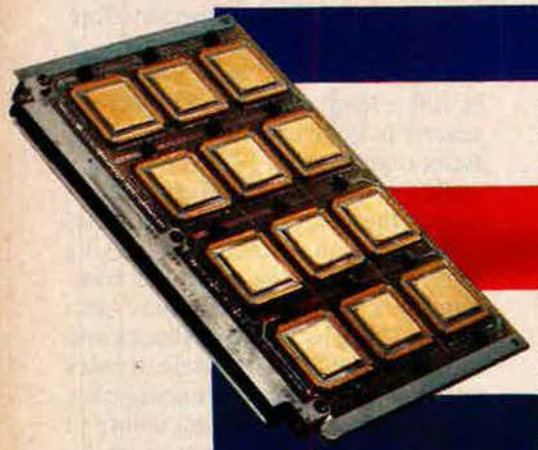

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He says the priorities are right, but that he leans toward more revolutionary approaches to systems and concepts.

Aldridge On the Is

New Secretary of the Air Force Edward C. "Pete" Aldridge, Jr., is not a man to be locked behind a desk, as this photo of him taken in front of the SR-71B dual-cockpit trainer illustrates.

BY EDGAR ULSAMER
SENIOR EDITOR (POLICY & TECHNOLOGY)

GROWING up some thirty years ago in Shreveport, La., right across the river from Barksdale AFB, Edward C. "Pete" Aldridge, Jr., learned, as he puts it, to "look up" to the US Air Force and the leaders who made it great. The Shreveport teenager's admiration begot a dream—some time, in some form, to join the Air Force team. In August 1981, that dream came true when he joined the "team" as Under Secretary of the Air Force. Over the intervening five years, Mr. Aldridge became one of the most respected and longest-tenured occupants of that office.

His outstanding performance was not lost on the Defense Department's leadership and the White House. On April 7, following the resignation of Russell A. Rourke for weighty personal reasons, President Reagan named Mr. Aldridge the seventeenth and newest Secretary of the Air Force, making him the civilian head of the service that he had first learned to admire three decades ago. At this writing, Senate confirmation of his new assignment is pending.

The prospect of leading what he calls the greatest Air Force in the world puts a king-size lump in the throat of this normally unflappable, erstwhile aerospace engineer and defense analyst: "It is almost more than this person can endure." Pete Aldridge seems tailor-made for the high office that he has just assumed. He holds a bachelor of science degree in aeronautical engineering from Texas A&M and a master of science degree, also in aeronautical engineering, from Georgia Tech.

For a number of years following his professional schooling, he held engineering and, eventually, management slots in the aerospace industry. For five years thereafter, he served as a Defense Department systems analyst and as an advisor to the US SALT I team in Helsinki and Vienna. After a year as senior manager

ies

with an aerospace company, he was named a senior management associate in the White House Office of Management and Budget. Next came two years as a senior OSD executive charged with oversight of strategic programs and then an assignment as principal advisor to the Secretary of Defense in the field of planning and program evaluation of US military forces and force structure. During the Carter era, Mr. Aldridge served as a vice president in a respected think tank responsible for a range of defense planning and analysis functions. The incoming Reagan Administration quickly picked him for the job of Air Force Under Secretary.

The Priorities Are Right

In an interview with this writer, the new head of the Department of the Air Force posed a rhetorical question: "What is Pete Aldridge going to do about the priorities [of the Air Force that have evolved over the past five years of the Reagan Administration]?" The answer, he said, "is nothing. The priorities are right, the Air Force is on a roll, and I don't see any reason to change the winning game plan that we came up with." The top priority that he inherited from his predecessors and the one that he views above all others as sacrosanct is "people. Keeping quality people certainly will always be at the top of my list. You can have the greatest, fanciest aircraft in the world, but if you don't have quality people to maintain them and fly them, they won't do you much good."

Ranking right behind this imperative, in Secretary Aldridge's view, are "readiness and sustainability."

The fact that he sees no intrinsic need for reordering either general or mission-area priorities doesn't mean there won't be adjustments, he emphasized. Two factors that come into play here involve pending drastic budget cuts, on the one hand, and structural changes that are likely to ensue from the Administration's implementation of the findings of the Blue Ribbon (Packard) Commission on Defense Management, Secretary Aldridge acknowledged.

In the first instance, he harbors few illusions. Maintaining the rate of budget growth experienced by the Air Force over the past five years is not in the cards that are being dealt by Congress. "At best, we might be able to sustain a very limited real growth, and it's going to be tougher to get the military manpower to man our forces," he warns. But there is a mitigating factor: "We are starting from a solid base, [because over] the past five years, we were able to take our budget from $42 billion to about $100 billion."

Concomitantly, over the past five years, USAF's flying hours shot up by twenty-two percent, aircraft mission-capable rates by forty-four percent, sorties per pilot by fifteen percent, air-to-air capability by sixty-five percent, strategic airlift capability by twenty-five percent, and "force-multiplier" space programs by a staggering 384 percent. The contention by congressional malcontents that the $1 trillion that the country has spent on national security over the past five years has bought nothing is, he asserted, "garbage."

The "down side" of freezing defense spending is that "the threat hasn't gone away, and that is what should set our requirements, not how much money" the country is willing to spend on defense, he points out. It follows that some tough choices lie ahead. "The programs that we started over the past few years in anticipation of continued high growth [are in for] close scrutiny." As a consequence, "Sick programs are not long for this world." A case in point is PLSS, the precision location strike system *(see "In Focus . . . " p. 24 of this issue).* Any program that has "the slightest degree of problem" in terms of cost, schedule, or performance or that lacks a rock-solid base in terms of requirements will be looked at closely and critically and may be headed for the chopping block, he emphasizes.

The Impact of the Packard Report

The impact of the President's Blue Ribbon Commission on the current structure of the Air Force, while not fully sorted out, is likely to be significant, Secretary Aldridge suggests: "It is clear, if you put Packard [meaning the provisions of the Commission] against the current structure of our program management, that there will have to be some changes." The Defense Department and the Air Force are looking at the alternatives for adapting current resource allocation and program management functions to the matrix drawn up by the Presidential Commission. For the time being, however, "we don't know yet what the changes should be."

What, in the Pentagon's view, does seem clear, however, is that the management functions ought to be carried out on two distinct tracks, he suggested. The resource allocation function flows from the President to the Secretary of Defense and then to the service Secretaries, with the basic objective of fitting essential programs into a given budget and then funding them. The program management function starts where the resource allocation task leaves off. The Packard Commission's matrix notwithstanding, "somehow we will have

to continue to manage the resource allocation process, and somehow we will have to manage our programs."

Secretary Aldridge suggested that the Packard Commission's recommendations in areas affecting military organization and command structure—in the main, the call to broaden the authority of the unified commanders—require no drastic changes on the part of the Air Force. The reason is that the Air Force already "does an excellent job of supporting the CINCs."

The Packard Commission, he added, might have overlooked some of the cooperative measures already undertaken by the Air Force in terms of CINC support, with the result that "we are in better shape than the Commission gives us credit for." He pointed out that the Air Force's four-star general officers, several of whom serve as CINCs, participate fully and actively from start to finish in the development of the program objective memorandum (POM) that in effect is the Air Force's five-year plan. He stressed that this participation extends from the early stages of the POM process—when requirements are juxtaposed with the budget bogeys and "disconnects," meaning critical omissions, are resolved—to the stage when adjustments necessitated by cuts are made and then all the way to formulation of the complete document that is delivered to OSD. The Air Force component commanders, he stressed, also "are doing an excellent job" in supporting their CINCs. As a result, Secretary Aldridge sees no compelling need for major adjustments in the way the Air Force operates in the joint-service arena.

A Partial Move to Prototyping

One of the first tangible effects on the Air Force of the White House's decision to implement the Packard Commission recommendations involved the Advanced Tactical Fighter (ATF) program, according to Secretary Aldridge. The Commission found that in the case of such critically important weapon systems as a new air-superiority fighter, the need for maximum performance dictates the introduction of truly state-of-the-art technology. The reason is that the "benefits of the new technology offset the concomitant risks." The Packard Commission suggested further that the only consistently reliable means for gauging the trade-off between risks and benefits is by building prototypes that "embody the new technology."

Based on this guidance, the Air Force decided to "make the Advanced Tactical Fighter a model program for implementing the recommendations of the Packard Commission," Secretary Aldridge emphasized. This means prototyping—or "fly-before-buy"—of competing aircraft to demonstrate key technologies as well as "our ability to maintain cost control," he added.

Other factors that persuaded the Air Force to change the ATF program to a prototype format include the unprecedented degree of integration associated with this weapon system: "This is going to be the most integrated aircraft ever built in terms of engines, airframe, avionics, structure, and aerodynamics" and thus justifies a "head-to-head flyoff." The approach will be similar to that taken with the YF-16 and YF-17. The engine/airframe integration of these competing prototypes was evaluated in the 1970s.

The restructuring of the ATF program is scheduled to lead to the award of two contracts that require both competitive flying and ground avionics prototypes. The flyoff of the two competitive flying prototypes is to get under way in 1990, which will put the ATF into the air two years earlier than previously planned.

But the fly-before-buy decision on ATF does not signal a wholesale shift of Air Force development programs toward the prototype approach, Secretary Aldridge cautioned. In the case of some other programs, "dual-sourcing" will be applied, he suggested. In yet other instances, the "very good lessons" learned from the B-1 program, such as baselining and multiyear procurement, will serve as the paradigm, he said. This might apply in some measure to the ATB (advanced technology, or "Stealth," bomber) program, he hinted.

The Importance of Revolutionary Technologies

While the new Secretary plans, in general, to follow the policies and management philosophies developed and honed by his immediate predecessors in concert with the military heads of the Air Force, he won't rule out "changes in what football coaches call 'tendencies.' My tendencies might lean more toward revolutionary, rather than evolutionary, approaches to weapon systems or concepts." He explained that he might "tend to decide in favor of [approaches] that exploit the advantages of [advanced] technology by taking a great leap forward." In terms of specifics, he cited in this context his support of "ATB, ATF, SDI, the National Aerospace Plane, the C-17, and technologies coming out of [Gen. Lawrence A.] Skantze's Project Forecast II" high-technology roadmap.

He cautioned, however, that he planned to apply his preference for highly leveraged technologies selectively: "Out of a hundred decisions, I might do that seventy percent of the time, but in the other thirty percent, that might not make sense." He is fully aware that decisions in favor of long-term revolutionary performance gains can take their toll in short-term force structure. By going for the quantum leap embodied by ATF, for instance, the consequences in the current budget environment might well be that "we can't build as many F-15s and F-16s [as we wanted because we have] to pay for the longer-term investment." Given a choice between fixing up existing weapon systems by grafting on evolutionary improvements or taking the step toward revolutionary gain, "I will probably tend to support a smaller force, but a much more capable one that [gives us] all the force multipliers we need."

In this context, he cited the importance of looking for technologies that beget massive performance gains, such as the combination of stealth and autonomous standoff weapons: "Technology now supports a broader role for standoff weapons. It's ridiculous to put man in a threatening environment when there is a smart [unmanned] weapon that can do the job effectively." Remotely piloted vehicles (RPVs), he suggested, "have a place in our Air Force. We ought to be pushing them with a certain amount of vigor."

Similarly, Secretary Aldridge came down four-square in favor of advanced spacelaunch systems, especially the National Aerospace Plane (NASP). In his view, the best long-term solution to the challenge of spacelaunch economics is NASP, a derivative of the Defense Ad-

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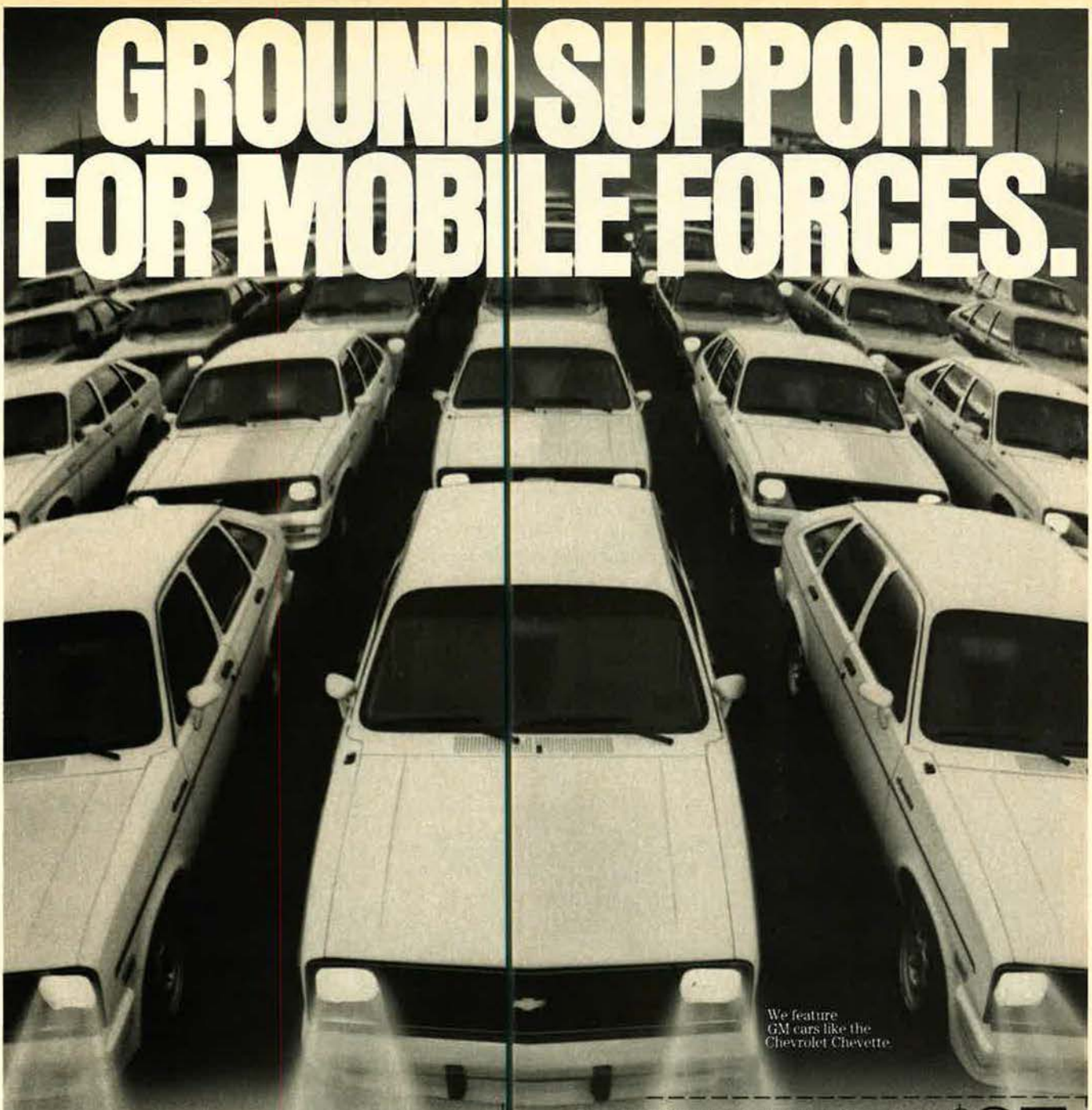

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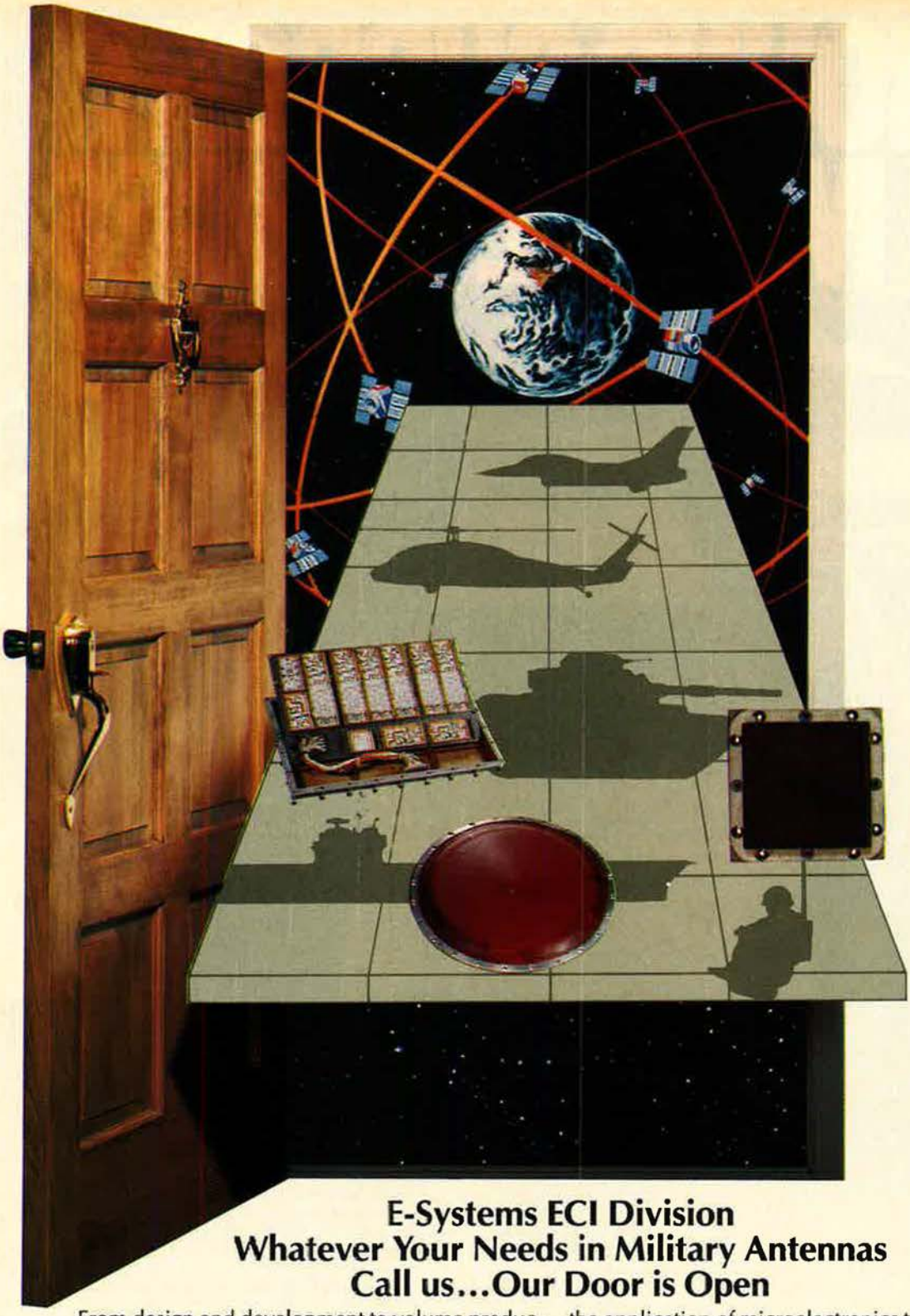

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vanced Research Projects Agency's "Copper Canyon" program, as "opposed to the Transatmospheric Vehicle," or TAV, approach, a technically less-ambitious concept: "I support the long leap forward" over TAV promised by NASP.

