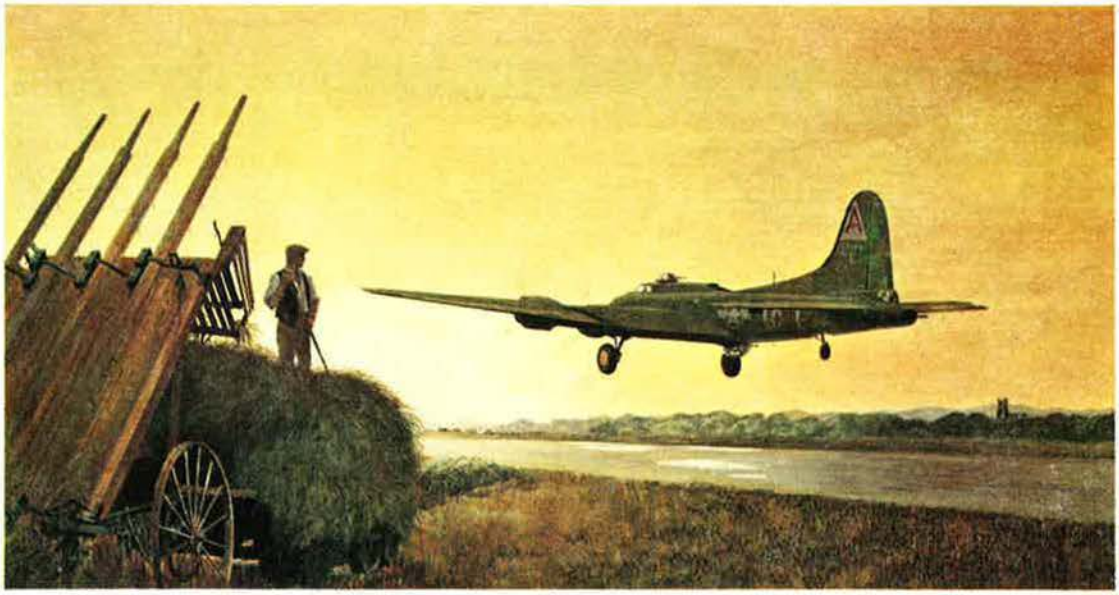
SEPTEMBER 1970 / $1.25

AIR FORCE

and SPACE DIGEST

The Magazine of Aerospace Power / *Published by the Air Force Association*



"Return from Mission,"
by Donald M. Hedin.
Courtesy, Air Force Art Collection.

USAF—The Momentous Quarter Century Since World War II

"Air Support—Vietnam '66,"
by George Akimoto.
Courtesy, Air Force Art Collection.

AWACS

Airborne Warning And Control System

The drawing above shows an eight-engine version of a Boeing 707-320 Intercontinental as it will look carrying the U.S. Air Force's Airborne Warning and Control System.

The large radome atop the fuselage will house surveillance radar antenna capable of detecting low-flying aircraft.

Boeing, under its Air Force contract, will provide two testbed 707s for intensive flight-testing of competitive AWACS radars.

Described as the nation's first priority need for air defense, AWACS would involve a fleet of flying command posts equipped with radar, communications, computers and displays.

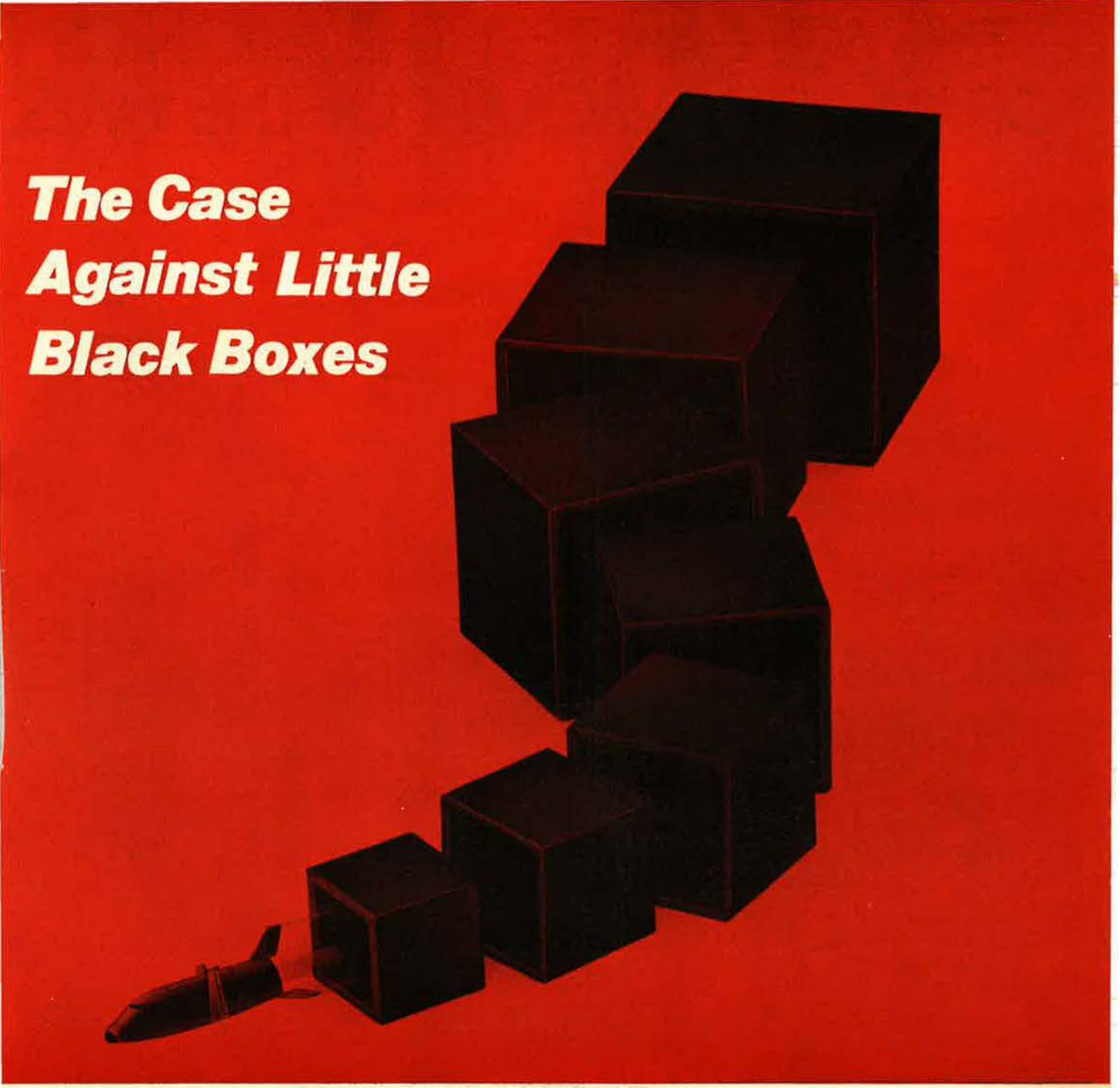
As an airborne tactical command post, the aircraft would provide minute-by-minute control of air-to-air and air-to-ground battles. As an airborne warning and control system the aircraft would detect, and direct the interception of, low and high flying missile-armed enemy bombers.

The proposed AWACS fleet would replace existing ground-based radars and older aircraft, resulting in substantial defense savings.

Prime Air Force AWACS responsibility is held by the Electronics Systems Division of the Air Force Systems Command.

BOEING

The Case Against Little Black Boxes



or one thing, there are too many of them. All over the irplane. And more are being added all the time as new vionic subsystems are developed or old ones nproved. All are doing vital jobs, of course. But the ogistics problems alone are staggering. Not to mention ne growing problem of interference during operation.

It's time to take a new look at the overall problem. ime to find ways of combining many functions into a ingle box; to look at techniques for integrating ommunications, navigation, and identification nctions for military and civil aircraft.

These ways must also insure greater cost effectiveness and higher reliability. And no one is more qualified for all of these tasks than TRW.

At TRW, we have a broad background in communications and navigation equipment, in data processing, and in LSI technology. We understand the need for integrating these equipments and technologies. And it's being done...in our activities from Space Shuttle avionics integration to our advanced design and development work for user equipment and related terminals for NavSat and CNI application.

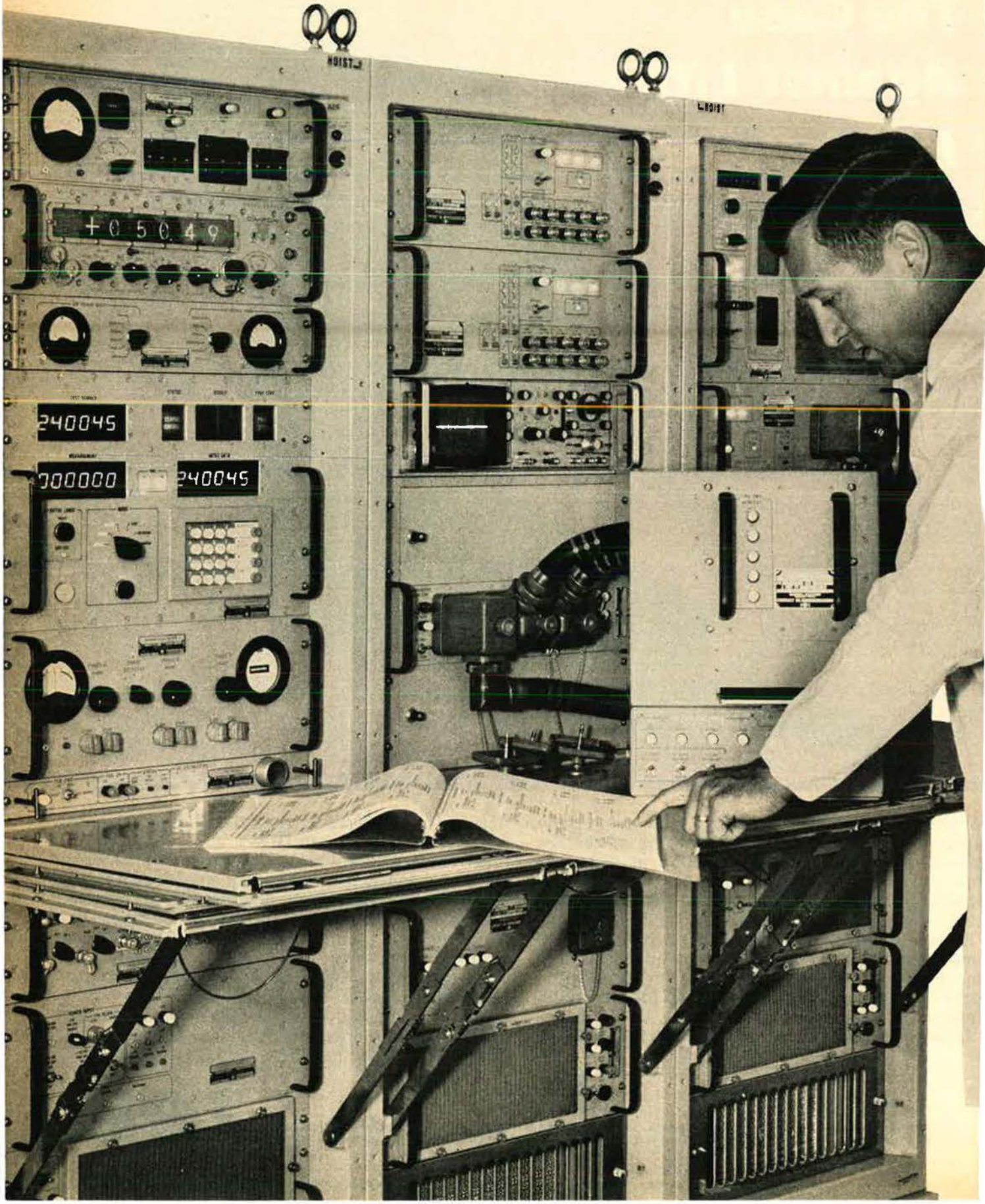
For more information about TRW's avionic capabilities, contact Marketing Services, TRW Systems Group, One Space Park, Redondo Beach, Ca. 90278.

TRW®

The Systems Group is a major operating unit of TRW Inc., where more than 85,000 people at over 300 locations around the world are applying advanced technology to products, systems and services for commercial, industrial and government markets.

TRW solutions to the "case of the little black boxes" will be highlighted at the AFA Convention and Aerospace Briefings & Displays. Plan to visit with our avionic specialists in Booth #232 on September 22-24.

THIS AGE CAN TEST THE AVIONICS OF ALL NEW AIRCRAFT OF THE 1970'S.



Historically, a new Aerospace Ground Equipment system has been designed for each new aircraft. This has led to recurrent problems. Less than optimum standardization, repetitive research and development costs, variable quality and reliability, and often a lag between delivery of aircraft and the system to support them.

What's needed is AGE that will support not just one aircraft but a whole generation. A system that will be on line when the aircraft goes operational. General Dynamics has designed and developed an AGE concept that meets these requirements.

First completely integrated system.

Our Electronics division, in support of the Fort Worth division, developed and delivered concurrently with the F-111, the first totally coordinated AGE system. It was available when the avionics were delivered.

The system is made up of integrated test stations. They use a highly flexible building block configuration that can readily be adapted for use with all advanced operational aircraft planned through the late 70's.

This AGE system, on line with the F-111, could be adapted to the new F-15, meeting 70% of its avionics AGE requirements with little or no change; another 15% with minor modification; and only 15% with new development. The system is also applicable to the AWACS and B-1, as well as other Air Force programs; and the Navy's F-14 and S-3A programs.

Automatic and manual testing.

The test stations are a combination of automatic and manual units offering the advantage of selective automation.

The multiple input design of this system virtually eliminates the possibility of an AGE shutdown when trouble is encountered at an input position, and allows simultaneous testing of several avionics equipments.

One AGE for all avionics systems.

The capability of General Dynamics' integrated AGE system ranges over the full spectrum of analog and digital avionics found in multi-mission aircraft, including flight control systems, mission and traffic control subsystems and penetration aids.

The AGE subsystems are configured to serve the full range of flight line, field and depot level requirements.

The adaptability and flexibility of this AGE concept also makes it feasible for application as an integrated shipboard test center for the Navy, or as an advanced electronics depot testing center in support of ground forces.

The universal AGE concept is just one example of how General Dynamics puts technology to work solving problems from the bottom of the sea to outer space... and a good bit in between.

GENERAL DYNAMICS

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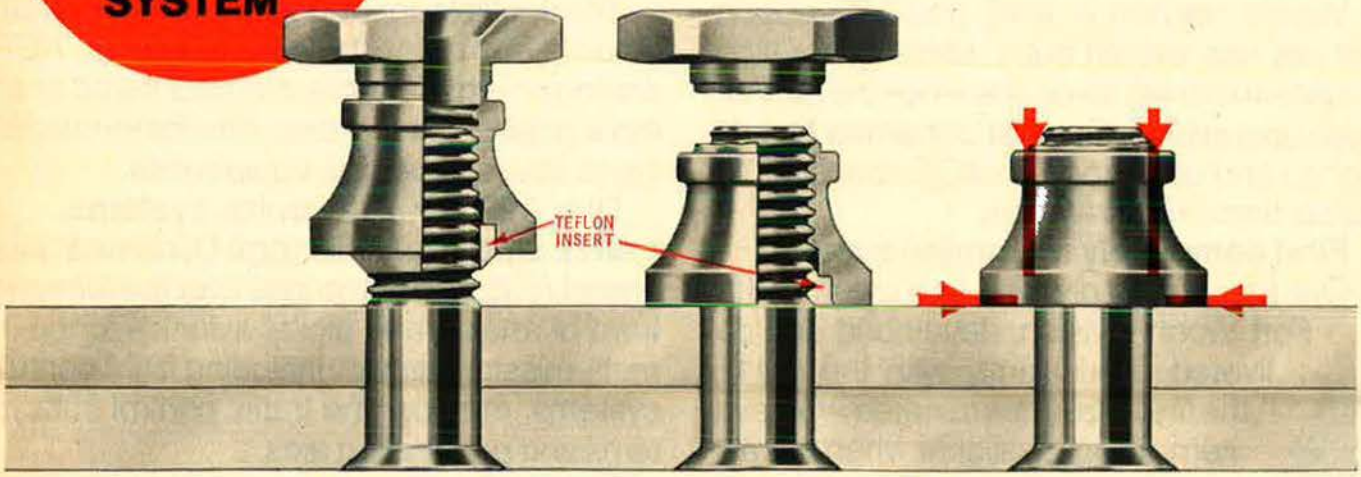
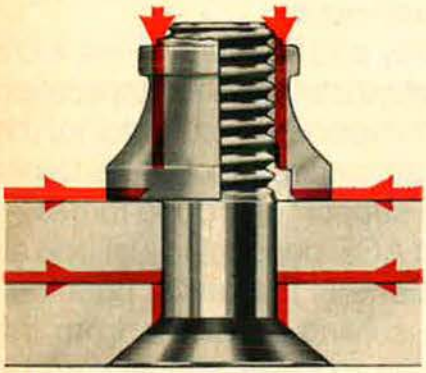
hi-Lok®
FASTENING SYSTEM

Stop fuel leaks with new Hi-Lok® sealing collars and pins

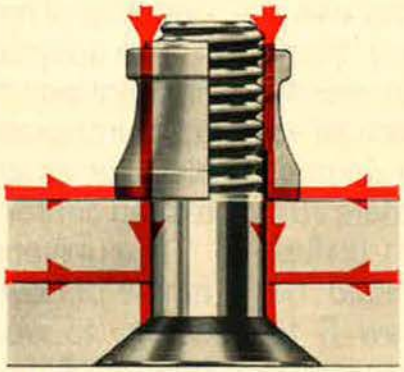


New Hi-Lok sealing collar being installed on standard Hi-Lok pin or threaded structural pin.

A Sealing collar on standard pin stops leaks from collar end (or head end of pin).



B Hi-Lok sealing pin combined with Hi-Lok sealing collar provides maximum control of leaks from any direction.



C Hi-Lok sealing pin used with Hi-Lok standard collar stops leak from head end of pin.

By using the new Hi-Lok Sealing Collar, a simple fix can be accomplished for fuel leaks through threaded fasteners in wing spars, beams and panels on in-service airliners and military aircraft. The new collar provides positive sealing in addition to controlled preload.

More than 10,000 leak-free flying hours have been accumulated on two heavy cargo military aircraft, known "leakers," since being field-fixed with Hi-Lok Sealing Collars. These sealing collars also are used in the integral tank structure areas of the Boeing 747, the world's largest and newest commercial airliner.

The Hi-Lok Sealing Collar for field-fixes eliminates need for sealing caps and for caulking with sealant compound.

The Hi-Lok Sealing Collar incorporates a Teflon insert fitted into the internal counterbore of the collar. During collar installation, in any pin grip condition, the insert cold-flows in the counterbore to tightly seal the area of thread runout and shank of the fastener. The sealing collar can be positioned inside or outside the tank area.

Hi-Lok fasteners also can be sealed from the head end of the pin. An undercut, made at the base of the flush head, is fitted with an approved O-ring. When sealing is critical, the Hi-Lok system additionally permits the new sealing collar to be used in combination with the O-ring sealing pin.

The Hi-Torque bolt, another Hi-Shear fastener development, also is available with an O-ring for use as a removable fastener in inspection doors or close-out panels.

Hi-Lok Sealing Collars are developed in materials including titanium alloy, Type 303 stainless, A-286 alloy and in aluminum alloy.

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AIR FORCE and SPACE DIGEST

The Magazine of Aerospace Power
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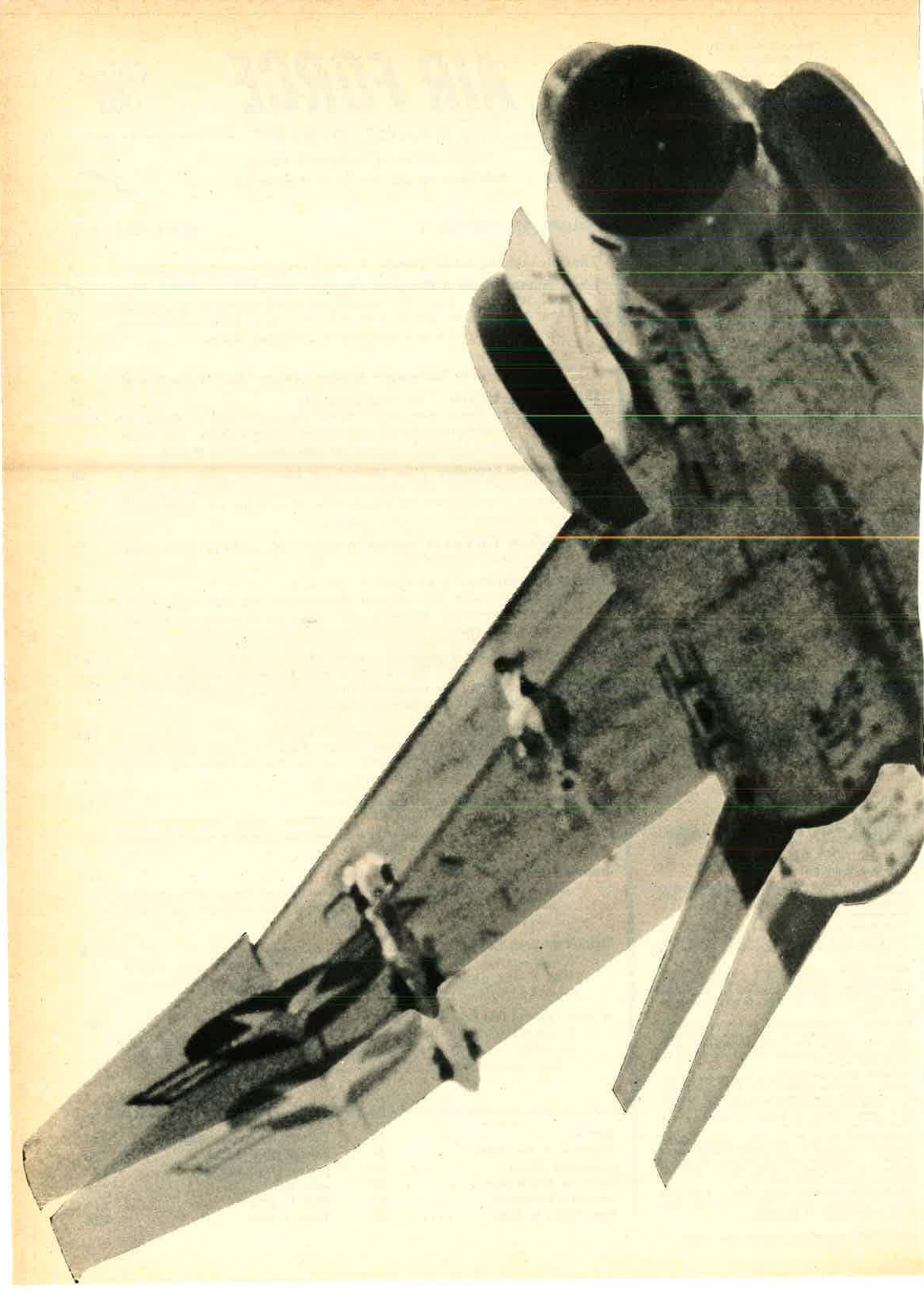

Westinghouse delivers airborne radar systems on time—within predicted costs. We've had a perfect record for the past three years, delivering as many as 84 systems a month. Note: they're on every F-4 fighter. The complete management team that achieved these results is still with Westinghouse, ready for more.

You can be sure...if it's Westinghouse

AN EDITORIAL

The Only Certainty Is Uncertainty

BY JOHN F. LOOSBROCK

Editor, AIR FORCE Magazine

ON HIS eightieth birthday, Maurice Chevalier is supposed to have been asked how it felt to reach that advanced milestone.

"Not bad," was the quick reply, "especially when I consider the alternative."

We have a good many years to go before reaching eighty but not quite as many, alas, as have passed since we were twenty years of age.

We have been led to these chronological thoughts, of course, through our pondering of the twenty-five years that have passed since the end of World War II, the years that are examined in some detail in this special issue of AIR FORCE Magazine. What really shook us was the realization that a youngster born on V-J Day could very well be a captain today.

All this is not to indicate any deep worry about approaching senility on our part. It is rather the result of suddenly realizing that the past quarter of a century has been a truly momentous one, with the pace of change accelerating at a rate that one neither noticed nor assessed at the time events actually were occurring. Take technology alone. The revolution began with nuclear fission, which ended the war. Then in rapid succession came the transition from a piston-powered Air Force to jet propulsion, air-to-air refueling on a mass scale, supersonic flight as a part of daily operational routine, intercontinental ballistic missiles and space exploration—all these along with incredibly giant leaps in electronics, communications, computerization, materials, fabrication, and all of the technological underpinning that transforms the minor miracles of yesterday into tomorrow's standard operating procedures.

The lesson is, of course, that we cannot predict with confidence where new technology will take us. We can be sure only that it will be further, in different directions, and at a wildly faster pace than we ever could conceive at any given point in time. And in recognizing this truth, we cannot forget that technology is apolitical. It follows no flags; it owes no ideological allegiances. It cares not which master it serves, nor whether it be bent toward good or toward evil ends. It will work for anyone who has the wit, the will, and the resources to employ it.

Even less susceptible to forecasting are the operational exigencies of the years ahead. In looking back, as we are, over twenty-five years, we observe with some trepidation that the big plays were never in the game plan. The Berlin Airlift was an improvisation—although admittedly a masterly one. The Korean War was another "play-it-by-ear" affair. And Vietnam—well, it was no sudden shock but a slow and unforeseen enwebment. And, while it is all well and good to blame the politicians for bad decisions, or to credit the Communists with superior cunning and dedication, the fact remains that thinking about the unthinkable is a *sine qua non* for the future because it very often is the unthinkable that happens. The only certainty is uncertainty or, to quote the famous Murphy's Law, "Anything that can go wrong, will."

Where, then, can one look for a constant in the equation? Perhaps it is man himself, the human element. But is this really true? With due respect to all of us relics of World War II vintage, a strong case can be made that today's crop of Americans generally is of higher quality than that of our generation. Certainly they are better educated, or at least more educated. They are harder working intellectually and, if not physically, it is because our generation has reduced the requirement. They are more dedicated, although not always to the kinds of causes we would like them to follow. They may be less obedient, less susceptible to discipline, but at the same time are more inquisitive, more demanding of new and better reasons for obedience and discipline. These attitudes may pose new problems for those charged with weaving this new breed into a military framework, but we should remember that in both World Wars the independent nature of the American soldier was put forth as a great military benefit, and there is no reason this cannot continue to be true.

Fortunately, the intellectual capabilities of the professional Air Force officer corps have progressed along with the accumulation of new challenges and more complicated requirements. Once again, no derogation of past leadership is implied or intended. It was more than sufficient for its time. But the new crop of leaders, with its higher educational levels and great reservoir of operational experience, should be able to close any generation gap that presently may exist.

We older types, therefore, have no reason to be up tight about the future of our Air Force. In 1799 a philosopher named G. C. Lichtenberg wrote:

"How do we spend our old age? In defending opinions, not because we believe them to be true, but simply because we once said they were."

We must resolve never to let this be said about us.—END

COST-CONSCIOUS TECHNOLOGY AT NORTHROP

This underwater vehicle designed by Northrop for the U.S. Navy to simulate a full-sized submarine will permit significant savings in anti-submarine warfare training.

Northrop saved more than 2,000 critical pounds in designing the 153-foot fuselage for the magnificent 747 airliner.

The most modern target in service for low-level surface-to-air missile training, the MQM-74A has the lowest cost per mission in its performance class.

Northrop is a major designer and builder of navigation and guidance systems for long-range subsonic and supersonic aircraft. The heart of one such system is this unique spherical platform.

More than 14,000 USAF pilots have graduated in the T-38 Talon, world's first supersonic trainer. Since 1961, more than 1,100 of the Northrop jets have logged over 2½ million hours in Air Force, Navy, NASA and German Air Force service.

Iran's new nationwide communications system will double the number of phones, provide a national TV network and expand telegraph and data transmission facilities. A Northrop-led consortium of multi-national companies is building the 8,700-mile system.

Northrop is one of the nation's biggest producers of special purpose, light-weight, low-cost digital computers for airborne electronics and navigation systems.

The Northrop F-5, in service with 15 nations, is designed to provide the needed performance level while taking into account purchase, maintenance and operation costs.

The Bell TwinHuey

Air Force like a blue shirt.

11 big reasons:

1. The UH-1N TwinHuey is a multi-mission ship for a multi-mission service. 220-cubic-foot interior. Holds 14 troops or six litters. Plug-in mission modules include guns, hoist, loud speakers, you could even have internal fire suppression tanks.

2. Full 13-foot clearance with rotors turning. Plenty of head room for med evac, rescue, troop deplaning, fire-fighting, SOF activities.

3. Twin-engine versatility. Back-up power means more dependability. Which means more usability: At night. In bad weather. Over water, boondocks, and metro areas.

4. Doors on both sides. Extra-wide, sliding doors. They don't blow closed. They don't get in the way of loading and off-loading.

5. Dual instrumentation. Good engine and flight instrument visibility from either crew seat.

6. For communications: The SLAE system — the most advanced light weight solid state system developed.

7. World-wide spare parts inventory with inter-Service support agreement between U.S. Army, U.S. Air Force, Navy, Marine Corps. Typical low Huey maintenance requirements.

8. Excellent single pilot control. No stability problems, consequently pilots love to fly it. No Chinese fire drill if you lose an engine. The other one compensates automatically. The correction's so smooth, you don't feel it or hear it.

9. Twin turbine powerplant. Two Pratt & Whitneys linked in a power-sharing gear box. Single-engine performance: better than excellent. Power reserve: 500 to 750 more horsepower than you need for ordinary operations.

10. Famous Huey dependability. Airframe proved by more than 10 million flight hours. Engines by 3½ million hours.

11. Value through versatility. The UH-1N's multi-mission capability makes it the most usable helicopter in the air. That's why it's to see multi-Service use.

fits the

The UH-1N TwinHuey is scheduled to be as standard as a blue shirt in six different Air Force commands: (TAC, MAC, USAFE, HQCOMD, PACAF, USAFSO).

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Defense Comparison

Gentlemen: The report by Edgar E. Ulsamer on his interview with Dr. John S. Foster, Jr., DoD's Director of Defense Research and Engineering, in July's AIR FORCE/SPACE DIGEST ["Technological Superiority—Key to US Security and Survival"], was excellent information for the public in general.