The Imperative of Assured Access to Space

Because of his intimate involvement with oversight of space operations, Secretary Aldridge is extremely concerned over the current, simultaneous stand-down of both the Space Shuttle and Titan 34D. It is imperative, he avers, that the US build up its "spacelaunch posture to a [level] that is greater than what existed before the accidents." He inveighed against "ever again letting ourselves get into a situation where for eighteen months we don't have a way to get into space with a major portion of our launch force." As the new Secretary of the Air Force, he promised to "push for a launch posture that is more robust, more flexible, and more capable than what we had" before the tragic loss of the Space Shuttle *Challenger* and its crew in January and of a Titan 34D in April of this year.

This restoration and buildup of the national spacelaunch capabilities should and will be undertaken "very cautiously," he said, adding that there is a "difference between the Shuttle that has people on top compared to Titan." While there were two Titan failures in a row, they were the first in eighteen years involving launches of this system from Vandenberg AFB, Calif. One of the failures involved the launch vehicle's solid-rocket motor, the first accident of this type in the history of the Titan system. The other failure—in August of last year—was totally unrelated and involved the Titan's liquid-fuel engine.

These two unrelated failures, Secretary Aldridge explained, do not indicate "any design flaws," but suggest the need to look for procedural and quality problems: "We probably should have been checking a little more thoroughly." Nevertheless, there are no fundamental reasons to doubt that the Titan 34D is "a very reliable system [whose overall] reliability, in fact, is about ninety-six percent."

With the Shuttle Orbiter fleet down to three vehicles—of which only two are capable of accommodating the heavier DoD payloads—"we simply don't have enough capacity and [as a result] will be backlogging payloads to a point where we are going to have thirty or so Shuttle rides before we can start up again." This backlog, he predicted, will have to be worked off in part with expendable launch vehicles (ELVs). In addition, Secretary Aldridge supports acquisition of a replacement Orbiter. This need is made especially compelling, he said, because if one of the two existing Orbiters that can handle the heavier DoD payloads were to stand down, "we would really be in deep trouble." He considers it essential that "we rebuild our Shuttle fleet to a point where we won't have to worry too much if one Orbiter is down."

The fundamental, long-term lesson from the current launch paralysis is "that we can't allow ourselves to depend on a single spacelaunch system" and instead must commit to a mixed-fleet concept. As the decision time draws nearer on the joint NASA/DoD Space Transportation Architecture Study (or STAS, which limns US spacelaunch requirements beyond 1995), "we need to look at both manned systems to replace the Shuttle and unmanned systems to replace our CELVs," meaning complementary expendable launch vehicles of the Titan 34D-7 type that possess a Shuttle-bay-equivalent payload capability. Key objectives of the STAS include creation of a mixed fleet of launch vehicles to increase flexibility and "robustness" and to bring about an order-of-magnitude decrease in the cost of delivering payloads into space.

Principal STAS candidates include an unmanned heavy-lift launch vehicle (HLLV) capable of taking between 150,000 and 300,000 pounds of cargo into orbit and the NASP, which would have the potential for routine spacelaunch from horizontal takeoff. The manned and unmanned systems should be built of "separate components" to preclude the risk of simultaneous stand-downs, Secretary Aldridge stressed.

Current launch vehicle stand-downs notwithstanding, "the US space program is still healthy. We have more than 125 satellites working in orbit. Our space program is still unsurpassed by any other nation, and I believe we will get over the current small setback." The military space function, he asserted, "is growing. The reason is that we have finally begun to realize the potential that space can offer the military commander in the air and on the ground."

The SICBM Riddle

One of the key issues facing the new civilian head of the Air Force is the debate in Congress and within the Administration about the ICBM force mix, especially the requirement for 100 Peacekeepers (MX) and the nature of the proposed new Small ICBM. The Air Force's position, he emphasized, is to support the President's program, which for the time being, at least, "envisions the SICBM as a single-warhead system." He added, however, that, in his view, the SICBM should be larger than the congressionally-mandated 30,000-pound ceiling, "because the system will have to live for twenty years or more."

Because of imponderable factors—such as changes brought on by the threat or by arms control—"we need the flexibility to adapt." This need for flexibility, he said, might include "rationales for MIRVing the SICBM, so long as the missile's [mobility and hence its] survivability" are not unduly impaired. If Congress were to deny deployment of the second fifty Peacekeepers permanently—thereby creating the need for the SICBM to make up the resultant deficit of 500 warheads, for instance—"then we might need a MIRVed small missile." The Air Force, therefore, the new Secretary said, "will look realistically at what it takes to make a good-sized missile mobile without [running the risk of] debonding its solid-rocket" motors.

He added that the Air Force will complete its in-depth technical investigation of various design options for the SICBM later this year, in time for the go-ahead decision on the program by the Defense Systems Acquisition Review Council (DSARC) scheduled for December of this year. "We have no argument with MIRVing the SICBM, if that becomes necessary . . . but we need to prove out" before the DSARC all the consequences associated with significant size increases, he said. ■

Our Tech Base Needs Attention

Neither the nation nor the Defense Department has provided adequately for basic R&D, on which vital capabilities of the future depend.

BY GEN. ROBERT T. MARSH, USAF (RET.)
CHAIRMAN, AFA SCIENCE & TECHNOLOGY COMMITTEE

With its commanding lead in military technology, the United States has been able to ensure national security with relative ease since World War II. The numerical advantage of our adversaries has been readily countered with weapon systems that were more capable.

But technological leadership is not lasting without constant attention. It requires substantial investment and aggressive pursuit of the full range of technologies that make superior systems possible. If we seek to maintain our security without paying the prohibitive price of matching the Soviet Union in sheer numbers, then we must resolve to support adequately the research and development effort necessary to stay ahead technologically.

Obviously, that challenge increases as Soviet R&D efforts begin to yield results approaching our own. And that is exactly where we find ourselves today. The Soviet Union has invested aggressively in military research and has further subsidized that investment with a highly successful effort to acquire and exploit Western technology.

A real danger has developed. The Soviets are pressing us hard, and the trend in the technology balance is clearly unfavorable. This is a direct result of diminished US support for military research and development.

For some time now, there has been a widening spread in the respective percentages of gross national product that the United States and the USSR spend on total research and development, of which military R&D is a subset *(see chart)*. Defense R&D, specifically, has suffered. If the effects of inflation are set aside, budgeting for defense R&D dwindled by fifty-six percent between the early 1960s and the late 1970s.

Little Money for Basic Research

While the total defense budget allocation for research, development, testing, and evaluation (RDT&E) seems to portray substantial technology investment, that is not the case in reality. The RDT&E budget is a compilation of all categories of R&D funding—most of which are actually full-scale development (FSD) activities in support of ongoing or planned production programs. The portion of the RDT&E budget that funds basic technology efforts oriented toward future defense systems is only a small share—the smallest share—of the R&D budget.

In fact, only 8.5 percent of DoD's FY '87 RDT&E budget request of almost $42 billion is earmarked for basic research and exploratory development, the two primary R&D categories that support development of technology for future systems. In addition, some basic technology-oriented work will be funded by a small portion of the money in the advanced development category. The result is that only about one percent of the total DoD budget is being allocated to the technology base budget activity (basic research and exploratory development).

The Air Force RDT&E budget reflects the same pattern of limited support for basic technology research and development. In FY '86, the Air Force planned to spend about $13.8 billion for RDT&E. However, that included $5.4 billion for the full-scale development of such strategic programs as ICBMs, bombers, and cruise missiles, $2.7 billion for tactical development programs, and $2.2 billion for C³I programs. While RDT&E expenditures on these programs contributes indirectly to modest advancement of technology, it does not fundamentally expand the technology base or develop the technologies upon which future generations of weapon systems will be built. Only $800 million is allocated to true technology base activity. This figure represents something less than one percent of the Total Obligational Authority (TOA) of $110.3 billion.

The trend in technology base funding has been negative in the early 1980s. Defense RDT&E budgets increased, but technology base funding accounted for declining percentages of those budgets. In FY '85, for example, the technology base budget activity was 10.1 percent of the RDT&E budget; in FY '86, it dropped to 9.7 percent; in FY '87, it will be only 8.5 percent. The Air Force budget followed a similar pattern. Although the plan is for overall Air Force RDT&E funding to grow by about twenty percent between FY '86 and FY '87, the technology base will still account for only about five percent of RDT&E in FY '87.

The Air Force has recognized this erosion and, in 1984, set a goal of allocating two percent of its TOA to reinvigorate the science and technology program and redress the decline. Since then, some tech base efforts have been withdrawn from the Air Force budget and put under the Strategic Defense Initiative (SDI). The exact extent to which SDI growth compensates for the reduction in USAF tech base funding is uncertain, but the trend does not look positive.

In any case, the Air Force's technology base budget has not reached two percent of TOA. FY '85–87 levels have not risen much above one percent of TOA, despite continuous increases for overall RDT&E.

This situation cries out for correction. Tech base funding is the foundation upon which future capabilities depend. Two percent of TOA is the minimum level of adequate support.

More Clouds on the Horizon

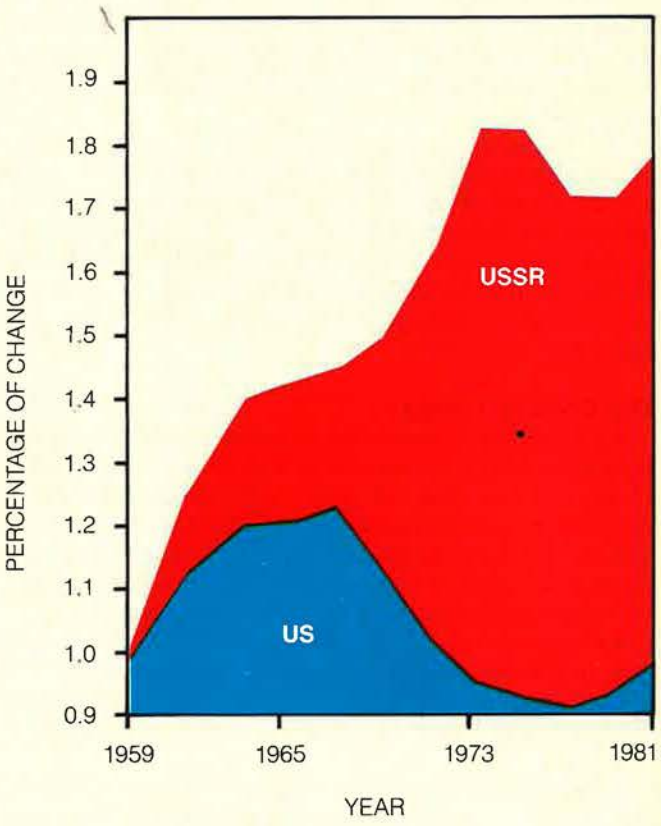
Meanwhile, other pressures—the Gramm-Rudman-Hollings deficit-reduction package foremost among them—resulted in a 4.9 percent reduction in tech base funding for FY '86. To achieve the estimated reduction target of $5.1 billion in outlays and $13.1 billion in budget authority, DoD was permitted to protect specific programs by increased, offsetting reductions in other programs in the same category. Thus, the decision to protect SDI in the R&D budget means that other defense R&D programs—including the technology base—must take especially heavy hits.

The impact on the tech base will be felt severely because the budget for it was so small to begin with. And as Congress looks for additional ways to reduce budgets and remain below the Gramm-Rudman ceiling, it may see value in cutting low-visibility research programs rather than production programs that may have impact in home districts.

Emphasis on SDI also influences the availability of RDT&E resources for other research efforts. Scientists and engineers, colleges and universities, and industry make decisions about in-house research based partly on their assessment of available DoD funding. When SDI-related research money predominates, we can anticipate missed opportunities in other areas.

Another concern grows out of the current demand for expanded prototyping. Prototyping of aircraft and other complex systems is expensive and consumes resources. It frequently involves the use of tech base funds. I

The Research Expenditure Spread



This chart, based on a 1985 US Department of Commerce report, traces the shares of GNP devoted to research and development — military and otherwise — by the US and the USSR since 1959. To establish a point of comparison, an arbitrary value of 1.0 has been assigned to each nation's level of spending in 1959.

strongly support selected prototyping as a precursor to full-scale development, but it should be funded elsewhere in the RDT&E budget and not at the expense of basic research and exploratory development.

The broad trends are more encouraging than the specific ones. A renewed national awareness of the importance of technology seems to be taking hold. It is possible—although by no means assured—that the technology base program will be buoyed by a generally rising R&D tide.

The President's budget for FY '87 proposes an increase in overall national R&D funding of about sixteen percent above the FY '86 level. That includes a substantial gain for defense RDT&E as well as increases for NASA, the nuclear physics program in the Department of Energy, and the National Science Foundation budget for research in computational science, geophysics, and biotechnology.

The Coming Trends

Although the nation's R&D budget is moving in the right direction, I remain concerned about our technology base. I fear that too many technologies with high potential payoff but not directly related to SDI may be ignored. These technologies might hold the key to future capabilities vital to our national security. Specifically, we might miss opportunities in the following areas.

- *Computers and Artificial Intelligence.* Now beginning to emerge from the laboratory, AI has almost unlimited potential for application to nearly all military missions. *(See also "Machines That Think" on p. 70 of this issue.)*
- *Propulsion Systems.* The National Aerospace Plane has focused attention on research into new fuels and propulsion systems for application in space and the atmosphere. Hydrogen-based fuels and new propulsion modules are under investigation. More work is required on such possibilities as the proton accelerator concept.
- *Materials and Structures.* The Stealth technology development efforts today have opened doors to new materials with great utility in combat. Also promising is the embryonic work in metal-matrix composites, carbon-carbon composites, and ceramics. Adaptive aircraft skins for various mission configurations and hypervelocity transatmospheric vehicles capable of speeds in the Mach 12–25 range could revolutionize our concepts of strategic and tactical warfare and improve access to space.
- *Electronics, Sensors, and Satellites.* Advances in electronics—beyond very-high-speed integrated circuits—could be dramatic. Integrating new sensors with flight/fire-control systems and finding new ways to overcome pilot overload are essential research areas. We can look ahead to new and more capable sensors used in conjunction with small satellites in survivable constellations.
- *Laser and Beam Technologies.* We should pursue research into potential uses of lasers and particle beams in a broader context than SDI. This would include weapons, communications, and countermeasures applications.
- *Robotics.* Building on the work in sensors and artificial intelligence, additional research could eventually lead to the construction of robotic machines that would allow us to perform essential tasks safely in dangerous environments. Remotely piloted vehicles deserve more research attention.
- *Biotechnology and the Integration of Man and Machine.* USAF's Pilot's Associate program is a first step toward using artificial intelligence and related technologies to aid the pilot in combat. There are many possibilities beyond that.

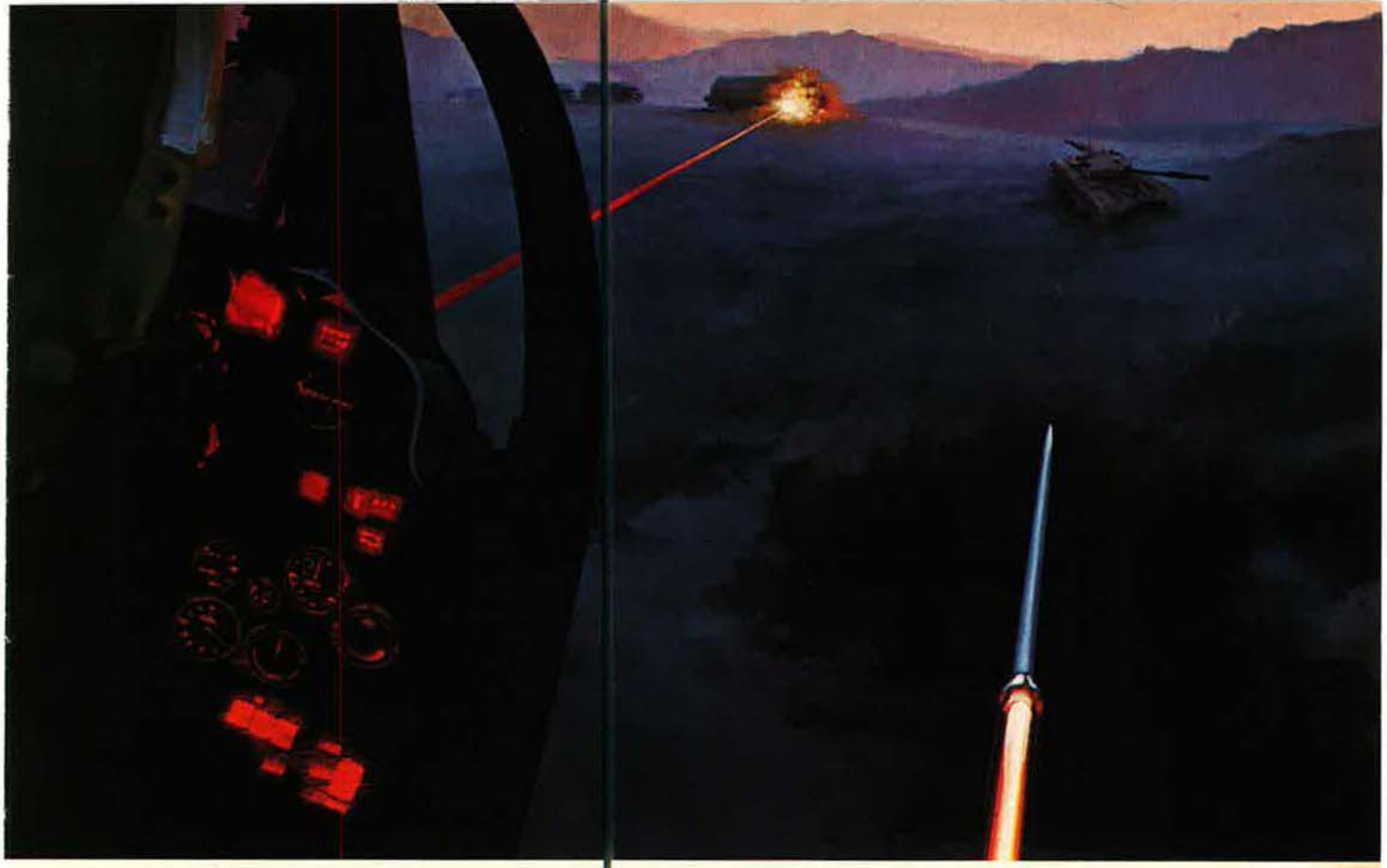
There may well be revolutionary change coming in the way we accomplish defense missions. But those revolutions tomorrow will not come unless basic technology gets adequate support today. ■

Gen. Robert T. Marsh, USAF (Ret.), is former Commander of Air Force Systems Command. He served twenty-four years in various capacities with AFSC and a total of forty-one years in the Air Force before his 1984 retirement. General Marsh is currently an aerospace consultant and chairman of AFA's Science and Technology Committee. His most recent contribution to this magazine was the article "Packard's Partial Fix," which appeared in our May '86 issue.

Where Defense RDT&E Goes

	FY '85	%	FY '86	%	FY '87	%
Technology Base	$3,120.7	10.1	$3,449.1	9.7	$3,585.3	8.5
Advanced Technology Development	2,750.6	8.9	4,234.3	11.9	6,574.7	15.7
Strategic Programs	8,169.0	26.5	8,054.4	22.7	9,429.6	22.5
Tactical Programs	9,062.2	29.4	10,901.0	30.8	12,671.5	30.2
Intelligence and Communications	3,953.0	12.8	4,703.4	13.3	5,102.8	12.2
Defense-wide Mission Support	3,814.0	12.3	4,124.5	11.6	4,566.0	10.9
TOTAL RDT&E	**$30,869.5**	**100.0**	**$35,466.7**	**100.0**	**$41,929.9**	**100.0**

Figures are Department of Defense TOA in millions of dollars. The FY '87 total and breakout are estimates.



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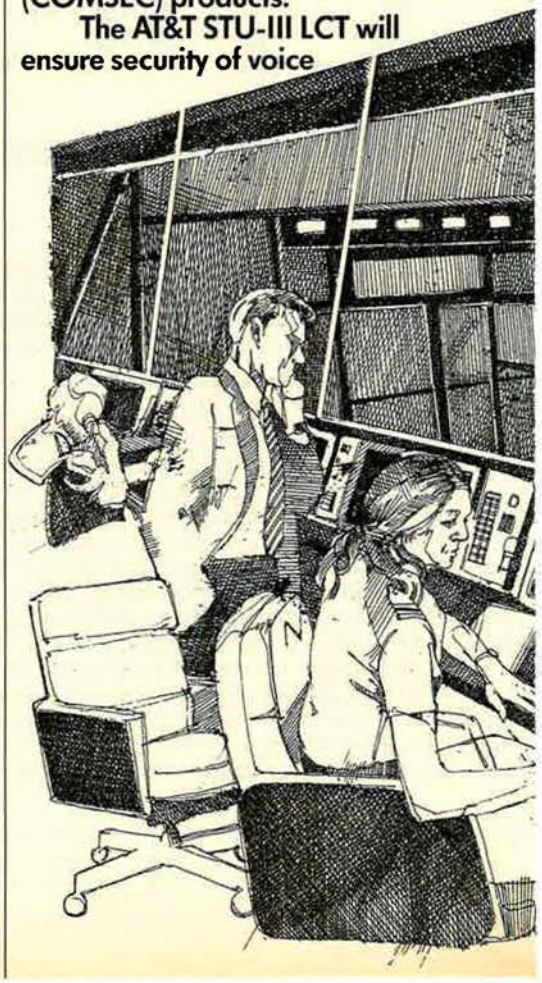
The AT&T STU-III LCT will ensure security of voice



nd data communications over the ublic-switched network through esk-top to desk-top encryption, liminating per-call re-keying and perator intervention.

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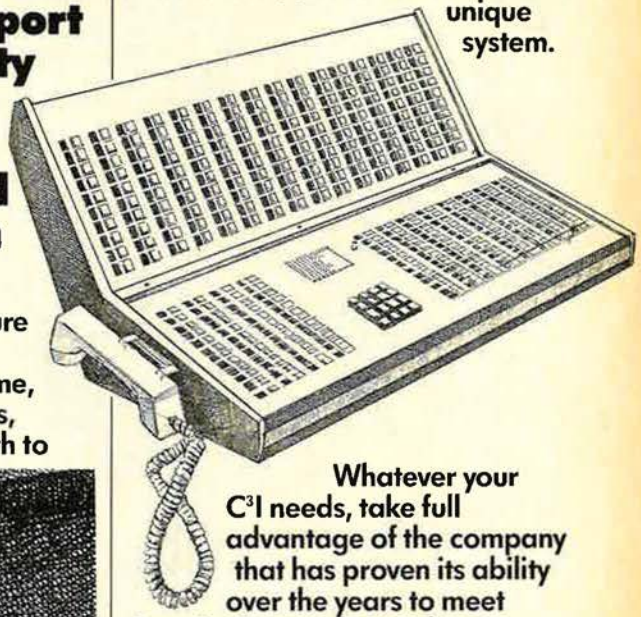

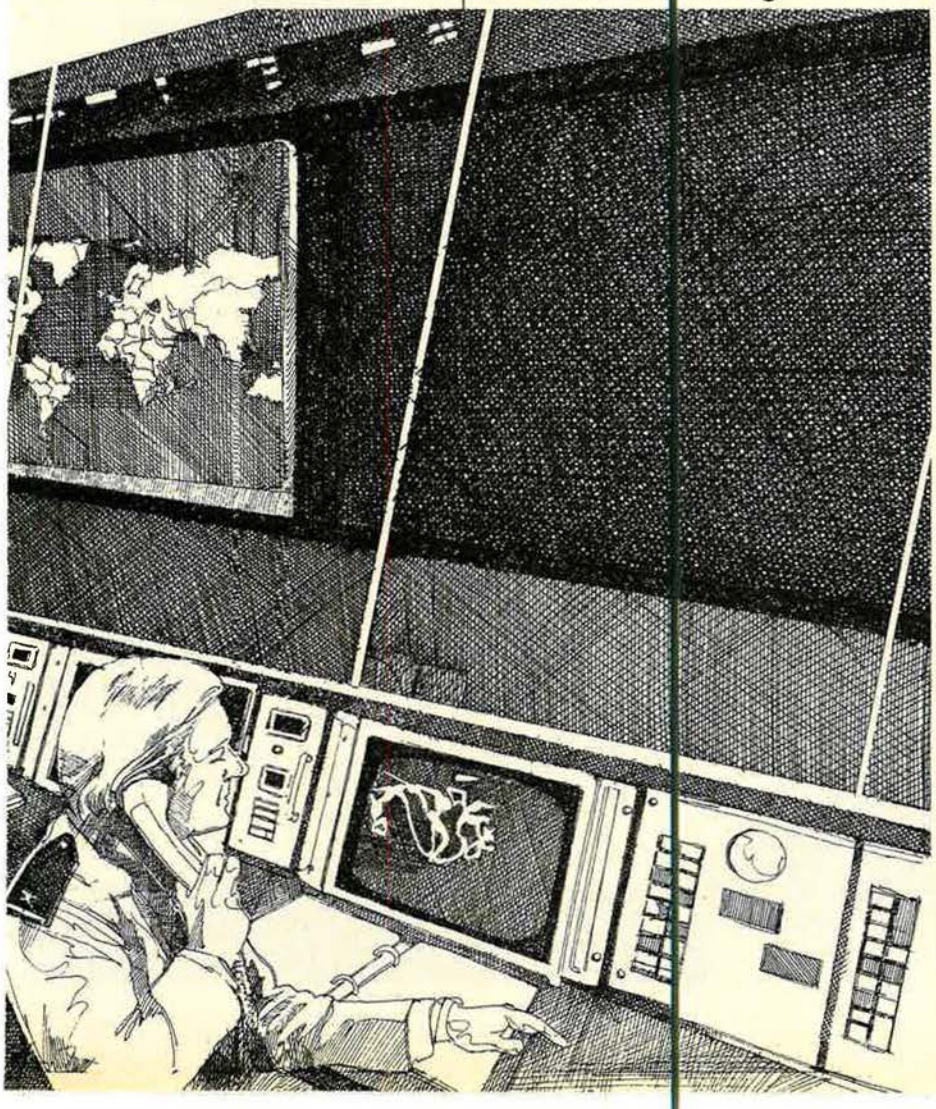

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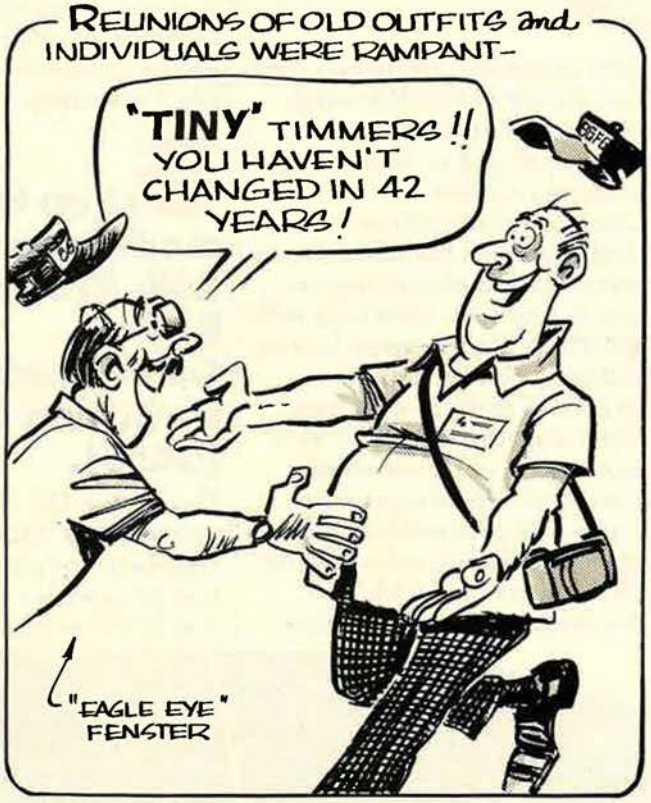
"There I was..."

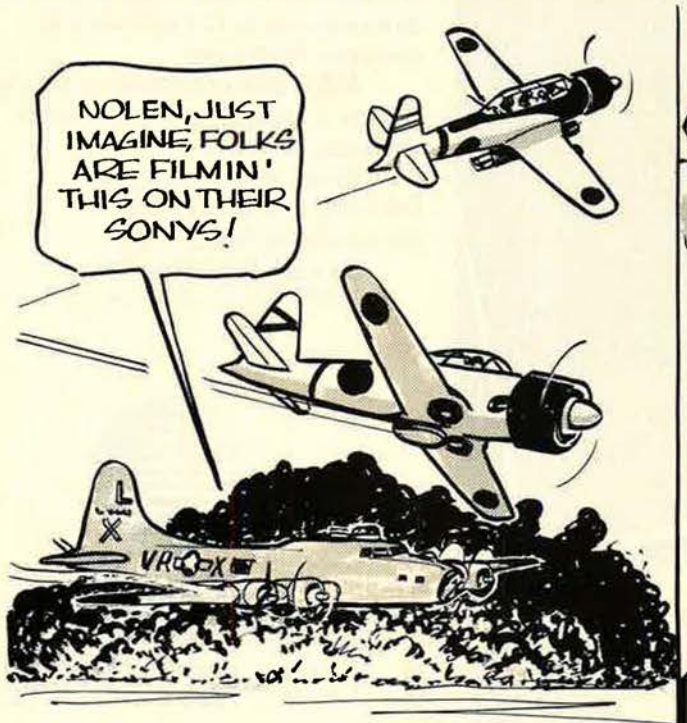
... AT AFA's "GATHERING OF EAGLES-1986" THE LARGEST and MOST SPECTACULAR AEROSPACE EVENT EVER HELD IN THE UNITED STATES! THREE GENERATIONS OF AIRMEN CAME TOGETHER IN LAS VEGAS, NEV., FOR A FIVE-DAY EXPOSITION OF AIRPOWER PAST, PRESENT, and FUTURE.

THE ROSTER OF ATTENDEES LOOKED LIKE THE "WHO's WHO" OF MILITARY AVIATION-

RELIUNIONS OF OLD OUTFITS and INDIVIDUALS WERE RAMPANT-

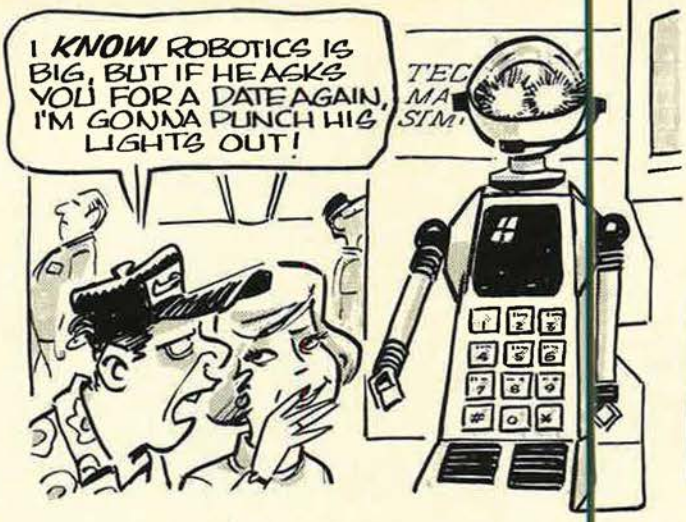


THE "THEN" WAS A CONFEDERATE AF WWII AIRSHO USING THEIR VINTAGE BIRDS-



THE "NOW" WAS AN AWESOME DISPLAY OF CURRENT USAF CAPABILITIES BY TAC-

AT THE GIANT CONVENTION CENTER, 150 INTERNATIONAL AEROSPACE FIRMS DISPLAYED THEIR WARES-



SOME 7,000 ATTENDEES FROM 54 NATIONS OGLED THE BEST IN THE WEST. THE FUTURE WAS THERE, TOO -

SYMPOSIA & MAJOR PANEL DISCUSSIONS DEALT WITH TIMELY MIL. AEROSPACE TOPICS-

HONORS NIGHT PAID TRIBUTE TO THE DOOLITTLE RAIDERS, MEDAL OF HONOR RECIPIENTS, and OTHER LUMINARIES...

THE WIND-UP WAS A GALA SHOW LOADED WITH STARS-STAGE and MILITARY.

WHEN THE SHOW LIGHTS DIMMED and ALL THE PARTICIPANTS DEPARTED, ONE STAR STILL SHONE and GAVE A CLEAR MESSAGE TO OUR ENEMIES:

"BEWARE OF THE EAGLE IN DEFENSE OF ITS OWN"

Bob Stevens
LAS VEGAS NEV.

The world aerospace community gathers to recall yesterday, witness today, and learn about tomorrow.

Air

BY JEFFREY P. RHODES, DEFENSE EDITOR
PHOTOGRAPHY BY SCOTT HARKE

THE Confederate Air Force, flying its vintage aircraft, had just stirred the collective memory of the large crowd at the Gathering of Eagles air show by recreating the major air battles of World War II, and the spectators had grown accustomed to the measured, graceful pace of B-17s, P-40s, and A-26s flying by. Most people, however, were totally unprepared for the horizon-to-horizon streaks of F-5s, F-15s, F-111s, A-10s, and others firing missiles and dropping bombs in the Tactical Capabilities Exercise that followed.

If there was one standout moment among the Gathering's whole week of memorable impressions, it would have to have been the sights and sounds of A-10s rolling in, firing their GAU-8/A 30-mm Gatling guns, and the target trucks nearly disintegrating.

AFA's Gathering of Eagles, held April 27 to May 1 in Las Vegas, Nev., more than lived up to its advance billing. For the some 5,200 week-long registrants and the 2,000 more people who attended the major events, among whom were nineteen Allied Air Chiefs or their repre-

The crowd for the CAF demonstration and the USAF Tactical Capabilities Exercise at the Gathering was brought out to Indian Springs Auxiliary Field in 111 buses. This group of dignitaries was part of the nineteen Allied Air Chiefs and fifty-one Air Attachés or Deputy Attachés who attended the five-day event in Las Vegas.

Full of Eagles

The last act of the Tactical Capabilities Exercise was a practice performance by the Air Force's Ambassadors in Blue—the Thunderbirds.

In days of yore, the Air Force flew airplanes with honest-to-goodness piston engines on them. They also wore different uniforms. These folks, who look as if they have just stepped out of 1944 and into the CAF's USO Dance, pay homage to the airmen of World War II by wearing their "pinks and greens."

sentatives and fifty-one Air Attachés or Deputy Attachés, the Gathering was an unforgettable experience. From Jim Fowler, TV naturalist and adventurer, and his brown eagle at the opening reception on Sunday to Jimmy Stewart and Tennessee Ernie Ford conversing by phone with personnel aboard "Looking Glass," Strategic Air Command's Airborne Command Post, at the Gala stage show on Thursday—and all of the four symposia, reunions of twenty-one veterans' groups, and more than 150 exhibits in between—the Gathering of Eagles was a fitting way to celebrate airpower. The event proved to be a fitting way to mark AFA's fortieth anniversary as well.

The bridge spanning the three generations of airmen honored at the Gathering was Brig. Gen. Chuck Yeager—World War II fighter ace, the first man to break the sound barrier, and veteran of both the Korean and Southeast Asian conflicts—who flew the Northrop F-20, one of USAF's new air defense fighter competitors, to Las Vegas. On the other hand, the most telling difference between then and now was seen at the air show. The CAF, which honored the people and planes of World War II, showed that the war was carried to the enemy's doorstep by hundreds of planes carrying hundreds of bombs to saturate a target. Today's Air Force, using F-111s, F-16s, A-10s, and F-4s, demonstrated its ability to knock out specific targets, such as airfields and control centers, with limited numbers of aircraft carrying precision-guided munitions.

The grand finale of the Gathering of Eagles was the gala stage show. The performance covered the spectrum from a chorus line to Bobby Berosini's trained orangutans to a phone linkup with SAC's airborne command post "Looking Glass."

More than 150 aerospace and related firms displayed their wares in the giant Las Vegas Convention Center during the Gathering. In addition to the Northrop F-20 mockup shown in the foreground, several other full-scale mockups and twelve actual airplanes were in the hall.

The booth of one of the makers of those precision-guided weapons, Texas Instruments, was an especially popular attraction in the exhibit hall. TI's Paveway III bomb is similar to the munitions used in the April Libyan raid, and many people were interested in getting a close-up look. Scattered among the close to three football fields of exhibit space at the Convention Center were twelve actual airplanes, including a P-51, an F4U Corsair, and a Spitfire from the CAF, a pair of Gates Learjets, and the Navy's new training

The CAF's demonstration recreated the major air battles of World War II, and this lone P-40 (left) represented the US resistance to the Japanese attack on Pearl Harbor on December 7, 1941 (inset). The P-40 was flown during the show by USAF Col. Joe Engle, who was commander of the Space Shuttle Columbia on its second test flight in 1981.

After the Global Aerospace Symposium, Air Chief Marshal Sir David Craig of the Royal Air Force (left) and Lt. Gen. Eberhard Eimler of the Luftwaffe (right) talk with Gen. Charles A. Gabriel, USAF Chief of Staff, who has his back to the camera. In the picture below, it is easy to see why the almost 7,000 attendees had a good time touring the exhibits!

The Gathering of Eagles was a celebration of three generations of airmen. The role of those airmen—whether in an F-15, F-86, or here in a P-51—has always been to fly and fight.

aircraft, the Cessna T-47, which is a modified Citation used to train Radar Intercept Officers, or RIOs. Also on display were full-scale mockups of the Grumman X-29 forward-swept wing (FSW) demonstrator, an F-20, a Republic T-46, and the latest in components, electronics, and weapons.

Daily receptions were held in the exhibit hall after the symposia and roundtables (a full report on these events will appear in next month's issue), which gave the attendees the chance to mingle with the many distinguished visitors at the Gathering. Eleven Medal of Honor recipients were in attendance, as was Gen. Curtis E. LeMay. Gen. Jimmy Doolittle (a Medal of Honor winner himself) and forty-nine members or honorary members of the Doolittle Raiders were also present. The stars literally shone in the Las Vegas Convention Center, as ten of the thirteen active-duty four-star Air Force generals spoke at the various events.

The Gathering featured an honors banquet on Wednesday night, during which all of the dignitaries were recognized by groups and which also saw artist Keith Ferris, on behalf of AFA, presenting an original painting of the Wright Military Flyer over Washington to the Air Force. All the events culminated in the Gala stage show on Thursday night.

The only "complaints" heard at the end of the Gathering of Eagles concerned mild cases of sunburn, exhaustion from constantly being on the go, and, as Barbara Stevens, wife of cartoonist Bob Stevens, said, a case of "neon burn."