I hope, sincerely, that it is reprinted in one of the more widely distributed publications so that US citizens on a broader front may be exposed to and benefit from this significant status report on the defense preparedness of the United States as compared to that of the Soviet Union.

LT. COL. J. T. GILMORE, USAF (RET.)
Denver, Colo.

Cause for Alarm

Gentlemen: I was very impressed with the article in your July issue, "Air Defense—The Forgotten Front," written by John L. Frisbee. The Aerospace Defense Command is fighting hard to keep up with the ever-increasing Soviet threat, and [his] foresight in writing about our declining air defenses must be brought to the attention of the public.

I would like permission to reprint the article to be used as a valuable addition to our public information effort.

LT. COL. A. F. MCCONNELL, JR.
Deputy Director
Directorate of Information
Hq. ADC
Ent AFB, Colo.

Excursion/Incursion

Gentlemen: [Claude Witze's "Airpower in the News" item] in your July edition, entitled "The Wayward Press (cont.)" was a breath of fresh air in setting the record straight on the press omissions and misleading statements in regard to Cambodia.

I was delighted to see you refer to this campaign as "The American excursion into Cambodia." I get sick and tired of the numerous references on radio, TV, press, and in news weeklies which have inundated the American public with the derogatory and completely misleading term "incursion" when referring to this event. My copy of Webster's tells me that excursion means "a short trip taken with the intention of returning to the point of departure" and "a military sortie or raid." Incursion, on the other hand, is "an unfriendly entry; invasion; raid" and hence the implication that the US and South Vietnam are unwelcome invaders.

I would certainly like to see you expand editorially on this rank injustice to our fighting men.

MAJ. RODMAN W. BARNES, USAF (RET.)
Bellevue, Neb.

The Dassault Way

Gentlemen: "The Designers of Dassault—Men Who Take One Step at a Time" [August '70 issue] is a first-class job of reporting by Edgar Ulsamer. Having known the company and watched its development since 1950, I can vouch for most of what he says from firsthand experience. More recently, a five-year close association with the Falcon program has given me even more insight into the Dassault approach, and has made me even more of an admirer of the company and its way of doing business.

Sure, they're not perfect. Their first reaction to pilot criticism of the Mystère 20 prototype was one of shock, and an attitude of "take it or leave it." But they are smart, and cooler heads prevailed in short order, and the engineers came back to the meeting with notebooks. What came out of several such sessions was a Falcon tailored to requirements which more realistically represented those of American business fleets, and what followed was a highly successful program.

There are all kinds of legends about M. Dassault, as I am sure Ulsamer found out. They tell the story in the prototype shop of the time that Dassault came in and ran his fingers along the leading edge of a fighter wing. He found a couple of rough spots. He called the lead man over and asked if his team had done that kind of work. Yes, they had. "You," said M. Dassault, "are fired—now." A few minutes later, Dassault told one of his aides to keep the guy on the payroll, but to see to it that he didn't work on wings again anywhere.

There are also stories about Dassault viewing a mockup of a completed airplane in a darkened room, by the light of strong portable units placed to create long highlights on the surfaces of the aircraft. He looked for smooth contours, and this was one way to get an eyeball check. It is said that whole fuselages have been redesigned because of this.

My early contacts with the engineering and design teams was a reminder of my first jobs at Grumman. The first project team I worked on totaled nine guys, and we were responsible for the development of the J2F-5, the last of the biplane amphibians for the Navy. We got it designed, and 144 built, with a tiny team with high morale and hard work, and the word from the top to get them the hell out of the assembly hall so that the TBF line could start.

Then I worked on the TBF-1, and we had three guys . . . to productionize the outer wing panels for high-rate production. I think there were two guys on the center section, and another two or three on the fuselage. Maybe two or three handled the problems of equipment, two on electrical and radio and one or two on hydraulics. Probably there were five on powerplant and other assorted problems, and, what with aerodynamicists and structures guys on part-time assignment, the whole group may have been as many as forty or fifty engineers. And we built an awful lot of TBFs, and it did a lot for the Navy.

I worked on some proposals at Grumman, also, and can understand the reasons why Dassault can do it their way and why no US company now can. The Grumman proposals used to go out in a paper folder with a gummed label on the front, and there were maybe a dozen pages inside describing the airplane and roughing out its performance. I imagine Dassault does the same thing.

But can you imagine anybody doing the equivalent for the F-15 proposal? Remember the picture of the wall of cartons that contained the Fairchild Hiller proposal on that airplane? Now you have to have a cubic acre of proposal paperwork, and a full corporate vice president in charge of the program, or the Air Force won't even talk to you.

If you want to do it Dassault's way, then the USAF is going to have to do it the French Air Force way, and I don't think there's a chance in hell that will ever happen. Otherwise there

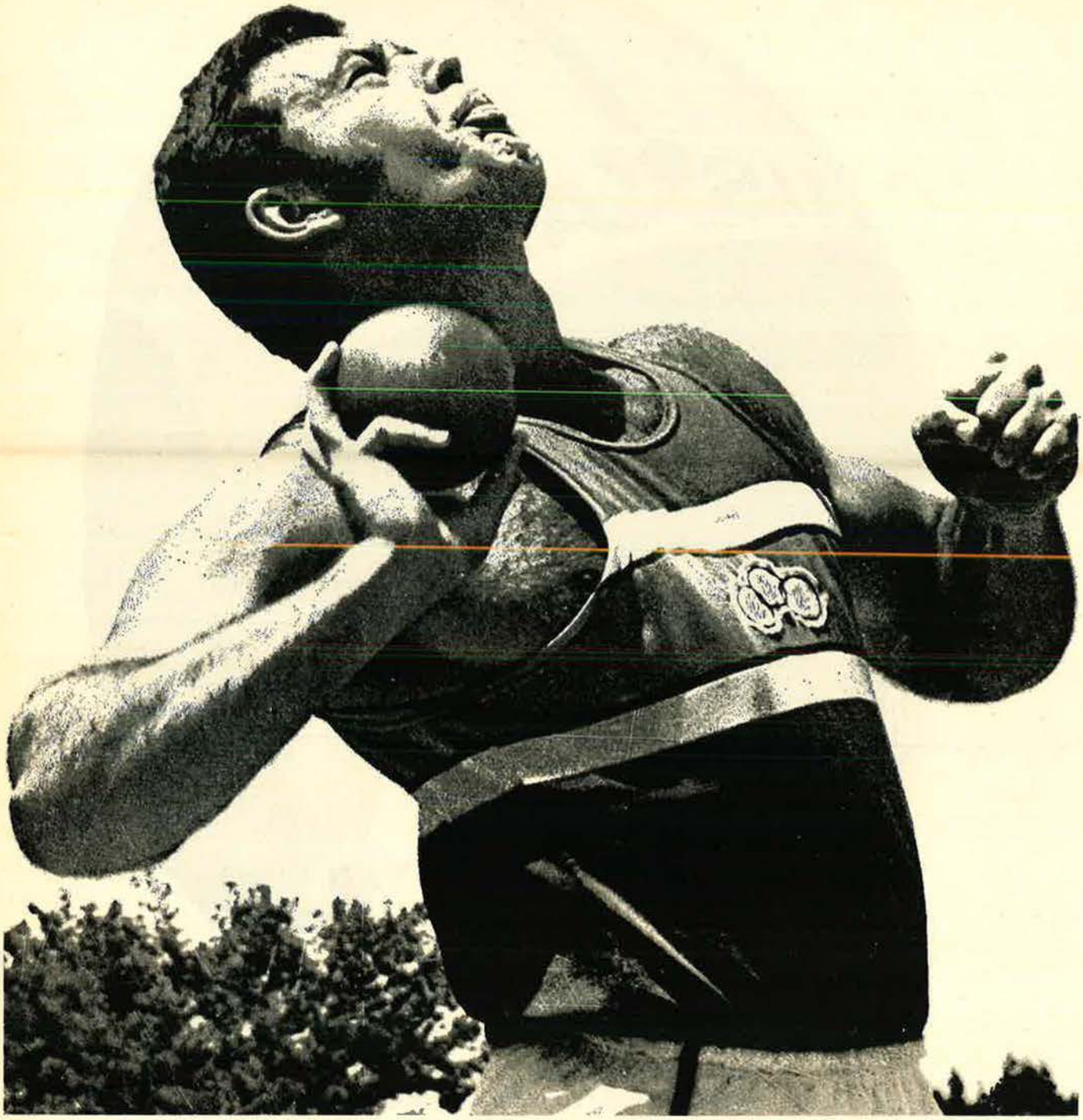
(*Continued on page 15*)

We wear well together

Having worked with you for your first 23 years, we feel like a part of the Air Force family. We're proud of the relationship—and send our best wishes for this happy birthday and all of those in your future.

SPERRY
FLIGHT SYSTEMS DIVISION
PHOENIX, ARIZONA 85002

SPERRY RAND



champions don't just happen

Neither do the leaders in industry. Especially ours. And the fact is that we started out as number one when this business got off the ground in 1942.

We've continued to increase our lead ever since . . . By doing this job faster, better, more economically than the competition. Isn't this what you expect from Champions?

aerojet solid propulsion company

FIRST IN SOLID ROCKETRY, IN ALL WAYS

will be a slew of unemployed bird colonels, B/Gs, etc., drifting around the halls of the puzzle palace on the Potomac looking for old proposals to read.

Forgive the lengthy letter; I get carried away when I see people wondering why a job can't be done simply.

DAVID A. ANDERTON
Technical Consultant/Aerospace
Ridgewood, N.J.

Canberra's Role

Gentlemen: Reference is made to the item on page 26, July issue ["Aerospace World"], concerning improvements to the B-57 Canberra and its supposed new role. The detection and attack of targets at night and at low altitude was the precise role that the Canberra was selected for in the first place.

As chief of AFRDQ-TA, Hq. USAF, in the early 1950s, I wrote the requirements for what we designated as a "night intruder." The first effort was for an "interim, off-the-shelf" aircraft that could immediately replace the aging B-26 being used for this mission in Korea. I was also a member of the investigating group that tested the Canberra, XB-51, B-45, AJ-1, and CF-100 for this role and recommended the Canberra to a senior officer's board for adoption. At that time, it was realized that the most serious deficiency to this mission was the lack of poor-weather, night-sensor, and weapon-release systems. However, it was felt that the Canberra had sufficient size and space to accommodate these systems when available at a later date. As it now turns out, much later.

The fact that the B-57 has frequently been termed the most successful air-ground attack aircraft in terms of ordnance load, unrefueled range, loiter-time ability, and low attrition rate in the Vietnam War attests to the wisdom of the senior officer's board decision nearly twenty years ago.

COL. FRANK ALLEN, USAF (RET.)
Colorado Springs, Colo.

Time for Constructive Action

Gentlemen: I read with interest the article "Urban Crisis at the Air Force Academy," by William Leavitt, in the June issue. I submit that the conferees' concern for the nation's ills and their solutions to them ultimately reduce to a dire need for responsibility at all levels of society and government. Responsibility means accountability for one's actions. Unfortunately, in this "liberated" age, responsibility for one's actions seems to be an old-fashioned and unpopular concept and practice, particularly with the vocal radical minority.

While I do not agree with some of the solutions advocated by the conferees, I believe they have taken the first step in responsible action, that is to identify the problem and resolve to remedy it within the present system.

However, the next step is the crucial one, and infinitely more difficult. This will be to maintain this responsible attitude and resolve despite the morass of apathy and irresponsibility that currently permeates our country. This will take all the initiative, determination, and zeal that these young people, and all Americans, can muster.

Time is late. But too much time already has been spent criticizing the country and pointing out its shortfalls. It is far easier to criticize and identify problems than to constructively solve them. What is needed now is responsible action at all levels of society and government to correct the defects that we have been identifying for so long.

CAPT. THOMAS E. LEE
Vienna, Va.

Service Separation

Gentlemen: A reduction in world tensions, combined with reduced American involvement in Southeast Asia, in Europe, and in Korea, brings an inevitable reduction in military strength. Personnel readjustment policies should be a major consideration when new force levels are imposed. A variety of policies, some presently within the power of the Defense Department, others needing congressional approval, should be considered now by the Air Force for DoD and congressional action. Forced retirement by those who anticipated a longer career deserves mention; however, present transition programs ease the impact upon this group, and retirement pay and fringe benefits relieve much financial burden.

The qualified enlisted man who is separated or denied reenlistment should receive separation pay on the same basis as an officer. Unfortunately, there is no way for these men to complete twenty active years for retirement. The forcibly separated officer receives separation pay, but the closer he is to the twenty active-year mark, the more difficult the financial problem. Should he enlist, a solution

(*Continued on page 17*)

How do you put a hot aircraft bang on target?

High-performance tactical aircraft require compact, precise weapons delivery systems—such as Automatic LORAN.

Automatic LORAN C/D makes the task easier for pilots of high-performance tactical aircraft. This computerized navigation system keeps track of aircraft course and position despite abrupt changes in attitude, altitude and speed. And leads the aircraft right to target, at tactical air speeds.

The system has been demonstrating its operational value since ITT Avionics developed it in 1968, drawing on our 25 years of LORAN experience. Over 200 sets are in operational use today. And we know the total LORAN system like nobody else. Over half of all LORAN C ground stations in operation around the world were produced by us.

Currently we're proving out major innovations to make our automatic LORAN C/D even more accurate, more compatible with other navigational aids, more adaptable to changing USAF tactical needs.

And, we're bringing to next-generation system development the realistic know-how that got automatic LORAN off the ground in the first place.

ITT Avionics Division, a member of the Defense-Space Group, International Telephone and Telegraph Corporation, Nutley, New Jersey 07110.

AVIONICS DIVISION ITT

might be forgiveness of a portion of his separation pay, three-quarters of which is now required to be repaid before he receives retired pay.

For example, if $200 a month is "forgiven," the officer who enlists for a little over six years repays nothing (seventy-five months multiplied by $200 equals almost $15,000, maximum separation pay), while the officer who needs only about twenty-four months to complete twenty years is forgiven $4,800.

To minimize the number of forced separations, the forgiveness of active-duty commitments required by government-sponsored schooling, promotions, etc., would allow those desiring separation or retirement to do so sooner than programmed. The discontinuance of flight pay for those who are paid for "not flying" would lead many affected officers to retire; should they continue, money would be saved regardless. Demotion in lieu of separation would allow retention of experienced men, often less costly than recruiting and training a man who will separate after a minimum tour. One admitted difficulty is in determining who will remain after a first hitch or commitment. Regardless, many well-qualified officers and airmen would rather continue with reduced rank than be separated short of retirement.

These short-term remedies would assist those facing separation in the near future, but many long-range problems need consideration. The often-discussed classification of all active-duty officers as "regulars" should be implemented. Promotions and eliminations can then be based on quality control of the entire officer strength. One interim policy, awaiting the above, is the use of promotion boards as regular officer selection boards, with the most qualified Reservists promoted being offered regular commissions. Conversely, the regular officer who is "passed over" would revert to career Reserve status. The regular and Reserve officer corps would both have a stimulus to maintain personal performance.

A yearly board can then decide what regular officers would remain past twenty years' service, similar to the enlisted selection-in process.

The Air Force has no obligation to retain any officer or airman until twenty-year retirement or beyond, yet it seems inequitable to use criteria of past years for personnel reduction that will come in the next few years, especially when outstanding individuals are considered. Prudent use of present regulations and prompt legislative action can prevent these inequities. Dedicated people have kept our nation strong, and these people deserve consideration.

MAJ. RICHARD I. BRUBAKER
Det. 111 AFROTC (AU)
Trinity College
Hartford, Conn.

"Night Mission"

Gentlemen: This month's [August] "Night Mission on the Ho Chi Minh Trail" is without a doubt one of the most beautiful and sensuous personal statements about flying I have ever read. If Major Berent must ever give it up, let us hope that he chooses writing as a second career. An absolutely haunting article!

E. SCOTT CHRONISTER
Chicago, Ill.

Fighter Units Book

Gentlemen: I am under contract to a major publisher to do a book on the fighter units of the Fifth and Thirteenth Air Forces during World War II. I would very much like to hear from anyone who might be able to make available to me photos, unit histories, mission reports, encounter reports, etc. Any material loaned will receive the best of care and be returned as quickly as possible.

WILLIAM N. HESS
9322 Overlook Dr.
Shreveport, La. 71108

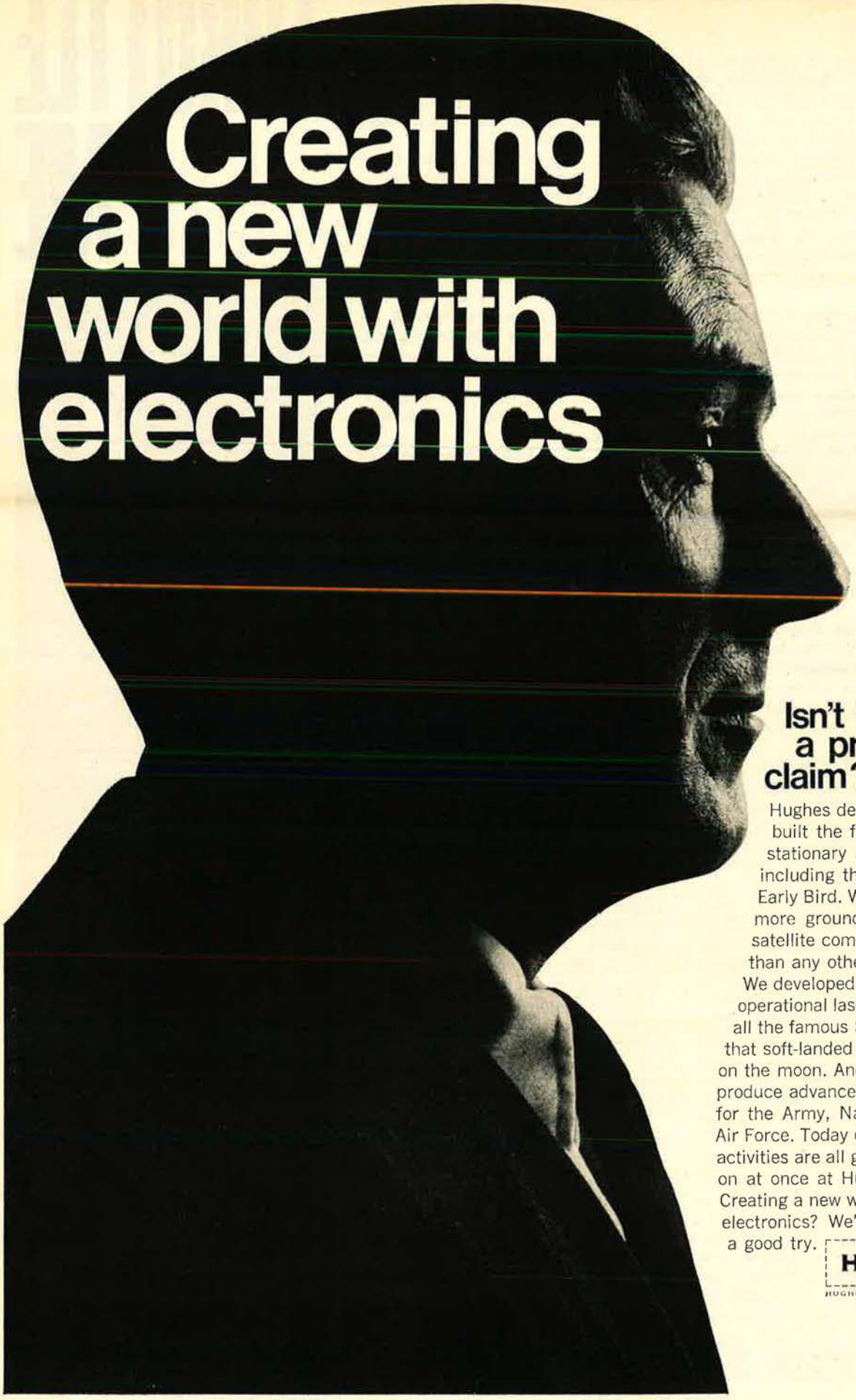
Other Side Heard From

Gentlemen: I have followed with interest several letters appearing in "Airmail" on technical managers, the plight of young men possessing graduate degrees in scientific and engineering fields, and their dastardly treatment by the tired old "military minds" who are given the privilege of supervising them while their talents languish in the service of their country.

Since I have had this supervisory privilege for many years, I feel compelled to try to even up the score a little.

In my experience, Air Force policy has been weighted heavily in favor of scientific and engineering officers, frequently offering them long, stabilized tours, more interesting jobs, and, in general, several privileges not accorded to their fellows. Had the disgruntled few paid more attention to the real world, they might realize that advanced academic degrees are merely a requirement for certain jobs, not a passport to the easy life. The most vociferous junior scientists are fre-

(*Continued on page 19*)



Isn't that a pretty big claim?

Hughes designed and built the first successful stationary satellites, including the Syncoms and Early Bird. We've put up more ground stations for satellite communications than any other company. We developed the first operational laser. We built all the famous Surveyors that soft-landed successfully on the moon. And we produce advanced missiles for the Army, Navy and Air Force. Today over 550 activities are all going on at once at Hughes. Creating a new world with electronics? We're making a good try.

HUGHES
HUGHES AIRCRAFT COMPANY

quently those who have spent much of their time, during duty hours, working to complete their thesis or dissertation, concentrating on their pet projects while the job "goes hang," and in general asserting an intellectual arrogance which they do not merit.

Supervisors, even those who also hold advanced degrees, learn with age that there is no escape from such sordid "trivia" as where does the money come from?—what is it worth to the taxpayer?—and how will I fill those critical personnel assignments?

Fortunately, the vast majority of scientific and engineering officers are more modest and appreciate what special considerations they do get. Those that ultimately leave service often have obtained valuable practical experience in their field, are then a more valuable addition to the civilian community, and frequently take positions in companies who discovered their value only by virtue of their business relationships while still in the Air Force.

It is also interesting to note that, when employers query me about these young men, their first questions relate to the prospect's abilities to deal with people, common sense, work habits, and management potential. The privileges of doing research and attending scientific conferences are, in fact, rewards for demonstrated special talent and demonstrated capacity to do productive work. In the military we still try our best to provide justifiable consideration to *all* men who show promise and ability. We have a tough time with those who demand constant coddling in return for promises or old report cards.

The "military mind" is a mossy fiction. I'd pit Socrates (a professional soldier) against H. G. Wells any day.

COL. ARNOLD J. CELICK
Sacramento, Calif.

Poetry Project

Gentlemen: A project to gather poetry about the war in Southeast Asia, written by men and women of the armed forces, is under way at the English Department of the Air Force Academy. Project officers there are requesting manuscripts from anyone who has written poetry on any aspect of the war, particularly day-to-day life, individual reactions and emotions, the war from differing perspectives, the attitudes of Americans in a strange land, the feelings of families and friends at home, and descriptions of the countries and peoples of Southeast Asia.

Poems submitted for this project will also be considered for publication in the "Poet's Corner" of *Air Force Times* or another appropriate periodical.

Poems should be printed or typed, one to a page, and sent to

MAJ. WALTON F. DATER, JR.
DFENG
USAF Academy, Colo. 80840

The As and Bs

Gentlemen: In the July issue there is a handsome two-page ad by McDonnell Douglas.

Too long ago, when I was a cadet, I was taught that the United States Air Force's system of numbering and designating planes was permanent, reserved for each particular plane for all time.

Remembering this, perhaps wrongly, I have often wondered why our A-26 of World War II became the B-26 of Korea, especially since the B-26 of World War II had such an outstanding record—as witnessed by your article on page 74 of the same issue ["How Jim Vining Took on the Luftwaffe's Finest," by Jack Taylor].

Could you clear up this matter for me? How did the A-26 acquire the B-26's number?

RICHARD M. TOON
Des Moines, Iowa

• *The A/B-26 may be the most notable exception to that old "rule" about aircraft designations.*

The Martin B-26 Marauder first flew in 1940, and during the war went through various modifications that brought the program up through the B-26H (or, actually, XB-26H). The "B" prefix was, of course, for Bomber.

The Douglas A-26 ("A" for Attack) Invader first flew in 1942. Specifications for the aircraft called for a "multipurpose light bomber, capable of fast attack operations at low level, as well as precision bombing from medium altitudes, and carrying a powerful defensive armament." The A-26B became operational with the Ninth Air Force in Europe in 1944. Model designations ran up through the "D" but only one of those was built (the XA-26D, which had eight .50-caliber guns in the nose and six more in wing packages), and production was canceled after V-J Day.

Many hundreds of B and C models of the A-26 remained in front-line service after the end of WW II, and the aircraft became the primary offensive weapon of the new Tactical Air Command, created in 1946. In June 1948, the "Attack" category was

(*Continued on page 21*)

At AC Electronics...where tomorrow's history gets its start.

On May 23, 1969, an Air Force TITAN III-C launch vehicle streaked skyward on one in a

series of spectacular military space missions. On board an AC Electronics all-inertial guidance system successfully carried out all phases of the intricate maneuvers required to put two VELA nuclear detection and three Orbiting Vehicle (OV 5) satellites into two distinct orbits, circular for the VELAs and elliptical for the OV 5s.

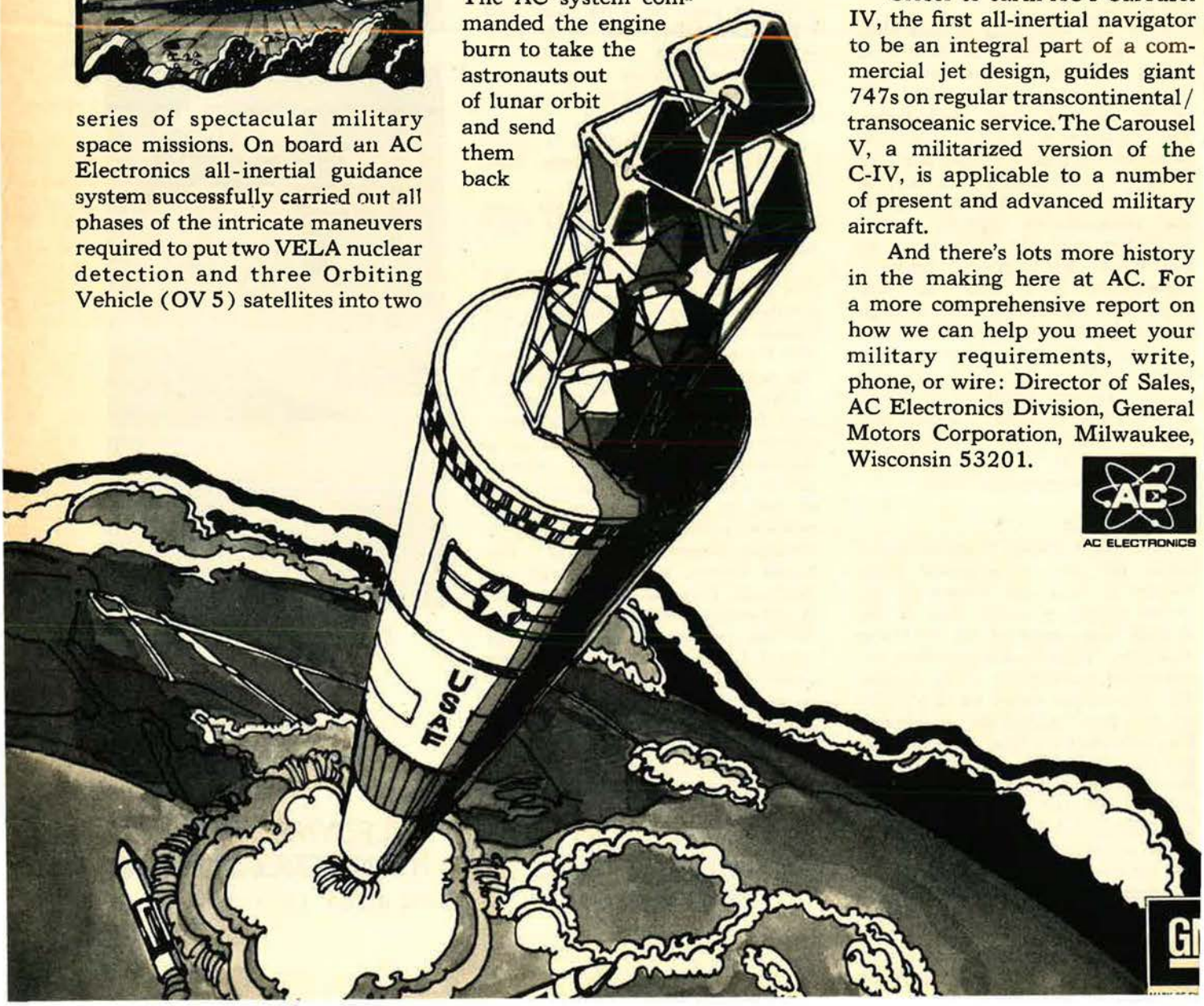
The addition of this successful TITAN III launch typifies AC's contributions to a number of other aerospace achievements of historic importance. It was an AC system that guided the first Americans to the moon and back. The inertial guidance system kept Apollo 11 on course to the moon, controlled the retro firing to put the spacecraft in lunar orbit, guided Eagle to a lunar landing . . . and back again for link-up with Columbia. The AC system commanded the engine burn to take the astronauts out of lunar orbit and send them back

toward earth, across a quarter-million miles of space.

Closer to earth AC's Carousel IV, the first all-inertial navigator to be an integral part of a commercial jet design, guides giant 747s on regular transcontinental/transoceanic service. The Carousel V, a militarized version of the C-IV, is applicable to a number of present and advanced military aircraft.

And there's lots more history in the making here at AC. For a more comprehensive report on how we can help you meet your military requirements, write, phone, or wire: Director of Sales, AC Electronics Division, General Motors Corporation, Milwaukee, Wisconsin 53201.

AC ELECTRONICS



officially abandoned (though it now is being used again, as in the A-1s in Vietnam and the forthcoming A-X), and the Invader's designation was changed to B-26B and B-26C, since by that time all of the Martin B-26s were obsolete and out of service—THE EDITORS

A Flyable Fortress, Anyone?

Gentlemen: The crew of the B-17 "Possible Straight," of the 550th Squadron, 385th Bomb Group, Eighth Air Force of World War II, recently held its twenty-fifth-year reunion. (We won the war this time, too!)

Plans were laid out for a thirtieth-year reunion in 1975, which call for flying ourselves back to England in a B-17 marked up with the red-checkered tail of the 385th.

Question: Can any readers help us come up with a flyable B-17?