In all, AFA's Gathering of Eagles proved to be a soaring success. ■

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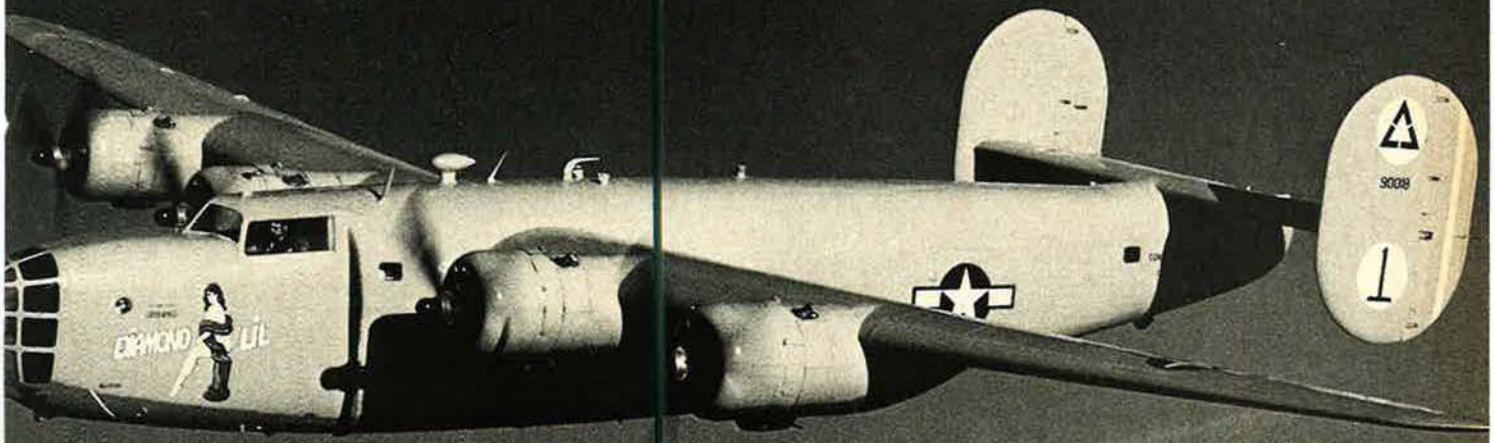
Congratulations — AFA

"GATHERING OF EAGLES—86" WAS A GREAT EVENT!

Thanks for the opportunity for "OUR TEAM" to fly with "YOUR TEAM" at Las Vegas and Indian Springs



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American young people are insufficiently prepared in science and higher mathematics. Our schools cannot solve the problem alone.

Partners in Education

BY KENNETH A. GOSS
MANAGING DIRECTOR, AEROSPACE EDUCATION FOUNDATION

A GREAT many public schools today put less emphasis on the teaching of science and higher mathematics than they did ten years ago. The national requirement for technical manpower keeps increasing, but the schools are not producing enough graduates to meet that requirement.

The divergence is felt strongly not only in business and industry but also in the armed forces. In the Air Force, for example, technical background is already important in seventy-five percent of the career fields, and the percentage is growing. *(See "Our Dangerous Shortfall in Technical Education," p. 60, December '85 issue.)*

The problem exists for a number of reasons, and the school systems cannot solve it alone. Federal Impact Aid to Education—which offsets the loss of tax base attributable to a nontaxpaying federal installation in the area—has been cut in recent years. Teacher salaries in the technical disciplines are not competitive with wages in the private sector, so math and science faculties tend to be thin. Scientific equipment and laboratory facilities are expensive. Faced with tight budgets and other priorities—such as repair of aging physical facilities—the schools have economized on math and science, which take a heavier toll on resources than do soft-core subjects in the curriculum.

It was in this context that the Aerospace Education Foundation decided in 1985 to take an active role in a White House Private Sector Initiative called Partners in Education (PIE). The objective of that initiative is to stimulate the nation's business community to share resources and people with local school districts, promoting the idea that quality education is the responsibility of the entire community. The White House program, however, does not single out math and science for special concentration.

The Aerospace Education Foundation's PIE program does.

By the end of this year, we hope to see pilot PIE programs, geared to the nation's high-technology needs, established in schools near Ellsworth AFB, S. D., and Vandenberg AFB, Calif. These locations have lost Federal Impact Aid in recent years and have a further problem in that the declining value of agricultural land in those areas has led to an additional drop in the tax base that supports the schools. The fact that these school systems serve Air Force families was another factor in their selection for the pilot PIE programs. The endeavor has the support of SAC, to which the bases belong, and the local school systems welcome the help.

Foundation as Catalyst

The Foundation's role in these pilot programs and in others that follow will be to act as a catalyst. The school district, working with the Foundation staff, will develop a needs analysis that examines deficiencies in personnel and material resources. Dr. Eleanor Wynne, Foundation Vice President, will oversee the review of requirements and, along with the Foundation staff, seek out local businesses that may be able to help.

Typically, a group of interested businesses may decide to divide up the list of requirements, each addressing a part of it. In other instances, a single business may choose to "adopt" a school and take on the entire list by itself. Once the partnership is established, the Aerospace Education Foundation will drop out and move on to another location.

The purpose is *not* to generate large financial grants from businesses to schools. As Susan Reagor, Communications Director of Holiday Inns, said at a Foundation roundtable earlier this year, the idea of partnerships is to "provide for youth the best education that money cannot buy."

The partnership aid could take several forms. The business partner might make a "teacher loan," sending some of its employees to conduct classes full-time, part-time, or on a rotating basis. It might give or lend laboratory equipment. It might furnish books, tapes, or films for technical education. If a business and a school are willing to commit to a partnership, the specifics will not be that difficult to work out.

The benefits to the school system are obvious, but the business partner gains, too. By helping improve the quality of technical education in the public schools, the business community is investing in the technically prepared work force that it will need in the future. Businesses may also claim tax credits for the assistance they give. And through their efforts, they may inspire young people to pursue careers in the fields of most interest to the participating businesses.

By helping improve the quality of technical education in the public schools, the business community is investing in the technically prepared work force that it will need in the future.

Business partners will be asked, initially, to make a three-year commitment to the PIE program, with hopes that all will work well and that the arrangement will be extended from there. "The building of a revitalized, informational, and technologically oriented society cannot be constructed on a crumbling educational foundation," Dr. Wynne said at the Foundation roundtable.

Basic Idea Not New

The basic idea of educational partnerships is not new. One role model goes back two decades. An aerospace firm in California had a recurring manpower problem. It was unable to find and hire enough technically skilled production workers. Near the plant was a large high school, noted mainly for producing dropouts and graduates poorly prepared for gainful employment. When the potential gains from cooperation between the plant and the school were at last realized, a classic educational partnership was established to the benefit of all.

Today, some 35,000 partnerships exist between schools and businesses in the United States, a number of them attuned to science, higher mathematics, computers, and other vital disciplines. There are not enough of them, however, and the Aerospace Education Foundation feels a special responsibility to help build more. This program would also be a splendid opportunity for AFA chapters to make a real contribution to their local communities as well as to aerospace education. PIE is a program in which everybody wins.

As Harry Wugalter of Rockwell International put it at the roundtable, the common factor in educational partnerships is "to create a better educated, more highly skilled labor force to maintain the economic strength of our nation. We need those young people, and they have to be able to participate." ■

In its day, the P-12 made pilots feel they'd sprouted wings and tail feathers. It couldn't end up in a dilapidated Chicago garage.

The P-12 Comes Home

BY STEVE McELROY
ILLUSTRATIONS BY THE AUTHOR

THE telephone jangled. "Alice Price here," came the voice over the wire. "Remember the P-12 that you want to paint?" I did, and Alice had not forgotten. The P-12E restoration project by the Air Force Museum at Wright-Patterson AFB, Ohio, was, she advised, at last complete. After nearly ten years of painstaking effort, all the parts and pieces had been found or fabricated, and the final assembly, recovering, doping, sanding, and painting were at an end. If I wanted to get my photographs, value studies, and sketches of the airplane before it was moved from the shops to the Museum floor, she would call the Director, Col. Richard L. Uppstrom, and make arrangements for me.

Alice is Mrs. Alice B. Price, Chief of the Air Force Art Program. This program began officially in 1950, and today its collection numbers more than 5,500 items. Air Force people, aircraft, and hardware generally provide the center of interest in paintings depicting Air Force ac-

"That's the way I saw and painted her—over the Pacific, south of Waikiki, moving fast at about 7,000 feet, with Diamond Head, the heavy cumulus buildups over the Koolau Range, and the afternoon's fleeting rainbow in the background. I called it 'Hawaiian Punch—'34 Style.' "

tions, moods, and operational environment, both on the ground and in the air. These paintings, in all media, are donated by participating artists and are made available for viewing by millions of people each year. I am an ex-Air Force pilot and am now an Air Force artist.

Was I interested in doing a painting of the last P-12E? Is the Pope a Catholic?

I suppose that everyone has dreamed of flying. But did you ever feel that you *really* could fly? That the experience of zero gravity and controlled buoyancy was yours? That you actually possessed the power of levitation? I did. And the chances are that you did, too, as you daydreamed your way through Arithmetic I or Geography II.

I still remember the Penrod and Sam stories by Booth Tarkington. Penrod *could* fly. When his teacher's attention was diverted, he would levitate silently upward from his seat, hover face down over her desk, and, at just the right moment, swoop over the heads of his admiring classmates and flash through an open window into the warmth of a bright spring day.

I fantasized about flight, but, fortunately, my illusions did not have to end there. I was of the generation of pilots who were privileged to fly the P-12 before it passed into history. The P-12 pilot used to be described as "a man with an engine in his lap and a feather in his tail." It was a fitting description. In flight, the little airplane gave the pilot the impression that its taut, stubby wings were firmly attached to his shoulders—a part of him.

A Nudge Was Enough

Most P-12 pilots whom I have talked to can't remember ever deliberately moving the controls in flight. All that seemed to be necessary was the desire to initiate a maneuver and, with imperceptible pressure on the controls, the little ship would respond. Old-timers said, "Trim her up for hands off. Poke your left hand out. She'll do a nice turn to the left. Pull it back in, and push your right one into the slipstream. She'll roll out of the left turn and continue on through into a smooth bank to the right." And she would! That was real hands-off, wind-in-the-face flying.

With her prop disc, two wings, wing struts and bracing wires, fixed landing gear, gear struts, and spreader bar, she was "dirty." And for fun, that wasn't all bad. She would split-ess into a vertical dive and stabilize her speed, all-out, at about 270 as I recall. And except for crosswinds, she was an "old-woman's" airplane to land. And, after all, there wasn't much excuse to get crosswind or a grass field.

The Boeing Co. called the prototype of the design the Model 83. The second ship off the line was dubbed the Model 89. They were identical, except for the landing gear. The Model 83 had a spreader bar with diagonal bracing from the belly centerline to the center of the spreader bar itself, while the 89 had a split-axle gear and carried a rack for a 500-pound bomb between the wheels. Both had arresting hooks for carrier operations. Navy and Marine aviators knew it as the F4B. To the Army, it was the P-12. Flyers of the commercial version called it the Model 100. But regardless of its designation, pilots who flew the little biplane were unanimous in enthusiastically classifying it as a genuine "fun machine."

Prior to the Model 83, Boeing had built fighters for both the Army and the Navy. The company's first fighter was the MB-3A, which was not a Boeing design at all, but one that came from the drawing boards of one of its competitors, the Thomas-Morse Corp. of Ithaca, N. Y. Boeing built 200 of the Thomas-Morse aircraft for the Army under a production contract that resulted from an early and peculiar practice whereby the Army bought the prototype aircraft from a designer and, at the same time, obtained its manufacturing rights. If the performance proved satisfactory, the Army might build follow-on aircraft in its own facilities in any number desired. On the other hand, it might decide to select a builder, or it could invite production bids from the aircraft industry at large.

Boeing's Gamble

With the production experience of the MB-3A behind them, the Boeing team decided to field a fighter aircraft of their own design, which they called the Model 15. The gamble paid off when the Army bought the prototype and awarded Boeing a production contract for thirty aircraft, which they called PW-9s (for Pursuit, Water-cooled, Number 9). The Navy followed with an order for the same airplane for the Marine Corps. They called it FB-1 (meaning Fighter, Boeing, Number 1). This led to yet another Navy order for the Model 15 with arresting hooks and modifications for carrier operations. This airplane was the FB-2. Boeing, now with both design and production experience in military fighters, decided to launch a second privately funded venture, a fighter called the Model 83.

The 83 was designed with the Navy in mind. It emerged from the Seattle works in mid-June 1928. Its first flight proved that Boeing had a world-class fighter on its hands. Speed was in the 170-mph range, and rate of climb was close to 3,000 feet per minute.

The 1928 National Air Races were just commencing down at Mines Field in Los Angeles, and the jubilant Boeing team had the prototype there, still in company colors of French gray and Boeing green and sporting the Boeing logo on each side. It was entered in the races as the "New Boeing Naval Fighter." Redesignated as the XF4B-1 and with Navy Lt. Thomas P. Jeter at the controls, it made the Aero Digest Trophy Race a "no-contest" affair as it was clocked over the 120-mile course at 172.6 mph.

Second place also went to the Navy and to Boeing as Lt. Edgar A. Cruise, in a F3B-1, turned the course at 159 mph. The Army Air Corps, flying a P-1D Hawk, came in a poor third at 147 mph. The exultant Navy pilots promptly challenged the Army to a race from the

deck to 10,000 feet. In this unscheduled event, the XF4B-1 climbed to 10,000 and was touching down at the takeoff point after a flight of 5.92 minutes while the Army's Hawk was still struggling toward the required altitude.

Although the Model 83 had been designed as a Navy fighter and, along with the Model 89, had been loaned to the Navy for testing, it would be the Army Air Corps that would get the first production. According to Paul R. Matt, an aviation historian and writer, the 83's performance at the races had made such an impression on one of the attendees, the Air Corps Chief, Maj. Gen. James E. Fechet, that he placed an on-the-spot order with the Boeing officials at Mines Field. His order was confirmed later in writing from Washington. Thus the Army, soundly defeated at the races, won the procurement race for the sensational new design.

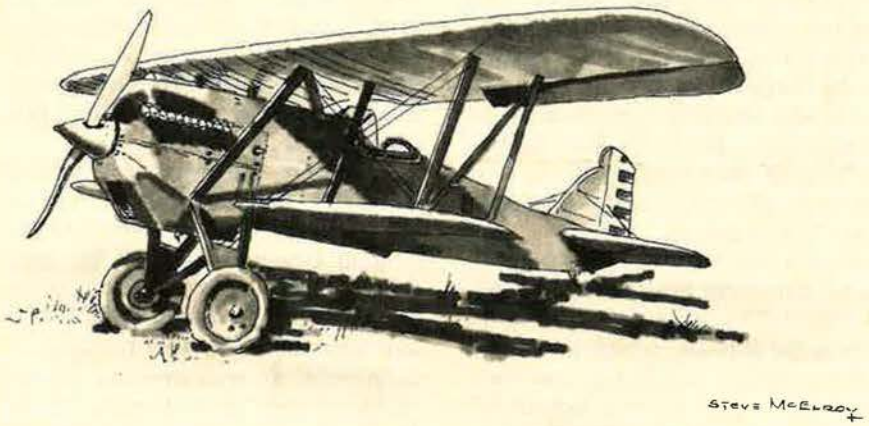
The First P-12

The first ten deliveries to the Army were identical to the Model 83. The first P-12, serial number 29-353, was completed on February 27, 1929. It came off the line in a special paint scheme of cream wings and struts, a dark blue fuselage, and orange for the empennage, wheel discs, and the cylinder streamline fairings. It was devoid of military markings, but bore the name "Pan American" on each side of the fuselage. It was accepted by one of the Army's rising superstars, Capt. Ira C. Eaker. Captain Eaker would use the airplane on a speed run, but this time it wouldn't be over a 120-mile triangular course. Instead, it would be flown from Bolling Field, at the nation's capital, on a goodwill mission into Central America and return.

The most numerous variant of the 83 series was the P-12E. It was an open-cockpit, single-place biplane powered by a Pratt & Whitney R-1340-17 nine-cylinder radial engine driving a Hamilton Standard fixed-pitch, ground-adjustable, two-blade metal propeller. The engine developed 500 horsepower at 7,000 feet, which gave the E a top speed of 189 mph and a cruise speed of 160. The combat ceiling was listed at 26,300, and it had a range of 580 miles.

The airplane was small, having a wingspan of thirty feet, a height of nine feet, and an overall length of twenty feet. Empty weight was 1,999 pounds, and, fully loaded, it totaled 2,690 pounds. Internal fuel capacity was fifty-five gallons. It could carry another fifty-five gallons in an external belly tank. Two .30-caliber machine guns (or one .30 and one .50) were mounted in gun troughs in the turtle deck and were synchronized to fire through the propeller arc. Weight was the operational consideration in gun selection. There was no armor, and self-sealing tanks were unknown. Racks for light bombs were provided.

Initially, streamlined fairings were provided just aft of the cylinders, but these were soon dispensed with because of engine-cooling difficulties. During the production run of the E series, the engines were provided with Townend rings—narrow circular cowlings that enclosed the cylinder heads, improving cooling and perhaps reducing drag to some extent. The P-12 ailerons and the entire empennage were covered with thin corrugated dural, a practice Boeing had first used on the F3B-1.



Forerunner of the P-12 was the earlier PW-9, Boeing's first fighter design. It had a 21,000-foot ceiling, top speed of nearly 160 mph, and range of 390 miles.

Colorful Transformations

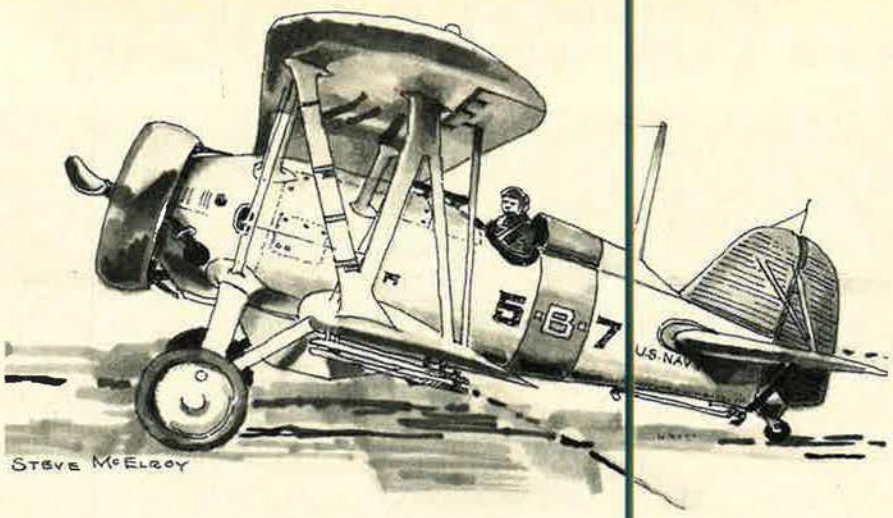
With the introduction of the E, Boeing discontinued the use of doped fabric for the covering and skinned the entire fuselage with thin metal. The airplane was provided with a steerable tail-skid. When the F model was introduced, it was equipped with a steerable tailwheel, and the entire E fleet was similarly retrofitted. The day of the turf-surfaced airfield was ending.

P-12s were delivered in standard Army olive-drab paint for the fuselage, struts, and landing gear, with chrome yellow on the wings and empennage. The rudder received special attention. It had a wide blue stripe from top to bottom just aft of the vertical stabilizer and was completed with thirteen horizontal red and white stripes like those on the American flag.

The US international identifying roundel, a red-centered, five-point white star superimposed on a circular blue field, was displayed at each wingtip on the top of the upper wing and the bottom of the lower one. Unit insignia were later painted on the sides of the fuselage. Cowl rings and wheel discs were painted in unit colors and designs. Command aircraft received identifying bands, stripes, and chevrons in contrasting colors.

With such embellishments, the Army's "drab" gave way to colorful transformations. But the Army would have the final say. "U. S. ARMY" in large block letters was painted in black across the bottom of the lower wing, the lettering extending from roundel to roundel, with the depth of the letters approximating the chord of the wing.

As advanced designs entered the inventory, the P-12s were phased out of the combat squadrons. Their fuselages received a dark blue paint



The Navy's version of the Boeing P-12 was the F4B-4, a sturdy little aircraft that remained in service with Navy squadrons aboard carriers until 1937.

cover, and they were reassigned to Kelly Field, Tex., for advanced pilot training. Many were relegated to administrative flying work, and a large number of others went to multi-engine bombardment and reconnaissance units in order to provide their pilots with the opportunity to "maintain single-engine proficiency."

And then, in 1940, the P-12 was declared obsolete. Its flying days were over. The little airplanes received an aluminum paint cover and were assigned to School Squadrons or were donated to civilian contract maintenance schools to be used as maintenance training devices. Finally, in 1941, the Army transferred the last twenty-three flyable P-12s to the Navy, which converted them to radio-controlled target drones. The Navy called them F4B-4As.

A Handful of Survivors

Within a short time, P-12 aircraft had all but disappeared. There is a P-12E at the Royal Thai Air Force Museum at Don Maung Airport just north of Bangkok. It is one of two that were delivered to the Thais as Model 100s in November 1941. Both fell into the hands of the Japanese and were flown by them. One was lost, and one was returned when the Japanese withdrew.

The National Air and Space Museum has a nonflyable F4B-4 in Marine colors on display. A nonflyable P-12E is reported to be in the Ontario Air Museum in California. A restored Model 100 in the colors of a P-12 of the 95th Pursuit Squadron is based in the Seattle area, where it is flown by its owners, Robert Muckleston and Lew Wallick. From the same area, a P-12E restoration project at the Clover Park Vo-Tech School near Seattle is in progress.

From the Air Force Museum comes the story of another P-12E, the one that I used as the model for a painting. Joseph A. Ventolo, Jr., of Wright-Patterson and Robert L. Cavanaugh of nearby Kettering, Ohio, have traced this airplane from its rollout at the Boeing Plant in Seattle to its final disposition.

It came off the line in September 1931 and was delivered to the 95th Pursuit Squadron at Rockwell Field, Calif. About three weeks later, the 95th moved north to join the other squadrons of the 17th Pursuit Group at March Field, near Riverside, Calif. While assigned to March, the aircraft was involved in a minor accident during a landing at Burbank, Calif. In August 1933, it went to the Air Depot at Rockwell for overhaul prior to shipment to the Hawaiian Department.

On December 29, 1933, it was sent to the 6th Squadron of the 18th Pursuit Group at Wheeler Field on the island of Oahu and assigned the squadron number "20." The following July, it was involved in a taxi accident. During the repair period, its tail-skid was replaced with a tail-wheel, and it was fitted with an "overseas headrest," an enlarged headrest that included space for a one-man liferaft. In March 1939, it was shipped back to the Air Depot at San Antonio, Tex., for overhaul.

On completion of that work, the airplane, 31-559, was assigned to Chicago's Midway Airport for use by Air Corps and National Guard pilots stationed in the area. The left gear collapsed during a landing at Chicago on May 11, 1940. It was her final touchdown. In August, with 1,716 airframe hours, the airplane was declared obsolete. It was retired from active service and donated to the Chicago School of Aeronautics.

Many years later, a dilapidated garage in Chicago was scheduled for demolition. In a debris-filled corner of the building stood the remains of A/C 31-559, without wings. The painstaking restoration of the basket case took almost ten years.

Finally, on August 20, 1983, 31-559, once again in fully flyable condition, complete in every detail from machine guns and bomb racks to a new Form 1 and gleaming in the fresh colors of the 6th Squadron, 18th Pursuit Group's #20, was placed on permanent display in the Air Force Museum.

And that's the way I saw and painted her—but over the Pacific, south of Waikiki, moving fast at about 7,000 feet, with Diamond Head, the heavy cumulus buildups over the Koolau Range, and the afternoon's fleeting rainbow in the background. I called it "Hawaiian Punch—'34 Style."

The P-12E had come home. ■

Steve McElroy is a free-lance artist and writer who lives in Austin, Tex. He joined the Air Corps in 1938. His first operational assignment was to a B-18 unit at Kelly Field, Tex., and this is where he first flew P-12s (used by the unit for single-engine proficiency training). During World War II, he flew B-24s out of England and, later, B-32s from the Philippines in the Pacific. During the Korean War, he flew B-29s out of Okinawa and served a three-year tour with SAC, flying B-47s and B-29s. He retired in 1967 as a brigadier general and then worked for Hughes Aircraft during construction of the NADGE (NATO Air Defense Ground Environment) system. Eight of his paintings are in the Air Force Art Collection.

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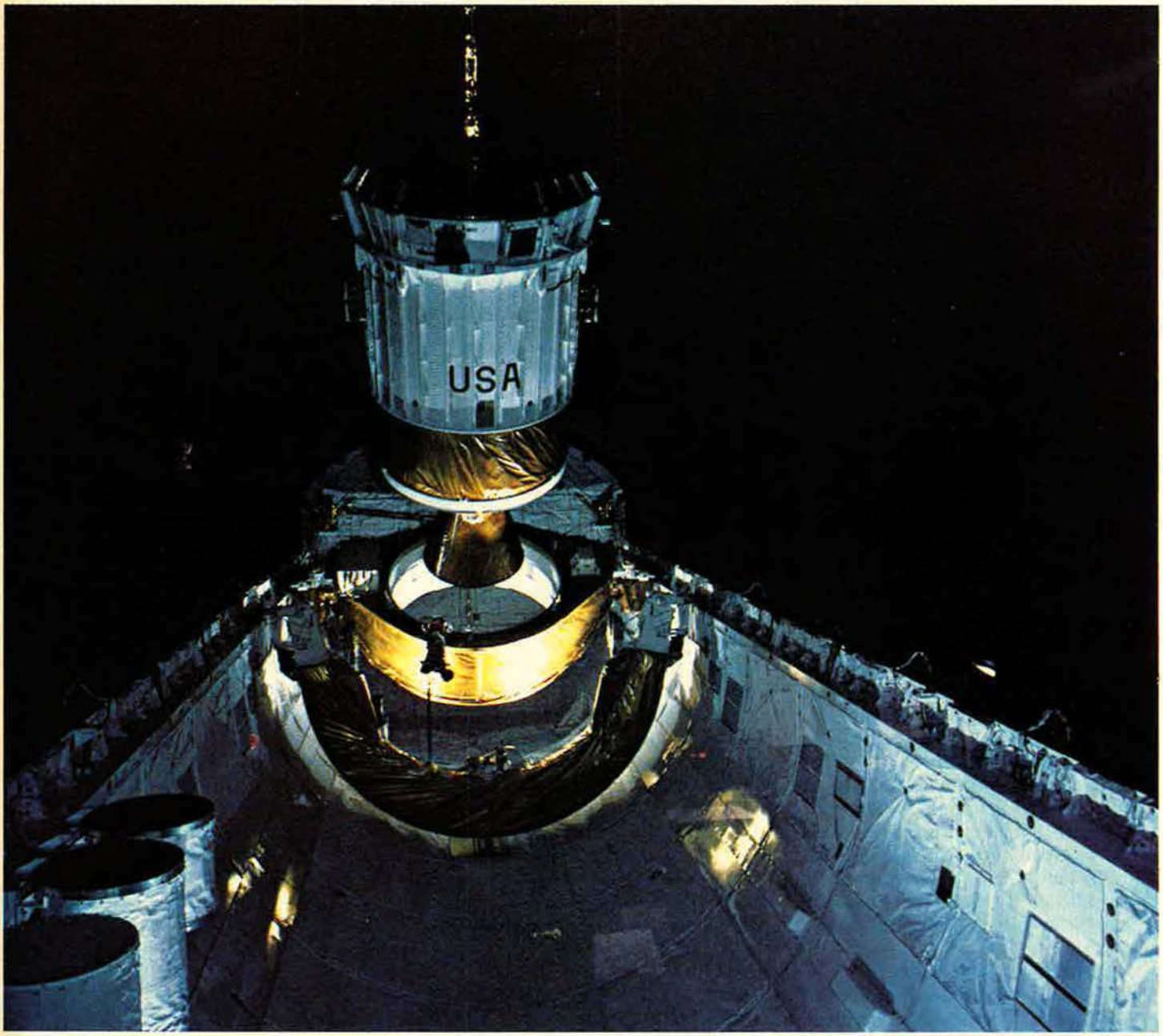

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VIEWPOINT

The Reality of the Philippines

By Gen. T. R. Milton, USAF (Ret.), CONTRIBUTING EDITOR

Aquino still enjoys goodwill, but faces staggering problems of poverty, unemployment, and political uncertainty. The future of US basing rights remains a matter of concern.

From all appearances, President Corazon Aquino's honeymoon with the populace was short-lived. That is not to say she doesn't still enjoy enormous goodwill, but there are signs that disillusionment is setting in. The euphoria surrounding her victory, one made possible by the improbable alliance of rebellious soldiers and unarmed civilians—and, it is fair to add, the forbearance of Ferdinand Marcos—has evaporated. It has been replaced by the harsh reality of life in the Philippines. That reality of unemployment, poverty, a guerrilla insurgency, and a bleak future cannot be wished away. Imelda Marcos's celebrated shoe collection provided a diversion for the crowds and titillating stories for the world press, but now it is the morning after.

Asian nations have worried a great deal these past ten years about the rot taking place in the vast Philippine archipelago. They have worried, but have been powerless to do anything about it. The Philippines, blessed with a fertile land and an enterprising population and thus a country that should be a pacesetter in Southeast Asia, has become, instead, an Asian problem.

John Foster Dulles created the Southeast Asia Treaty Organization, SEATO, in what he hoped would be the image of NATO. For various reasons, apathy being one of them, SEATO never achieved either the stature or the bureaucratic structure of NATO. Besides, as things turned out, SEATO was aimed at the wrong target. Red China was the bogeyman of pre-Vietnam days, and SEATO was designed to foil Peking's interest in the rice bowl of Southeast Asia.

When the People's Republic of China, emerging into the outside world, disclaimed any notions of foreign adventure, the Soviet Union and its Hanoi clients became the instant new menace. As if that were not enough, what with a major Soviet base at Cam Ranh Bay, the Philippines began to come apart.

President Marcos must bear a heavy share of blame for the success of the New Peoples' Army (NPA). An oligarchic government in the hands of men with no visible interest in the welfare, let alone the betterment, of the working class created a friendly climate for Communist revolution. Filipinos, however, are not good candidates for the Communist Party. It would have taken extraordinary ineptitude on the part of the Philippine military for the Communists to have made any real headway in that Catholic land—and extraordinary ineptitude was precisely what they got.

Mercedes sedans and other tokens of affluence became visible evidence of corruption among the poorly paid officer corps. An army chronically short of transport for its troops in the field could nonetheless provide plenty of wheels for family shopping in Manila. All this was presided over by the infamous General Fabian Ver and his cronies. The good soldiers—and the Philippines has never lacked for them—became demoralized. It will take great effort, not to mention money, to turn the dispirited, untrained, and underpaid Philippine Army into a force that can deal with the NPA.

General Fidel Ramos, the Chief of Staff on whom so much hope rides, has made a brave start by retiring most of those senior officers who represented the worst in the Philippine military. It is, however, only a start. There are discouraging days yet ahead for the Philippine military services before the corner can be turned in the war with the New Peoples' Army. General Ramos must himself be occasionally depressed by President Aquino's kiss-and-make-up policy toward the hard-bitten Communist functionaries behind the NPA.

Meanwhile, the United States sits on the huge bases at Clark and Subic. Over the years, we have bargained away much of what we used to claim as ours. In 1961, for instance, we controlled 225 square miles at Clark; once inside the gate, it was US property. Now, there is a Philippine base commander, and the American area is only a small fraction of what we once had. So long as relations remain cordial and the Philippine military takes seriously its obligation to provide base security, that fraction is quite enough, but the future does hold uncertainties—uncertainties that are inextricably tied to the future of the country itself.

As we have all heard many times, there is no real substitute, from a geographic standpoint, for our Philippine bases, not to mention the investment we have in them. They would be hard to duplicate elsewhere. The bases, however, will be of little account if the revolution begins to threaten their security. Hundreds of American military families live in nearby Philippine communities. The daily routine of the bases themselves, with their thousands of Filipino workers, depends on a peaceful environment.

The present twenty-five-year agreement runs out in 1991, after which its term becomes indefinite. Either side can then end the agreement with one year's notice, a fairly shaky basis on which to make long-term capital improvements—although should the political situation stabilize, that would pose no real problem. The political situation, however, will not stabilize, but can only deteriorate, unless there is an early and urgent rehabilitation of the armed forces and of the political and economic structure.

We have a big stake in helping that come about. ■

Experiment at Yangdok

The Communist supply train in that narrow North Korean valley was top priority for an unorthodox attack.

BY JOHN L. FRISBEE
CONTRIBUTING EDITOR

IN THE early summer of 1951, a cease-fire was declared in Korea while Soviet-inspired peace negotiations were conducted between Chinese and North Korean Communists and United Nations forces. It soon became apparent that the Communists were using the cease-fire as a screen for large-scale resupply of their armies, preparatory to moving once more against US and other allied forces.

On August 18, Far East Air Forces (FEAF) responded with Operation Strangle, a determined interdiction campaign against railroads in North Korea. Daylight attacks by F-84 fighter-bombers, B-29s, and Douglas B-26s (the A-26 of World War II) forced the Communists to shift to nighttime movement of supplies by both rail and truck convoys. Strangle then became a round-the-clock operation, with two wings of USAF B-26s and a Navy F4U squadron flying continuous four-hour interdiction missions against targets of opportunity.

USAF's 3d Bomb Wing, based at Kunsan, was responsible for the transportation net in western North Korea, and the 452d Wing at Pusan was assigned the eastern half of enemy territory. In both areas, roads and rail lines ran for much of their length through narrow valleys flanked by rugged mountains. To make the game even sportier, the Communists lined those routes with multiple-mount .50-caliber machine guns and both 20-mm and 40-mm antiaircraft guns. The enemy had devised a variety of tricks to lure low-flying B-26s into mountainsides. It was a sweaty mission for the B-26 crews, who were out an average of fifteen nights a month, weather permitting. And if a crew had to bail out, the chance of rescue was slight. Each B-26 operated independently in an assigned area that might extend as far north as the Yalu River. Pinpointing a downed bomber was virtually impossible.

To help in locating and attacking trains and trucks, a few B-26s of each wing were equipped experimentally with old 80,000,000-candlepower searchlights that the Navy had used on its submarine-hunting blimps during World War II. Capt. John S. Walmsley of the 3d Wing's 8th Bomb Squadron was one of the pilots selected to develop tactics for searchlight attacks. On the night of September 12, 1951, he scored the first success with a searchlight, stopping a truck convoy with 500-pound fire bombs and then making several bombing runs on it using the light, which could be used for no more than fifty seconds at a time.

Two nights later, Captain Walmsley, call sign "Skillful 13," halted a train near Yangdok, about ninety miles north of the Thirty-eighth Parallel, and made searchlight passes on it until he ran out of ordnance. Circling over the train, which was in a valley surrounded by craggy peaks, he called for another B-26 to come and continue the attack.

Capt. John Walmsley won the Medal of Honor for valor during the Korean War.

Blowing up a locomotive had top priority, since one freight car could carry as large a load of supplies as eight trucks.

Finally, a 3d Wing B-26, "Skillful 16," responded. Walmsley gave its pilot his location as accurately as the uncertain maps of North Korea would allow and used his searchlight as a beacon, making himself a clear target for enemy AA guns. When the other bomber arrived, Walmsley twice flew his B-26 through heavy flak along the correct axis of attack, illuminating the area with his searchlight. As "Skillful 16" prepared for its bomb run, Walmsley peeled off in a low-level pass, his searchlight blazing.

Communist gunners on the hills surrounding the train threw up a concentrated barrage across the path of Captain Walmsley's brightly lit B-26. Ignoring the web of tracers ahead of him, Walmsley refused to take evasive action and continued his run in order to pinpoint the train for "Skillful 16" as long as possible. He was well aware of the risk. This was John Walmsley's twenty-fifth intruder mission. As he approached the target, his plane was hit. It continued to fly straight and level for about two miles, but then crashed into a mountain and exploded.

For his determination to complete a top-priority mission in the face of almost certain injury or death, Captain Walmsley was awarded the Medal of Honor posthumously. He was one of only four Air Force pilots to be so honored during the Korean War. All four awards were posthumous.

A month after Walmsley's heroic act, the searchlights were abandoned. They proved too fragile and unreliable for bomber operations and increased the risk of crew losses to a degree that was out of proportion to their limited usefulness. The light may have failed, but not John Walmsley or the other B-26 crews who participated in that bizarre experiment. ■

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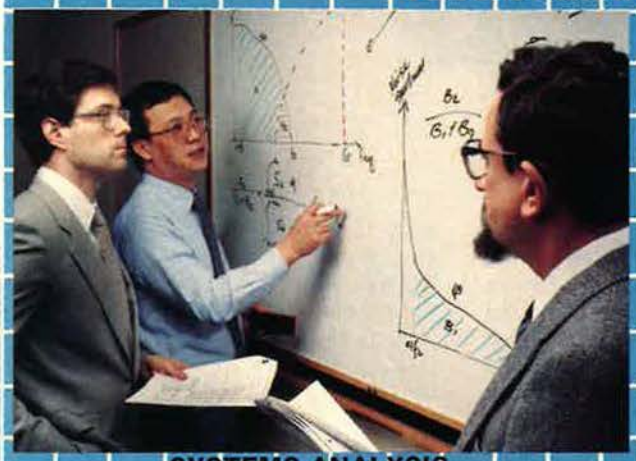

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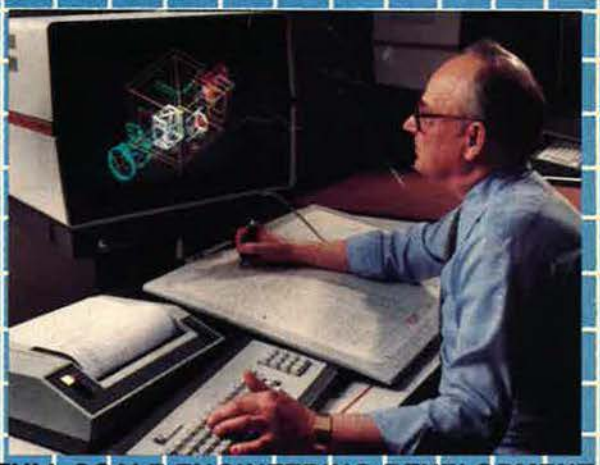

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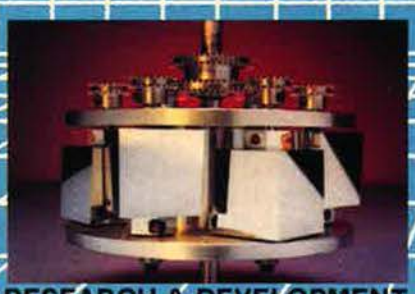

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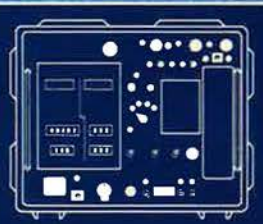

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The Debate Over SDI

Strategic Defense: Star Wars in Perspective, by Keith B. Payne. Hamilton Press, Lanham, Md., 1986. 268 pages with illustrations, tables, and index. Paper $9.95; cloth $20.95.