W. W. VARNEDOE, JR. (Navigator)
Rt. 4, Box 1853
Huntsville, Ala. 35803

Book on MoH Winners

Gentlemen: The Office of Air Force History would like to hear from AFA members who have personal or first-hand information about any of the Air Force Medal of Honor recipients of all wars. Anecdotes and other details about their careers and combat experiences, as well as their character and other personal qualities are desired for a book on these airmen. Background information on their units and the operations in which these men were involved would also be valuable.

Although the book will emphasize the Medal of Honor recipients, it is also hoped that their exploits will serve to illustrate some of the highlights of Air Force history.

Personal records, including photographs, loaned for this project will be safely returned to contributors. Correspondence and other materials should be addressed to:

Hq. USAF (AFCHO)
Washington, D.C. 20330

Program for Leadership

Gentlemen: This letter is prompted by articles in AIR FORCE/SPACE DIGEST in recent editions, *i.e.*, "An All-Volunteer Force," by Louis R. Stockstill (April '70); "Some Thoughts on Leadership," by Gen. Bruce K. Holloway (July '70); and "The Responsibilities of Youth," by 2d Lt. Charles R. Reed (July '70). I am glad for these articles, but I sense that their contents are incomplete.

This letter is also prompted by my background as CCC camp educational adviser (US Civilian Conservation Corps, 1933-42-46) followed by service in the US Army Air Corps, both at home and overseas, in World War II.

In the 1950s, I lived at length in the national capital. Several times in the Pentagon, from the top down, I was informed that the CCC camps had given to the US armed forces the finest officers and noncoms that the US armed forces had ever received from any source at any time. This is a wonderful tribute. My own personal experience in the armed forces during World War II confirms this tribute. . . .

Yet, who in the national capital or elsewhere, since World War II, has dramatically made known the superiority of the US Civilian Conservation Corps as a training program for wartime leadership? Informed citizens know very well that the CCC Camps made marvelous contributions in peace and in war to the American people, to humanity, and posterity, that are unprecedented, unequaled, unapproached in human history. . . .

Let us have an examination and evaluation of the CCC camps for their social significance during the life of that Corps and since. . . .

CLARENCE C. CASE
Lansing, Mich.

UNIT REUNIONS

12th Tactical Fighter Wing
The officers of the 12th Tactical Fighter Wing will hold their third annual stag reunion September 18-19, 1970, at the Sheraton-Park Hotel in Washington, D.C. Hospitality suite will be open at 1600 hours. Contact

Lt. Col. Tommy I. Bell
Hq. USAF (AFRDPN)
Washington, D.C. 20330
Phone: (202) OXford 74434

20th Special Operations Sqdn.
The "Pony Express" helicopter pilots in SEA are planning a reunion in Washington, D.C., on October 23-24, 1970. Write or call

Maj. Bill McGuth
1st Helicopter Sqdn.
Andrews AFB, Md. 20331
Phone: (202) 981-5131
Autovon 858-5131

4258th Strategic Wing
The officers of the 4258th Strategic Wing, U-Tapao Airfield, Thailand, are holding a reunion at Carswell AFB, Tex., on September 25. All officers who served PCS or TDY with the unit are invited. Contact

Col. James Marr
Hq. SAC, DOCS
Omaha, Neb. 68113
Phone (402) 291-2100
ext. 2518/2537

A Special Report

USAF and the Medal of Honor

The eighth Air Force man to win the Medal of Honor is Col. William A. Jones, III, whose medal was awarded posthumously on August 6 in a ceremony at the White House.

The accompanying citation started out with these words: "For conspicuous gallantry and intrepidity in action at the risk of his life above and beyond the call of duty. . . ."

The late USAF Col. William A. Jones, III, is the eighth Air Force man to receive the Medal of Honor in the Vietnam War. He died in a light-plane crash last fall, after his return from Southeast Asia. President Nixon presented the Medal on August 6 to the family.

"For conspicuous gallantry and intrepidity in action at the risk of his life above and beyond the call of duty."

Those are the words that introduce the citation accompanying the Medal of Honor awarded posthumously, in White House ceremonies on August 6, to Col. William A. Jones, III, USAF. Colonel Jones's Medal of Honor was the eighth such award to an Air Force member for actions in the Vietnam War, and he was the fifty-fourth airman to receive the honor since the beginning of aerial combat in World War I.

The veteran flyer, a native of Norfolk, Va., was graduated from the University of Virginia in 1942, before entering the US Military Academy at West Point, from which he graduated in 1945. He won his wings in 1945, served in the Philippines, in SAC, in a troop carrier wing in Europe, attended the Air War College, and had flown ninety-eight combat sorties out of Thailand.

On September 1, 1968, the incident took place for which Colonel Jones was to receive the Medal of Honor. He was flying a propeller-driven A-1H Skyraider over North Vietnam, as commander of a rescue mission searching for a downed Air Force F-4 pilot. The weather was marginal, and the terrain near Dong Hoi was mountainous.

As Colonel Jones descended into the area, he got word from a forward air controller that 37-mm antiaircraft positions and other smaller automatic weapons were well within range of his slow-moving craft.

Just at that time, his Skyraider was hit, but Colonel Jones kept control, and as the smoke in his cockpit cleared he continued the search for the downed pilot. As he sighted the survivor, Colonel Jones spotted a multiple-barrel gun position firing at him from near the downed pilot's location. The enemy gunners hadn't

USAF MEDAL OF HONOR WINNERS IN VIETNAM

As the eighth Air Force member to receive the Medal of Honor for valor during the Vietnam War, Colonel Jones joins the following list of USAF Vietnam Medal winners: Maj. Bernard F. Fisher, for action at A Shau Valley, South Vietnam, on March 10, 1966; Capt. Hilliard A. Wilbanks, for action at Dalat, South Vietnam, on February 24, 1967; Maj. Merlyn H. Dethlefsen, for action in the Hanoi area, North Vietnam, on March 10, 1967; Capt. Gerald O. Young, for action in the Da Nang area, South Vietnam, on November 9, 1967; Lt. Col. Joe M. Jackson, for action in the Da Nang area, South Vietnam on May 12, 1968; 1st Lt. James P. Fleming, for action at Duc Co, South Vietnam, on November 26, 1968; and A1C John L. Levitow, for action at Long Binh, South Vietnam, on February 24, 1969. Of these seven, five are still on active duty, one has completed service, and one, Captain Wilbanks, was killed in action that earned him the Medal.

At a White House ceremony on August 6, President Nixon, left, presents the Medal of Honor to the widow of USAF Col. William A. Jones. Between them is Congressman William L. Scott (R-Va.), and the others, from left, include Mary Lee Jones, 9; Mrs. Elizabeth Kelley (behind Mary Lee), the mother of Colonel Jones; Elizabeth, 13; Anne Marie, 19 (partially hidden behind her sister, Elizabeth); Sen. Harry Byrd, Jr. (D-Va.); and Sen. William B. Spong, Jr. (D-Va.).

yet seen the F-4 pilot, who was only a few feet from them.

Colonel Jones went after the gun position with cannon and rocket fire. On his second pass the aircraft was hit again with several rounds from the automatic weapons. His cockpit burst into flames, and most of his windshield was blown away. He tried to eject, but the ejection-seat mechanism didn't work.

Though suffering severe burns, he somehow put the Skyraider into a climb. At the same time, he tried to radio the location of the survivor and enemy gun positions to friendly aircraft in the area. But his transmissions were blocked by repeated calls from other aircraft telling him to bail out. Shortly, his cockpit fire burned itself out, but by then all his transmitters were disabled and he could receive on only one channel.

Having miraculously reached altitude in his shattered aircraft, Colonel Jones signaled by hand to his wingman that he would fly his Skyraider back to base, some ninety miles away, instead of bailing out over the first secure area. It was the only way he could get the information on the downed pilot through. The wingman took over the lead, and Colonel Jones, flying in close formation through instrument conditions, followed the wingman and made a GCA landing.

As he was lifted, badly injured, from his aircraft, his first concern was to relay the vital information on the location of the downed F-4 pilot and the enemy gun positions so that the rescue could be made. The survivor was retrieved later that day, but only after the gun position Colonel Jones had sighted had been destroyed.

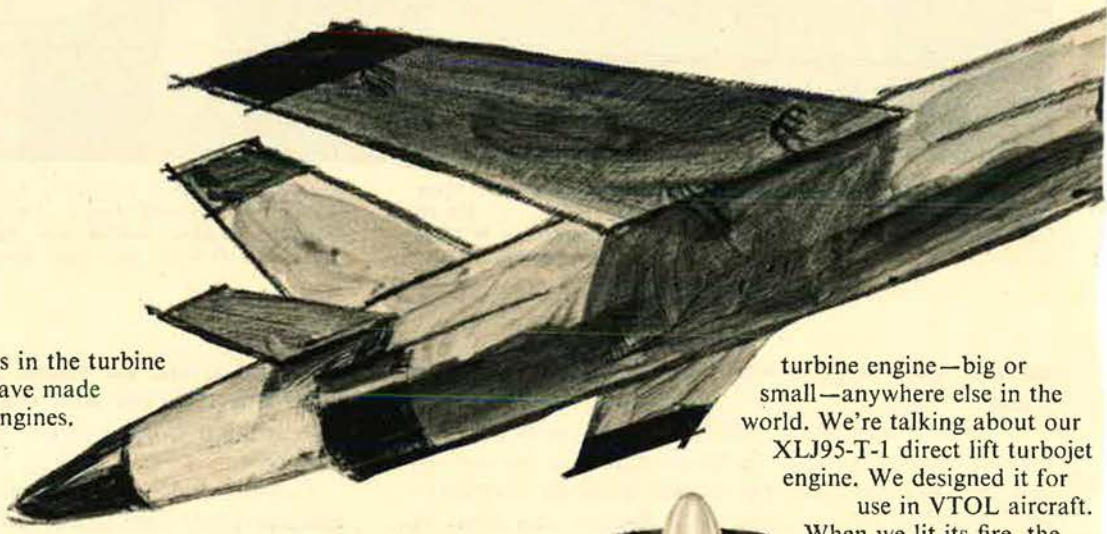
Colonel Jones was air-evaced back to the US for medical treatment. After recuperation from the burns he suffered during the mission, he returned to active duty and, early in 1969, was assigned as Commander of the 1st Flying Training Squadron, 1st Composite Wing, at Andrews AFB, Md.

On November 1, 1969, Colonel Jones was promoted to full colonel. He was still on assignment at Andrews AFB when he was killed, on November 15, 1969, in the crash of his private plane near Woodbridge, Va.

He is survived by his widow, Mrs. Lois Mc. Jones; the couple's three daughters—Anne Marie, 19; Elizabeth, 13; and Mary Lee, 9—and his mother, Mrs. Elizabeth H. Kelley, all of Charlottesville, Va.

There was a poignant moment after the formal presentation of the Medal during the White House ceremony. Mary Lee gave President Nixon a copy of *Maxims for Men-at-Arms*, by her late father. The new book is a collection of quotations by famous people about the military profession, gathered by Colonel Jones during his career in the Air Force. Each page bears an appropriate pen-and-ink illustration by Colonel Jones, who had received the first copy of the book himself only the day before his death.—END

We've
in a



There are companies in the turbine engine business that have made it big by making big engines.

Then there's us. Teledyne CAE.

We've made it big by making small turbine engines.

Like our engines for target drones. We happen to be the world's leading manufacturer of turbojet drone engines. So far, Teledyne CAE engines in the BQM drone series alone have been successfully launched over 20,000 times. And nearly 10,000 of these launches have been in the air. Way up in the air.

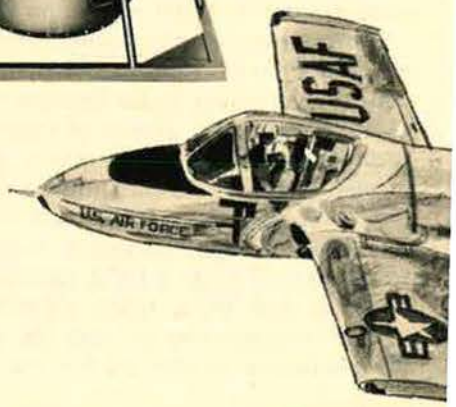
Just recently our 1920-pound thrust YJ69-T-406 engine completed its flight test program in the Navy BQM-34E drone. It reached Mach 1.1 at sea level and Mach 1.5 at 60,000 feet. This same engine is programmed for the Air Force BQM-34F, incidentally.

Another one of our drone engines, the Tri-Service J69-T-29 is famous, too. But for a slightly different reason. On a per pound of thrust basis, it's the lowest cost engine in the world today.

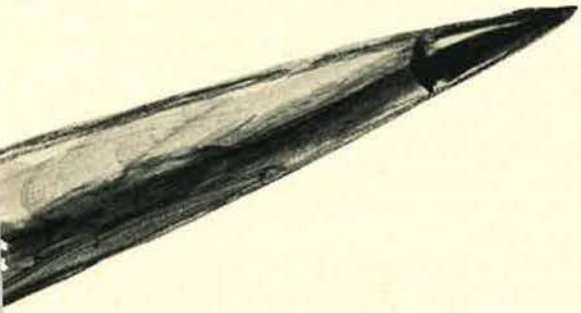
And, as you know, thrust per dollar is the name of the game.

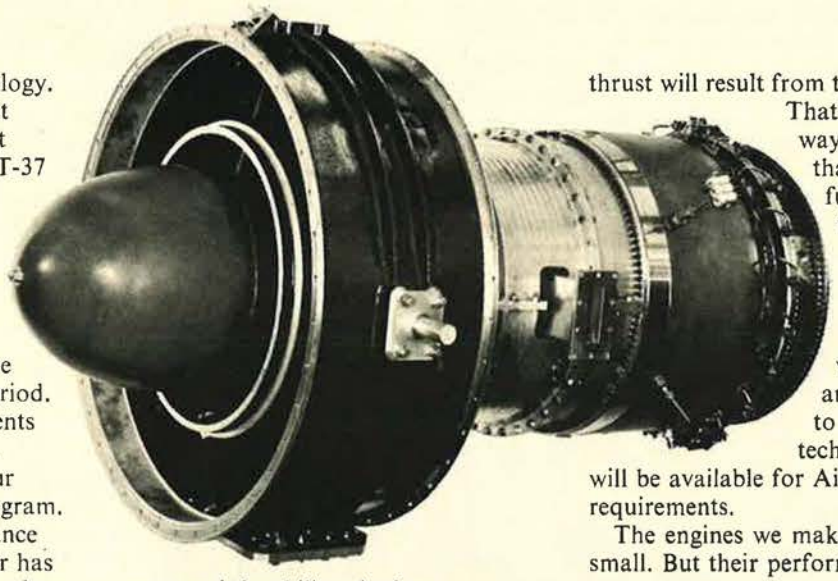
We own another record that also hasn't been duplicated in another turbine engine—big or small—anywhere else in the world. We're talking about our XLJ95-T-1 direct lift turbojet engine. We designed it for use in VTOL aircraft. When we lit its fire, the XLJ95-T-1 demonstrated a thrust-to-weight ratio in excess of 20:1.

You don't get that kind of a thrust-to-weight ratio unless you know all about the most advanced



made it big small way.





ncepts in gas turbine technology. We also build an engine that as been powering the T-37 jet ainer ever since there was a T-37 t trainer. From the beginning of the program until ow, the 3,900 engines we've pplied have logged over 000,000 flight hours.

It also has the lowest aintenance cost of any engine the Air Force inventory. Period.

One of our latest developments n't in the military inventory. ot yet, that is. It's part of our TEGG or "core" engine program. or some time now, our Advance urbine Engine Gas Generator has been demonstrating extremely high levels of performance and durability. And we expect that turbofan engines with a thrust to weight ratio of 10:1 and specific fuel consumption of less than 0.4 lbs/hour/lb. of thrust will result from this technology.

That's a technical way of saying that, in the future, small turbofan engines in the 2,000-5,000 lb. thrust range with performance equivalent to large advance technology engines will be available for Air Force requirements.

The engines we make may be small. But their performance is big.

See you at the AFA Show
Booth 101-105

TELEDYNE CAE

1330 LASKEY ROAD · TOLEDO, OHIO 43601

AIRPOWER IN THE NEWS

By Claude Witze
SENIOR EDITOR, AIR FORCE MAGAZINE

A Package Tied in Blue Ribbon

WASHINGTON, D.C., AUGUST 11

An experienced congressional staff executive, who has spent many years monitoring military operations, remarked earlier this year that "every incoming defense administration believes itself duty-bound to show that it has a new approach, one that will be vastly superior to the old ways, more conducive to economy, efficiency, and responsibility."

He also delivered the opinion that reforms always fall short of expectations. The current example, of course, was the revolution introduced by Robert S. McNamara. After nearly a decade of Mr. McNamara's reforms, the situation in the Pentagon seemed to be worse than ever, this observer said. It was a judgment that stood in sharp contrast to the speech of a Democratic senator, who hailed Mr. McNamara as "one of the finest public servants ever produced by this country . . . the finest Secretary of Defense . . . a man for all seasons [who] leaves behind him a legacy of accomplishments in the defense complex which will stand for many years."

These men can't both be right, and their difference of opinion may account for the deep silence on Capitol Hill since the Nixon Administration's program for Pentagon reform was handed down on July 27 by the Blue Ribbon Defense Panel. This group, headed by Gilbert W. Fitzhugh, Chairman of the Board and Chief Executive Officer of the Metropolitan Life Insurance Co., has been working for a year—which probably was not long enough—to draft a list of 113 recommendations for changes in the organization and procedures of the Defense Department. The report itself is 237 pages long and is a worthwhile discussion of all aspects of Pentagon interest, including organization, command and control, procurement, research and development, intelligence, personnel policies and practices, and conflicts of interest. To get your own copy, send a check for $2.25, made out to the Superintendent of Documents, to the Government Printing Office, Washington, D.C. 20402. Ask for the "Report to the President and the Secretary of Defense on the Department of Defense by the Blue Ribbon Defense Panel, 1 July 1970."

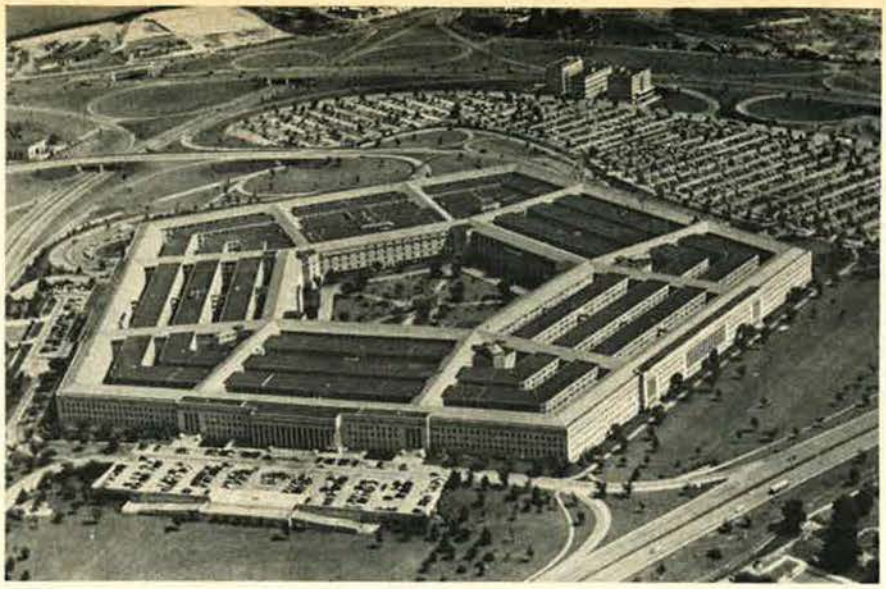
The silence that greeted the report in Congress may be more than matched by the reluctance of anyone in the Pentagon to offer comment. Defense Secretary Melvin R. Laird, who had the first copy, has said only that he assumes a majority of the recommendations will be adopted. While the document sits on his desk awaiting action, the men in uniform are under orders to hold their silence. It is an admonition that is somewhat meaningless, as the record shows.

In USAF circles, for example, there is some satisfaction garnered from an observation by Mr. Fitzhugh, who told a press conference that the basic difficulty in defense administration is a "diffusion of responsibility." He said, "there is nobody below the level of the Secretary and the Deputy Secretary that has the purview of the whole operation of the Department. The same people have an interest in everything, so they are all bogged down with too much detail work, too many responsibilities; there are too many man-killing jobs, and nobody really has the responsibility for anything."

He continued:

"Everybody is somewhat responsible for everything, and nobody is completely responsible for anything. So there's no way of assigning authority, responsibility, and accountability. You can't hold anybody accountable. There is nobody that you can point your finger to if anything goes

Report on Blue Ribbon Defense Panel recommendations was given to Pentagon press corps by Chairman Gilbert W. Fitzhugh (right) and Defense Secretary Melvin R. Laird (left). One of the major weaknesses in Defense Department organization, the chairman said, is the fact that all basic decisions come to the top, because nobody below has authority to make them.



The Pentagon, largest office building in the world, has too many people working in it, the Blue Ribbon Defense Panel says. The Office of the Secretary of Defense, with 3,500 persons now on the payroll, should be reduced to not more than 2,000. The Secretariats and military staffs, the report continues, should be slashed in a similar manner for more efficiency.

wrong, and there is nobody you can pin a medal on if it goes right, because everything is everybody's business and, as you know, what is everybody's business is nobody's business. . . . Nobody can do anything without checking with seven other people."

Well, the discovery of this fact, at the conclusion of the McNamara regime, came as no surprise in the Head Shed, where it was not necessary to ask for formal comment. The documentation is there. About a year ago, in his swan song to the Senate Appropriations Committee, Gen. John P. McConnell, retiring USAF Chief of Staff, bewailed high centralization and the burden of providing more and more information to upper-level decision-makers. He called for more management by responsible officials at lower levels.

Then the General made an observation that could have provided the text for Mr. Fitzhugh:

"In running flying outfits, I never had any trouble. When a squadron commander goofed, he was fired. In our procurement and development areas, I can't find anyone to fire. Too many people at too many levels have had too much to say about the program."

The text of the Blue Ribbon report itself provides several examples of situations, unearthed by the panel in its year of work, that have been the subject of military critiques for a long time. One is the discovery that public attitudes toward conduct of the war in Vietnam have an effect on defense operations and that these public attitudes sometimes have no basis in reality. Take the general blame for inefficiency in the conduct of the war. Much of the public holds the military services responsible. There are congressmen, cartoonists, and commentators who join in the chorus. Yet the Fitzhugh report says, "Many of the rules and restraints regarding how this war has been fought have not originated with the military, but with the civil authorities of government. Many operational tactics, believed by some to be more militarily efficient, have been precluded by the United States's self-imposed 'rules of engagement,' which reflect many factors in addition to military efficiency. Whether or not one agrees with the weight given the various factors in coming to such judgmental decisions, or with the actual decisions, the fact is that these decisions relating to the war in Southeast Asia were made by civilian, not military, officials—sometimes upon the advice of the military, and sometimes against such advice."

In another area, the panel found that the Office of the Assistant Secretary of Defense (Systems Analysis) "has proved to be a controversial organization." The reason, in large part, is that "it initiates, rather than reviews, force structures . . . and, in effect, has made, rather than advised on, decisions." This is an observation made long ago. Specifically, it was the source of an outburst by Gen. Thomas D. White, after he retired as USAF Chief of Staff in 1961, lamenting the advent of "Whiz Kids," who puffed on their pipes and told old hands in uniform what they really needed to know. The review of force structures and programs for the Secretary of Defense is an essential task, the panel declares, but it "requires the application of a broad range of disciplinary skills, maturity born of experience, and firm, responsible direction."

If we shift again, to the subject of military personnel, the report suspects that antimilitarism, on the campus and off, deters young men and women from serving in the armed forces. Positive steps are needed to restore respect for uniforms. Within the services, the panel is critical of rotation practices, arguing that both officers and enlisted men are rotated too frequently. The policy is wasteful and inefficient, and makes it difficult to fix responsibility. In a study of 174 new general officers, the staff found their average service was twenty-four years and that in this time these 174 men had been given a total of 3,695 assignments—an average of twenty-one per man. The average duration per assignment was fourteen months. The panel recommends that specialist careers be established in professional fields and that the duration of assignments be increased.

There is something here, too, for the maligned military-industrial complex. With a bow to Dwight D. Eisenhower, the panel says he often is quoted out of context on the subject, and says that industrial capability is essential to national defense. The report is confident that Pentagon civilian officials can and will control the military-industrial complex, for the simple reason that the critical decisions are made by civil authorities in the executive and legislative branches of the government. The men in uniform and the contractors do as they are told.

Next to this lies the subject of profits and the current concerns that "defense contractors make large profits, and that the desire for profits leads them to press for ever larger defense budgets." Not so, says the panel. It can find no grounds for a charge that in recent years there have been excessive profits, and points to the requirement

(Continued on page 29)

LOG COORDINATE CONVERTER

DATA TRANSMIT UNITS

DUAL VERTICAL SCALE INDICATOR (tachometer)

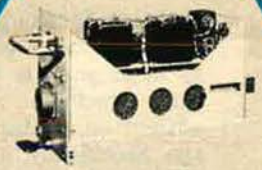
AL VERTICAL SCALE INDICATOR (temperature)

AIR DATA INDICATORS

VERTICAL SCALE ATOR (elevation)

INS TIME-TO-GO INDICATOR

ARINC DUAL DME INDICATOR



DUAL CHANNEL SYNCHRO AMPLIFIER

DECI-LINE

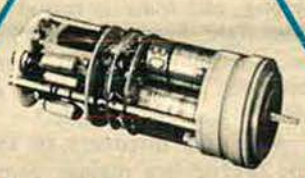
DUAL VERTICAL SCALE INDICATOR (fuel flow)

SOLID STATE SERVO REPEATER

AREA NAV. SYMBOLIC PICTORIAL INDICATOR

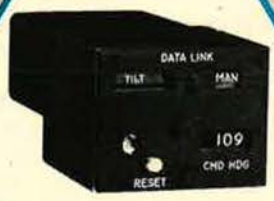
LORAN "C" RECEIVER

ARINC DME INDICATOR



SERVO REPEATER

LAT/LONG INDICATOR



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for renegotiation as a protection against abuses. Further, the report calls for a recognition that incentives are required to attract industry into competition for defense business. It notes that while a great number of dollars are spent for research and development and procurement, they represent only part of the defense budget, and that profit accounts for less than ten percent of the money spent in this area. "Too much attention to profits," the panel concludes, "can divert attention from the much larger elements of costs, quality, and performance."

The continuing congressional interest in the conflict-of-interest issue, and the employment of retired officers by defense contractors, also gets a review, and the critics, for the most part, are rebutted. The concern over the possibility of a retired general or colonel exercising influence on behalf of a contractor is not viewed as a menace. And it is more than offset, the report indicates, by that of the former Defense Department civilian employee who has joined the defense business. A study of the statistics indicates, the report continues, "that retired military personnel (a) leave the service at an early age, (b) normally seek a second career, (c) frequently have difficulty in translating military skills into comparable civilian skills, and (d) do not tend to cluster around military-related industries."

The panel says "it is difficult to envision a retired officer who would have sufficient personal influence within the Department to manipulate the whole [procurement] process." It concludes that the emphasis of the statutes and regulations "should be directed toward prohibition of and punishment for specified undesired acts, rather than toward prior restraints." It is critical of the existing statutes and says they should be reevaluated in the interests of fairness and consistency.

When the Fitzhugh report was made public in late July, the initial reaction reflected in headlines and the press commentaries was that the real news involved procurement policy and a change in the role of the Chiefs of Staff. One of the reasons for the profound silence from Capitol Hill and the Pentagon corridors probably is that these flash reactions to the Fitzhugh panel report were incorrect. The chairman said, frankly, that ninety percent of the recommendations can be carried out without legislation, which means that Mr. Laird, exercising the same powers that Robert McNamara used, can select the ideas he likes and use them. It is more than a year ago, for example, since Mr. Laird and his deputy, David Packard, turned away from the McNamara total package procurement concept that proved so unworkable and embarrassing in the case of the Lockheed C-5A program. Thus, the fact that the Blue Ribbon Panel also rejects it and calls for a "fly-before-you-buy" policy hardly rates as surprising news. In all of this, there was little attention paid to what Chairman Fitzhugh had to say on the subject. He is worth quoting:

"We don't think there should be a $3 billion contract that can get a defense contractor into a problem of solvency. We think it's too much to expect anybody, any defense contractor, to put in a bid today as to how much it's going to cost him to build a weapon or a plane or a tank that neither he nor anybody else has ever built before, or knows whether it is possible to build.

"He has to guess at all the so-called unknown unknowns, the technical uncertainties, and he has to guess what costs are going to be over the next eight years. It is no wonder that they don't come up with the right answer, that [systems] cost more and take longer."

His realism continued:

"Right now, to put in a proposal for one of these major weapons, it takes more than one ton of paper. Each bidder puts in a proposal with more than a ton of paper. Who can analyze that? Who can really know which is the better proposition? It's just too big." His panel proposal is that the system be divided "into smaller pieces" with "more prototypes . . . and less reliance on paper studies."

In order to do this, the panel's proposed new table of organization includes a Deputy Secretary for Management and Resources, who would be in charge of research and development and procurement. There would be two more Deputy Secretaries—one for Evaluation and one for Operations. The present chair of Deputy, the one occupied by Mr. Packard, would be abolished.

Mr. Fitzhugh explains his idea of splitting the old office of Director of Defense Research and Engineering, now occupied by Dr. John Foster, as part of the effort to break the department into "manageable pieces." The user would be separated from the provider by independent DoD test and evaluation. And, "We think that research and development should not be together, that, by putting that all under one Director [Dr. Foster], he can move things back and forth from research to development." The result: "The Secretary does not have the visibility he ought to have of what's going on, Congress does not have visibility of what's going on, and it's too much of a job anyway."

It is at the level of changes in the table of organization, of course, that controversy will emerge. This also is the level at which Congress is empowered to take a hand. Congress would have to approve the changes, as well as future political appointees to the three new Deputy Secretariats. It is not difficult to imagine the storm that would arise if a new executive branch sought approval to one of these slots of an Adam Yarmolinsky or Alain Enthoven or today's Herbert F. York or Jerome Wiesner.

This is why one of the key issues is the panel's proposal to shake up the machinery that would fight a war, if we got into one. In addition to the one mentioned above, suggested changes include the creation of a military operations staff for the Secretary of Defense that is separate from the Joint Staff of the Joint Chiefs of Staff. The Chiefs now work in three roles. They are commanders of their services, military advisers to the President, and serve as a link between the Secretary and forces in the field. As a matter of fact, this last job was thrust upon them by Secretarial decree and is not required by the law.