Not since the beginning of the Manhattan Project has the nation's scientific community embarked on an endeavor that, if successful, could so radically alter the international military balance of power as the Strategic Defense Initiative (SDI).

Supporters of SDI claim that it has not enjoyed the benefits of secrecy, as did the Manhattan Project. They also claim that its potential impact could well put the US in a position far superior to that of once having been the world's only atomic power.

On the other hand, a number of SDI critics believe that the project is technologically infeasible. Among other points, they also argue that limited US defense dollars are better spent modernizing strategic nuclear forces and adding to conventional force capability to counter the continuing buildup of Soviet forces.

One thing is clear: Unlike the Manhattan Project, SDI is the hot topic of scientific, political, and international debate, even before it can be determined if it will work.

The spark for this debate was President Reagan's announcement of SDI in a televised speech in March 1983. During his address, the President challenged the American scientific community to investigate the technologies necessary to produce a defensive system that would render nuclear weapons "impotent and obsolete." Since the time of the President's remarks, critics and supporters of SDI have locked horns in an unprecedented debate that touches all aspects of US military planning.

In this book, Keith B. Payne sheds new light on this debate by examining the relationship between SDI and such issues as nuclear deterrence, arms control, and relations with our NATO allies. He begins by presenting the reader with this scenario: "It is mid-May, the year is 2000. The United States and the Soviet Union have been involved in a military crisis for about one week. This military crisis soon will erupt into a shooting war, a war involving nuclear weapons for the first time since World War II."

What precipitates the US-Soviet nuclear exchange is a conflict that begins in the Middle East. The Soviets take advantage of growing civil unrest in Iran and send troops across the border into that country. The US responds by requesting a withdrawal and warns of grave military consequences if the invasion is not halted. The President receives a set of military options to head off further Soviet incursion. One option is to send the reestablished Rapid Deployment Force (RDF) to critical chokepoints to block advancing Soviet troops. As an alternative option, he could use limited nuclear strikes to seal off the chokepoints. Not wanting to risk a nuclear war, the President sends in the RDF.

The Soviets, eager to add Iran to their sphere of influence and to demonstrate to Warsaw Pact allies that Soviet military might can quash any resistance, orders an attack on the RDF. The Soviets resort to chemical warfare as the fighting escalates. The President responds by authorizing nuclear strikes against the attacking forces. The Soviets respond by launching a limited nuclear strike against targets in the US, and the world teeters on the brink of full-scale nuclear war.

Payne suggests that this scenario could not happen if the US possessed a defensive capability to intercept and destroy incoming ICBM warheads before they reached their targets. The objective of SDI is to provide that capability.

However, he suggests further that a defensive capability less comprehensive than that proposed by the President—one that might effectively protect US retaliatory deterrent capability alone—could also bring about a more favorable outcome to his scenario. Conventional wisdom holds that the Soviets would not risk launching their ICBMs if they knew full well that US nuclear forces could not be effectively knocked out.

Regardless of whether SDI results in a ballistic missile defense (BMD) devoted to protecting only military assets or a dome-like protective shield over the entire country, the author suggests that both ends are worth pursuing. He points out that the Soviet Union has been developing a strategic defense capability of its own. Unlike the US, the Soviets are less concerned about achieving 100 percent leakproof defenses. After all, he writes, "Soviet doctrine does not anticipate coming through a nuclear war unscathed." He reminds the reader that Soviet strategic defense programs include the world's only operational BMD system, the most extensive protection against strategic bombers, and a robust civil defense program.

In examining the proposed US program of strategic defense, Payne introduces the reader to technologies that have come to be synonymous with SDI—particle beam weapons, lasers, and electromagnetic railguns. He describes, through a series of illustrations, how a layered strategic defense system might work.

Payne singles out the relationship between SDI and arms control for special examination. Critics of the program maintain that it will escalate the arms race by forcing the Soviets to increase their ICBM arsenal significantly and to develop exotic countermeasures in an attempt to defeat the system's ability to track and destroy incoming targets.

Mr. Payne concedes this point, with one important exception. He argues that SDI could result in deep reductions in nuclear forces *if* BMD technology were applied to protect US retaliatory nuclear forces. As technology matured, that protection could then be expanded to shield the US entirely. Furthermore, Mr. Payne maintains that US offensive force modernization must continue simultaneously with SDI to convince the Soviets that they could not knock out

retaliatory nuclear forces and limit damage to their homeland. This approach would wean them away from a military strategy of offensive counterforce buildup and toward one of investing in systems for strategic defense.

The author notes that US allies are both supportive and suspicious of the SDI program. On the one hand, the allies have endorsed the need for a research program, if for no other reason than to hedge against Soviet BMD developments. However, he adds, "There will likely be great allied reluctance to support any US decision to deploy BMD unless the Soviet Union has first blatantly and unarguably expanded its own BMD capabilities. . . . Allied leaders who have endorsed SDI have made plain that their support is for BMD research within the bounds of the ABM Treaty and not for BMD deployment."

Although Mr. Payne does not address the issue head on, the requirement to comply with the ABM Treaty may well be the biggest stumbling block for SDI. Critics claim that to determine whether or not an SDI system will work will require a regimen of testing that is barred by the ABM Treaty. Without such developmental testing, SDI will have to be evaluated on the basis of discrete simulations. Most scientists agree that such simulations would not reliably predict if the entire system would work. Indeed, only a full-scale attack could demonstrate the reliability of the entire system.

This book may not answer all the doubts that critics have expressed about SDI, but it does make a strong case for proceeding with a vigorous R&D program. It is a level-headed and valuable addition to the debate over SDI.

—Reviewed by Capt. Napoleon B. Byars, USAF. Captain Byars is Deputy Chief of the Civil Affairs Branch, Community Relations Division, Secretary of the Air Force Office of Public Affairs.

New Books in Brief

Soviet Radioelectronic Combat, by David G. Chizum. This book, an entry in the Westview Special Studies in Military Affairs series, is a relatively brief overview of how the Soviets view and prepare for the "battle of the beams." The Soviets, according to the author, have made radioelectronic combat (REC) an integral part of their combined-arms concept of military operations and plan to exercise electronic combat options in a centralized, coordinated fashion. This "penchant for centralization" will serve the Soviets well in this arena, says the author, but they apparently still lag behind the West in terms of sophisticated electronic technology. An especially valuable feature of this book is its extensive annotated bibliography of Soviet REC literature. With glossary and index. Westview Press, Boulder, Colo., 1986. 125 pages. $17.

Zones of Conflict: An Atlas of Future Wars, by John Keegan and Andrew Wheatcroft. This book rests on an interesting, if gruesome, premise—it enumerates and describes those geographic crucibles where the friction of confrontation could erupt into armed conflict. Applying a "constellation of factors—physical, climatic, logistic, economic, military, and political," the authors analyze those areas most likely to constitute the focus of future wars. Accompanying each short description are maps illustrating the geography and disposition of forces making up these zones. Simon and Schuster, New York, N. Y., 1986. 158 pages. $10.95.

—Reviewed by Hugh Winkler, Assistant Managing Editor.

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AFA INTERCOM

By Robin L. Whittle, AFA DIRECTOR OF COMMUNICATIONS

First Titan II Museum

Midway between Tucson, Ariz., and Mexico is the world's only intercontinental ballistic missile site that is open to the public. It is operated by the Pima Air Museum, the nation's third largest aviation museum. This year, the museum celebrates its tenth anniversary.

"What started as a pipe dream became a reality when the Titan IIs started being deactivated," said Charles T. Niblett, executive director for economic development at the Pima Air Museum. Dedication ceremonies were held May 8, culminating three years of effort by the Pima Air Museum, military and political luminaries, AFA's Green Valley Chapter, members of the Chamber of Commerce Military Affairs committees, and the 390th Strategic Missile Wing at Davis-Monthan AFB, Ariz.

"One of the difficulties we encountered involved arms control and achieving a way that the Soviets could be assured that the Titan II site was definitely deactivated," Mr. Niblett said. Large "windows" were cut in the missile to show that it is inoperable. Then SAC shipped it from Sheppard AFB, Tex., to Davis-Monthan AFB and then to the site. There it was placed above the missile site for thirty days to permit satellite surveillance by the Soviets. Another stipulation requires that the Titan II missile site be open to anyone who wants to see it.

"This has been a major project for us," said Francis Nugent, President of AFA's recently formed Green Valley Chapter. Early this spring, Chapter members rolled up their sleeves and cleaned and painted a modular building that was moved to the site to serve as a briefing room.

Green Valley Chapter officials and members man the facility and serve as docents and volunteers in the gift shop. "Our volunteers—from the community and the Chapter—go through eight hours of training in order to become docents," said Mr. Nugent, who has helped to round up more than 100 volunteers to conduct the tours that start every thirty minutes and to man the gift shop. The tour includes a briefing on the history of the Titan II program and its contributions to America's defense, a look at the control room, and a topside view of the missile and silo and mock living quarters. Tourists must be accompanied by a guide and are not permitted below the second level. Tour groups are limited to twenty people and are arranged by reservation only.

Technicians from Titan II missile wings in Arkansas and Kansas guide the first stage of a deactivated Titan back into its silo in preparation for the opening of the world's only intercontinental ballistic missile site now open to the public.

The museum is expected to draw visitors from around the world, since it exhibits the only one of the fifty-four deactivated Titan II missile sites in the US that has been modified for civilian use.

Approval for the new museum was given at the highest DoD level, with strong support by the Air Staff and Strategic Air Command, according to Mr. Niblett.

"When the 390th Strategic Missile Wing deactivated, it left the site in museum-quality appearance," Mr. Niblett said. The 308th Strategic Missile Wing, Little Rock AFB, Ark., and the 381st Strategic Missile Wing, McConnell AFB, Kan., installed the only Titan II missile trainer and a shell reentry vehicle in the silo.

"The Titan Missile Museum is a memorial to the thousands of Air Force members who have dedicated untold hours in lonely missile sites throughout the United States in the defense of the free world," Mr. Niblett said.

Roanoke Chapter Celebrates AFA's Fortieth

Earlier this year, AFA's Roanoke Chapter in Virginia held its first annual awards banquet and celebrated AFA's fortieth anniversary. The Chap-

INTERCOM

ter's first AFA Community Partner, the Coach and Four Restaurant, was honored at the banquet.

Bob Breakell, a Southeast Roanoke resident who saved three people from drowning, was also honored at the event. Roanoke Chapter President George W. McKay said that Mr. Breakell, a licensed pilot, was boating on Smith Mountain Lake when he spotted a capsized boat. He dove under the sinking boat and pulled out a young girl and two women who were trapped underneath. Mr. Breakell was presented a medallion and plaque and was made a member of the Roanoke Chapter.

Members of the Air Force's 3534th Recruiting Squadron of the Roanoke Valley who were honored during the banquet included Capt. Joe D. Shrum, junior officer of the year; MSgt. Gary Borosky, senior NCO of the year; TSgt. Kathy F. Davis, junior NCO of the year; and Lt. Col. Jerry M. Geloneck, Commander, who received a framed copy of the poem "The Men Who Fly" in appreciation of his support of the Chapter. In turn, Colonel Geloneck presented the Chapter with a flag and standard.

Robert W. Breakell (right) receives the Air Force Association medallion and plaque from Roanoke Chapter President George W. McKay for his courageous rescue of three people whose boat had capsized on Smith Mountain Lake near Roanoke.

The Roanoke Chapter Treasurer, Thomas L. Leivesley, Jr., was awarded a certificate of appreciation for his strong support of AFA activities. In addition, a model of the B-1 was presented to cadets from the William Fleming High School AFJROTC unit for their model aircraft collection.

"Life truly begins at forty, and AFA's fortieth anniversary gave us the perfect occasion to initiate an excellent program for AFA and the Roanoke Chapter," Mr. McKay said.

On the Scene

At a Florida Highlands Chapter meeting in mid-April, **SSgt. Jay Hinson** gave a briefing on the Air Force's tank-buster aircraft, the Fairchild A-10. Designed specifically to counter the vast numbers of Warsaw Pact tank forces in Europe, the A-10 Thunderbolt II was nicknamed after the P-47 Thunderbolt of World War II, Sergeant Hinson noted.

AFA's Cheyenne Chapter joined forces with the Greater Cheyenne Chamber of Commerce Military Affairs Committee to sponsor the annual Armed Forces Day dinner in May. Scheduled to speak was **Lt. Gen. Leo Marquez,** Deputy Chief of Staff for Logistics and Engineering, Hq. USAF.

Pennsylvania AFA President **Jack Flaig** reported that a nominating committee in Carlisle selected a slate of youthful state officers—three of the four nominees are under forty. In the running for president is former Under-Forty Director **David Jannetta** of AFA's Altoona Chapter. Mr. Janetta is Mayor of Altoona. **Ron Chromulak,** President of AFA's Joe Walker Chapter, is running for vice president. Current Under-Forty Director and Altoona Chapter Secretary **Anthea Germano** is running for secretary. **Frank Juliano** is running for treasurer.

Cleveland Chapter leader **Jim Larkins** recently debated the nuclear freeze issue at a local high school. The session was videotaped for further debate and discussion at the May 21 Cleveland Chapter meeting. Mr. Larkins served as a B-52 crew member for ten years, a Weapon Systems Analyst for USAF's High Energy Laser Program, and as Chief of the Space System Division at Hq. SAC. Cleveland Chapter officials put out a flyer announcing that the two and one-half hour video meeting was free and encouraged AFA members to bring a guest.

Some 150 people recently turned out for the renaming of AFA's Peoria, Ill., Chapter. Now known as the Richard E. Carver Chapter, the AFA unit was renamed in honor of the Assistant Secretary of the Air Force for Financial Management. Mr. Carver served as Mayor of Peoria for nearly twelve years before his current appointment. Carver Chapter President **Col. Kenneth Peterson,** Commander of the 182d Tactical Air Support Group, Illinois Air National Guard, said that the former mayor was "the person we most wanted to rename the Chapter for because of his unique and spirited community involvement and his strong support of the Air Force and national defense." A plaque was presented to Mr. Carver in honor of the occasion.

Also honored was **Arthur F. Szold,** Chairman of the Greater Peoria Airport Authority, for his strong support in improving the 182d Tactical Air Support Group facilities. Chapter President Peterson said that with the new name and new mission, AFA's Carver Chapter just might increase its membership to 250 by next year's banquet. The Chapter currently has 100 members.

The Peppermill Inn and Casino in Reno, Nev., was to be the site of the Dale O. Smith Chapter's annual "Washington Report" membership dinner meeting scheduled for May 18. Guest speaker was to be **Eric M. Thorson,** Deputy Assistant Secretary of the Air Force for Economic Analysis and Financial Control. In June, Smith Chapter officials were to present the Chapter's annual scholarship award to **Carrie Lynn Bonner,** the daughter of **MSgt. and Mrs. Thomas R. Bonner.** Each year, the Chapter honors Nevada ANG dependents who maintain high scholastic averages. The award is $250 per year for two years.

Phil Saxton, AFA National Vice President for the Northwest Region and Chairman of the Portland, Ore., Chamber of Commerce Military Affairs Committee, recently presented a certificate to **Rep. Ron Wyden** (D-Ore.) for his outstanding service to the Portland business and military community. The award was presented at a joint meeting of the Portland Chapter and the Chamber Military Affairs Committee.

Thanks to the hard work of Arkan-

sas AFA, led by President **T. P. Williams,** funds were raised to help purchase 1,000 gallons of aviation fuel in order to help the Confederate Air Force Razorback Wing get their A-26 Invader to AFA's "Gathering of Eagles" in Las Vegas last April. A check covering one-third of the fuel bill was presented by Mr. Williams to **J. Dennis Devine,** Razorback Wing Leader, during ceremonies held one month before the Gathering got under way. "All AFA members in Arkansas contributed, since state funds were used in addition to funds provided by the state's David D. Terry, Jr., Blytheville, Razorback, and Fort Smith Chapters," President Williams said.

Arkansas AFA recently contributed funds to support a memorial to Arkansas Vietnam veterans. The memorial will list the 594 Vietnam servicemen and women from Arkansas who died during that conflict and is expected to be completed and dedicated on Veterans Day 1986. "This, too, was a joint effort by all the chapters in this state to show our appreciation to those who made the ultimate sacrifice," President Williams said.

Active Sedona, Ariz., Chapter leader **Ed Przybys** addressed the local chapter of the International Airstream Club in mid-April on the Space Shuttle program. His presentation, which includes a slide show, has been well received by civic groups and organizations in the area. Mr. Przybys, a former aerospace engineer, has an extensive background in the aerospace industry. Now retired, Mr. Przybys is active in AFA and writes a column for the Sedona *Red Rocks News* called "Flightline."

Dr. Robert W. Smith, Special Assistant for Ocean Affairs and Policy Planning in the Office of the Geographer, US State Department, addressed AFA's Llano Estacado Chapter on April 11 at the Cannon AFB, N. M., Officers' Club. Dr. Smith discussed his research in political geography, marine navigation, and overflight programs.

In March, Texas AFA and its Alamo Chapter in San Antonio cosponsored the ninth annual Air Force Junior ROTC symposium at Samuel Clemens High School. More than 700 cadets from throughout Texas, Louisiana, and Oklahoma attended the event, which was moderated by **Brig. Gen. Carey Deckard,** public affairs mobilization assistant to SAFPA and active AFA leader. The event was keynoted by **Bob Mayfield,** education specialist with NASA. Mr. Mayfield gave an update on NASA's Aerospace Education Program, which features an extensive display of space vehicles and related

Rep. Ron Wyden (D-Ore.) displays the plaque he received from the Portland Chamber of Commerce Military Affairs Committee. From left: ANG Brig. Gen. Curt Madson, AFA National Vice President for the Northwest Region and Military Affairs Committee Chairman Phil Saxton, Representative Wyden, and Chamber Executive Director Dickwin Armstrong.

equipment from the LBJ Space Center in Houston. **Col. Bennie Blansett,** professor of aerospace studies and commander of the AFROTC unit at Southwest Texas State University at San Marcos, discussed the demands and requirements of college ROTC programs. The afternoon was devoted to reviewing static displays and witnessing aerial demonstrations of model rockets conducted by the various AFJROTC units.

In related news, Alamo Chapter officials presented AFA bronze medals to the following local outstanding AFJROTC cadets: **Foster Yerrington,** Holy Cross High; **David Osborn,** Clark High; **Jim Lloyd,** Samuel Clemens High; **Joe Kellogg,** Judson High; **Charles Shinn,** John Jay High, and **Dave Stoltz,** Holmes High.

Paul Revere Chapter members in Boston, Mass., heard **Hank McCard,** President of AVCO Systems Textron in Wilmington, discuss the need for a "conventional defense initiative" to bolster US conventional forces in order to counter Warsaw Pact forces in Europe and to reduce reliance on nuclear weapons.

Arizona AFA President **Bob Munn** recently presented a plaque to the first contributor to the state AFA's Endowment Fund, which supports Air Force junior and senior ROTC scholarships. Contributor **John Storie** was honored for his $1,000 donation.

The former Ohio AFA President, **Chester Richardson,** and his wife **Nettie** were recently asked by the Youngstown, Ohio, *Vindicator* why they are active in AFA. Said Mr. Richardson: "It's an organization where everyone feels like they are doing something for their country. And everyone likes to tell their stories of when they were in the service. The most interesting stories come from those who were prisoners of war," he said. "When you go to the conventions, you meet the people who have made history and who are making history today," Mrs. Richardson added. **Fred Kubli,** Secretary of AFA's Steel Valley Chapter, was also interviewed for the article. "One thing I like is that AFA members are very friendly people. It's a good, positive atmosphere. I do this because it's something I believe in," Mr. Kubli said. "In fact, I have a whole presentation I give, letting people know why a strong defense is important," Mr. Kubli added. The article also announced the Steel Valley Chapter's military ball, which was held at the Consolidated Club at the Youngstown Air Reserve Base on April 19, and the Chapter's aerial acrobatics show, scheduled for July 12.

Bud Bacon, President of AFA's General Bruce K. Holloway Chapter in Knoxville, Tenn., has been named superintendent of the Castle Heights Military Academy effective June 1. Mr. Bacon retired from the Air Force as a brigadier general in 1980 after serving in command positions and as Executive Assistant to the Under Secretary of the Air Force. He was a

(Continued on p. 123)

Southwest Region—The Big-Hearted

Several things stand out in my travels about the Southwest Region. First, great distances separate our chapters. For example, regional meetings held in South Texas require some folks to travel the approximate distance from Washington, D.C., to Peoria, Ill., and in some cases, from Washington, D. C., to St. Louis, Mo.

Second, these friendly patriots stand strongly behind the concept that freedom is not cheap. They are willing to make sacrifices, recognizing that US military strength deters and costs the country and the free world much less in the long run than the alternative.

Finally, the most outstanding impression to date is the young people—those in school as well as those in ROTC and on active duty. All of the states in the Southwest Region have programs that address young people in a unique way. Texas has a patriotic essay contest each year that is open to high school seniors throughout the state. A topic relevant to AFA's mission is furnished by Texas AFA. It is abundantly clear that this essay contest provides a powerful communications vehicle that reaches into the schools, the home, and to the parents. If I had to judge a program that I felt merits strong recognition, it is the essay contest in Texas. I would hold it up for consideration by all AFA regions throughout the country.

—Bryan L. Murphy, Jr., National Vice President, Southwest Region.

Bryan L. Murphy, Jr., is the AFA National Vice President for the Southwest Region. In his travels throughout the Southwest Region, its young people have made a significant impression on him.

New Mexico

New Mexico AFA is led by Louie T. Evers and has three chapters. During the year, plans centered on establishing a scholarship to honor outstanding Air Force Junior ROTC students selected by the detachment. Work continues on this program.

Valin R. Woodward leads AFA's Albuquerque Chapter, which each quarter honors the outstanding junior officer, senior NCO, NCO, and first-term airman from Kirtland AFB by presenting them with inscribed AFA silver trays. Each year, the Chapter presents the "Lt. Larry Francis Memorial Award," established in 1983 to a deserving AFROTC cadet from the University of New Mexico. Quarterly meetings have featured local speakers, including Jim Arholz, a popular local columnist for the Albuquerque *Journal*. During the year, Chapter officials arranged to have a cadet contingent from the Air Force Academy address the local Rotary Club and held a joint function with the local Daedalians.

AFA's Fran Parker Chapter is led by Frank S. Gentile. The Chapter presents awards to graduates of the NCO Leadership School at Holloman AFB at each graduation banquet. Each year, Chapter officials provide funds to help defray expenses for an outstanding cadet to attend the National Arnold Air Society and Angel Flight Conclave.

Oliver J. Cook leads AFA's Llano Estacado Chapter, which honors the Airman of the Quarter from Cannon AFB with a complimentary AFA membership. The Chapter holds quarterly meetings and often meets with the local Daedalians. One meeting, devoted to "everything you always wanted to know about air rescue," featured Capt. Joseph Dye, staff officer of the 1550th Air Base Wing at Kirtland AFB.

Oklahoma

Oklahoma AFA is led by G. G. Atkinson and has four chapters. The Altus Chapter, led by Aaron C. Burleson, hosted the 1985 state convention. Rep. Dave McCurdy (D-Okla.) and Rep. Les Aspin (D-Wis.), Chairman of the House Armed Services Committee, were the featured speakers. The events were well attended. A meeting with Gen. Duane Cassidy, CINCMAC, was one of the Chapter's highlights of the year.

AFA's Central Oklahoma/Gerrity Chapter is led by Alfred J. Nett. During the year, a meeting was held at Tinker AFB that featured Lt. Gen. John A. Shaud, DCS for Manpower and Personnel. Some 250 people attended.

The Enid Chapter, which hosted the 1986 state convention last month, is led by Ken Lohse. Regular quarterly meetings are held at Vance AFB. At one meeting, Col. Jeffrey Ellis, former CO at Vance and now Commander at Laughlin AFB, Tex., briefed members on base facilities.

The Tulsa Chapter is led by John F. Loerch. Meetings are often held with the Rockwell International Management Club. During the year, the Chapter participated in the Tulsa Air Fair.

Texas

Texas AFA, led by President Ollie R. Crawford, has twenty chapters. The state convention was held in Austin last July and was hosted by the Austin Chapter. Convention activities included a luncheon that was open to the public and featured former Air Force Secretary Dr. Hans Mark as the speaker. The evening banquet was attended by 250 people, and Lt. Gen. Charles Cunningham, Commander of Twelfth Air Force, addressed the AFA crowd.

C. W. Lawrence heads the Abilene Chapter. In November, the Chapter sponsored a "Salute to Former POWs" banquet. Rep. Charles W. Stenholm (D-Tex.) was the speaker. Chapter members sponsored the attendance of Abilene-area POWs and their spouses. The event attracted nearly 400 people. Excellent news coverage resulted.

The Aggieland Chapter is led by Harry C. Hill. Weekly social hours are held for members at the Casa Tomas from 5:30 p.m. to 7:00 p.m. Last October, Chapter officials sponsored a fall banquet featuring Lt. Gen. Charles Cunningham as the speaker.

Claire M. Garrecht is the President of AFA's Alamo Chapter. The Chapter sponsors many excellent programs and publishes a newsletter. One highlight of the Chapter's activities is the annual Blue-Suit Awards Banquet, which honors selected outstanding local Air Force personnel and AFA leaders. Alamo is AFA's largest chapter. Its strength is reflected in the outstanding awards it receives and its superior programming.

Region

Oklahoma AFAers Joan and David Blankenship (right) welcome JCS Chairman Adm. and Mrs. William J. Crowe, Jr. (left), to Armed Forces Day festivities in McAlester, Okla. Admiral Crowe's grandfather made the Oklahoma land run of 1889 and became a hardware store entrepreneur in McAlester.

George A. Edwards, Jr., is President of AFA's Austin Chapter. The Chapter hosted the 1985 state convention and held a meeting featuring Maj. Gen. Robert Takes as the speaker.

AFA's Concho Chapter is led by Roger M. Dollive. A highlight of the past year's activities was a Chapter meeting that hosted officials from Dyess AFB, who spoke on the B-1 program.

Chester J. Milczarek is President of AFA's Corpus Christi Chapter. During the year, he visited Vandenberg AFB, Calif., and reported back to the membership in the Chapter newsletter.

AFA's Dallas Chapter is led by Robert S. Seide. During the year, a meeting held at the Lancers Club featured W. Clive Sloan, Senior Vice President, Bell Helicopter, and Director, Bell-Boeing CV-22 Joint Program Office. Mr. Sloan discussed the CV-22 tilt-rotor aircraft program.

AFA's Del Rio Chapter is led by Ernest L. Worley, Jr. During the year, a dinner meeting at the Laughlin AFB Officers' Club featured Rep. Albert Bustamante (D-Tex.) as the speaker.

AFA's Denton Chapter is led by Robert E. Edge and holds quarterly business meetings.

L. B. "Buck" Webber is President of AFA's Fort Worth Chapter, which has sponsored many nationally recognized activities. The Chapter works closely with Carswell AFB, contributing funds and honoring outstanding blue-suiters. It hosts an annual dinner dance honoring area Air Force Academy cadets and an annual Fort Worth Military ball, boasts an active "Community Partner Program," and maintains a speaker's bureau that reaches out into the community with AFA's message. In 1985, the Chapter reached a total audience of 3,360—a dramatic increase from 1984. The Chapter also supports Texas AFA's annual essay contest for high school students.

AFA's Greater Amarillo Chapter is led by Robert E. Hoffman. Each year, the Chapter mans a popcorn booth at the Amarillo Air Show. Chapter members participated in the annual Panhandle Military Ball and will be doing so again this year, Chapter officials say.

Edward J. Fox, President of AFA's Heart of the Hills Chapter, reports that the Chapter's briefing team addressed many local groups last summer on the crisis in Central America. Officials showed a film from AFA's film/video lending library and opened up the sessions to questions.

Mason Honeycutt is President of AFA's Houston Chapter. During the year, the Chapter helped find temporary housing in the Houston area for Air Force Academy cadets at the time of the Bluebonnet Bowl. (The Academy beat Texas to finish the season ranked in the top ten in the national polls.) Chapter officials organized the effort, contacting civic clubs and mailing letters in order to find housing. They kept detailed records, met the cadets, and ensured that they departed on time after the visit.

Eldon K. Turner leads AFA's Lubbock Chapter. Last September, Dr. F. Story Musgrave gave a presentation on his experiences aboard the Space Shuttle in 1983 and 1985. One mission was operational, and the other was devoted to scientific experimentation. Some 115 people turned out to hear Dr. Musgrave discuss his tense wait for blastoff and the novelty of working weightlessly in space. President Turner reports that his "simple and humorous mannerisms in describing space experiences transfixed the audience" and that his slides of earth from 300 miles up in space were "extraordinary." The Lubbock Chapter holds regular quarterly dinner meetings with important speakers and a breakfast business planning session each quarter for leaders.

The Northeast Texas Chapter is led by Jim L. Haptonstall. Chapter members work with area AFROTC units and support the state's Earle North Parker essay contest each year.

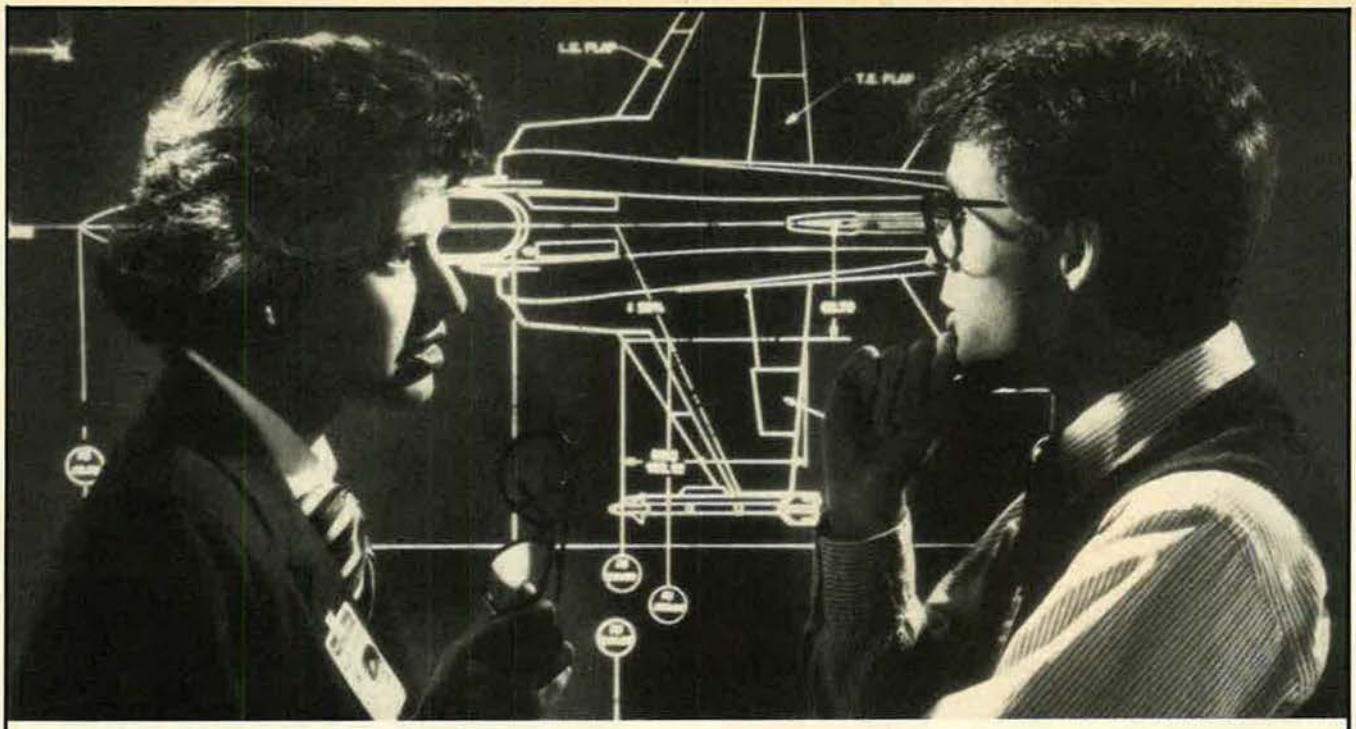
F. B. Gallagher leads AFA's Paso del Norte Chapter, which presents insignia to newly commissioned second lieutenants in ceremonies at the University of Texas/El Paso campus each quarter. The Chapter supports the Texas AFA essay contest as well.

AFA's Permian Basin Chapter is led by John R. Key. During the year, small meetings are held in the homes of Chapter members.

The Rio Grande Chapter is led by Allen H. Moore, Jr. Mr. Moore is presently working to revitalize chapter activities in the area.

AFA's Lee Glasgow Chapter in Waco is led by Claude Ervin.

AFA's Wichita Falls Chapter is led by Robert D. Haley. The Chapter will host the Texas AFA convention this month. The chapter recently sponsored a meeting with Sen. Phil Gramm (R-Tex.), who discussed the Gramm-Rudman-Hollings Deficit Reduction Act. During the year, the Chapter initiated an excellent newsletter for members. Regular, informative meetings are held, and one meeting featured astronaut Joe Engle as the speaker.



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decorated tactical fighter pilot with two combat tours and 5,000 hours of flying time. The West Point graduate was an English instructor at the Air Force Academy and a faculty member of the National War College. Last fall, Mr. Bacon worked as an intern at the Knoxville *Journal.* Castle Heights Military Academy, founded in 1902, is one of the nation's oldest and Tennessee's only remaining honor military school. A write-up on Mr. Bacon's appointment appeared in the April 25 Knoxville *Journal* and was forwarded by Tennessee AFA President **Jack Westbrook.**

At a recent meeting, **Doyle Larson,** President of AFA's General E. W. Rawlings Chapter in Minnesota, announced that the Chapter was to begin sponsoring field trips for outstanding ROTC cadets. The first trip was to be scheduled for late May, when six cadets were to spend two days at Nellis AFB, Nev. The cadets were to attend briefings on Red Flag operations, observe firepower demonstrations, and view exercise activities. The six cadets selected by their commanders are **Paul Panka, Mike Tichenow,** and **Darcy Dilling** from the University of Minnesota and **David Schwarze, Rebecca Keller,** and **Jennifer Neumann** from the College of St. Thomas. The ROTC Field Trip program is sponsored by donations from Chapter members.

The Chapter also sponsored a banquet in early May honoring all ROTC cadets attending local universities and colleges. The event was held at the Thunderbird Motel, and the guest speaker was **Brig. Gen. Grover E. Jackson,** Vice Commander of Electronic Security Command.

In April, AFA's Fresno Chapter in California sponsored a western dance contest during the Fresno Chamber of Commerce's annual "Big Hat Day Festival." Chamber and AFA officials estimate that some 10,000 residents turned out for a day filled with arts and crafts, food, and entertainment. More than 100 vendors displayed their wares in the booths that lined the streets. The AFA-sponsored dance contest featured three dance groups from the area. The "Crazy Horse Saloon Dancers" from the Hacienda in Fresno were awarded the $100 first prize. About thirty groups entered the ribs cookoff contest. The $500 first prize went to "Earl Jackson and the E. J. Company."

"Portrait of a Community Partner" is a new feature in the Anchorage Chapter's *News & Views* newsletter. **Arctic Bee Construction,** owned by active AFAers **Bill and Lorraine Brooks,** was featured in April. The

INTERCOM

newsletter plans to feature a Community Partner each month.

In other Anchorage Chapter news, *Top Cover for America* has gone into a second printing for the soft-cover copy. The book is about Air Force history in Alaska from 1920 to the present. It is published by the Chapter and coauthored by **John Cloe** and the late **Maj. Michael E. Monaghan,** son of AFA National Director **Ed Monaghan** and Anchorage Chapter Treasurer **Mary Monaghan.** An additional 200 hard copies, numbered and autographed, have also been published.

In addition, the Chapter commissioned a limited-edition printing of 950 four-color lithographs of the book's cover by aviation artist **Steve Hillyer.** The cover depicts the dramatic contrast between the F-15A Eagle, Mt. McKinley, and the P-36A Hawk, which was flown in 1941 as part of the first operational squadron assigned to the demanding flying environment of Alaska. The books and lithos help fund the Anchorage Chapter's two college scholarships for deserving high school graduates. The scholarships are presented each year at the Anchorage Chapter's awards banquet, which was held at the Elmendorf AFB Officers' Club this past May, reports active AFA leader **Vic Davis.**

AFA has a new chapter in Heidelberg, West Germany, named the **Maj. Gen. Robert M. White Chapter. Lt. Col. Thomas L. Burke, Jr.,** is the President . . . **Vivian Carson,** longtime civilian employee at Dyess AFB, Tex., recently received the first Civilian Employee of the Year award from AFA's Abilene Chapter in Texas.

Several Air Force Academy cadets were on hand at the Cape Coral Elks Lodge in Cape Coral, Fla., to discuss Academy life and Air Force ROTC with area high school students at a luncheon sponsored by AFA's Cape Coral Chapter.

The US Air Force Band and the Singing Sergeants were in concert at the Performing Arts Center in Tulsa, Okla., thanks to a joint effort by the Tulsa *Tribune* newspaper and AFA's Tulsa Chapter.

Palm Beach County commissioners approved spending funds to send Commissioner **Jerry Owens** to Offutt AFB, Neb., for a visit in late April. He joined forty other community leaders touring Strategic Air Command, thanks to the sponsorship of AFA's Palm Beach Chapter. The trip was offered to county, business, civic, and political leaders as part of the local AFA's Distinguished Visitors program . . . "The Air Force Association is looking for a few good men and women—quite a few," the Enid, Okla., *Eagle* announced in a recent article. The occasion was the kickoff of the Enid Chapter's membership drive. ■

UNIT REUNIONS

Reunion Notices

Readers wishing to submit reunion notices to "Unit Reunions" should mail their notices well in advance of the event to: "Unit Reunions," Air Force Magazine, 1501 Lee Highway, Arlington, Va. 22209-1198. Please designate the unit holding the reunion, time, location, and a contact for more information.