Under the new operations staff, reporting to the new Deputy Secretary (Operations), would fall three new military commands: Strategic, Tactical, and Logistics. The Strategic Command, of course, would include USAF's SAC, the Navy's nuclear-submarine fleet, and the Continental Air Defense Command (CONAD) as well as the Joint Strategic Target Planning Staff. The Tactical Command would include all general-purpose forces in all services. The Logistics Command would be responsible for support activities of all services.

The reason for this program is spelled out. The panel finds the present arrangement "awkward and unresponsive" and says it provides "a forum for interservice conflicts" and "inhibits the flow of information."

Whether or not all these things are true will depend on the experience and wisdom of the observer. That the conclusions in this regard will be contested, there is no doubt.

The one certain thing is that the Blue Ribbon Defense Panel has dealt a blow to many of the military's loudest critics. A government that can bring about so many changes, if it wants to, is not in the grip of a military monster.—END

AEROSPACE WORLD

News, Views & Comments

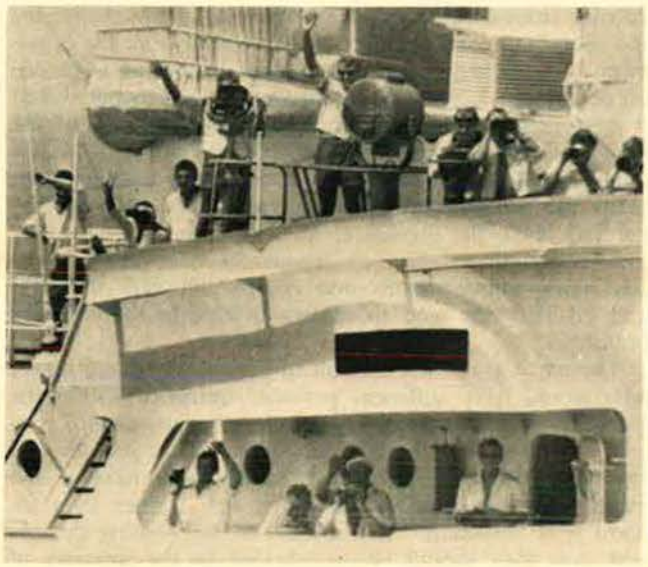
By William P. Schlitz
NEWS EDITOR, AIR FORCE MAGAZINE

WASHINGTON, D.C., AUGUST 17

A run-in on August 3 with a Soviet snooper ship almost stole the spotlight from an event of great significance: the first underwater firing of the Poseidon missile.

The Russian ship—the *Laptev*—came so dangerously close to the USS *Observation Island* on two occasions that the US skipper had to sound the international danger signal; once, the US vessel went into full reverse to avoid a collision. The Soviet ship also made an unsuccessful dash to retrieve some of the debris left on the ocean surface following the Poseidon shot, which took place from a US nuclear submarine about thirty miles off the Florida coast.

Russian ferret ships have observed other ocean tests of US missilery, but



Crewmen of the Soviet spy ship Laptev *wave and snap photographs as the vessel approaches to within eighty yards of a Navy support ship on August 3. The approach was made after the US sub* James Madison *successfully launched a Poseidon missile for the first time from underwater.*

—Wide World Photos

The McDonnell Douglas Corp.'s DC-10, a new, wide-bodied trijet, was rolled out on July 23 and later began a flight-test program. Capable of transporting 270 passengers and their baggage over distances up to 6,100 miles, the 182-foot-long aircraft is powered by GE CF6 engines derived from the advanced-technology, high-bypass engines of the C-5. Fourteen US and foreign airlines hold options and orders for 237 DC-10s.

Lockheed Corp.'s L-1011 TriStar, which is to begin test flights in November of this year, can carry up to 345 passengers over distances of more than 3,500 miles when configured for transcontinental operations, or up to 6,300 miles in its proposed Dash 8 intercontinental model. It is fitted with Rolls-Royce turbofan engines. Thus far, 173 TriStars have been ordered by the airlines.

never before at such close quarters or with such aggressiveness.

Poseidon is scheduled to replace the US's arsenal of Polaris missiles in this decade, and, with its MIRV (multiple independently targeted reentry vehicle) warhead carrying up to twelve nuclear weapons, will complement Air Force missiles and bombers in supplying the potential punch to deter the Soviet Union from any surprise attack.

The first submarine set for installation of operational Poseidon missiles is the *James Madison,* the craft that conducted the underwater test shot. In all, thirty subs will carry the new missile.

How the Poseidon deployment will affect the Strategic Arms Limitation Talks, currently under way with the Soviet Union, cannot be determined. Thus far, the talks seem to be making headway toward limiting the quantity of strategic weapons by both parties; applying curbs to such weapons as Poseidon remains a future prospect.

☆

The Air Force reached another milestone in development of its F-15 air-superiority fighter when, in July, it initiated the "fly-off" stage of two advanced radar systems competing for the F-15 contract.

The radars are mounted in B-66 jet bombers, and, following the "fly-before-you-buy" test series, prime contractor McDonnell Douglas will select the winner from the two competing companies—Hughes Aircraft Co. and Westinghouse Electric Corp.

The radar for the fighter, scheduled for first flight in 1972, will assist pilots in air-to-air combat situations. McDonnell Douglas already has picked IBM to produce the fighter's centralized computer, which will conduct all computation and memory functions for the high-maneuverability aircraft. Other subsystem contractors are currently under consideration.

In the "fly-before-you-buy" concept established by Defense Secretary Melvin Laird, specific development goals must be reached before the contractor begins production. With the exception of long-lead-time components, major subsystems must be flight-tested to reduce possible future problems of cost, performance, and schedules, before production is initiated.

Officials view this method as the answer to the kind of problems that plagued development of the F-111 and C-5 under "total package procurement" contracting procedures.

In another matter, Boeing Co., prime contractor for development of the Air Force's Airborne Warning

(Continued on following page)

JAPAN STEPS UP CIVILIAN VTOL USE

Japan's high-density urban areas, long a hindrance to rapid airport commuting, are one major factor in the strong drive for introduction of VTOL and helicopter air-taxi services.

Large corporations are particularly interested in helicopters to keep their top executives out of time-consuming road traffic. The choppers would operate from heliports atop downtown offices to branches and plants located around such major cities as Tokyo and Osaka.

Road travel is currently so slow that many businessmen prefer to use the subway instead of a company car. The crowded vehicle conditions also are responsible for the nonprofitable operation of the monorail that links Tokyo and the present Tokyo International Airport.

Since its opening in 1964 until recently, the monorail has been consistently in the red, mainly because it did not operate all the way to the downtown area. As a result, travelers preferred taxis to and from the airport. However, vehicle traffic on the airport roadnet is now so heavy that passengers often face long delays and frequently miss flights.

(Ironically, the monorail's hope of future prosperity may be short-lived because of new government planning. A new airport is being built at Narita to handle all of Tokyo's international flights. The present Tokyo International Airport at Haneda will be used mainly for domestic flights.)

The Transport Ministry is planning a rapid-transit system to link the New Tokyo International Airport at Narita to the downtown area and the present Tokyo International Airport at Haneda. VTOL aircraft, a monorail, and a bullet train similar to the New Tokaido Line will provide high-speed transportation to and from the airport within a few years.

VTOL aircraft are scheduled to be in service by 1975, and will make the thirty-seven-mile flight from the new airport to the heart of Tokyo in just twenty minutes. The VTOLs will have a seating capacity of 150, and will also link the old and new airports.

The bullet-like train will run from the airport to the centrally located Tokyo Station, also in twenty minutes. The monorail, however, will involve a change to the subway, and that trip will total fifty minutes. These facilities are not expected to be operational when the new airport opens next April, but plans call for completion prior to 1975.

A sidelight to introduction of VTOL aircraft on a large scale in Japan is that the Aeronautical and Space Technological Research Institute of the Science and Technology Agency is well into testing to develop a domestic VTOL. The experimental aircraft is powered by two JR 100F lift-jet engines, each with a thrust of 1.37 tons. It is conceivable that by 1975 at least some VTOLs in Japan will be domestically designed and built.

As mentioned above, private business is the prime mover behind the growing use of helicopter transportation in and around large Japanese cities. Until recently, helicopters were used exclusively by the military, news agencies, and for agricultural spraying.

Transportation Ministry figures show the number of registered civilian helicopters rose from only thirty-one in 1955 to 270 last year. The first Japanese company to purchase a helicopter to improve management efficiency was the giant Japan Miniature-Bearing Co., in 1967. A company spokesman said the helicopter has already paid for itself. Other companies now using helicopters include Sony Corp., Tohoku Electric Power Co., and Daini Seikosha.

One problem standing in the way of air-taxi services is the difficulty involved in locating heliports in built-up city areas. Seibu Department Store and the forty-story World Trade Center Building were refused permission to construct heliports on their roofs, mainly because of the noise.

However, to ease ground-transportation congestion, the Japanese Transport Ministry is being forced into a more permissive stand on VTOL/helicopter use over high-density urban areas, as evidenced by its own plan to introduce VTOL service to downtown Tokyo by 1975.

Commercial helicopter chartering firms, however, face other problems besides restrictions on heliport construction. The several major air-taxi firms in Japan have to contend with high operating costs. Presently there are about eighteen helicopter chartering companies in Japan.

As the use of helicopters for urban transportation increases in Japan, experts predict the number of chartering firms will decrease due to mergers forced by competition and high operating costs. —RONALD C. GOLDEN

and Control System (AWACS), has awarded contracts to both Hughes and Westinghouse for creation of AWACS' overland surveillance radar.

Flight tests of the two competing radar systems, which are to be designed to "look" down and separate moving targets from the ground clutter, are scheduled to begin early in 1972. Boeing plans to outfit two 707-320 Intercontinental aircraft as testbeds for the program.

☆

In a surprise move late in July, Dr. Thomas O. Paine resigned as Administrator of the National Aeronautics and Space Administration.

The forty-eight-year-old Dr. Paine, who headed the team responsible for man's first landing on the moon, said that he would return to private life and a "challenging opportunity" with General Electric Co., where he had been employed for nineteen years prior to his move to NASA early in 1968.

There was immediate speculation that Dr. Paine's resignation was the result of the series of cuts in NASA's budget. This he emphatically denied: "Now is the appropriate time for a change in command at NASA," he told President Nixon in his letter of resignation, "and this coincides with my wish to return to private life."

Knowledgeable observers of NASA affairs suggest that the front runner among those mentioned as possible candidates for the top NASA job is the current Deputy Administrator, George M. Low, who has served at Houston's Manned Spacecraft Center in prime posts before coming to Washington.

Dr. Thomas O. Paine recently resigned as Administrator of NASA, where he headed up the team that put the first man on the moon. Dr. Paine announced that he will accept a position with GE, his employer before his NASA work.

Maj. Henry M. Dyches, Jr., admires the Koren Kolligian, Jr., Trophy, given each year to an Air Force crew member for outstanding performance during an in-flight emergency. Major Dyches won for such an action at Yokota AB.

NASA, already beset by its funding difficulties, has a number of other question marks in its future. Among them: whether or not to continue its original schedule of moon landings; how best to develop the reusable space shuttle; and how to balance its manned and unmanned space efforts.

☆

Following a lapse of five years, USAF once more plans to conduct its "William Tell" fighter-interceptor competition. The event, October 26–31, will be under the auspices of the Aerospace Defense Command and will be held at Tyndall AFB, Fla.

Top ADC and defense-assigned Air Guard fighter-interceptors will compete. Canadian forces also have been invited to participate.

The event was begun in 1954 as the air-to-air rocketry part of USAF's third annual Fighter Gunnery and Weapons Meet held in Arizona. It moved to Tyndall in 1958 and became the USAF Worldwide Fighter-Interceptor Weapons Meet. Not held in recent years because of Vietnam combat needs, it has been made possible this year because of funds already available for training purposes, the Air Force said.

The competition's aim is to evaluate crew ability to maintain, handle, and load defense weapons under sim-

(*Continued on page 34*)

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The burned-out hulk of a C-130 aircraft lies on the airfield at El Toro Marine Corps Air Station, Calif., after it crashed and exploded. Its pilot was killed and four-man crew severely injured. In the background, President Nixon's Boeing 707 —Air Force One—performs a practice takeoff near the wreckage.

—Wide World Photos

ulated combat conditions, and to demonstrate the interceptor weapons' capabilities. A best team is named in each aircraft type participating.

Competing will be F-106 Delta Darts, F-102 Delta Daggers, and F-101 Voodoos. Firing is to take place on the Air Force test range over the Gulf of Mexico.

Late in July, Panavia Aircraft GmbH, Munich, received a go-ahead to begin the first development phase of Europe's multirole combat aircraft (MRCA).

The prototype planned by Panavia is to be a twin-engine, two-seat aircraft with variable-geometry wings; a major characteristic is to be its very short takeoff and landing capability. Panavia is an international consortium established by Britain, Germany, and Italy to manage production of the aircraft. Prototypes are to be built in all three countries, and operational aircraft are scheduled to enter the three air forces by 1975.

The green light to Panavia came following the signing of a Memorandum of Understanding by Great Britain and Germany. Italy has yet to sign the memorandum.

The British Aircraft Corp., Fiat of Italy, and Germany's Messerschmitt-Bölkow-Blohm are Panavia's parent companies.

Despite initiation of prototype manufacture, the long-term outlook for the MRCA project is shrouded in doubt because of financial and other major question marks. (*For additional details on the MRCA, see April AF/SD, page 22.*)

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The Departments of Defense and Transportation have teamed up to test helicopter capability in a logical but heretofore largely overlooked role: providing evacuation and medical assistance to civilian automobile-accident victims and others needing emergency care.

The test program began in the San Antonio, Tex., area in July and will continue through the end of December. Participating Army helicopters and medical corpsmen are to apply techniques developed during the Korean and Vietnam Wars. Rapid helicopter evacuation is one reason that the death rate of wounded soldiers was cut from 4.5 per 1,000 in World War II to 2.3 per 1,000 in Vietnam.

Theoretically, the same trend should apply to critically ill civilians, especially in remote rural areas, or

to those injured on the nation's highways.

In the test, a UH-1 Huey helicopter and crew from the Army's 507th Air Ambulance Company, Fort Sam Houston, are on constant alert to respond to emergency calls. A Huey can carry three stretcher and four sitting passengers along with its flight crew and medical personnel.

Two military and sixteen civilian hospitals in the ten-county area of the test program are also involved.

Besides saving lives, the program should help to determine communication and coordination effectiveness, civilian and military training requirements, and other related factors. The program already is to be expanded to other areas.

☆

The Coast Guard is also experimenting with helicopters to help prevent massive oil spills from stricken oil tankers. It hopes that the technique can eventually be put to use as far as 300 miles offshore.

The system relies on removing the cargo from a distressed tanker before the oil spreads on the ocean surface and becomes unmanageable. Theoretically, a helicopter would deposit pumping equipment and a salvage crew aboard a troubled tanker. Oil in the holds would be pumped into giant, floating rubber containers, each capable of holding hundreds of thousands of gallons of oil.

Sikorsky HH-52A and HH-3F helicopters have already participated in a series of tests to prove the system, using a US Navy water barge as a simulated tanker.

(*Continued on page 37*)

—Wide World Photos

On August 4, this British-built Harrier V/STOL aircraft flew demonstration missions at the Marine Corps base at Quantico, Va. The Marines are buying twelve of the aircraft to help in close support, at a cost of $57.6 million. Deliveries are set to begin next January.

Uncle Sam's trying to save money.

And there's one very important area where we can help you help. Your department's communications system.

When you call on the Bell System to put together or modify your communications setup, you can subscribe to services instead of buying equipment. Avoiding major capital investment.

It's a concept that's helped balance many a budget, in many a branch of the government.

But we offer a lot more than savings. Take a good look at our column on the facing page—then give us a call.

You can bank on our help.

AEROSPACE WORLD — CONTINUED

If the system works in actual cases, the plan calls for the rubber containers to be towed to shore to recover the oil. The containers are reusable.

☆

Personnel who served with British Commonwealth forces prior to US entry into World War II have been invited to attend a reunion of Commonwealth aircrews.

The reunion, dubbed a "nostalgic happening" by the sponsoring Winnipeg Wartime Pilots and Observers Association, is scheduled for September 24–27.

Planners of the reunion expect attendance by some 2,000 flyers from Britain, Australia, Canada, New Zealand, India, South Africa, the US, Norway, Denmark, and other wartime allied countries. Invited are wartime flyers of any war, regardless of rank or aircraft specialty.

For additional information, write Commonwealth Air Reunion, P.O. Box 1702, Winnipeg, Canada.

☆

Talk about supergadgets! USAF recently unveiled a rotating-arm test apparatus designed for speeds up to Mach 3 (2,280 mph). That is more than twice the velocity of the free world's only other supersonic rotating arms at Wright-Patterson AFB, Ohio, and Dornier Systems GmbH, Germany. Those will do Mach 1.4.

Actually, the supersonic rotating-arm test apparatus has a very practical purpose: studying the effect of particles hitting solid surfaces at high speed. Major damage to even the highest-strength materials takes place when they are bombarded with water, ice, or sand particles. Naturally, this phenomenon is of considerable interest to military and commercial aerospace communities alike.

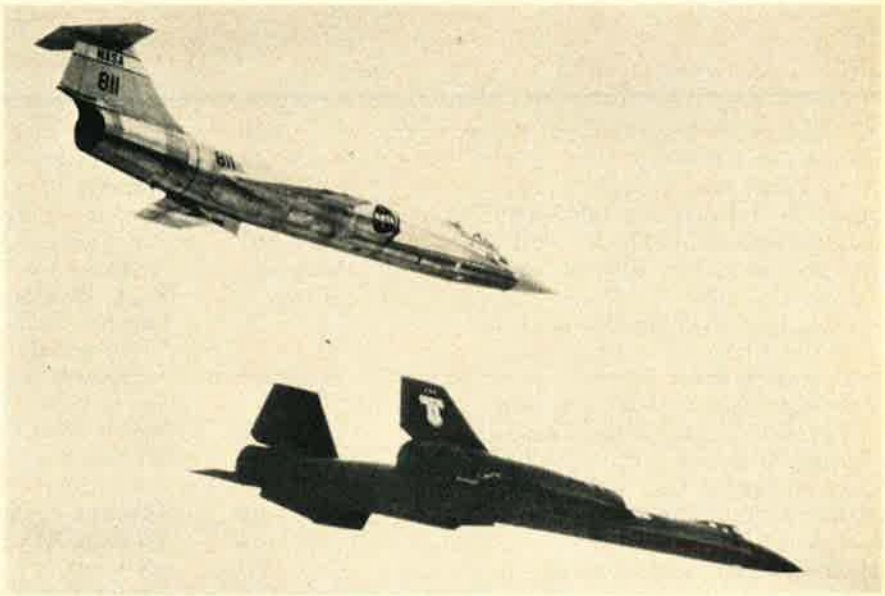
USAF experience testifies that rain and ice particles have severely damaged missiles and aircraft noses, canopies, radomes, and wing and tail leading edges. In some cases, damage was done in only thirty seconds while flying through heavy rain at 680 mph.

The test apparatus, at Textron's Bell Aerospace Division in Buffalo, N.Y., will be used in a program to determine the erosion characteristics of about 600 materials at sustained speeds ranging from Mach 0.66 to Mach 3 and at simulated altitudes up to 60,000 feet.

Among the specimens Bell will test for the Air Force are polymers, elastomers, ceramics, nucleated glasses, composites, and a variety of steel, aluminum, and titanium superalloys. The purpose is to develop materials that will withstand particle erosion.

The rotating device is housed in a concrete-encased twenty-six-foot-diameter vacuum chamber. Specimens are mounted on a tapered blade that extends nine feet in radius. At Mach 3, the blade hits 3,500 revolutions per minute and develops load factors of 35,000 Gs. An environmental control system introduces sand and water particles, and a closed-circuit television

(Continued on following page)



High in the skies over Southern California, a "blackbird" YF-12A research aircraft—the world's fastest interceptor—is shadowed closely by a "chase" Starfighter. The planes, both built by Lockheed-California Co., work for NASA in training astronauts and observing the performance of high-speed aircraft undergoing tests at Edwards AFB.

The Air Force, too, has its changing fashion scene. Above is how the WAF uniform looked back in the 1950s. Skirts had that floppy look and came all the way to mid-calf with no length options.

A1C Pat Rowe (left) and Sgt. Paulette Stugart model 1970 WAF uniforms to show maximum and minimum permitted skirt lengths. Just what effect fall's anticipated fashions will have is unclear.

On the masculine side, Col. John R. Hansen of the C-5 Systems Program Office, Wright-Patterson AFB, Ohio, wears an experimental two-tone summer uniform that may replace the tan one.

system is part of the monitoring equipment.

☆

About a month had elapsed between the disastrous Peruvian earthquake (*see AF/SD, July, page 22; August, page 26*) and the arrival of massive Soviet aid to the stricken area.

Huge Soviet AN-22s (until the US Air Force's C-5, the record-holder in lifting air cargo) and smaller AN-12s brought in medical personnel and supplies, including a complete hospital unit, prefab housing, food, clothing, and helicopters.

The transports came from northern Russia via Iceland, where they refueled at Keflavik Airfield.

One of the giant AN-22s disappeared from US radarscopes monitoring the Soviet flights, presumably having crashed in the North Atlantic off Greenland. Although an immediate search was undertaken, nothing of the aircraft and its twenty-five passengers and crew was found.

☆

NEWS NOTES—**Dulles International Airport,** near the nation's capital, has

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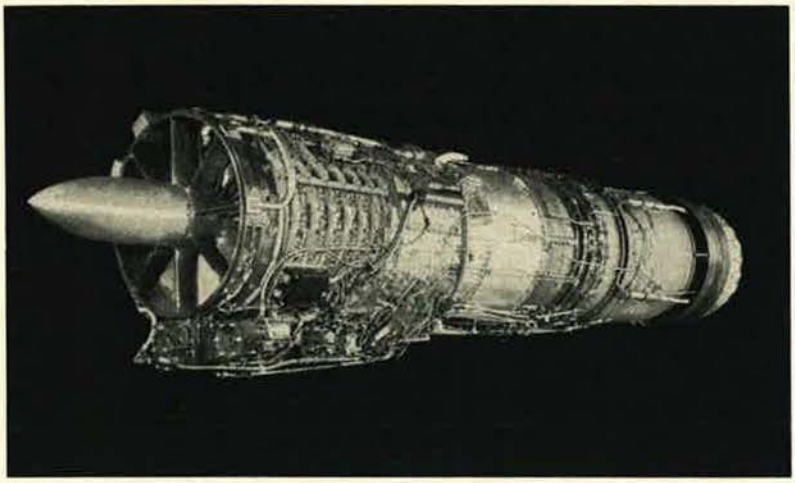
jet set

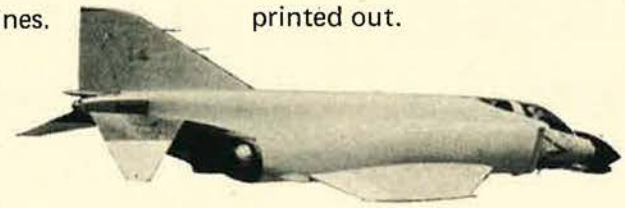
How to economically test jet engine fuel controllers — Testing fuel controllers on the J79 engine used to be a large scale, expensive, manual operation. RCA has developed something better — called the Automated Test System/Jet Engine Accessories — ATS/JEA.



One Computerized System —
This RCA system tests fuel controllers automatically, precisely, and at far less cost. One time-shared process controller monitors all test stands.

How does it work? —
Four test stands (thirty-six more can be added to the system). Each stand is a self-contained unit complete with hydraulic system and reservoir, transducers, actuators, control panels, digital display, and teletype-writer. Using printed or visual instructions, an operator merely hooks up and makes mechanical adjustments. The process controller does the rest. Any adjustment or malfunction is identified and printed out.

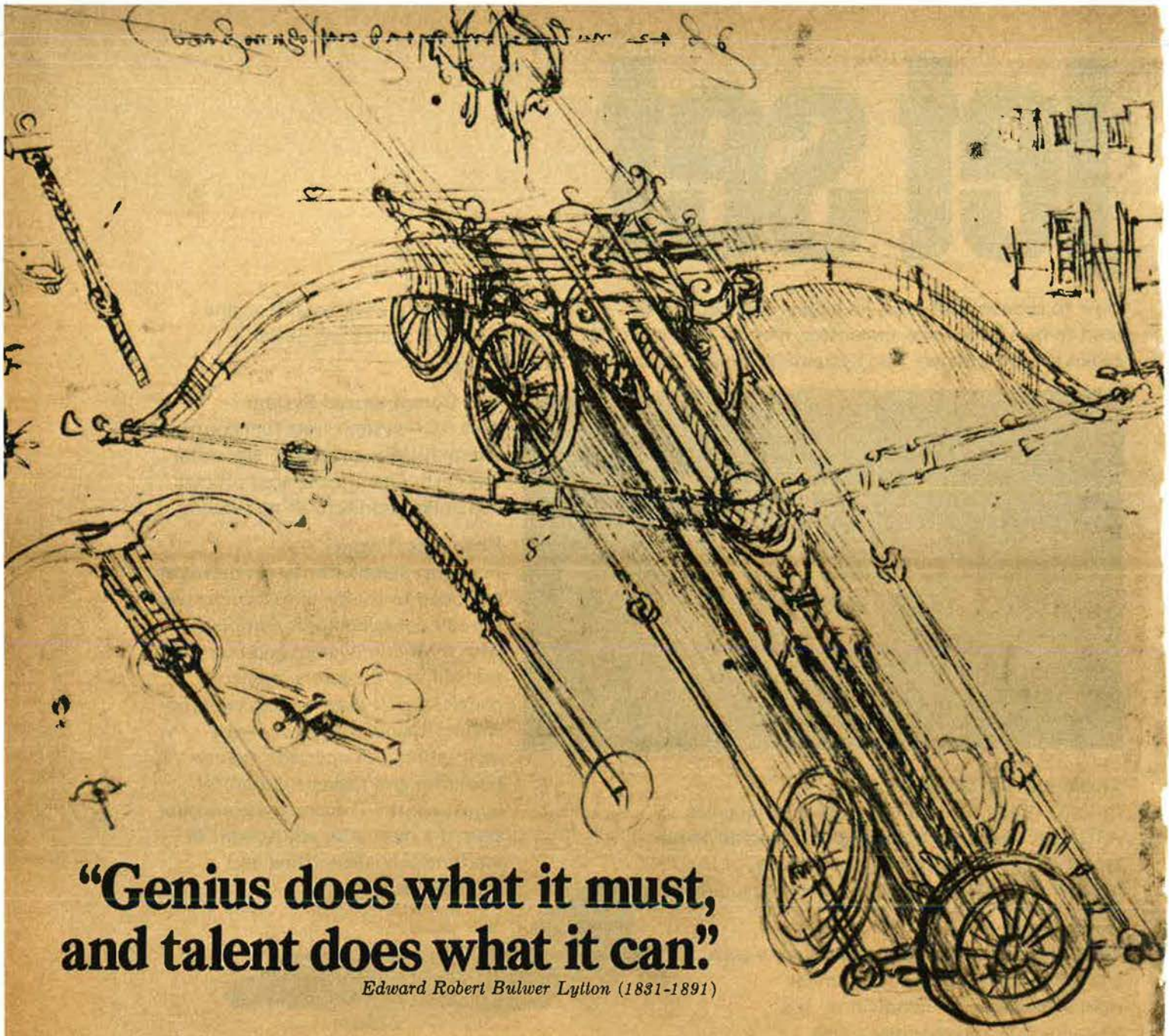
This is just the beginning —
Initially it will be used for overhauled engines. ATS/JEA has broad applications in engine manufacturing plants for production testing, or in maintenance hangars serving commercial airlines.



How reliable is it? —
The system uses standard components with a proven record of reliability under rigid environmental conditions. It's all solid state and modular. This makes it easy to maintain while simplifying future expansion.

If you want more information about the ATS/JEA System, contact:
RCA Defense Electronics Products,
Aerospace Systems Division,
Burlington, Mass. 01801.

RCA Defense Electronic Products



"Genius does what it must, and talent does what it can."

Edward Robert Bulwer Lytton (1831-1891)

. . . Lytton, a contemporary of Robert Browning and the other great Victorian writers, wanted nothing more than to be a great poet. But wanting wasn't enough. Nor was he deluded by the praise he did receive. Toward the end of his life, he realized that greatness took genius, and that the only thing worse than failing in a life's prime purpose was to be content with a little success. Genius is never content. "Genius is master of man," he said. "Genius does what it must, and talent does what it can . . ."

Talent alone is never good enough. Especially today. The demands are too great. The needs too critical. The results of failure too devastating.

We must somehow stay a step ahead of technology, and not settle for "little successes."

Our approach has always been to conceive and design communications equipment that others either haven't thought of, or just can't seem to produce.

Especially when it comes to converting theoretical electronic ideas into practical, functional products.

Our computerized tactical field telephone switching system is smaller, faster, and more reliable than any other. And it automatically tells you if there's anything wrong and how to fix it.

Our pocket-size two-way rescue radio lets downed fliers tell air and sea rescue units where they are and how to get them home.

Our Standard Lightweight Avionics Equipment (SLAE) was the first to be specially designed and built for small helicopters.

And there are dozens of other things our people are working on that we can't talk about.

We don't develop these things because we can. We do it because we must.

Sylvania Electronic Systems, Sylvan Rd., Waltham, Mass. 02154.

SYLVANIA
GENERAL TELEPHONE & ELECTRONICS

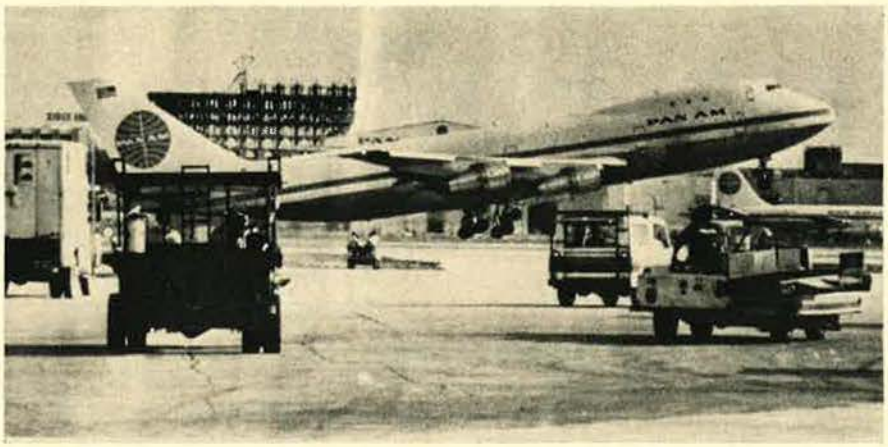
Air Force Academy third-class cadets (from left) Grant W. Meadows, Jr., William P. Beck, and Richard W. Harris quench their thirst with snow during a rest break at Saylor Park, Pike National Forest. The three received training in Survival, Evasion, Resistance, and Escape, a course designed to teach them how to live off the country under combat conditions and while so doing evade capture by an enemy's forces.

been picked as the site of the first **US International Aeronautical Exposition** now scheduled for June 1972. It is predicted that the event will draw more than 500 exhibits on aeronautical matters and advanced transportation methods and more than a million visitors.