Camp Forrest Reunion
As part of "Tennessee Homecoming '86," the city of Tullahoma is planning a Camp Forrest homecoming celebration to be held on August 14–16, 1986, at the Arnold Engineering Development Center (AEDC) at Arnold AFS, Tenn. Army and Air Force personnel who trained at William Northern Field, Tenn., and anyone who was stationed at Camp Forrest during World War II are invited to attend. **Contact:** Tullahoma Chamber of Commerce. Phone: (615) 455-5497.

Fuzzy-7
Fuzzy-7 personnel are planning a reunion for October 1986 at MacDill AFB, Fla. Former members of the AN/FSS-7 "Fuzzy-7" Sea-Launched Ballistic Missile Warning site at MacDill AFB are invited. **Contact:** Det. 1, 20th MWS/LG, Attn: Captain Woolston, MacDill AFB, Fla. 33608. Phone: (813) 830-2095. AUTOVON: 968-2095.

Lockbourne AFB
Officers who served at Lockbourne AFB, Ohio, will hold a reunion on October 2–5, 1986, in Albuquerque, N. M. **Contact:** Bobby J. Dunagan, 1824-A Father Sky, Albuquerque, N. M. 87112. Phone: (505) 292-3844.

Sherman Field
Veterans who served at Sherman Field, Kan., will hold a reunion on September 12–14, 1986, at the Ramada Inn in Leavenworth, Kan. **Contact:** Roscoe Swenson, 2053 Highland, Salina, Kan. 67401. Phone: (913) 827-2577.

Tactical Fighters
Tactical Fighter members will hold their reunion on October 2–5, 1986, at the Union Plaza in Las Vegas, Nev. **Contact:** Col. Floyd "Buckshot" White, USAF (Ret.), 3650 S. Eastern Ave., Suite 360, Las Vegas, Nev. 89109.

2d Ferrying Group
Air Transport Command's 2d Ferrying Group (now The Wilmington Warrior Association), which was based at New Castle AAB, Del., during World War II, will hold a reunion on October 3–5, 1986, at the Red Lion Inn in Seattle, Wash. **Contact:** Ray Kuhlman, 7 Springwood Lane, Kinston, N. C. 28501. Phone: (919) 522-0356.

2d Schweinfurt Memorial Ass'n
The 2d Schweinfurt Memorial Association "Black Thursday" will hold a reunion on October 13–15, 1986, at the Union Plaza Hotel in Las Vegas, Nev. **Contact:** Herman E. Molen, 4299 Calimesa St., Las Vegas, Nev. 89115. Phone: (702) 644-0034.

7th Ferry Group
Members of the 7th Ferry Group and support squadrons stationed at Gore Field, Mont., during World War II will hold a reunion on August 15–17, 1986, in Great Falls, Mont. **Contact:** C. D. Markle, 1104 Valley View, Glasgow, Mont. 59230. Phone: (406) 228-4819.

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Coming Events

July 18–20, **Pennsylvania State Convention,** Wilkes-Barre . . . July 25–26, **Indiana State Convention,** Fort Wayne . . . July 25–26, **Texas State Convention,** Wichita Falls . . . August 1–2, **Colorado State Convention,** Colorado Springs . . . August 1–3, **New York State Convention,** Rome . . . August 8–9, **North Carolina State Convention,** Seymour Johnson AFB . . . August 9–10, **Arkansas State Convention,** Fort Smith . . . August 21–23, **California State Convention,** Riverside . . . September 15–18, **AFA National Convention and Aerospace Development Briefings & Displays,** Washington, D. C. . . . September 19–20, **Washington State Convention,** Tacoma.

7th Troop Carrier Squadron
The 7th Troop Carrier Squadron will hold a reunion on August 15–17, 1986, at McChord AFB, Wash. **Contact:** Lt. Col. John W. Crump, USAF (Ret.), 18902 94th W., Edmonds, Wash. 98020. Phone: (206) 776-2662.

8th Tactical Fighter Wing
The 8th Tactical Fighter Wing "Itazuke Afterburners" and the 68th Fighter Interceptor Squadron will hold a reunion on October 10–12, 1986, in Scottsdale, Ariz. **Contact:** Jim Matchette, 1567 W. Butler Dr., Phoenix, Ariz. 85021. Phone: (602) 943-3935.

12th Tactical Recon Squadron
The 12th Tactical Reconnaissance Squadron will hold a reunion on September 25–27, 1986, in Winston-Salem, N. C. **Contact:** J. L. Gates, 2730 Melinda Dr., Winston-Salem, N. C. 27103. Phone: (919) 765-1893.

18th Troop Carrier Squadron
Members of the 18th Troop Carrier Squadron who served in World War II will hold a reunion on September 25–28, 1986, in Williamsburg, Va. **Contact:** Col. Robert S. Walker, Jr., USAF (Ret.), 286 E. Queens Dr., Williamsburg, Va. 23185. Phone: (804) 229-5473.

20th Combat Mapping Squadron
The 20th Combat Mapping Squadron will

hold a reunion in October 1986 in San Antonio, Tex. **Contact:** Lt. Col. David W. Ecoff, Sr., USAF (Ret.), 13850 Tulane St., Brookfield, Wis. 53005.

20th Fighter Group Ass'n
The 20th Fighter Group will hold a reunion on October 16–20, 1986, in Washington, D. C. **Contact:** John Hudgens, 409 University Ave., Apt. 108S, Lubbock, Tex. 79401. Phone: (806) 763-5576 or (619) 276-5297.

20th Tactical Recon Squadron
The 20th Tactical Reconnaissance Squadron will hold its first reunion on August 31–September 4, 1986, in Louisville, Ky. **Contact:** Stanley A. Gawlik, 661 Woodland Dr., Tallmadge, Ohio 44278. Phone: (216) 633-5750.

32d Troop Carrier Squadron
A reunion will be held for members of the 32d Troop Carrier Squadron, 314th Troop Carrier Group, Ninth Air Force, on October 16–19, 1986, at the Crystal City Marriott Hotel in Arlington, Va. **Contact:** Harry Bonnes, 10000 Blackthorn Ct., Fairfax, Va. 22030. Phone: (703) 273-5088. Robert Shawn, 422 Sugarland Run Dr., Sterling, Va. 22170. Phone: (703) 430-6887.

33d Photo Recon Squadron Ass'n
The 33d Photo Reconnaissance Squadron will hold a reunion on October 6–8, 1986, in Cocoa Beach, Fla. **Contact:** Rev. Neal E. Lake, 640 Jacaranda St., Merritt Island, Fla. 32952. Phone: (305) 452-8785.

41st Bomb Group
The 41st Bomb Group, along with the 47th, 48th, 396th, and 820th Bomb Squadrons, Seventh Air Force, will hold a reunion on October 16–18, 1986, in Las Vegas, Nev. **Contact:** Gene Olsen, 2100 Meridian Park Blvd., Concord, Calif. 94520. Phone: (800) 227-2814 or (415) 825-8151.

Class 41-E
Members of Flying Class 41-E (Barksdale, Brooks, Kelly, Maxwell, Selma, and Stockton) will hold a reunion on October 3–5, 1986, in Fort Worth, Tex. **Contact:** Lt. Col. L. O. Berglund, USAF (Ret.), 1510 Tatum Dr., Arlington, Tex. 76012.

Class 42-H
The Kelly Field, Tex., Class of 42-H will hold a reunion on November 2–5, 1986, in New Braunsfel, Tex. **Contact:** Don H. Offerman, 653 Encino Dr., New Braunsfel, Tex. 78130.

Class 42-I
Members of Class 42-I will hold a reunion on September 18–20, 1986, in Colorado Springs, Colo. **Contact:** D. I. Holmes, 1219 N. Tejon St., Colorado Springs, Colo. 80903. Phone: (303) 473-4627.

46th Troop Carrier Squadron
The 46th Troop Carrier Squadron "Jungle Skippers" will hold a reunion on August 21–24, 1986, at the Hilton Inn North in Columbus, Ohio. **Contact:** Tom Soltis, 23332 Roger Dr., Euclid, Ohio 44123. Phone: (216) 732-9492.

49th Fighter Group Ass'n
The 49th Fighter Group will hold a reunion on October 2–5, 1986, in Niagara Falls, N. Y. **Contact:** Paul J. Brown, 47 S. Whispering Lane, Hamburg, N. Y. 10475. Phone: (716) 627-4331.

50th Troop Carrier Wing
Members of the Headquarters Squadron of the 50th Troop Carrier Wing will hold a reunion on September 4–6, 1986, at the Ramada Inn in Cincinnati, Ohio. **Contact:** Frank Ehrman, 840 Staton Place West Dr., Indianapolis, Ind. 45234. Phone: (317) 271-8568.

62d Troop Carrier Group
The 62d Troop Carrier Group will hold a reunion on October 30–November 1, 1986, at the Broadway Plaza Hotel in San Antonio, Tex. **Contact:** George H. Miller, 29460 N. Le Hace, Boerne, Tex. 78006.

68th Air Service Group
Members of the 68th Air Service Group will hold a reunion on October 9–12, 1986, in MacAllen, Tex. **Contact:** Bob Pierce, P. O. Box 15061, Denver, Colo. 80215. Phone: (303) 985-1933.

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68th Fighter Interceptor Squadron
Members of the 68th Fighter Interceptor Squadron will hold their reunion on October 24–26, 1986, at the Crockett Hotel in San Antonio, Tex. **Contact:** R. E. Rigney, Rte. 2, Box 31-J, Richmond, Tex. 77469.

91st Troop Carrier Squadron
The 91st Troop Carrier Squadron, 439th Troop Carrier Group, will hold a reunion on October 24–26, 1986, in Fort Worth, Tex. **Contact:** Milton Dank, 1022 Serpentine Lane, Wyncote, Pa. 19095.

92d Bomb Group
The 92d Bomb Group will hold a reunion on October 1–5, 1986, in Tampa, Fla. **Contact:** Sheldon W. Kirsner, 2603 Cathedral Dr., St. Louis, Mo. 63129.

93d Fighter Squadron
The 93d Fighter Squadron will hold a reunion on October 10–12, 1986, at the Holiday Inn in King of Prussia, Pa. **Contact:** John J. "Doc" Dougherty, 201 Bartram Lane, Ocean City, N. J. 08226. Phone: (609) 398-5375. Dayno W. Weaver, 462 Driscoll Dr., Bricktown, N. J. 08724. Phone: (201) 892-4228.

185th Tactical Fighter Group
Members of the 185th Tactical Fighter Group and the 174th Tactical Fighter Squadron will hold their reunion on September 19–21, 1986, at the Sioux City ANG facility. **Contact:** Maj. Larry Harrington, IowaANG, Sioux City Municipal Airport, P.O. Box 278A, Sgt. Bluff, Iowa 51054-1002. Phone: (712) 279-7500.

339th Fighter Squadron Ass'n
The 339th Fighter Squadron will hold a reunion on October 9–11, 1986, in Gulf Shores, Ala. **Contact:** Richard Cowles, 745 Harrison St., Belding, Mich. 48809.

342d Fighter Squadron
Members of the 342d Fighter Squadron will hold a reunion on October 2–5, 1986, in Fort Worth, Tex. **Contact:** Charles F. Whistler, 6400 Independence Pkwy., #3408, Plano, Tex. 75023. Phone: (214) 985-9052.

367th Fighter Group Ass'n
The 367th Fighter Group will hold its reunion on October 23–26, 1986, at the Key Bridge Marriott in Arlington, Va. **Contact:** Jack T. Curtis, 437 Cedar Dr., Beaver Shores, Rogers, Ark. 72756. Phone: (501) 925-1796.

375th Troop Carrier Group
Members of the 375th Troop Carrier Group will hold a reunion on October 3–5, 1986, at the Raintree Inn in Colorado Springs, Colo. **Contact:** William J. Maloney, 1440 Dorchester Rd., Havertown, Pa. 19083. Phone: (215) 449-2661.

376th AREFS Ass'n
Members of the 376th Air Refueling Squadron will hold a reunion on September 5–7, 1986, at Barksdale AFB, La. **Contact:** Lt. Col. Colvin L. Sammons, USAF (Ret.), 2309 Ashdown Dr., Bossier City, La. 71111. Phone: (318) 742-8552.

376th Heavy Bomb Group Ass'n
Veterans of the 376th Heavy Bomb Group "Liberandos" will hold their reunion on November 2–6, 1986, at the Holiday Inn in Las Vegas, Nev. **Contact:** 376th Heavy Bomb Group Association, 1522 Oak Knoll Dr., Cincinnati, Ohio 45224.

379th Bomb Group
The 379th Bomb Group will hold a reunion on October 15–18, 1986, at the Riverside Hilton Hotel in New Orleans, La. **Contact:** Bill Barrett, 170 Pinewood Dr., Slidell, La. 70458.

384th Bomb Group
The 384th Bomb Group will hold its reunion on November 6–9, 1986, in Kansas City, Mo. **Contact:** Fred Nowosad, P. O. Box 1021-A, Rahway, N. J. 07065.

386th Bomb Group
Members of the 386th Bomb Group will

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Send hotel reservation requests, in writing, for the Sheraton Washington to the Sheraton Washington Hotel, 2660 Woodley Road, N.W., Washington, D.C. 20008. Phone: (202) 328-2000. For the Normandy Inn, send to Normandy Inn, 2118 Wyoming Ave., N.W., Washington, D.C. 20008. Phone: (202) 483-1350.

Make your reservations as soon as possible. Both hotels have a cutoff date of August 14. To assure acceptance when making your reservation requests, please refer to the AFA National Convention. All reservation requests must be accompanied by one night's deposit or an American Express, Mastercard, or VISA number and expiration date. Deposits will be refunded only if cancellation notification is given at least forty-eight hours prior to arrival.

Convention activities include Opening Ceremonies, Business Sessions, luncheons honoring the Secretary of the Air Force and the Air Force Chief of Staff, the Aerospace Education Foundation Awards Luncheon, the Annual Reception, and a black-tie Reception and Dinner Dance salute to the Air Force's thirty-ninth anniversary.

AFA delegates: Watch your mail for additional information on this September 14-18 event.

Airline Reservations: Once again, arrangements have been made for Convention attendees to enjoy discount fares on United and Eastern Airlines. United's toll-free number is (800) 521-4041, Eastern's is (800) 468-7022, in Florida (800) 282-0241, AFA Account #EZ9AP69. When calling, please identify yourself with the AFA Account Number.

AFA's 1986 National Convention and Aerospace Development Briefings and Displays

INTERCOM

hold a reunion on October 22–25, 1986, at the Bay Harbor Inn in Tampa, Fla. **Contact:** E. R. O'Neill, Jr., 2450 Somerset, Apt. 201, Troy, Mich. 48084. Phone: (313) 649-1062.

388th Bomb Group
The 388th Bomb Group will hold a reunion during the week of October 19, 1986, at the Marriott Hotel on the Riverwalk in San Antonio, Tex. **Contact:** Edward J. Huntzinger, 1925 S. E. 37th St., Cape Coral, Fla. 33904. Phone: (813) 542-4807.

401st Bomb Group
Members of the 401st Bomb Group will hold their reunion on October 16–19, 1986, at the DeSoto Hilton Hotel in Savannah, Ga. **Contact:** Ralph W. Trout, P. O. Box 22044, Tampa, Fla. 33622.

420th Air Refueling Squadron
The 420th Air Refueling Squadron will hold its reunion on October 2–5, 1986, in San Antonio, Tex. **Contact:** Col. D. A. Curto, USAF (Ret.), 11211 Whispering Wind, San Antonio, Tex. 78230. Phone: (512) 492-9644.

450th Bomb Group
Members of the 450th Bomb Group and the 720th, 721st, 722d, and 723d Bomb Squadrons will hold their reunion on September 4–7, 1986, in Dayton, Ohio. **Contact:** Arnold or Eva Daniels, 228 Holly Rd., Sweet Home, Ore. 97386. Phone: (503) 367-4053.

461st/484th Bomb Groups Ass'n
The 461st and 484th Bomb Groups based in Italy during World War II will hold a reunion on November 13–16, 1986, at the Marriott Hotel in San Antonio, Tex. **Contact:** Bud Markel, 1122 Ysabel St., Redondo Beach, Calif. 90277. Phone: (213) 316-3330.

463d Bomb Group
The 463d Bomb Group and supporting squadrons will hold a reunion on November 12–15, 1986, in Tucson, Ariz. **Contact:** Rev. Eugene E. Parker, P. O. Box 127, Edwardsport, Ind. 47528. Phone: (812) 735-5679.

Where Is It?

Readers who normally turn first to this page to check out the new "There I Was . . ." will have to look (this month only) on pages 96 and 97, where they'll find (this month only) an expanded, two-page "There I Was . . ." as part of our Gathering of Eagles coverage.

—THE EDITORS

492d Bomb Group
The 492d Bomb Group will hold its reunion along with the 8th Air Force Historical Society on October 15–19, 1986, in Hollywood, Fla. **Contact:** Elmer W. Clarey, 2015 Victoria Ct., Los Altos, Calif. 94022. Phone: (415) 961-0231.

501st Tactical Control Group
Members of the 501st Tactical Control Group who served in Germany during the 1950s will hold a reunion on October 15–17, 1986, at the Hilton Plaza Hotel in Kansas City, Mo. **Contact:** Col. Warren "Doc" Ohrvall, USAF (Ret.), 10516 E. 35th Terrace, Independence, Mo. 64052. Phone: (816) 356-2577.

509th Bomb Wing
The 509th Bomb Wing will hold a reunion on October 9–12, 1986, in Omaha, Neb. **Contact:** John H. Vincent, 608 Martin Dr., Bellevue, Neb. 68005. Phone: (402) 291-3430.

610th ACWS
The 610th Aircraft Control and Warning Squadron will hold a reunion on October 23–26, 1986, at the Quality Inn in Orlando, Fla. **Contact:** Col. Kenneth Coleman, USAF (Ret.), 4434 Carolwood St., Orlando, Fla. 32806. Phone: (305) 857-0053.

801st/492d Bomb Groups
Members of the 801st and 492d Bomb Groups "Carpetbaggers" will hold their reunion on October 15–19, 1986, in Hollywood, Fla. **Contact:** Sebastian H. Corriere, 4939 N. 89th St., Milwaukee, Wis. 53225. Phone: (414) 464-8264.

1708th Ferrying Wing Ass'n
The 1708th Ferrying Wing will hold a reunion on October 2–5, 1986, at the Fort Magruder Inn in Williamsburg, Va. **Contact:** Maj. Ernest D. Davis, USAF (Ret.), 17881 S. W. 113th Ct., Miami, Fla. 33157.

2510th USAF Medical Det.
The 2510th USAF Medical Detachment (Brooks Field, Tex.) will hold a reunion on October 23–25, 1986, at the El Tropicana Hotel in San Antonio, Tex. **Contact:** Mack Brushwood, 2512 Fleetwood Dr., Columbia, Mo. 65202. Phone: (314) 474-7108.

Class 54-P
I would like to hear from members and instructors of Flight Class 54-P, both military and civilian, in order to plan a reunion.
Please contact the address below.
Brig. Gen. Jack L. Lively, USAFR
Box 9
Coffeyville, Kan. 67337
Phone: (316) 251-1069

442d Air Service Group
I would like to hear from anyone who served in Wormingford, UK, with the 442d Air Service Group. We are planning a reunion for members of this unit.
Please contact the address listed below.
Neil A. Webster
314 S. River Park Dr.
Guttenberg, Iowa 52052

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