On July 31, **USAF** was presented with the **Award of Honor,** the **National Safety Council's** highest award for safety-active industries and government agencies. The Air Force achieved a 17.7 percent reduction in worldwide ground accidents involving motor vehicles. It is the eighteenth time USAF has won the award.

The keel laying of the **Navy's** new nuclear-powered **attack carrier** USS *Dwight D. Eisenhower,* took place on August 15 at Newport News Shipbuilding and Dry Dock Co., Newport News, Va.

The Air Force's **C-5 transport** has begun regular flights to **Europe.** The giant aircraft's cargo-airlift role is scheduled at an initial one flight a week, but this will increase as more of the aircraft enter the inventory and demand rises.—END



—Wide World Photos

Finally on its way to San Juan, Puerto Rico, is this Pan American Airways 747 jet, the first of its kind to be hijacked. The aircraft, with 360 passengers aboard, was on a New York to San Juan flight when it was forced to fly to Havana, Cuba. Here it is shown taking off from Miami International Airport, where it had returned from its trip to Havana. Aircraft hijackings have become one of the airlines' major concerns.

AIRMAN'S BOOKSHELF

The U-2 Pilot—Hero or Bum?

Operation Overflight: The U-2 Spy Pilot Tells His Story for the First Time, by Francis Gary Powers, with Curt Gentry. Holt, Rinehart and Winston, New York, 1970. 375 pages. $6.95.

On May 1, 1960, a near-miss by a Soviet surface-to-air missile crippled Francis Gary Powers' U-2 spy plane near Sverdlovsk, about midway along his planned course between Peshawar, Pakistan, and Bodö, Norway. In the wake of the incident came twenty-one months of imprisonment for Powers, the end of the US program of manned overflights of the Soviet Union, the abrupt cancellation of the Eisenhower-Khrushchev Summit meeting in Paris, and some fundamental moral questions about the conduct of intelligence operations by a democratic society.

Now, ten years later, the U-2 pilot tells his story. It is a story that for some years after his repatriation (in 1962, in exchange for Russian "master spy" Col. Rudolf Abel) Powers was "discouraged" from telling, by the CIA, his employer.

The book adds invaluably to the public record of the U-2 affair and in turn raises a number of questions for which answers may never be forthcoming.

Mr. Powers tells his story in straightforward fashion, from his Depression boyhood in the coal-mining hills of Appalachia, through his joining the Air Force in 1950, his flight training, recruitment by the CIA in 1955, his learning to fly "Kelly" Johnson's remarkable new plane—the U-2—and descriptions of the U-2's use in operations, both high-altitude research and reconnaissance.

Certainly the most graphic part of Powers' book is his account of the May 1 overflight, his struggle to escape from the crippled plane, his capture and interrogation, and his own thoughts while the Soviets were playing cat-and-mouse with the US government, which found itself uncomfortably hoist on its own inept cover story.

Powers gives his version of the trial, describes in detail his experiences in Lubyanka and Vladimir Prisons, and tells how the exchange (initiated by his father and Colonel Abel's American attorney, James Donovan) of Abel for Powers came about.

The most telling part of the book is the final section, describing Powers' return to the US, where the public was unable to decide whether he was, in the words of one newspaper headline, "HERO OR BUM?"

The suppression, until now, of Powers' memoirs left largely unanswered such questions as why Powers didn't blow up his plane, why he didn't use the "poison needle" the Soviets made such an exhibit of, why he didn't report by radio when he knew his plane was going down, and why, at his show trial, he was so cooperative with his Soviet captors, even to the point of "apologizing."

Powers' book furnishes credible answers to all these questions, and to others. But it goes further. It raises some questions of its own. For instance, did President Eisenhower *want* the Russians to know about the May 1 overflight, to give him bargaining strength at the coming Summit for his "Open Skies" program? Was the U-2 flight betrayed by Martin and Mitchell, the two National Security Agency cryptologists who, after giving the Russians secret information since 1958, defected to the Soviet Union two months after Powers crashed? And, perhaps most intriguing of all, was there any connection between Powers' capture and the defection to Russia, six months earlier, of a former Marine Corps radar operator who had been based at Atsugi, Japan, one of the U-2 bases? The Marine's name: Lee Harvey Oswald.

Operation Overflight is in many ways a defensive book, even an angry book. The author may have justification. One can make the case that the U-2 pilot was treated more shabbily by his own government than by that of the Soviet Union. After his return to the US, Powers found himself in a gray area. He was cleared by the CIA, but the CIA's statement seemed designed primarily to get the Agency off the hook. In Vladimir Prison, at least, Powers knew where he stood.

Powers worked briefly for the CIA after his repatriation, but did not find the work "meaningful" and yearned to return to flying. The Air Force would have taken him back, but reneged on its earlier promises that Powers would suffer no loss of time in grade or credit toward retirement for his service with the CIA. Until recently, Powers worked for "Kelly" Johnson at Lockheed, test-flying U-2s.

On some of the larger issues, there can be no doubt that the U-2 program was highly productive. In his memoirs (*The Craft of Intelligence,* Harper and Row, 1963), published after his retirement as Director of the CIA, Allen Dulles said that the U-2 "could collect information with more speed, accuracy, and dependability than could any agent on the ground. In a sense, its feats could be equaled only by the acquisition of technical documents directly from Soviet offices and laboratories. The U-2 marked a new high, in more ways than one, in the scientific collection of intelligence."

The "in more ways than one" phrase refers, of course, to the extraordinary altitude capabilities of the U-2, an area in which Powers is still reticent. He told the Russians he was flying at 68,000 feet when his U-2 was crippled. In his book, he says this was two lies: that this was not the altitude he was flying on that mission, and that the U-2's maximum is higher than 68,000 feet.

It was Powers' own decision to withhold vital technical and operational details from the Russians. His entire CIA guideline on what to do if captured consisted of: "You may as well tell them everything, because they're going to get it out of you anyway."

"They" didn't get it all out of him. Powers talked—"confessed," if you prefer—but told the Russians only what he felt they already knew.

History should record that Francis Powers—a product of his times, when "gentlemen" still do, and must, read "other people's mail," and when technical accomplishment sometimes outruns human considerations—was a man who behaved honorably, even heroically, under terribly difficult circumstances.

—Reviewed by Richard M. Skinner. Mr. Skinner is Managing Editor of this magazine.

More Melman Mania

Pentagon Capitalism: The Political Economy of War, by Seymour Melman. McGraw-Hill, New York, 1970. 290 pages. $8.50.

Pentagon Capitalism is professed to be a concerned view of a fundamental institutional change in the American economy. Surprisingly, we learn from a critic of the

defense establishment that the military-industrial complex is dead, having been replaced under Secretary of Defense Robert S. McNamara's regime by a system of State Capitalism. But we are warned to take no comfort from this, for the new system faces a task described as impossible, and it is motivated by a sort of Parkinson's Law to strive only for expansion of its own authority.

The charge that management of the defense establishment has fundamentally altered the US economic system sounds novel but, in fact, there is little new-Melman in this latest work by one of the foremost critics of the defense effort. Seymour Melman probably is best known to readers of AF/SD as the principal proponent of the "overkill" thesis. In *Pentagon Capitalism,* overkill is adopted as a basic premise, and the author also draws heavily upon his 1965 book, *Our Depleted Society.*

The author reasons that additions to or improvements in the strategic forces have no military value since we already can overkill any enemy. Furthermore, Melman considers defense against an attack to be infeasible in light of advanced weaponry. He dismisses deterrence as no more than a speculative experiment in applied psychology. Thus, he claims to have disposed of the presumed objectives of the Defense Department managers. Instead, every activity and every policy of the "state managers" is interpreted as a move to extend the influence and authority of the Department of Defense.

The main points of the book are summarized in the first chapter, where the Office of the Secretary of Defense is characterized as a super-management that is so intimately concerned with the operational details of defense contracts as to make government become business, and contractors become mere submanagements. Subsequent chapters document the thoroughness of state control by descriptions of the activities of the Defense Supply Agency and by lengthy quotations from the Armed Services Procurement Regulations (ASPR).

The reader is sure to be impressed by the degree of control exercised by the Pentagon but, if he is concerned by the very difficult problems of choice inherent in the procurement of major weapon systems, it is likely to be a positive impression. It is only because all procurement is irrational in the view of the author that these controls are seen as mere means for the extension of Pentagon power.

Melman regards a penchant for increased authority as a natural propensity of management. In successive chapters, he deplores "Extension of Control over Means of Production" and "Extension of Control over the Universities and Research." In a chapter entitled "The Vietnam War Program," he characterizes both the SEA conflict and preparedness to face insurgency elsewhere in the world as mere excuses for the state management to enlarge its powers.

This wide-ranging censure of every defense activity loses credibility because of its manifest bias and inconsistencies. Melman decries the utilization of civilian universities and researchers for fear that they become subverted by defense interests. (This has a hollow ring today, after so much campus criticism of Pentagon-sponsored research.) He ignores any possibility that civilian institutions and individuals might constructively influence government. He charges that any conceivable benefits of military service are foreclosed to those who need improvement because of the high rejection rates of young men with physical or educational shortcomings. But he also criticizes "Project 100,000" as an incursion into basic education. He discounts the collateral benefits of military R&D, but criticizes DoD interest in furthering technology in housing and hospitals.

A curious bit of irrelevance appears in his criticism of cost-benefit analysis, which he deems ineffective in aiding systems selection. He offers as evidence a list of sixty-five contracts that were canceled only after the expenditure of substantial sums of money. But, of those sixty-five contracts, only two were started after 1960 and only twenty-three were canceled after 1960. Thus, most of his data predate the emphasis upon systems analysis associated with Secretary McNamara. So his "evidence" could as well be used to *justify* cost-benefit analysis.

Melman's accounting of the real costs of the defense effort is drawn almost entirely from his earlier *Our Depleted Society.* It is remarkable for attributing virtually every social and economic problem of the nation to the activities of the Pentagon. The state managers are blamed for high infant-mortality rates, aged capital equipment, high interest rates, and dislocations in the world gold market, among many others. In general, Melman considers defense expenditures "parasitic," as contrasted with "productive" expenditures that add to current or future consumable goods and services. This, again, is based upon his assumption that defense is unattainable. Such a distinction recalls the long-abandoned controversy among nineteenth century economists between productive and nonproductive labor.

Pentagon Capitalism will no doubt serve as a useful compendium of arguments for critics of the defense establishment. But it is neither a well-reasoned analysis of political economy nor a constructive critique of defense decision-making.

—Reviewed by Maj. Edward L. Claiborn. Major Claiborn is an Associate Professor of Economics, at the Air Force Academy.

NEW BOOKS IN BRIEF

Americans to the Moon, by Gene Gurney. A considerably shorter and more enthusiastic account of Project Apollo than *Journey to Tranquility* (*see below*). Well illustrated, easy reading. Random House, New York, 1970. 147 pages with index. $3.95.

Fighters Over the Desert, by Christopher Shores and Hans Ring. The air campaigns in North Africa between 1940 and 1942, written by English and German coauthors. Includes hundreds of photographs. Arco Publishing Co., New York, 1970. 250 pages with appendices. $8.50.

Flight to the Stars, by James Strong. Contains much interesting data and some fascinating speculation on interstellar flight. Hart Publishing Co., New York, 1965. 178 pages with index. $4.95 hardback; $1.95 paperback.

Journey to Tranquility, by Hugo Young, Bryan Silcock, and Peter Dunn. Three British writers record the history of the US space program to the first moon landing. Impressed by US technical and managerial genius, they see little of value in what they believe to have been a largely unsuccessful bid for world prestige. Doubleday & Co., New York, 1970. 302 pages with index. $7.95.

The Royal Australian Air Force and Royal New Zealand Air Force in the Pacific, by Rene J. Francillon. This is the third in a series of Aero Pictorial histories, and the only such work on the RAAF and the RNZAF. Contains more than 200 pictures and much additional data on all aircraft flown in the Pacific by both Air Forces. Aero Publishers, Fallbrook, Calif. 98 pages. $3.95.

They Flew Alone, by George Sullivan. The author writes knowledgeably and with a good sense of drama about a number of notable flights, from Wilbur Wright through Chuck Yeager's breaking the sound barrier. Frederick Warne & Co., New York, 1969. 164 pages. $3.95.

POW ACTION REPORT MIA

Rescue Line

On May 1, 1970, newspaper advertisements in Bangkok, Stockholm, and New Delhi appealed for humane treatment of American POWs in Southeast Asia. The appeals, addressed to North Vietnam, were paid for by an organization called "Rescue Line."

The ads represented a modest beginning for what Rescue Line's founder, Mrs. James Lindberg Hughes, hopes will become a major newspaper campaign wherever the North Vietnamese have embassies.

Mrs. Hughes, wife of an Air Force lieutenant colonel who is being held prisoner by North Vietnam, is a determined and resourceful woman. She began her appeals for POWs through paid ads in foreign newspapers in August 1969. And she has even traveled to Laos to meet her husbands' captors face to face.

Her husband was shot down over North Vietnam in May 1967. The Hughes family received three letters from him in the next two months, and then the letters stopped. In August 1969, Mrs. Hughes began an advertising campaign with an appeal in a Hong Kong newspaper, for information about him and other American POWs. She followed with several ads in the Bangkok *Post*, paying for these ads herself.

In December 1969, Mrs. Hughes, along with Mrs. Louis F. Jones, wife of an Air Force lieutenant colonel shot down over Laos, journeyed to Vientiane, Laos. They were the first MIA/POW relatives to be granted interviews in Laos by Pathet Lao and North Vietnamese officials. Mrs. Hughes was told by a North Vietnamese representative that her husband was alive and well. Mrs. Jones, who now lives in Fairfax, Va., was unable to get any information about her husband.

After returning home, Mrs. Hughes continued to place ads in foreign newspapers. She became convinced of the value of her campaign after the ad in the Bangkok *Post* appeared to have persuaded the Communists to broadcast a message from her husband over Hanoi radio. This small success led to the establishment of Rescue Line.

Last spring, Mrs. Hughes began publicizing her program and seeking funds. Early support came from friends in New Mexico, and from other POW families. Now other groups, including Air Force wives' clubs across the country, have joined in the effort.

Mrs. James Lindberg Hughes has started an ad campaign to aid POWs in Vietnam.

In May, Mrs. Hughes wrote to additional foreign newspapers for advertising rates. Many said they would not accept the ads because they were "too political." There was more than enough response, however, to expand the campaign as money became available. In the meantime, the Rescue Line campaign continues with an ad each week in the Bangkok *Post*, at a cost of about $500 a month.

Mrs. Hughes asked a former USAF information officer, retired Col. Harold Woodruff, for help in securing new ad layouts. Colonel Woodruff now is Director of Programs for Santa Fe (N.M.) College. He suggested that the inmates of the Penitentiary of New Mexico might help, since many of the prisoners were enrolled in art courses through the college. In early June, Mrs. Hughes met with Warden Felix Rodriguez, other officials, and an inmate, to talk about prisoners helping prisoners. Out of this meeting came POWER DRIVE.

POWER DRIVE

The Penitentiary of New Mexico inmates, with the support of New Mexico prison authorities, formed a committee to organize a concentrated campaign in behalf of American prisoners in Southeast Asia.

POWER drive
(PRISONERS OF WAR EFFECTIVE RELEASE)

This emblem was designed by inmates of the New Mexico State Penitentiary to symbolize their campaign of prisoners helping prisoners through support of "Rescue Line."

The name "POWER DRIVE" was coined—for Prisoners Of War Effective Release Drive.

Special artwork was done, posters were prepared, and publicity and advertising ideas were worked out. Service clubs and other inmate groups were contacted, and money started to come in—from convicts.

Contributions ranging from $1 to $10 were received. And, through the combined cooperation of the prison administration and officials of the blood-plasma program, arrangements were made whereby inmates could give blood and have $5 deposited to the account of Rescue Line.

By early July, Mrs. Hughes had received twenty-eight starkly dramatic, black-and-white posters and a

check for $269 from inmates. To date, more than sixty-five percent of the New Mexico prisoners have contributed to POWER DRIVE.

The prisoners now are spreading the campaign from the Penitentiary of New Mexico to other penal institutions.

The address for Rescue Line is Box 2392, Santa Fe, N. M. 87501. For additional information on POWER DRIVE, write to the Penitentiary of New Mexico, Santa Fe, N. M. 87501.

Eglin, Fla.

The Citizens Assistance Program of Ft. Walton Beach, Fla., spearheaded by the Eglin AFA Chapter, reports that it has been "snowed under" by requests from individuals and groups wanting to know how they can help MIA/POWs.

By mid-July, they had distributed more than 35,000 copies of their twenty-four-page brochure, "Lest We Forget," to all parts of the country and overseas. More than 1,000 mailings were made as a result of an editorial appearing in Hearst newspapers across the country in mid-June, which gave the Eglin Chapter's address as a source of information.

By mid-July, the program had also distributed some 36,000 bumper stickers and 10,000 ministickers, measuring 1¼ x 4 inches. An additional 10,000 bumper stickers were procured by Dr. Dan Callahan, president of AFA's Middle Georgia Chapter, which purchased them to support its campaign in behalf of MIA/POWs.

The Eglin-area group has been working with many organizations, including the National League of Families; United We Stand, of Dallas, Tex.; I Care, Inc., of Atlanta, Ga.; and The Forgotten Americans Committee, of Omaha, Neb.

The Eglin AFA Chapter recently presented AFA membership to thirteen MIA/POW wives so that each would receive a personal, monthly copy of AIR FORCE/SPACE DIGEST.

The Eglin campaign has been an area-wide project, with volunteer help and money coming from many organizations. Two of the volunteers most responsible—both retired USAF officers, Col. Harry Howton, Area Coordinator, and Lt. Col. David J. Andersen, his assistant — have been working up to sixteen hours a day to keep up with the mail and their many, varied programs.

Time Is Money

Americans who own "Spiro Agnew" wristwatches have indirectly contributed some $10,000 to the National League of Families to help the League's efforts on behalf of POWs. Mr. Agnew collected $20,000 from two manufacturers of the novelty watches and specified that American Indian children and the League share the money equally. In addition, Varsity House Inc., of Columbus, Ohio, which makes Spiro Agnew sweatshirts, made an advance payment of $5,000 and will give two percent of its royalties to the Agnew-designated recipients.

POW/MIA Seminar

A major meeting to report on efforts on behalf of MIA/POWs, and to explore new approaches, is scheduled for AFA's Annual Convention. The seminar will be held at the Sheraton-Park Hotel on Wednesday morning, September 23. Three presentations are planned by the Department of Defense, Department of State, and the Red Cross—to be followed by comments from a discussion panel that will include a former POW released by Hanoi.

—BY MAURICE LIEN

This is a sample of the twenty-eight posters done for "Rescue Line" by inmates of the New Mexico State Penitentiary. This example is accompanied by a quote from Ho Chi Minh: "Four inhuman months in the depths of this jail. More than ten years aging has ravaged my body."

Volunteers assist in a recent mailing of Ft. Walton Beach, Fla., brochure on helping POWs. They are, from the left, Mrs. Carl B. Crumpler, wife of a POW; area coordinator Col. (Ret.) Harry Howton; Postmaster; Col. (Ret.) Bud West, Vice President of the Florida AFA; and Chuck Widaman, Eglin Chapter President.

Arnold Air Society and Angel Flight assistance in the MIA/POW issue was discussed recently at AFA Headquarters by, from left, Mrs. Kevin J. McManus (Capt.-POW); Mrs. Bobby G. Vinson (Col.-MIA); and U. of Md.'s Barbara Arata and Mary McCarthy, Angel Flight National Secretary and Commander.

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Precedence	Objective	Average Performance
Z—emergency	10 minutes	3.45 minutes
O—operation	1 hour	5.04 minutes
P—priority	6 hours	12.21 minutes
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This is typical of Western Union's approach to the needs of civilian and military communications Our services go beyond installing systems. We continually maintain and upgrade performance. And that's because our goal is to make electronic data communications as useful and practical as electronic data processing.

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USAF—The Momentous Quarter Century

THE essence of editing is selection, choosing from the reams of copy available, from the mounds of photos, from the endless vault of ideas, that which is most important and informative. To highlight in words and pictures the twenty-five momentous Air Force years from 1945 to 1970 is a formidable assignment. So much history has been made so fast.

Yet there are major themes in the Air Force story since 1945, and we have tried to illuminate them in this issue. Senior Editor John Frisbee tells, as one who was there on active duty, what it was like to live through the vast changes that have transformed the Air Force in the past quarter century. Air Force historian Thomas Sturm relates how the Air Force organization evolved in response to the challenges it has faced. Associate Editor Edgar Ulsamer recounts how from the beginning the Air Force has immersed itself in technology as the key to air and, later, aerospace supremacy.

Aerospace Industries Association president, Karl Harr, Jr., chronicles industry's response to the challenging demands of aerospace superiority. Senior Editor William Leavitt traces how airpower became aerospace power and tells of the vital role the Air Force played in crossing the space frontier. Senior Editor Claude Witze analyzes the politics of airpower since 1945. And Robert C. Moot, Assistant Secretary of Defense (Comptroller), speaks of money as it has to do with defense *and* with pressing domestic needs. Capt. Aaron Thrush, of the Air Force Academy's Department of Political Science, explores the nature of the Soviet challenge then and now, and Maj. David MacIsaac, an Associate Professor of History at the Air Force Academy, analyzes the significance of that most important and so often misunderstood aspect of airpower—strategic bombing.

For this issue, we have assembled an array of specially commissioned drawings, gracing each section of our chronicles, from the bold hand of Cliff Prine, whose illustrations have appeared in many previous issues of AIR FORCE Magazine. The poem on page 70, by Lt. Col. Don Clelland, was specially written for this issue to accompany a spread of striking paintings from the Air Force Art Collection.

All of this we dedicate to those of the United States Air Force who have gone before, to those who man it now, and to those who will man it in times to come.

—THE EDITORS

The Panorama Unfolds

BY JOHN L. FRISBEE

Senior Editor, Plans and Policy

TWENTY-FIVE years ago this month, two great wars—one in Europe and North Africa, and one in the Pacific—had just ended. The United States already had begun to dismantle the most powerful military force in history. Perhaps "dismantle" is not the right word. It implies some orderliness of process. Our victorious forces were smashed with a wrecking ball. Shortly before V-J Day, the Army Air Forces had commanded the equivalent of 243 operational wings. Only a few months later, Gen. Carl "Tooey" Spaatz warned that he could not muster a single, fully effective squadron.

The story of how the Air Force rose from the ashes of victory to again become the most powerful fighting force in the world has to be told in several parts. It is a story of technology, of response to an external threat, of organizational arrangements, and of public acceptance. Those parts are discussed elsewhere in this issue of AIR FORCE Magazine.

It also is a story of ideas: how the Air Force looked at itself, at its military responsibilities, at its people, and at its place in American society. Some of that story is told here with acknowledged subjectivity. Perhaps no one whose life has been touched by a great organization, as all of ours have by the Air Force, can pretend to talk about that organization with complete objectivity. So this is not a capsule history of Air Force life, but rather some impressions of a tumultuous quarter century, told in the knowledge that each of us gained from his Air Force experience something of value—a satisfaction that perhaps is found only in a corporate endeavor whose goals transcend personal gain. And also in the belief that the sum of our individual efforts was of value to the United States and to much of the rest of the world.

For most of us there are trivial things—often far in the past—flashbacks that stake out the parameters of a situation. Sometimes they do it in a positive way, sometimes in the negative. There are four such personal trivia that often pop up when I think about my own nearly twenty-five years in the postwar Air Force.

One occurred around V-E Day, while I was assigned to the Air Staff of Supreme Headquarters, Allied Forces, Europe. There was a Reserve colonel in the headquarters, who had gone through flight training in the 1930s, served a few years' active duty, then returned to civilian life and a successful law career. He asked me what I planned to do after the war. I told him I was thinking about applying for a Regular commission.

"Don't do it," he said. "You'd die of boredom in the peacetime air force. Your work—such as it is—is done by noon. It's a nice life, but no challenge. That's the way it was in the '30s and that's what it will be again."

A Poor Prophet

The Soviets made a very bad prophet of the colonel. It's easy to say he should have known better. Even then, in the closing weeks of the war, we couldn't get a bomb line from the Russians. Soviet liaison officers in the headquarters had as little to do with the other Allies as possible. The Soviet command gave us a very bad time whenever we tried to clear a supply flight to the US mission in Moscow. For their part, if they wanted to send a plane to London, they did it and informed us after it had landed. A few months later, in the fall of 1945, Soviet fighters shot down at least one unarmed American transport that strayed out of the poorly defined air corridor from West Germany to Berlin. What they were doing to Eastern Europe, as Russian troops pushed toward Berlin prior to V-E Day, was well enough known.

The colonel should have known better than to think that conflict would stop when the shooting did. But so should a lot of others who were in on much more than he was. Anyway, the Air Force never went back to the tranquil garrison life of prewar days.

Another trivial incident happened when I got back to the States late in 1945 and told friends, who weren't exactly military-oriented, that I intended to stay in the Air Force. That was the first time I heard the old cliché: "The military spends all its time getting ready to fight the next war with the weapons and tactics of the last." The atomic bomb, jet aircraft, electronics, computers, and missiles made poor prophets of my friends, too. The next twenty-five years were to see an upheaval in weapons, doctrine, strategy, tactics, and management like nothing that had happened previously—and maybe like nothing that will happen again. Prophets tend to be more cautious these days.

The last two trivia relate to the other side of the Air Force's hardware/people equation. In January 1942, I was a preflight cadet at Maxwell Field, living in newly built concrete barracks set in a sea of mud. We used to talk about what would happen to those rows and rows of barracks after the war. All they would be good for, it seemed, was low-cost public housing.

A little more than a year later, I was back at Maxwell as a second lieutenant, aide to a general and copilot on his Lodestar. It was obvious that the more senior officers who lived in permanent quarters enjoyed certain perquisites that weren't available to cadets at the other end of the field. For one thing, the commissary shopping list was left in a box by the door, picked up each day by someone, and groceries delivered by noon. Someone else came around from time to time to cut the grass. Clearly, the phrase "officer and gentleman" related to more than a code of military ethics.

Some three years later, I was back at Maxwell once more, this time as a major with a wife and two small children. We were living in those same concrete barracks of cadet days, hastily converted to family housing. Our air-conditioning during Alabama summers consisted of a block of ice with an electric fan behind it in the middle of the living room floor. Still, we were a lot better off than officers and airmen living off base or on the many temporary bases that had been built during the war. For several months the groceries were even delivered from the commissary and someone cut the grass. Then, the commissary stopped delivering, and then each barracks got its own lawnmower.

All this is by way of defining a postwar environmental background that was dictated more by events than by Air Force choice. In the continuous competition for scarce resources between the urgency of combat readiness in a nuclear world and the crying need for more and better housing, better pay, more stability—in short, a better life for the people who kept the show going—readiness usually had to be given the nod. Much of the graciousness of the old, established military life disappeared. It was replaced by hard work and long hours, but also by the excitement of helping to build a new Air Force in a period of rapid change, and by the satisfaction of knowing that freedom—with all its practiced imperfections—had a better chance of survival and growth because of American airpower. For Air Force people those twenty-five years haven't been all sweat, tears, and earnest striving by any means. There were plenty of good times with good friends. But more than 4,000 Air Force men have given their lives since V-J Day in the belief that what they were doing was worthwhile.

Instant Demobilization

We sometimes forget how Herculean was the task that faced the AAF in the years immediately following World War II. First there was the instant problem of demobilization. At its wartime peak, the AAF had more than 2,000,000 people in uniform, operating and supporting 68,400 airplanes. By mid-1947, there were only 303,000 people and 25,000 planes left.

Along with the other services, the AAF had occupation responsibilities in Europe and Japan. Our war-

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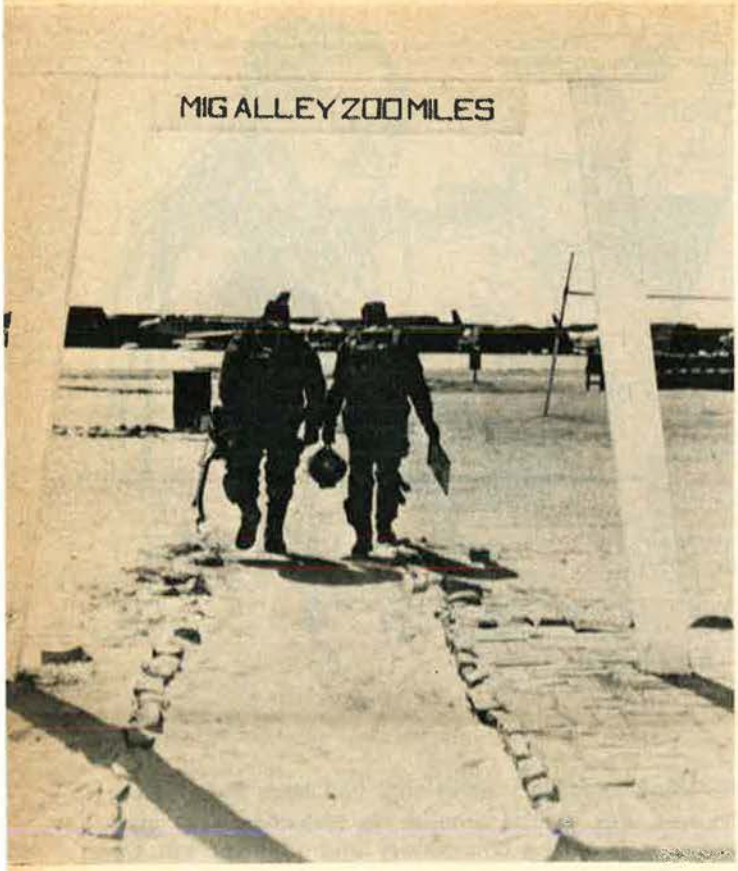

Korea saw the first aerial battles between jet fighters. In MIG Alley, far to the north of USAF bases, World War II-seasoned F-86 pilots ran up a 10-to-1 score over the enemy.

time Allies were physically and economically exhausted while the USSR—badly damaged, too—already showed signs of increasing truculence in Greece and Iran. Some operational air capability had to be restored as soon as possible. In March 1946, SAC had only one bomb group capable of sustained operations.

An independent status for the air arm was in the wind. While the fighting was still going on, the War Department, in Field Manual 100-20, had acknowledged that "land power and airpower are coequal and interdependent; neither is an auxiliary to the other." Almost everyone in the AAF believed that a separate air force was imminent. That created some rather large problems of preparing to take over administrative, support, and housekeeping functions that had been provided by the Army.

There were bound to be interservice disputes over roles and missions, and these would be complicated by nuclear weapons and by the growth of missilery, which didn't fit neatly into the traditional pattern of land, sea, and air forces. These issues had to be studied and the lessons of the war evaluated against a backdrop of technological change and a drastically altered international power balance.

All these were tasks that demanded the skill and knowledge of broadly experienced professionals. The emerging USAF didn't have enough of them. Before World War II, the Air Corps had numbered about 50,000 officers and airmen. From 1946 to 1950, Air Force personnel strength fluctuated between 300,000 and 400,000. Even taking into account the older, experienced Reserves who stayed on active duty and the more senior officers who transferred from the Army to the Air Force, probably eighty percent of the postwar Air Force was made up of people who had come in during the war. By and large, they were well-trained and experienced technicians who knew a specialty—operations, maintenance, training, supply—but who had not had the time or the opportunity to broaden their professional competence. Only about a quarter of the officers were college graduates, and many had gone into the AAF directly from high school.

In the closing months of the war and immediately after, AAF leaders made several decisions that helped fix the pattern of Air Force development for the next twenty-five years. Their outlook was global, although the country had not yet decided to assume worldwide commitments through the series of alliances and bilateral treaties that were entered into during the late 1940s and early '50s. As a result, it was decided that postwar airpower was to be built around the strategic air arm as a deterrent to future large-scale war (many airmen then thought to *all* war) and as the predominant element in combat if deterrence failed.

The Air Force was organized along simple, functional lines with each combat and support command having a clear-cut mission, coordinated with the missions of the other commands. With some modification and temporary departures, that organizational scheme has remained.

Preeminence in Research

Before his retirement, Gen. Henry H. "Hap" Arnold, the AAF's wartime commander, recognized that ". . . the first essential of the airpower necessary for our national security is preeminence in research." General Arnold recognized, too, that the Air Force would have to look to the civilian world for advice and assistance in both technical and nontechnical areas. He appointed that von Kármán Committee, which laid out a remarkably accurate forecast of the technology that would be needed and might be available to the Air Force. The RAND Corporation, first of the defense-oriented think tanks, was General Arnold's brainchild. Very early, there began a continuing close relationship between USAF and the civilian intellectual world.

Perhaps the decision that had the greatest long-term influence on the Air Force was the plan to develop a body of professionals as the nucleus of the postwar Air Force. Nuclear weapons and long-range bombers made forces in being, rather than in reserve, an essential of national security. Professional education was separated from training and established under the Air University, which opened its doors in 1946. The curricula of Air University schools and colleges were broadly oriented to develop men who not only knew their profession but were concerned with the political, ethical, and moral aspects of the use of military power. Since that time more than 47,000 USAF officers have attended Air University schools and colleges.

The new Air Force became the most education conscious of all the services. Along with professional competence, education became an important determinant of career advancement. Over the years, thousands of of-

ficers have been sent to civilian colleges and universities to complete educations that had been interrupted by the war, or to study a wide range of disciplines needed in a service that had become the nation's first line of global defense.

The Air Force Institute of Technology (AFIT) was established at Wright-Patterson AFB, Ohio, to provide both undergraduate and graduate education in engineering and management, and to administer the civilian institutions program of the Air Force. Air Force ROTC expanded to nearly 200 campuses at its peak.

The Air Training Command (ATC), charged with responsibility for teaching specific skills to both officers and airmen, was faced with a whole range of new problems as the Air Force moved to jets, nuclear weapons, advanced electronics, computer technology, new management techniques, and a host of other innovations. Its job was further and constantly complicated by wildly fluctuating force levels and budgets, by personnel retention rates that varied with shifts in the domestic economy and international tensions. Between 1945 and 1953, for example, the Air Force had five different force programs ranging up and down from forty-eight groups to 143. Military and civilian educational specialists helped reduce the size of the training problem by developing training aids and techniques, many of which have been accepted gradually by civilian educational systems.

Finally, the long-dreamed-of Air Force Academy became a reality in 1954 and rapidly assumed the leadership among service academies in modernizing the undergraduate education and training of future Regular officers.

In a sense, these early developments set a tone and style that, in broad outline, has continued to this day. It was based on an all-volunteer force, operational readiness to be attained if necessary at the cost of creature comforts, simplicity of organization, heavy reliance on technology, across-the-board professionalism, and an approach to management that laid the groundwork for systems analysis and automated management techniques that have spread to the other services, government agencies, and to industry.

Operators and Missionaries

That all sounds pretty sterile, but it wasn't. There were real people doing these things in the various headquarters and in the operational units that were fighting back to some semblance of combat readiness. The young Air Force had its operators like Curtis LeMay, O. P. Weyland, and Bill Tunner. It also had its missionaries, just as airpower had had during the Billy Mitchell days. Gen. Orvil Anderson, the first Commandant of the Air War College, was among the most

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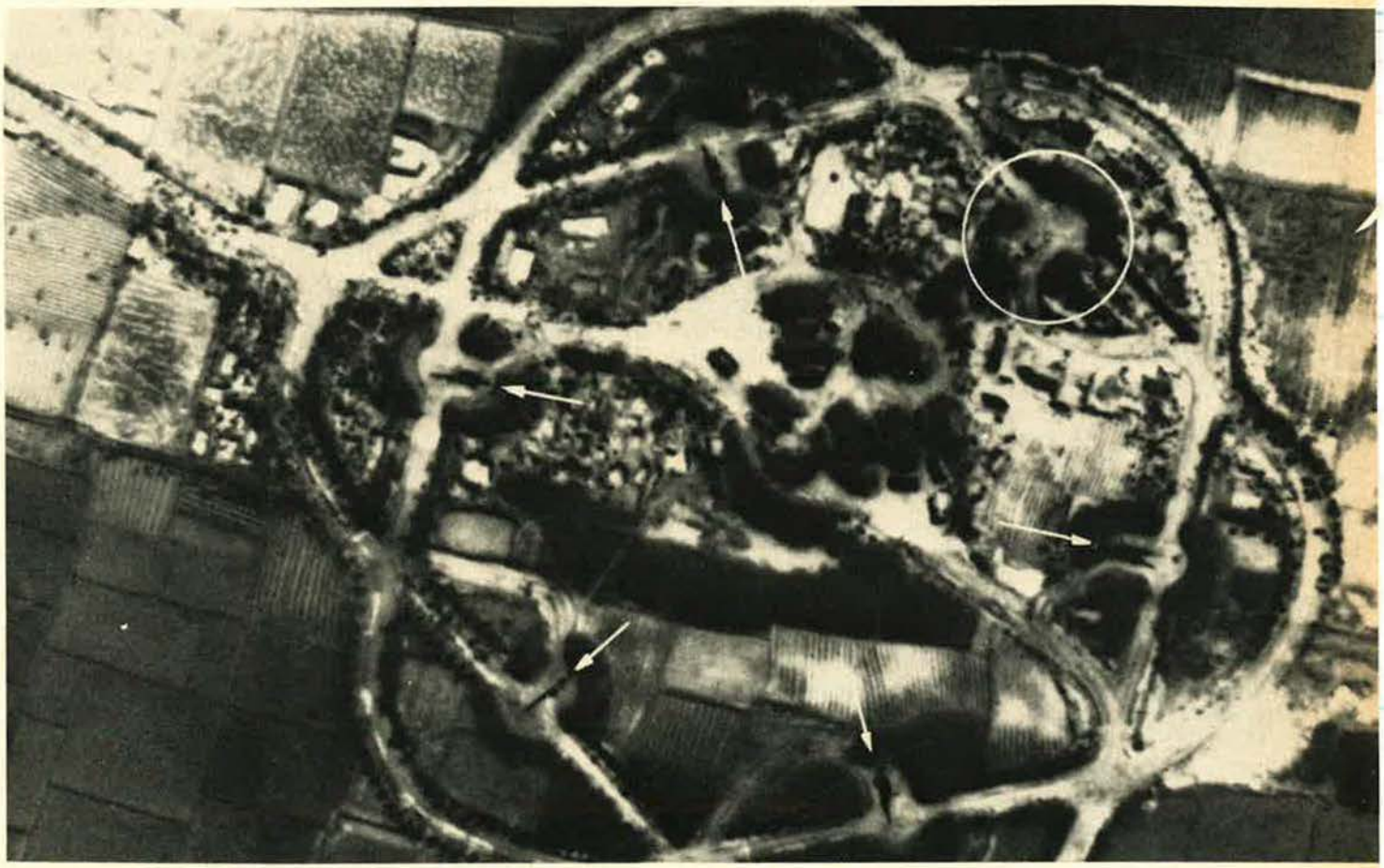

USAF aircrews gained their first combat experience against enemy surface-to-air missiles (SAMs) in North Vietnam. Tactics had to be modified constantly to successfully counter the formidable threat of Soviet-built SAMs in sites like these.

Unit rotation to overseas bases became a way of life for SAC people. These B-47s are preparing to take off from Thule AB.

vocal and persuasive. I remember entering the barber shop at Austin Hall, where the AWC was housed in its early days, and seeing a nervous, bewildered barber pinned in the corner by the General, who was giving him the word on strategic doctrine. Wherever one or more gathered, there was General Anderson's pulpit.

There was no fully developed nuclear doctrine in those early days. It was more an application of very limited nuclear experience to the strategic ideas of World War II, but the basis for elaborate formulations of Counterforce, Minimum Deterrence, and Finite Deterrence began to emerge. Many Air Force people who were to be influential in the great debates over nuclear strategy that occurred in the 1950s and '60s began to think systematically about strategy at the Air University. The early faculty and the first two classes at AWC and the Air Command and Staff College probably aggregated the greatest array of talent and experience that any air arm had ever assembled up to that time.

It wasn't an ivory-tower atmosphere, however. There was a lot of red blood circulating around the place. No one who was at Maxwell in those days will ever forget Big Foot Brown, the Marine Corps's gift (or rather, loan) to the Air Force. Or the Saturday night at the Officers' Club when, in a dazzling display of judo, the hundred-pound wife of an RAF exchange officer floored two of the Air Force's most colorful 220-pound colonels whose argument about tactics was about to pass over to physical violence.

And I'll never forget flying back to Maxwell from Stewart AFB, N.Y., in a B-25 with an equally colorful former fighter group commander. We were IFR over Washington with everything going sour—intermittent radio contact, traffic control noting us and another aircraft over the same reporting point at the same altitude at the same time, and so on. "To hell with it," he said. "Tell them we're now VFR and cancel the IFR flight plan." With that, he pulled back the throttles, pointed the nose down, and we broke out at 1,200 feet. The greatest miracle of all—we were never charged with a violation.

Triumphs and Disappointments

Very early in the game, the Air Force reached some of its most cherished goals. In September 1947, it gained independent status under the National Security Act that had been passed earlier that year. Six months later, at Secretary of Defense Forrestal's Key West Conference, the Air Force was given sole responsibility for strategic air operations and primary responsibility for air defense of the continental United States. Subsequent decisions in 1955 confirmed the Air Force assignment of tactical airlift, tactical reconnaissance, interdiction, and close support. These arrangements have been reinforced and expanded by interservice agreements since that time.

In June 1948, the wartime Air Transport Command and the Naval Air Transport Service were merged to form the Military Air Transport Service (MATS), a major Air Force command and an agency of the Department of Defense. This decision set the pattern for later consolidation of similar DoD-wide functions under one command or agency. A month after MATS was formed, it was plunged into the Berlin Airlift. That operation was significant for more than the great humanitarian work performed. The Airlift fed a starving city, warmed a freezing city, and earned the admiration of the non-Communist world—and probably, secretly, of a good many people on the other side of the Iron Curtain. The Berlin Airlift also demonstrated the use of airpower as an instrument of national policy in cold war—a function that MATS (now MAC) was to perform many times in later years, along with its support of military forces and operations.

But some Air Force objectives—particularly operational objectives—could not be reached between 1945 and 1950. That was a period of superausterity. Because

of its inability to reach even minimum essential force levels, the Air Force put heavy reliance on the Air Force Reserve and Air National Guard, though it never was able to provide them first-line equipment.

In Fiscal Year 1950, Congress appropriated $4.7 billion for the Air Force (in 1970, the budget of Air Force Systems Command alone was nearly $7.5 billion) and that same year the aircraft inventory dropped to a postwar low of fewer than 21,000 planes. This despite the fact that the Soviets had exploded a nuclear device in 1949, and the previous year had seized control of the Czech government and blockaded Berlin. At the time of the Czech coup, the Air Force had only one radar station operating in our continental air defense system.

Those were the days when interservice competition for roles and missions—and a slice of the budget that went with them—reached a crescendo. The carrier/B-36 controversy between the Navy and Air Force was a wide-open fight with no holds barred—a fight the likes of which couldn't possibly happen in today's more tightly controlled defense regime. A Navy captain publicly offered to demonstrate how safe a carrier would be in nuclear war by standing at one end of the runway at Anacostia Naval Air Station while the Air Force dropped an atomic bomb on the other end.

Korea—The Turning Point

Korea was a turning point. It found the Air Force, like the other services, ill-prepared and ill-equipped as a result of five successive starvation budgets. As Gen. Hoyt S. Vandenberg said, it was a shoestring Air Force that went to war in Korea. Much experience and talent came back via the Reserves and Air National Guard during the Korean buildup. The Air Force budget for Fiscal 1951 rose to $15.9 billion and the next year to $22.3 billion.

Not all of it went to the Korean War. NATO, established in 1949, placed additional demands on US airpower. The growing military power of the USSR, and its thermonuclear breakthrough of 1953, gave SAC real meaning in the eyes of most Americans. During the late 1950s, it was hardly possible to pick up a newspaper or magazine without seeing a story about SAC. It was one of those rare occasions when military men were heroes in peacetime.

Korea not only saved the United Nations from a probably fatal decline; it confirmed the tactical air warfare lessons of World War II and demonstrated that strategic airpower could confine hostilities to Korea at a time when NATO defenses were too weak to have withstood a Soviet attack.

For the first time in aerial warfare, jet fighters locked in combat. MIG Alley became a household word, and the USAF's 10-to-1 margin of victory over enemy fighters a legend. It's a legend that came back to haunt the Air Force when "Whiz Kids" used it to justify cutting the size of tactical air forces or turning down a new air-superiority fighter.

Korea was our first experience with a completely unprincipled enemy who resorted to brainwashing, torture, and forced confessions of "war crimes." After the war, a lot of nonsense was spoken and written about men who allegedly signed these confessions. Most of the nonsense came from people whose only experience with torture was having a thoroughly numbed molar filled by an expensive dentist.

Korea was limited war fought for limited objectives under close political control, but it did convince a majority of Americans that our security depended on military strength in being, and that conviction has lasted, at least until now.

Korea to Vietnam

Defense budgets declined after Korea, but less at the expense of the Air Force than of the Army and Navy. The "New Look" of Eisenhower years placed heavy reliance on airpower as the principal deterrent in a strategy of Massive Retaliation. The expansion and modernization of SAC continued at a steady pace to a peak strength of about 1,900 bombers, reducing in number during the 1960s as the ICBM force built up to its present strength of 1,054 missiles.

Concurrently, strategic defenses received a badly needed transfusion as the Soviet bomber force grew in size, range, and nuclear ordnance. New interceptors were brought into the inventory—the F-102 in 1956, and the F-101, F-104, and F-106 between 1958 and 1960. Radar coverage was vastly expanded with the Pinetree and Mid-Canada Lines, and the DEW Line, completed in 1957, the same year that NORAD, the joint US-Canadian defense command, was established.

Radar coverage was extended offshore by Texas Towers, picket ships, and airborne early-warning aircraft. Then came the Air Force surface-to-air missile, Bomarc, and finally the SAGE system of communication to tie the whole strategic defense array together. Very little air defense modernization has taken place since the early 1960s. The size of our strategic defense forces, in fact, has been cut drastically, but the Soviet bomber threat continues undiminished.

The years after Korea did not see an abatement of crises. There were the Suez and Hungarian affairs in 1956, Sputnik in October 1957, and Lebanon and Taiwan in 1958. These latter two tested the Air Force's limited-war capabilities and found deficiencies in mobility, airlift, and bare-base operating ability. But the reorientation of priorities from strategic forces to general-purpose and airlift forces was not to begin until 1961, when our strategic nuclear superiority seemed assured, and the Kennedy-McNamara team began a shift from its brief endorsement of a counterforce strategy to Assured Destruction—a strategy that came to imply effective, if not numerical, nuclear parity. Somewhat ironically, it was nuclear superiority, whose value Secretary McNamara later discounted, that settled the Cuban missile crisis of October 1962.

The War in Southeast Asia

The story from 1962 onward revolves principally around Vietnam, where by mid-1965 the United States was deeply committed to a war in which the most effective use of airpower was constrained by a strategy of "controlled escalation," or gradualism.

How can Vietnam be characterized? It has been a war of contrasts, contradictions, and paradoxes. Despite

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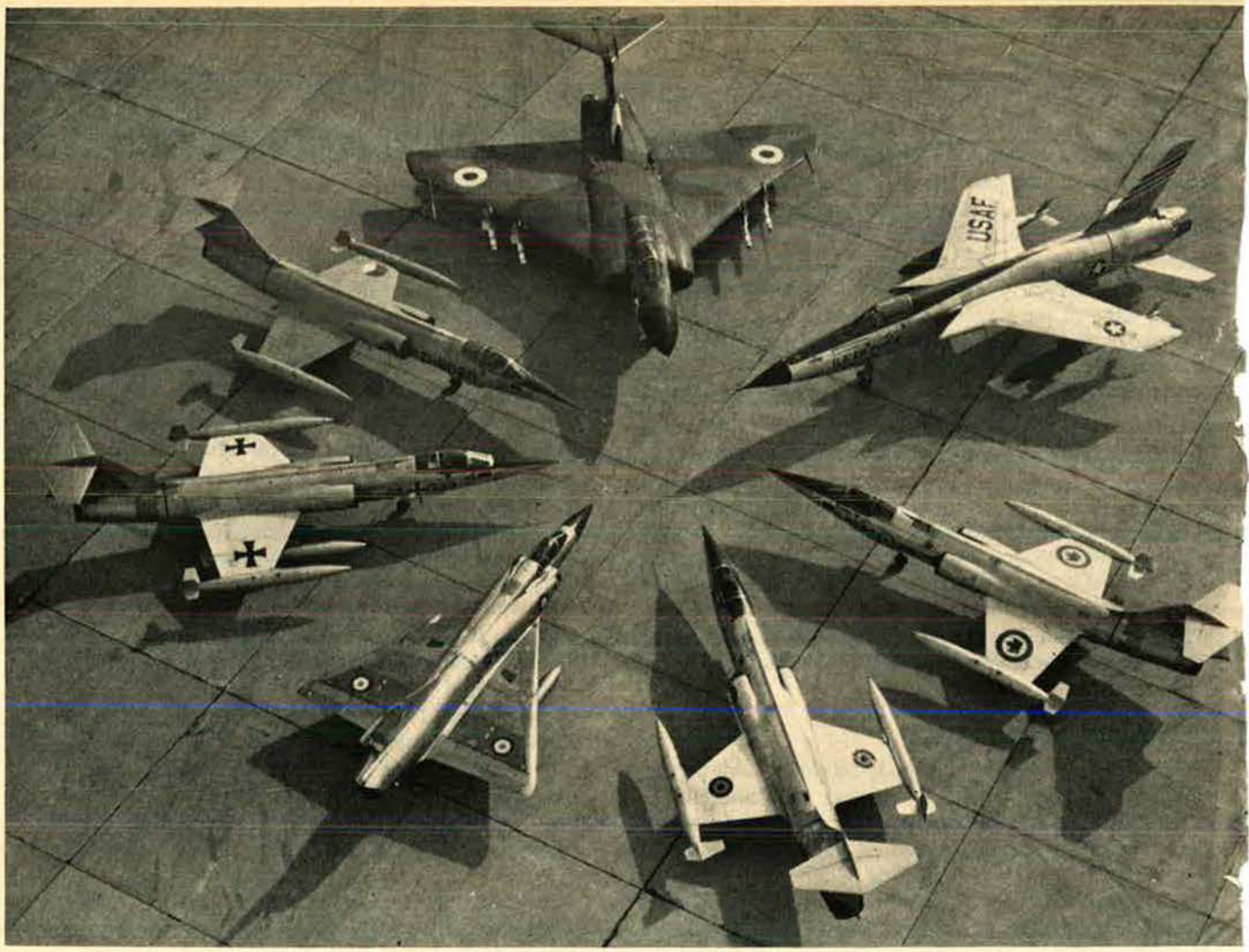

USAF people became accustomed to working with allied airmen from many nations. Seven members of NATO, our largest and best-equipped alliance, contributed these aircraft to NATO's Central European Air Force, known as AIRCENT.

indifferent public support at home, morale among Air Force people in the combat zone has never been higher. With improved equipment, tactics, and techniques, interdiction and close support have been performed better (terrain taken into account) and given less recognition than ever before. An innovation of the war—sustained use of strategic bombers in tactical air warfare—has been denounced by journalists, moralists, and armchair strategists as either wasteful or infamous, but the B-52 has been praised by ground commanders as the most effective weapon of the war. Another paradox: Prior to the cessation of the bombing of North Vietnam, what strategic bombing was undertaken was done by tactical fighters, while the strategic bombers carried out tactical missions in the South.

Vietnam—A War of Contrasts

Vietnam has been a war of contrast in ages, too—the very young and (relatively, but only relatively) the very old. In World War II, it was commonly believed that few men could fly fighters in combat successfully past the age of thirty. A couple of years ago, I checked out the fighter wing commanders in SEA. They averaged twenty-six years of experience and forty-seven years of age, and there wasn't a chairborne commander among them. I asked a prematurely gray (that's anyone under sixty) fifty-year-old deputy wing commander at Cam Ranh Bay if he had any trouble keeping up with the young bucks in F-4s. "Well, not in the F-4," he said. "I've been flying fighters all my life. But these kids think they have to take me on at the bar, too, and that does get a little wearing after a while."

In SEA, strategic and tactical airlift reached unsurpassed levels of sustained efficiency. After 1961, MAC was no longer primarily a scheduled, airline-type operation with heavy commitments to passenger-carrying operations. It became a military airlift command in the true sense of the word, with most of the passenger lift contracted to civilian airlines.

Special Air Warfare forces—now called Special Operations Forces—were created for low-intensity fighting. They had their baptism of fire in Vietnam, helped train the airmen of other countries in nation-building, and have become a permanent part of the Air Force.

As the war grew in intensity, logistic miracles were performed to support a war halfway round the world. Research and development produced more innovations

and refinements in the conventional warfare field than in the previous twenty years. Aerospace Rescue and Recovery teams day after day displayed a heroism that used to be front-page news. So did the aircrews who flew against targets in the Red River Valley—the most heavily defended real estate in the history of air warfare. The most-shot-at aircrews of the war in the South —the C-123 crews who flew defoliation missions— are probably the most anonymous of all the anonymous heroes of a war that has had no Ernie Pyle or Bill Mauldin.

Vietnam has put a high gloss of professionalism on everyone in the Air Force—aircrews, support people, staffers, everyone. No one I know in the Air Force would want to fight a war for that reason, but that has been one result of this strange war. It's a result that could stand the country in good stead in the years to come when Air Force people may have to do more, but with fewer hands and less hardware, than most of us would consider desirable.

Drastic Change

Facts and decisions of the last twenty-five years have changed life in the Air Force so drastically that it bears little resemblance to life in the Air Corps of pre-World War II. Customs of the service became less formal, in part because of the sheer size of Air Force bases. A colonel, now retired, used to tell about his days as a bachelor officer at Randolph Field, when social calls were part of the drill. All officers were expected to remain in uniform to receive callers until 2100 hours. About that hour one evening, he and several friends, properly uniformed, heard a knock on the door. Thinking it was too late for a caller, he shouted (approximately), "Butter your butt and slide under the door." Naturally it was the base commander.

Social calls were a postwar casualty, although they still were part of Army life when I served a very pleasant tour at West Point in the early 1950s. In those days, Army people seemed to take themselves less seriously, but customs of the service more seriously, than we did in the Air Force.

The lack of on-base housing, especially in the early postwar years, tended to separate Air Force families from military life. Often the husband became a commuter and his wife and children visited the base only on occasional trips to the commissary, hospital, or club. They knew less about the husband's work, about military customs and traditions, and military life than in earlier days when nearly everyone lived on base in a small, close-knit community. To generalize broadly, the corporate spirit of the Air Force became a professional/social mix, where once military corporateness had been more a social/professional amalgam.

The lack of on-base housing also worked another change. Military people became part of the local community, joining the PTA, churches, clubs, and other community activities. They were not aliens in a civilian society. Today, antimilitary feeling is far less prevalent around an Air Force base than it is in areas where the civilian population has little contact with the military. It can be added that with the return of several thousand Air Force, Navy, and Army pilots to civilian life and with the expansion of commercial and private aviation, the Air Force has lost some of the exotic character that also fostered exclusiveness in earlier days.

In another quite different way, Air Force life in operational units—first SAC, then TAC, MAC, and to some extent ADC—came to resemble military life on a frontier post in the last century. Aircrews and support people were on either constant or frequent alert—an especially heavy burden on SAC people. It's doubtful that anyone (I include myself, since I never served in SAC) can appreciate the prolonged tension of those years of alert duty, never knowing, when the klaxon went off, whether it was for real or not. SAC also be-

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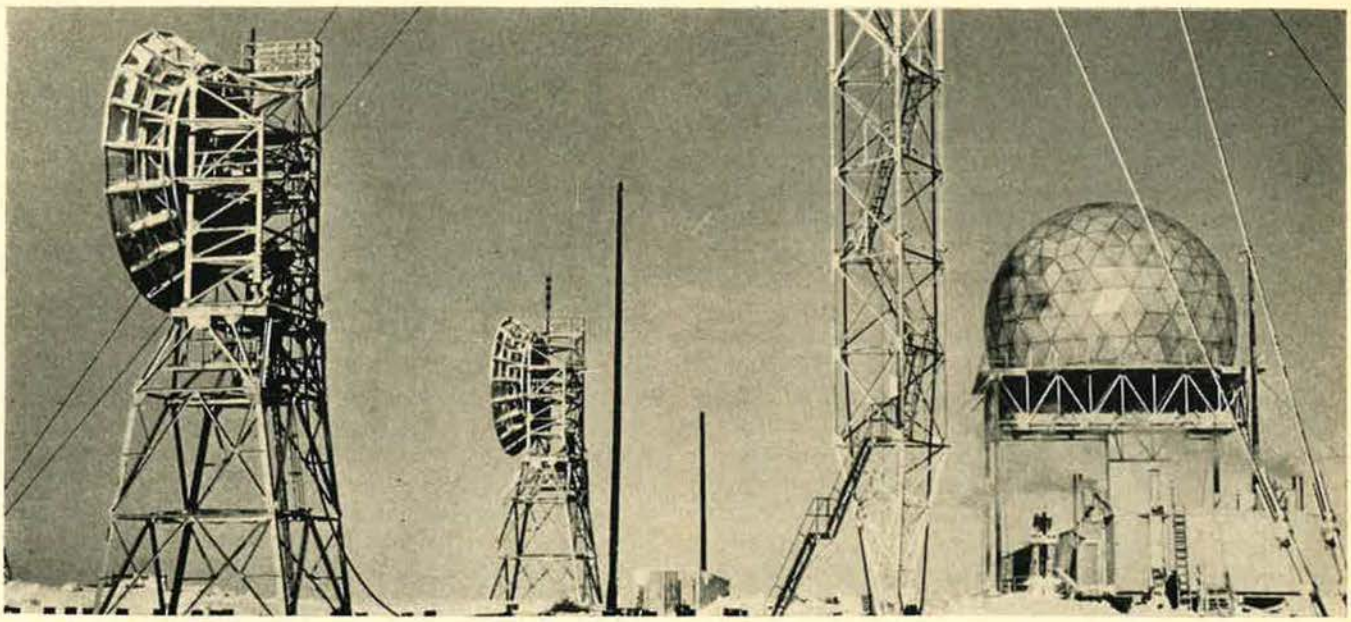
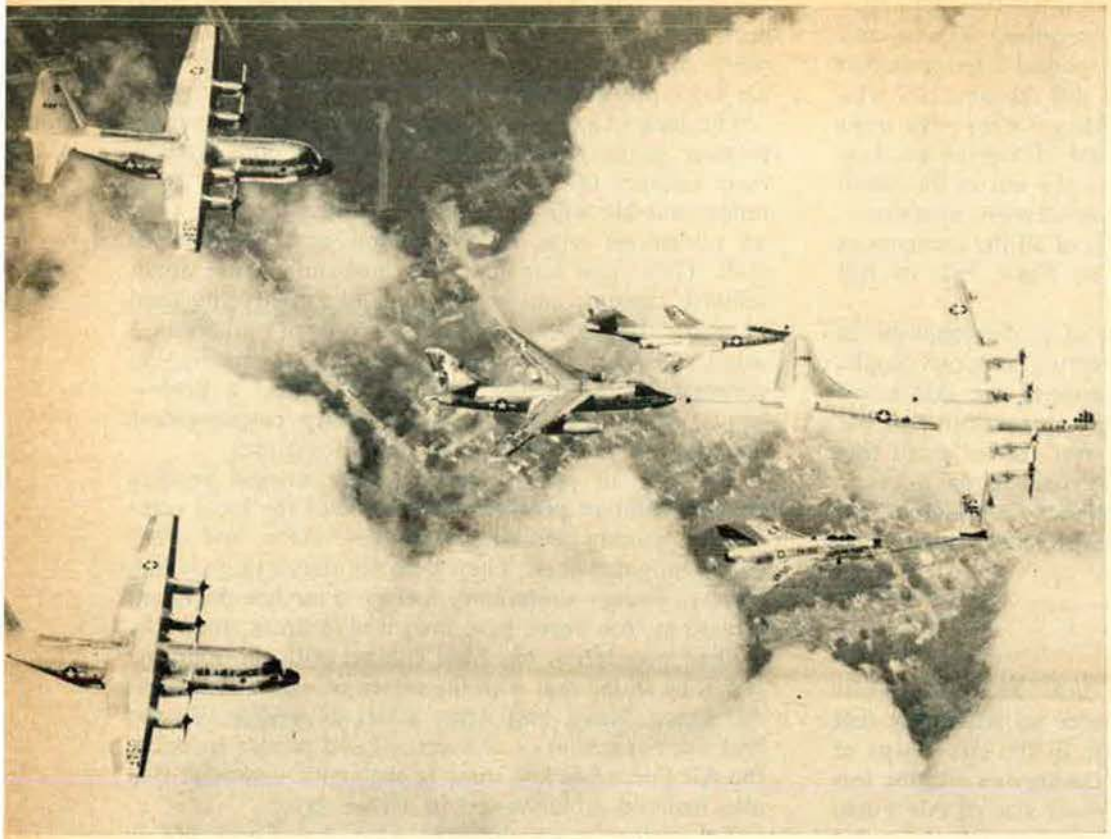


Operations in the northern areas of Alaska and Canada became routine for USAF aircrews and support people, and for the men who operated these remote warning sites of the DEW Line, some of them even north of the Arctic Circle.



To meet limited-war challenges, TAC developed Composite Air Strike Forces (CASFs), which could be tailored to suit any small-war threat. This typical force of the late 1950s is made up of F-100, F-101, B-66, and C-130 aircraft, with KB-50 tanker support.

gan to rotate units overseas as early as 1947 and continued this practice until the range of its bombers made unit rotation no longer necessary. Constant TDY disrupted family life and, combined with often substandard housing, the hazards of military flying, and relatively low pay, drove many people out of the service despite the Air Force's best efforts to improve conditions for both the men and their families.

SAC, with its requirement for instant readiness, set the pattern for the other combat commands in both training and management. Its training became the most realistic and demanding in military history. Practice missions were as close to the real thing as they could be made in peacetime. Probably for the first time in history, the combination of alert duty, overseas rotation, exercises, operational readiness inspections, transition to new aircraft and tactics, the drive for spot promotions, and competition among SAC units resulted in cases of combat fatigue in peacetime.

Necessary, Accepted, Honored

Despite the hardships of life in the operational units, people did stay on year after year, and there was public recognition of the sacrifices made by our airmen. They were a necessary, accepted, and honored part of American society during the hottest days of the cold war.

Those also were the days of military construction projects that staggered the imagination: the SAC bases in Morocco, the DEW Line radar sites in the far north, and construction of the ICBM sites—the greatest earth-moving project of all time.

The need for instant combat readiness, efficient management of very expensive equipment, and the responsibility that goes with vastly destructive nuclear weapons, brought about far-reaching changes in organizational and command arrangements. Support functions were consolidated rather than decentralized at squadron level as they had once been. Standardization was a watchword, and the position of squadron commander in most units became principally that of a scheduler of aircraft and crews. The number of command assignments, in the traditional sense of the word, decreased proportionately, and the potential for seasoning a young officer by rotation through duties in squadron supply, maintenance, mess, and so on, largely disappeared. It became an age of specialization. Broadening experience was gained to a great extent vicariously through professional schools, though Tactical Air Command's return to the self-contained squadron may make this less true for some Air Force people.

The requirement for operational efficiency also tended to keep many Air Force people in the same command year after year. To some indeterminable degree this "professionalism within a profession" encouraged compartmentalized thinking about the uses of aerospace power, though that never appeared to create a serious problem. In any event, the buildup of TAC and MAC forces after 1961, and the concurrent reduction of ADC squadron and SAC bomber units as missile forces grew in size, has resulted in a rather thorough shuffling of Air Force people among the operational commands.

As both total capital investment and unit value grew (the cost of a bomber has increased by at least 800 percent since the end of World War II) the old management practices would no longer do. The Air Force became a pioneer in the use of computers to manage everything from supplies to maintenance schedules. It

In the early '60s, pessimists thought USAF would become the "silent silo-sitters," but manned aircraft remain essential.

innovated, borrowed from business and industry, and in turn contributed much to civilian management practices. The comptroller became as indispensable to a commander as was his director of operations. The Air Force grew more businesslike and in a sense more like business. But it has not made the mistake of looking at itself as a business rather than as a unique profession, an instrument of both national defense and international diplomacy.

A Cosmopolitan Character

With the growth of American commitments since 1949, Air Force life took on a cosmopolitan character that it had not known before. Prior to World War II, "overseas" meant the Philippines, Hawaii, Panama, or Alaska. Later it came to mean any of nearly 100 countries where Air Force people were stationed. There is hardly an Air Force family that has not had at least one tour of duty in Europe or the Far East.

Finally, the overcentralization of decision-making and the downgrading of military advice that were characteristic of the McNamara era appear to have ended. Secretary of Defense Melvin Laird has strongly supported decentralization of management. By allowing the military a voice in determining where painfully deep cuts will be taken, Mr. Laird has achieved the not inconsiderable feat of retaining the willing support of the military while reducing the defense budget to a level that most military men believe to be risky, at best.

With the passage of time, the Air Force as a whole has attained the maturity of outlook, the responsible professionalism shown by its early leaders—a professionalism that befits the principal custodians of the nation's greatest aggregate of military power. Gone is some of the fire and early, unbridled enthusiasm that were important ingredients in creating the world's most powerful military force out of the shambles that followed World War II. Gone are some of the amenities that made military life peculiarly attractive. Gone is the exclusiveness of the long-ago airmen who fired the imagination of an earlier generation. But who would say that the judgment, experience, and staying power of the professional is a lesser asset to the country than the faith and visions of the pioneer?

In September 1970, the Air Force, along with other military services, faces another period of uncertainty. While the US has been preoccupied by Vietnam, the wide margin of strategic nuclear superiority we held in the mid-1960s has been allowed to slip away. As the value of the US strategic deterrent in any situation except a direct attack on the United States has shrunk, the USSR becomes increasingly aggressive in the Middle East, the Mediterranean, and North Africa.

Concurrently, domestic problems of crisis proportion have diverted public attention from the growing Soviet and Red Chinese threats, and resources from the defense area. This situation has grown more serious, since heavy Soviet investment in research and development threatens to give USSR technological superiority within the next few years. The whole of this is exacerbated by antimilitary sentiment that springs largely from the frustrations of the long and unpopular war in Vietnam.

Unanswered Questions

Several questions that bear on the future of the Air Force cannot be answered now. What will be the impact of the Fitzhugh Committee report on organization of the Department of Defense, and on Air Force relationship to the other services? Will the Strategic Arms Limitation Talks bring about a neutralization of the strategic nuclear forces of both sides? If so, will that serve as a further stimulus to Soviet expansion, backed by conventional forces, or prosecuted by Communist proxies? How much further will US defense budgets be cut? Will there be enough military resources available to fulfill our international commitments? If not, must we look forward to a gradual decline of US influence and to abrogation of our position as a superpower, with all that implies for the economic, political, and cultural future of this nation?

And finally, what is to be the position of the Air Force in the American political/social structure? Will it be regarded as a necessary evil—or as an essential good? This question is much in the minds of American airmen who have held an honored position in a society that believed its secure and prosperous condition was largely attributable to the power and readiness of its aerospace forces and to the dedication of its military men and women.

One thing, at least, is certain. The Air Force of 1970 stands at a level of professional competence unequaled in its history. The members of this Association, who have supported the Air Force through good times and bad for nearly a quarter of a century, can look back with pride and satisfaction on their part in building the aerospace power of the United States Air Force.—END

Organizational Evolution

BY THOMAS A. STURM

Chief, General History Branch, Office of Air Force History

IT IS commonly recorded that a group of young Army Air Forces staff officers, in the waning months of World War II, conceived a brilliant postwar AAF reorganization plan which, when implemented a short time after the war's end, established the structural base from which today's thrice-larger and incomparably more lethal United States Air Force still operates.

Though it did not happen exactly that way, the legend is essentially true. What began as the "interim" postwar air force organization proved sturdy enough to weather twenty-five years of constant storm with scarcely a tremor. It happened this way because the founders grafted the feeble trimmings off the mighty wartime force to a deeply rooted doctrinal stock.

Thus, it would seem, the organizational introduction (which this essay is to serve) to this twenty-five-year examination of Air Force challenges and deeds can be compressed into one sentence: The Air Force restructured after the war, the new form survived every crisis, and the Air Force, despite its vast growth in size and power and awesomely more complex duties, shows much the same face to the world as it did a quarter century ago.

In other words, SAC remains SAC, as do TAC, ADC, USAFE, and PACAF. If the only alternative at this point to allay misconceptions that can spring from such oversimplification (*viz.*, Air Force organizational planners are omniscient) were to recite the hundreds of organizational readjustments and name changes that have taken place within the Air Force during these years, this indeed would be a good place to stop and get on with more interesting things. But that is not necessary. The postwar Air Force combat organization came into the world nearly full-grown, and matured in less than five years. How this happened can be related, hopefully, without wading too deeply into a quagmire of organizational bookkeeping.

The Seventy-Group Program

Air Staff consideration of the postwar Air Force began in 1943. A War Department estimate in July of that year set the "interim forces" required immediately after the war at twenty-eight Army divisions and 105 air groups. Using this latter figure, the Air Staff produced the IPWAF (Initial Postwar Air Force: Preliminary Study) Plan in February 1944. Eighty-seven of the groups were bomber and fighter escort, eleven troop carrier, and three reconnaissance. The remaining four were tactical fighter or interceptor. The distribution left no question as to where that staff proposed to concentrate postwar airpower.

Anticipating the possibility of the creation of an international air force within three years after the war, and assuming that the American air force would join it, staff planners next prepared PWAF No. 2 in July 1944. This recommended seventy-five groups, with missions unspecified. The plan was strictly a fallback position paper, designed for a situation that few believed would come to pass. The 105-group program remained the primary objective.

In the fall of 1944, with the end of war in Europe in sight, Gen. George C. Marshall gave his personal attention to postwar reorganization. He promptly decreed that the nation could not afford the cost of forces thus far proposed. Accordingly, Air Staff planners in May 1945 trimmed the 105-group IPWAF down to a seventy-eight-group "Interim Air Force Plan." Postwar air would build to seventy-eight groups and operate at this level until an international force came into existence, and then reduce to the seventy-five groups called for in PWAF No. 2. If the international force failed to materialize, the permanent Air Force would remain at seventy-eight groups. Manning proposals were 638,286 for the seventy-eight groups, 485,000 for the seventy-five.

At Japan's surrender in August 1945, the Air Staff, showing the beginning of political wisdom, had begun to merge its two plans into a single, more easily comprehended one. The result, still mysterious in precise origin, was the famous seventy-group, 400,000-man program adopted on August 29, 1945. Though never

attained, and finally rendered academic by the war in Korea in 1950, it remained a solid goal for the nation's airmen for five lean years.

The March 1946 Reorganization

The seventy-group program specified that the postwar Air Force would consist of twenty-one very heavy and five light bomber groups, twenty-two fighter, three all-weather interceptor, ten troop carrier, and nine reconnaissance and weather groups. The Air Staff now had to devise an organization that ensured the most efficient and effective command of these forces.

In December 1945, an *ad hoc* committee was formed to consider all earlier proposals on the subject and make final recommendations. Gen. Carl "Tooey" Spaatz (soon to take Air Force command from Gen. H. H. Arnold) accepted the committee's report on January 2, 1946. The AAF would consolidate its forces into four corps —one strategic, one tactical, and two geographic air defense—under a Headquarters Combat Command.

Odd as it appears in retrospect, the January 1946 plan was well suited to the times. The seventy-group force was a promise, nothing more. Meanwhile, the wrecking job that passed as demobilization had already cut the Air Force from two and a quarter million men to 700,000, and half of these would leave in the next year. Until the Air Force rebuilt, why not consolidate all combat forces in one command? Then, at least, if new trouble arose, the commander responsible would possess all combat aircraft available to confront it.

However, again for reasons not documented, the Air Force at the last moment chose a different course. Some say that simply because Gen. Dwight D. Eisenhower (who had replaced General Marshall as War Department Chief of Staff) urged it, the Air Force agreed to establish a Tactical Air Command as a separate major organization.

One thing is certain: If Eisenhower wanted it that way, the Air Force would have been loathe to oppose him. His advocacy of a separate Air Force and belief that all postwar War Department planning should lead easily to separation assured him a friendly Air Force reception on whatever wishes he may have had.

In any event, by the end of January 1946, a new Air Force organization plan had been written, which called for three combat commands instead of one. The reorganization, placed in effect on March 21, created the Strategic, Tactical, and Air Defense Commands. SAC got most of the forces—fighter as well as bomber—and TAC got the rest. ADC received the promise of forces under the seventy-group buildup. There was no threat of air attack on the United States as yet, so why worry?

A Time of Achievement

Looking back on the period of late 1945 to early 1946 some twenty years later, Air Force Gen. Earle E. Partridge remembered it as a "period of transition that was extremely difficult." With manning at a low point, the location and condition of many resources still unknown, communications disrupted, and the Air Staff small and inexperienced, it was very hard, he said, to "identify the problems inherent in getting the air arm back on a sound footing and in solving them." He felt at the time, and still did, that it was "a period of great accomplishment for all concerned."

And indeed it was. Air Staff planners failed to achieve both their original force and organization proposals. Instead of a 105-group objective, they emerged with seventy; and, instead of one combat command, they got three. In the process, however, the Air Force kept its cause for equality alive and fostered at a crucial time. With presidential approval in principle of the

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seventy-group force in Air Force hands, the War Department could not have considered reversing the policy of Generals Marshall and Eisenhower that Air Staff and General Staff would remain equals in practice until they became so by law. Unification would have come to pass eventually, there is no doubt, but the irritant presence of an illegal separate service certainly hastened the process.

As for the 1946 reorganization, it reflected by designation and mission assignment the Air Force's prewar and war-proved doctrine on the proper employment of airpower. In the war, one type of aircraft oftentimes performed missions for which it was not designed, when the proper ones either were not available or in too small numbers to handle the task alone. Since much the same condition existed in the postwar force—too many big jobs for the aircraft on hand—the Air Staff decision to recommend a single combat command was the right one. The creation of three, on the other hand, violated only logic, not basic principle.

Never flown in combat, but the mainstay of the Air Force's deterrent during the early 1950s, was the Convair B-36. The pusher-prop, nuclear-armed bomber helped keep the peace during an era when the Air Force was establishing itself as the nation's first line of defense against aggression by a truculent Soviet Union.

Despite its outlandish apportionment of forces, the March 1946 reorganization, as all good organizations should, focused attention where it belonged—on the missions.

Pooling the Forces

It was clear by the spring of 1947 that the seventy-group program was in trouble. The Air Force had identified and activated the units that would comprise the force, but fifteen remained paper outfits. Of the remaining fifty-five, only thirty-six could claim any degree of readiness. None operated at wartime standards. This situation generally prevailed until December 1948, when the 1950 budget decreed that the goal would no longer be seventy groups, but forty-eight.

Meanwhile, the absurdity of assigning commanders a mission without the forces to carry it out had become clear. The Air Defense Command, created under Lt. Gen. George E. Stratemeyer, with headquarters at Mitchel AFB, N.Y., was formed initially from the wartime First and Fourth Air Forces. Later, in 1946, it received four more such units, which were staffed as men became available. Unlike their counterparts in SAC, TAC, and ADC, the six ADC air forces were organized along geographical lines. That is, each encompassed a quota of states within which the commander was responsible not only for air defense but Air Reserve and a host of other lesser, but important, Air Force housekeeping tasks. From their histories, one gets the impression that commanding them was a miserable assignment, the sort of character-building experience that prepared one to handle anything thereafter.

Air Force Headquarters' problem with ADC was that General Stratemeyer and his particularly capable operations and plans officers refused to sit quietly on their air defense mission. They remembered Pearl Harbor and what happened to the careers of the officers entrusted with Hawaii's defense. They also took seriously the public warnings by General Arnold and other top civilian and military leaders that America was wide open at the top (via Alaska and northeast Canada) to air attack. They believed that, if these avenues for air strike were not closed by radar, interceptor aircraft, and antiaircraft artillery, America—along with SAC's long-range nuclear bomber force—might be destroyed before it could mount a counteroffensive.

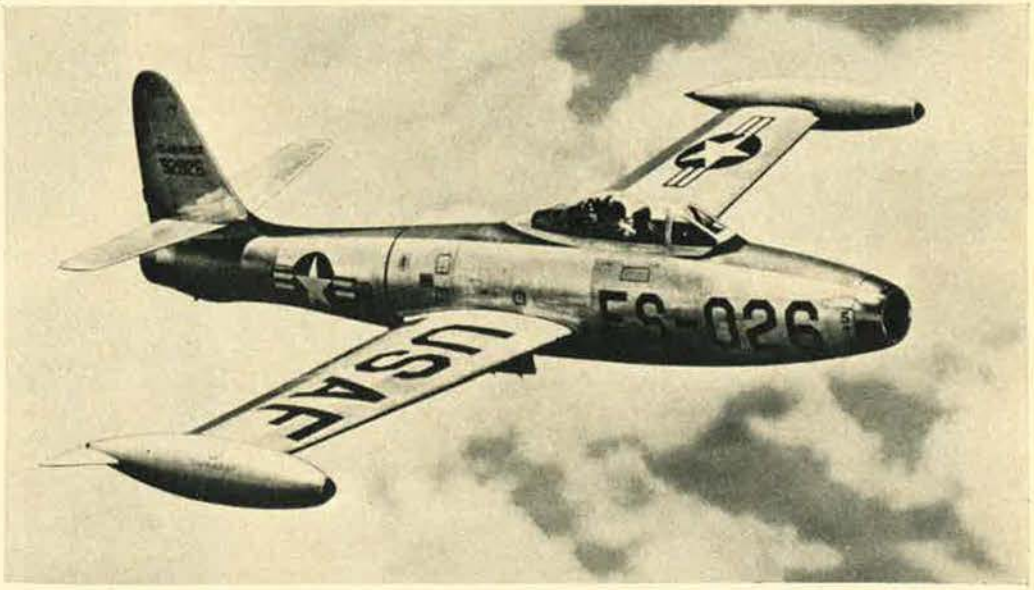
Throughout the years 1946 and 1947, the ADC staff inundated their Washington brethren with designs for air defense systems that sometimes exceeded the entire capacity of the worldwide Air Force as it then existed. On one occasion in 1947, General Spaatz practically ordered Stratemeyer to desist, at least until after unification when the exhausted Air Staff might muster energy to probe what ADC obviously regarded as a problem.

But it did no good. Within a week or so the Mitchel Field staff suggested that, since the Air Staff could not see a way to assign the ADC air force commanders forces of their own, it at least empower them, dur-

ing threat of air attack, to seize command of all other forces in their areas, regardless of other command or service objections. So it went. ADC prodded, the Air Staff tried to duck, but ADC refused to play the fall guy.

Perhaps it was a tempest in a teapot. As long as America held sole possession of atom bombs, the Soviet Union, now identified as the enemy, would not dare to attack. So why, with resources already dear, should TAC, SAC, and the overseas commands be robbed of fighters, and radar stations built and manned, to create a system which, by the time it was needed, would be obsolete?

ADC, and some on the Air Staff, had an answer to that argument, too. An air defense system, as the Battle of Britain and America's own limited overseas experience proved, takes time to install and perfect. And men do not learn the art of radar-controlled intercept overnight. To guard the nation against surprise air attack would require hundreds of radar stations, netted together by a gradually ascending series of combat control centers culminating in the Pentagon, perhaps even in the basement of the White House. Russia, with its copy of the B-29, was building a heavy bomber force. We also knew the Soviets were attempting to split the atom. While it would be 1952, perhaps even 1954, before they translated these activities into a long-range nuclear bomber force, it would take the Air Force that long to install even the beginnings of a radar aircraft warning and control net and provide it with the weapons for blunting an attack.



The Republic F-84 Thunderjet, first production-line jet fighter equipped for midair refueling and first USAF fighter designed for nuclear weapons, was a workhorse during the Korean War. That conflict reversed the defense funding policies, which had made it nearly impossible during the early post-World War II years to organize an Air Force at all.

Easing ADC's Predicament

True to his promise, General Spaatz, with unification an accomplished fact, directed the Air Staff to do what it could to ease the ADC predicament. First result was a proposal to Secretary of Defense James Forrestal for a national radar warning and control net. In late 1947, the Air Staff considered the creation of a new major command to handle the Air Reserves, freeing ADC headquarters and air forces for air defense. But the radar net proposal bogged down in the Bureau of the Budget, and the 1950 budget reductions killed all hope of acquiring all-weather fighter groups promised ADC under the seventy-group program. It was time to reexamine the 1946 established force priorities to see if they remained valid.

Gen. William M. Momyer, then a colonel and plans chief of TAC, started the ball rolling with the observation that TAC would not fight in an atomic war under war plans of that day except as a last-ditch measure when all else failed. Therefore, it appeared superfluous to continue to reserve TAC fighter squadrons solely for battle that might never come, especially since the nation so badly needed fighter-interceptors. He proposed that TAC fighters be cross-trained for both tactical and air defense missions. He also wondered about SAC's fighter-escort groups. It did not seem they could keep up on intercontinental missions. Maj. Gen. Gordon P. Saville, generally regarded as the Air Force's most experienced air defense expert and then heading the Air Staff's air defense division, agreed: Cross-train TAC fighters and steal three fighter groups from SAC for retraining in air defense.

In October 1948, President Harry Truman, in what proved a valiant but futile effort to substitute Reserve bulk for active-force muscle, directed the services to place greater emphasis on organizing and training the Reserves. This triggered the Air Force December 1, 1948, reorganization, which created Continental Air Command. Air Defense and Tactical Air Commands became "operational headquarters" in the new alignment, with General Saville commanding ADC and Maj. Gen. Robert M. Lee in charge of TAC. On line with the area air forces, they reported directly to General Stratemeyer, who moved up to take command of ConAC.

Fighter forces (including those transferred from SAC

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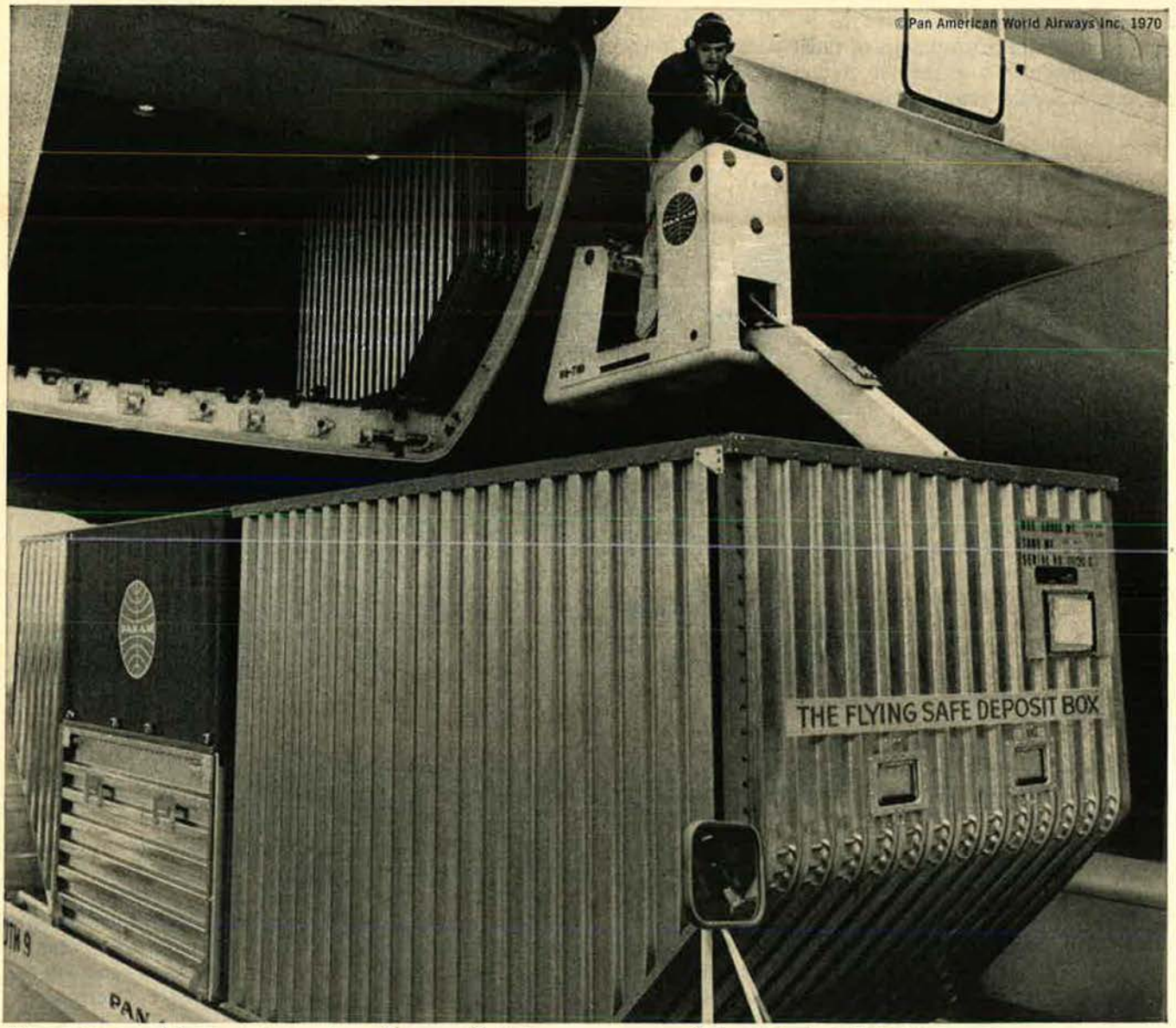

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Although air defense—along with tactical air—has taken a back seat to strategic offensive forces during most of the past quarter century, there has been a series of weapon systems in the inventory designed for the interceptor mission. The Lockheed F-94C Starfire, packing twenty-four rockets, was among the first all-weather jet interceptors.

to ConAC in accordance with Momyer's and Saville's recommendations) remained assigned to the area air forces, with ADC and TAC in charge of their combat training and employment in emergencies. Some fighter groups trained solely in air defense, the rest cross-trained in both missions. Publicly, the Air Force announced the change as one that freed area air forces to give more time to strengthening the Air Reserves, in compliance with the President's wishes. Gen. Hoyt S. Vandenberg, now Air Force Chief of Staff, wrote his major commanders that the reorganization became necessary because of reduction in strength and the economy program—that it enabled the Air Force to do more with fewer men and planes.

Actually, the December 1948 reorganization was a return to the idea of the Air Staff in its early 1946 proposal—to make multiuse of air forces as long as they remained in too short supply. It has been said that the ConAC reorganization reduced tactical and interceptor military aviation in stature—dropped them from major to subordinate command level. It indeed deprived TAC of some fighter forces, but for reasons which TAC officers like Momyer not only agreed with but implanted. For ADC, it was a great step forward. In order of priority, strategic air remained first, and air defense now moved up to second place.

An Air Force in Trouble

The ConAC organization had a flaw that General Stratemeyer and the Air Staff perceived from the start, but planned to overcome through good leadership. This was the assignment of combat forces to one commander (area air force) and the investment of operational control of them in another (ADC and TAC). Stratemeyer hoped to conduct his ConAC headquarters as a "balance wheel between training and combat operation requirements," thereby serving as a sort of psychiatrist to his slightly schizophrenic organization. All hands gave it the best try possible, but there was no time to see if it would work.

In April 1949 Gen. Ennis C. Whitehead, Far East Air Forces commander, swapped jobs with Stratemeyer and took an immediate distrust of the ConAC structure. The changes he initiated eventually resulted in the elimination of ADC headquarters. This did not entail much reshuffling. Whereas the TAC headquarters at Langley AFB, Va., had retained an adequate staff, which operated with relative independence, the ADC staff—collocated at Mitchel with ConAC's—never had a chance to fully form. Whitehead felt that the structure divided command, and his wartime experience had been that you could not win wars that way. With this change, he negated the rationale of the December 1948 reorganization, making further revision of air defense organization inevitable.

By late 1949, two Air Defense Force "operational" headquarters had formed, and, under them, air divisions. They, not the area air forces, assumed the air defense mission. Eventually, they took full command of the forces. In other words, General Whitehead had not turned the clock back completely on air defense organization. He simply left himself more major missions than one man could handle. He soon submitted a proposal to solve that.

The December 1948 reorganization brought a savings of only 2,000 men. To acquire the 15,000 additional men that SAC required in 1949 to man its gradually rebuilding bomber force, the Air Force in that year greatly reduced Far East Air Forces. As events soon proved, it was the wrong time. However, the forty-eight-group restriction still prevailed in the fall of 1949, and it appeared from the budget discussions that the Air Force would be lucky to keep that number.

On September 23, 1949, President Truman publicly confirmed that the Soviet Union had exploded an atomic device in late August. The enemy had the bomb. As would happen again eight years later when the Russians put the first man-made earth satellite in orbit, the government cautioned against undue alarm. One bomb does not a long-range nuclear bomber force make. The Pentagon dutifully complied, but worried task forces began working round the clock. On September 30, the top officers of the Air Staff agreed that planning timetables had to be advanced one to three years, and they directed that the entire Air Force program be updated for resubmission to the Joint Chiefs. Our actions shall be based on sound and calm judgments, Secretary of the Air Force Stuart Symington promised, adding, "But we shall not mistake inaction for calmness." There was no doubt in anyone's mind; the United States Air Force was under the gun.

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Brought into the operational inventory during the 1950s, the North American F-100 Supersabre has played an important role in the Tactical Air Command. It has been extensively used in Southeast Asia where, despite its age, it has acquitted itself well as a close-support aircraft.

The government, in the nine months following the Russian A-test, followed its own advice, "calmly" reducing the Air Force by another 7,000 men. Warning publicly that time had run out, and that the nation had to rebuild its defenses, not continue to pull them down, top Air Force leaders took every action possible to accelerate preparations for nuclear war. Gen. Muir S. Fairchild, the Air Force's No. 2 officer, directed the Air Staff to advance priority for men and weapons for air defense to one coequal (within practical limits) with that of the atomic retaliatory force. General Vandenberg, meanwhile, set the Air Force Scientific Advisory Board and the Air University to work on devising a means whereby the Air Force might more quickly translate ideas on new weapons into operational systems. Their recommendations corrected the one serious defect in Air Force organization, in January 1950, when the overloaded Air Materiel Command turned this responsibility over to a new Air Force Research and Development Command. (Today, of course, AMC has become the Air Force Logistics Command, while ARDC now is the Air Force Systems Command.)

One Mission, One Command

Reassured by the events of September 1949–June 1950 that the decision he made, upon taking ConAC command, that air defense was his first concern and that he should personally command it, General Whitehead proposed to Washington that he keep tactical air as well but be relieved of the Air Reserve mission. In late 1949 General Fairchild agreed and instructed the Air Staff to again consider the establishment of an Air Reserve Command. Before anything real came of it, the North Koreans attacked and the Air Force plunged into three years of tactical air warfare.

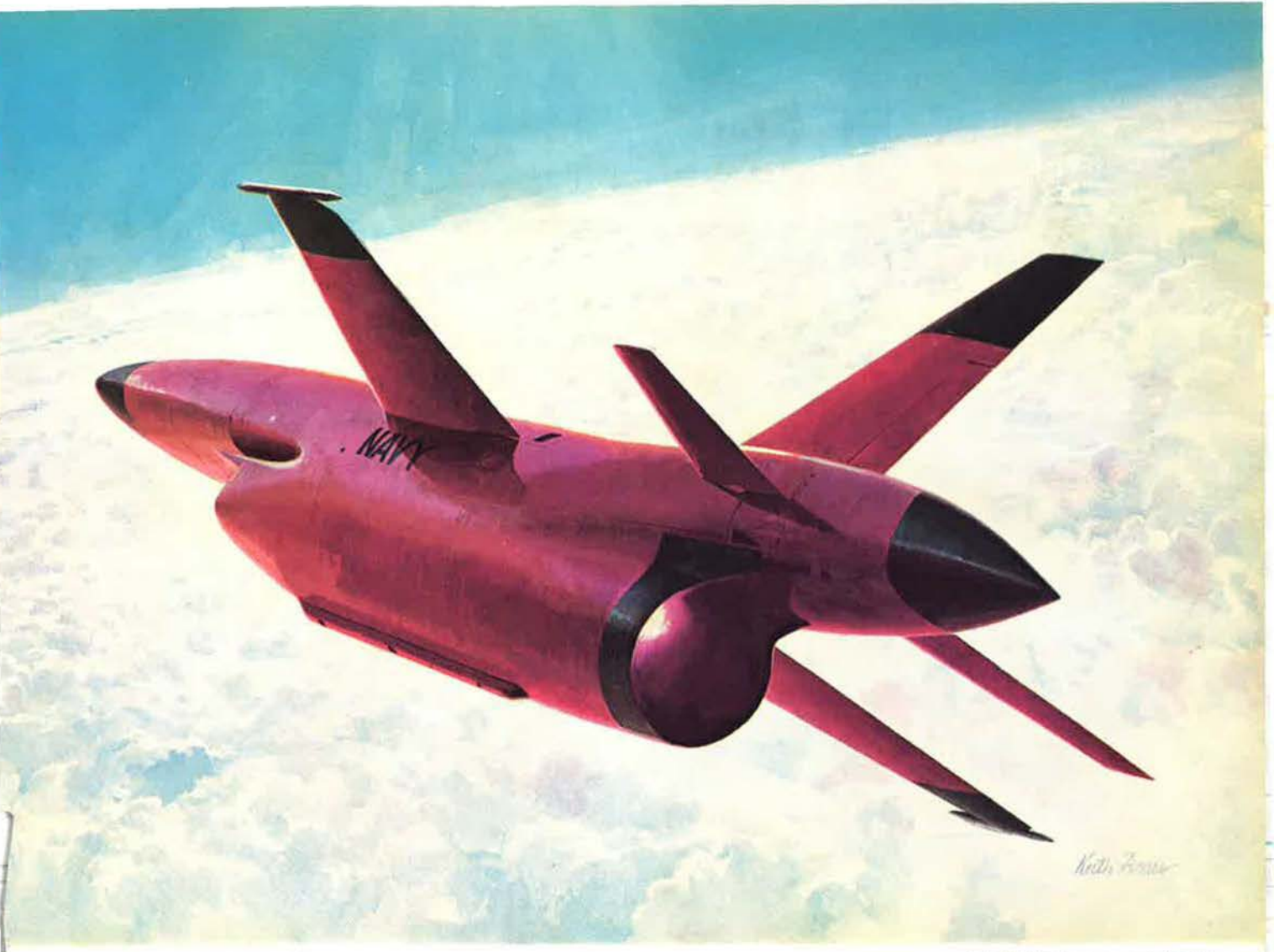
The Air Force now knew that its initially proposed postwar plans were correct, that, as in World War II, it still had three missions of equal priority, and that each required the best in men and equipment and the most effective organization possible. The organizational accommodations the Air Force made to the Army and the budget had been necessary but wrong. Men cannot perform missions without forces, or prepare for one kind of war and fight another—not without mortal danger to themselves and their country.

Before the Korean War force buildup reached any great size, the Air Force acted to sweep the cobwebs from its air defense and tactical air organizational mechanisms. On September 20, 1950, TAC reassumed command of the forces assigned that mission, from ConAC's area air forces. On December 1, 1950, it broke free of ConAC entirely to report directly once again to the Commanding General, United States Air Force. There was no need to move TAC headquarters from Langley. That had always been the right place—next door to the Army forces with whom it went into battle.

General Whitehead moved himself and most of his Mitchel staff to Ent AFB, Colo., and on January 1, 1951, reactivated ADC as a major command. This time it had but one mission: air defense. The Air Reserve and geographical jobs stayed back at Mitchel with ConAC, which later moved to Robins AFB, Ga., and took the new name Air Force Reserve.

And that, for all real purposes, is the Air Force organization story of these past twenty-five years. ADC relinquished direct command of forces during air attack to the Continental Air Defense Command (CONAD) in 1954, then to the North American Air Defense Command (NORAD) in 1957. Command of TAC forces, under certain circumstances, passed to Strike Command in 1961. However, the creation of the joint commands did not alter the organization of the tactical air or air defense forces, as set in late 1950 and early 1951. It merely confirmed the flexibility and solidarity of the basic Air Force structure.—END

Thomas A. Sturm holds B.A. and M.A. degrees in history from the University of Puget Sound, and has done further graduate work at Michigan State University. From 1951–57, he was Director of Command History at Air Defense Command and at Continental Air Defense Command Headquarters. After a five-year stint in the academic world, Mr. Sturm again joined the Air Force History Program, and is now Chief of the General History Branch, Office of Air Force History, at Hq. USAF.



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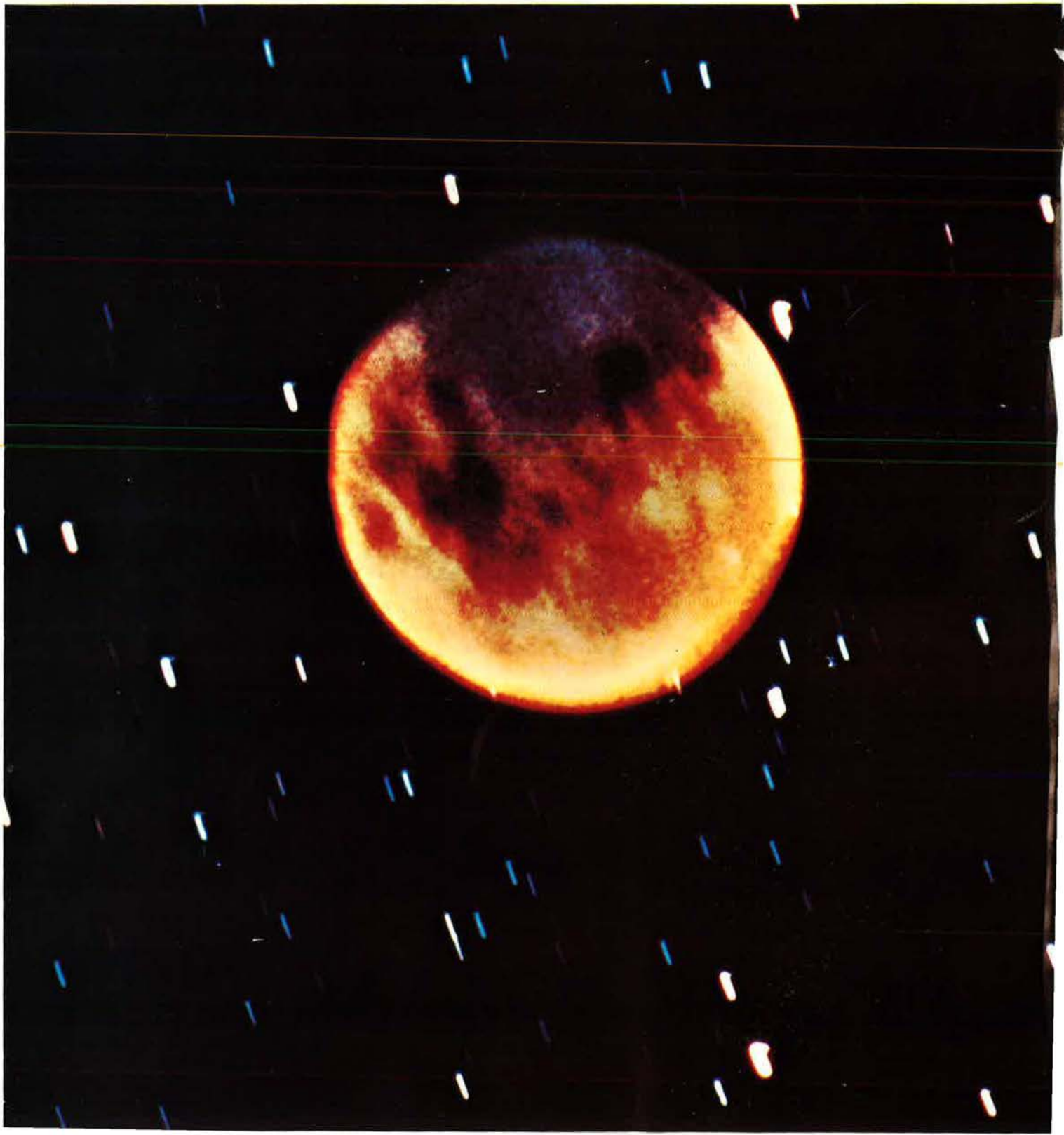

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"B-17s in Battle" ("Retirement Party for Old Thunderbird"), by Keith Ferr

USAF—From V-E Day to Vietnam

BY LT. COL. DON CLELLAND, USAF

Paintings courtesy of the Air Force Art Collection

The Jugs and Mustangs did their thing
Above the Forts en masse below
Which through day skies made dark by flak
Fought to the target and then back.

And by departing from the mold
Which shaped the early strategy,
A tested Air Force came of age
And claimed its place at center stage.

Since that brave time, decades ago,
Does what we've done meet all the tests?
Has doing what we think we must
Resulted in the people's trust?

Beset by pressures from without
We can look back on storm-filled years,
And say with simple honesty,
"What we have done is there to see."

An Air Force Art Portfolio

Colonel Clelland, a fighter pilot and former USAF Academy historian, recently moved from the Office of the Air Force Secretary to a billet in Europe. Three of his poems appeared in our May '70 issue.

"Ploesti, August 1, 1943" ("Operation Soapsuds"), by Nixon Galloway.

"Foul Weather—Tempelhof, Berlin," by Herb Mott.

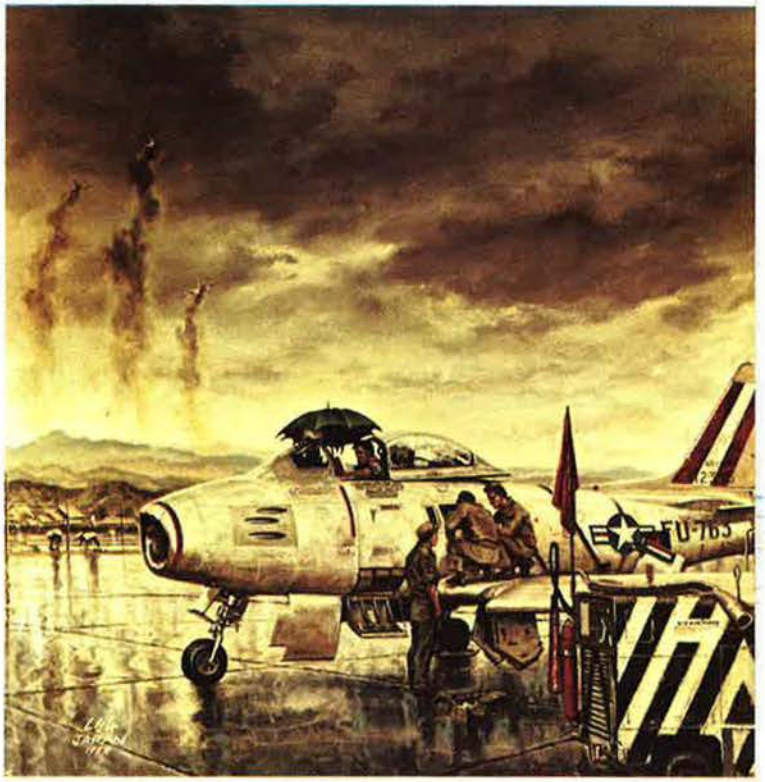
First came the proudness of Berlin,
Its prayerful thousands grouped in thanks.
Few quarreled with performance there
For in those problems all could share.

Then came the names, unknown before —
Yalu and Seoul and Takushan,
Khe Sanh, Ashau, Hanoi, Haiphong —
Restrained performance read quite wrong.

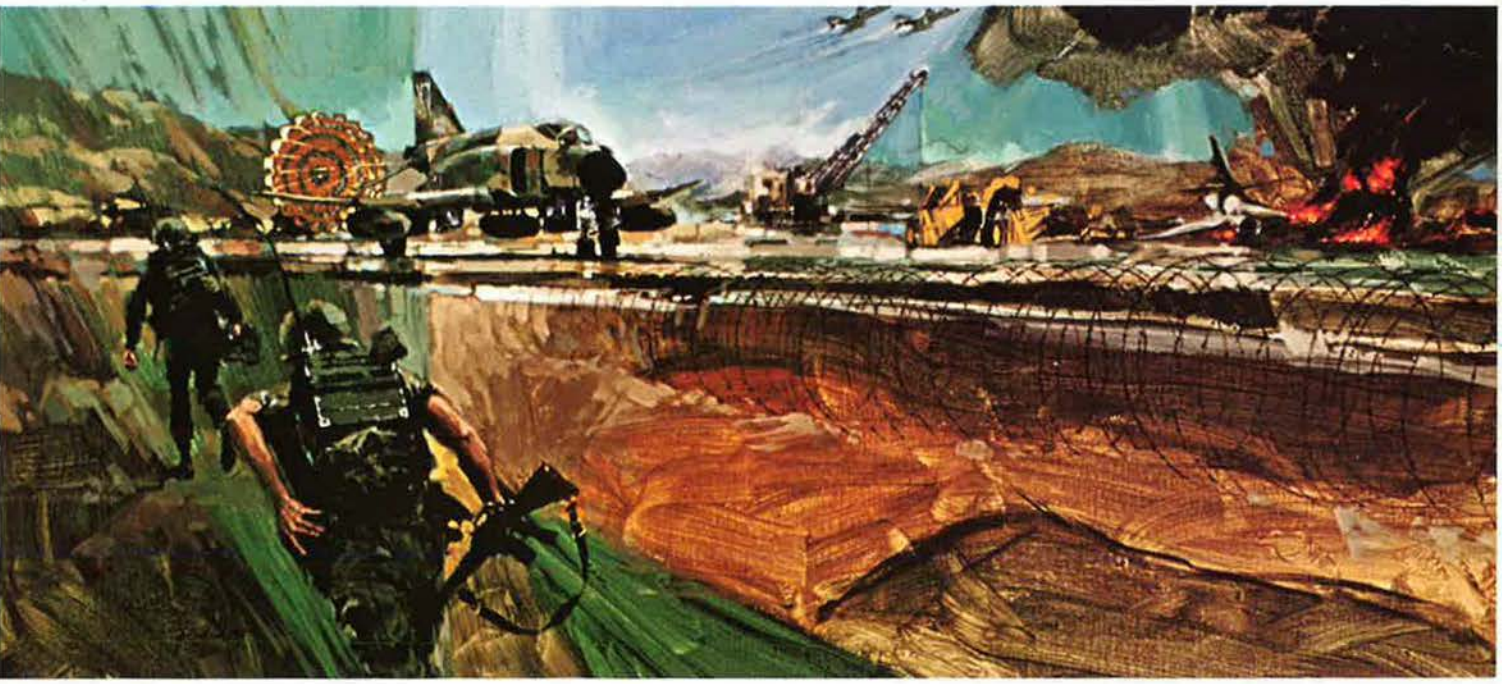
For even overconfidence,
And claims too great to be fulfilled,
Should not obscure the glorious hours
Of shackled but still vital powers.

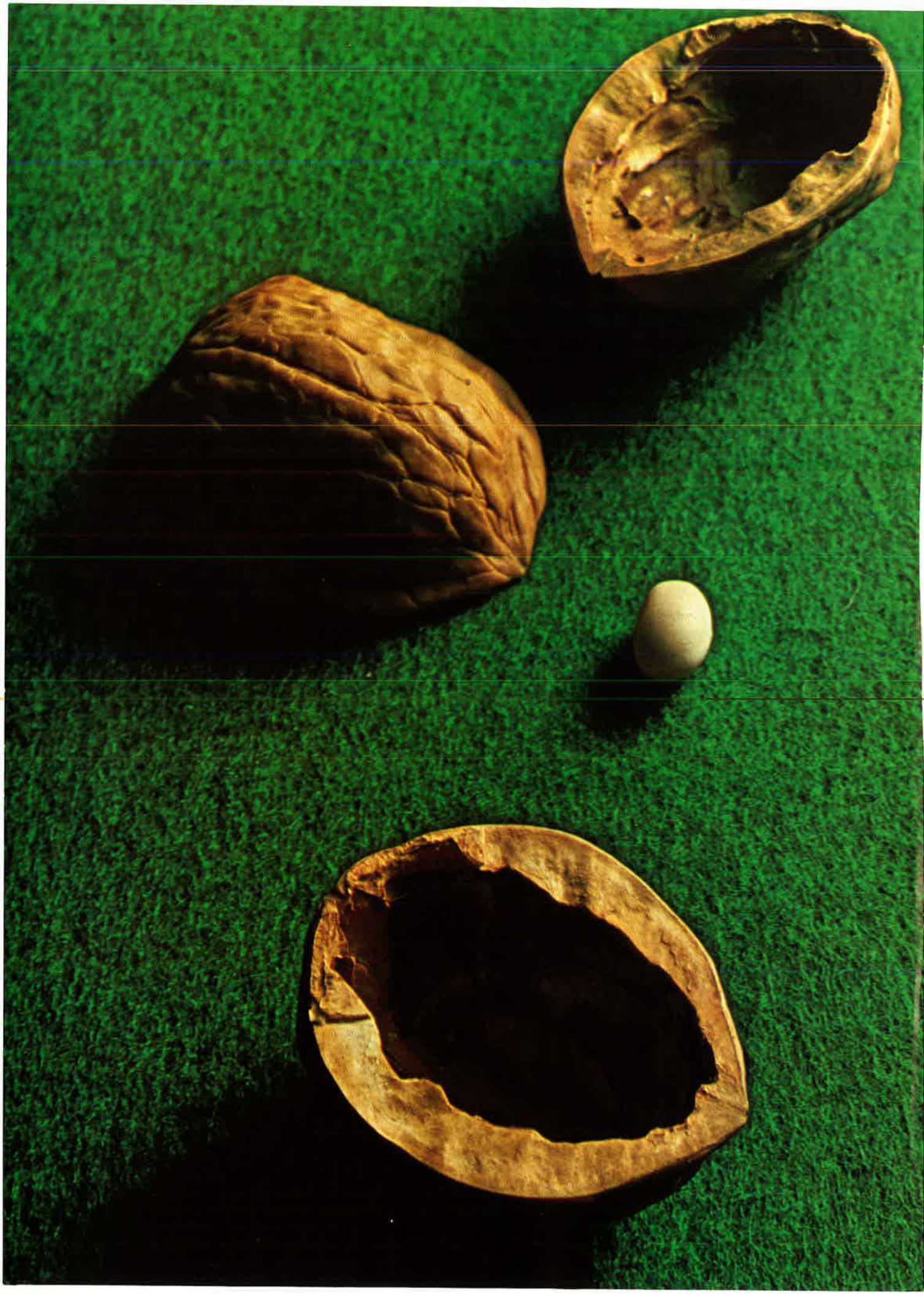
Nor should they blur decisiveness
Of awesome military strength —
An untapped capability
That still must keep our nation free.

"Twenty-Four-Hour Alert in Japan," by Louis Glanzman.



"F-4C Landing at Khe Sanh, Vietnam," by George Akimoto.





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Mastering Technology

BY EDGAR E. ULSAMER

Associate Editor, AIR FORCE Magazine

THE Air Force has been dependent on technology ever since that major technical breakthrough—the invention of the airplane—made military airpower possible. In this regard, the Air Force, "which sprang from the loins of the Army, is much more akin to the Navy—the other military service whose operating mission and mobility requirement dictate full reliance on technology," according to Maj. Gen. F. M. Rogers, AFSC's outgoing Deputy Chief of Staff for Development Plans.

But this intimate relationship has fluctuated, and presumably will continue to fluctuate, in one principal area: Sometimes technology leads concepts and doctrine, and at other times the reservoir of technological options permits doctrine to set the pace.

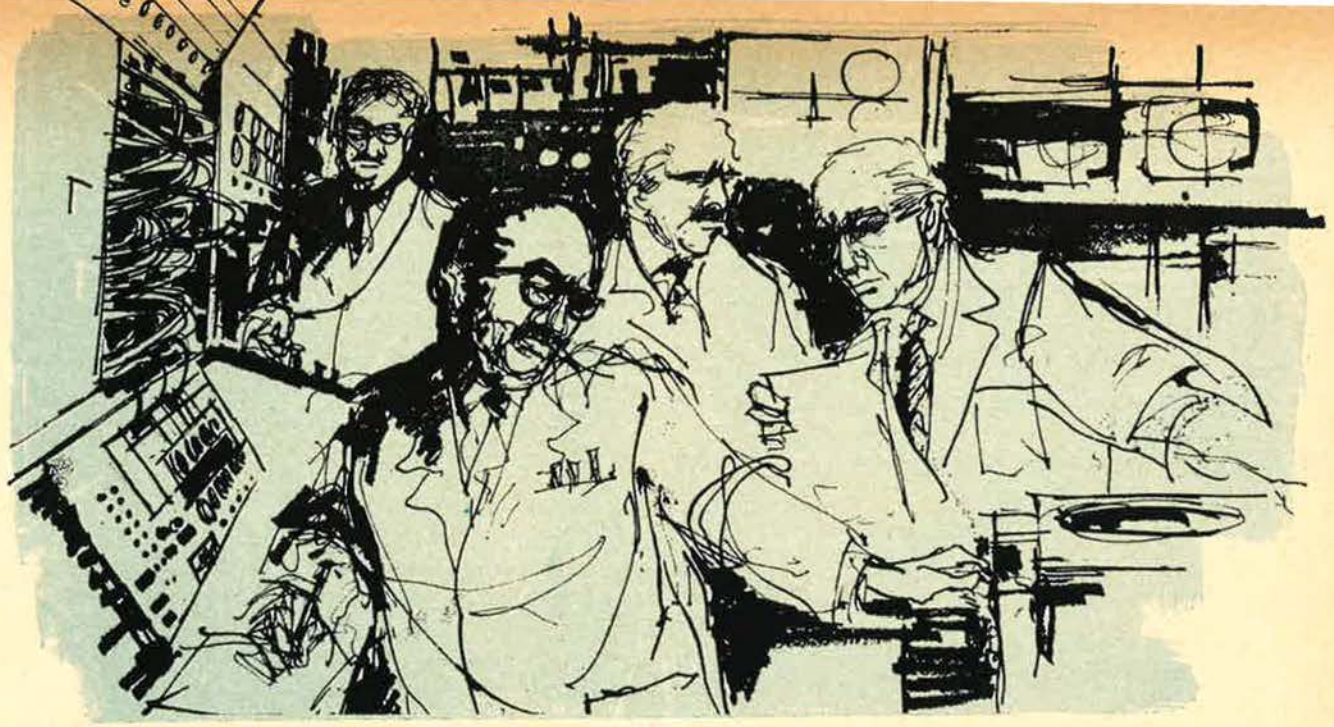
The most frequently obtaining condition, however, is somewhere in between, where the distinction between who is leading whom is blurred. This Air Force/technology "togetherness" is accented further by the fact that the scope and nature of the technological reservoir available at any one time are largely determined by the quantity and quality of the research and development effort launched and carried out over the preceding four to fourteen years.

It follows, of course, that while the Air Force owes its existence to technology, technology would not be what and where it is today without the Air Force's innovative exploitation, management, and relentless pushing against the state of the art. This impact is felt across the technological spectrum, from basic research to manufacturing techniques and systems' life and maintenance.

The past twenty-five years, in the view of the outgoing Commander of the Air Force Systems Command, Gen. James Ferguson, and in the view of other USAF leaders interviewed by AF/SD, were "characterized by the extremely rapid unfolding of technology . . . with at times traumatic impact on strategy, and frequently obsoleting weapon systems which had barely reached a nascent state."

Gen. H. H. Arnold, Chief of the Army Air Forces during World War II, was instrumental in shaping the Air Force's basic policies concerning research and development. He set up the AAF Scientific Advisory Group (forerunner of the USAF Scientific Advisory Board) in 1944.

Dr. Theodore von Kármán, an outstanding aerodynamicist, headed the AAF Scientific Advisory Board and directed the pioneering and prophetic study of the technological lessons of World War II, entitled Toward New Horizons. *Its impact is still being felt by the Air Force today.*



While this examination of the interfaces between technology and aerospace power is arbitrarily confined to the past quarter century, this period, by coincidence, may well be seen as precisely delineated in an historic sense. It begins with the US attainment of broad and undisputed technological superiority and ends at this time with the US relinquishing this lead because of political, economic, sociological, and psychological pressures.

General Arnold Mobilizes US Technology

In terms of US aerospace power, the era of methodical management of its scientific and technical resources and development planning, most Air Force technology leaders agree, began in the waning days of World War II. While the war catalyzed development of nuclear power, radar, strategic missiles, and the jet engine, World War II was fought by the US predominantly in terms of quantity—that is, the country's ability to outproduce the adversary while at the same time laying waste his production base.

For the most part, the technological content of the weapon systems was the product, at least in terms of earlier advanced research, of other nations. These ideas and techniques from abroad included (in the case of aircraft): retractable landing gears, controllable-pitch propellers, and monocoque construction. These were capably mass-produced by US industry.

But the advent of the missile, the jet engine, and the atomic bomb signaled to the more thoughtful managers of the national technological resources the need for a new look in basic as well as applied research. Foremost among this group was the Chief of the Army Air Forces, Gen. H. H. Arnold, whom AFSC's Deputy Director of Laboratories, P. R. Murray, described to this reporter as "that rare combination of visionary and two-fisted pragmatist, a man who could fight the war with one hand while plotting the nation's long-term technological future with the other."

Convinced that a new era in the relationship with technology was dawning, in the fall of 1944 General Arnold set up an organization of scientific advisers (the AAF Scientific Advisory Group), under the direction of the brilliant aerodynamicist, Dr. Theodore von Kármán, with the specific instruction to "forget the past [and] think ahead twenty years, in such terms as supersonic aircraft, pilotless aircraft, and other advanced concepts."

The group, forerunner of the present Air Force Scientific Advisory Board, was also given the dual task of surveying the scientific and technological accomplishments of the Allied and Axis powers, and extrapolating from them long-term development potentials. The findings of this survey were published in August 1945 under the title of *Where We Stand,* and the recommendations, in December of that year, titled *Toward New Horizons.* Significantly, the introductory volume bore the title *Science: The Key to Air Supremacy.* These efforts not only affect Air Force-sponsored technology efforts to this day but eventually resulted in the creation of vital test and laboratory facilities still in use.

The studies also provided the impetus for the development and management methods that underlie the systems approach, which is the axiom of modern technology management. This came about when Dr. von Kármán's group was struck by the unique, single managership employed by the German missile scientists at Peenemünde. There, under central control authority, in one organization, were German experts in aerodynamics, structural design, electronics, servomechanisms, gyros and control devices, propulsion, and all other disciplines necessary to develop a total system. The group, impressed by the eclectic system evolved by the Germans, urged its adoption by this country.

Von Kármán predicted that the development of future sophisticated weapons involving across-the-board state-of-the-art advances could be attained only by

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Bell Aircraft's X-1A and X-1B, derived from the supersonic X-1, attained Mach 2 speed and reached altitudes above 90,000 feet.

emulating the German approach. This would require the creation of an organization of diverse experts who must be provided "with facilities for laboratory and model shop production in their specialties and with facilities for field tests."

These recommendations came to fruition in the Arnold Engineering Development Center and the USAF Laboratories and Test Centers.

The vision of General Arnold and von Kármán also gave rise to what Air Force leaders now view as a fertile age in aeronautical technology, attained during a period marked by an absence of any major foreign threat and by unbridled demobilization. As such, it broke with the historic pattern of withering technology efforts during periods of geopolitical calm.

The first of the X-series of experimental aircraft (X-1 to X-15) plus the B-36 bomber and the Distant Early Warning (DEW) Line radar screen were either conceived or developed during this period. But, while the von Kármán report's impetus was formidable with regard to air supremacy, it accorded only a low priority to the research and development of advanced missiles.

It recommended an evolutionary approach geared to air-breathing missiles, which were to augment the capabilities of bomber and fighter aircraft and to enhance air defense. This proposal was not in accord with the recommendations of the RAND Corporation, which General Arnold's directive had launched in March 1946 as Project RAND (for Research and Development). This group, first of the independent, nonprofit "think tanks" devoted to long-range planning relating to national security in such divergent areas as electronics, nuclear physics, and social sciences, had proposed a "World-Circling Spaceship."

But, because the peacetime budget was extremely lean, the planning emphasis in the late 1940s was directed at manned strategic systems capable of delivering the US's technological trump card—the atomic bomb—to the heartland of any potential enemy. This reasoning becomes more understandable even in retrospect because of the broad skepticism with which many prominent members of the scientific community viewed the prospects for intercontinental missiles. Many considered the German missiles, whose maximum payload was below one ton, as not cost-effective.

The great weight and size of the atomic bomb, as opposed to the later and lighter H-bomb system, seemed to rule out missiles as delivery vehicles. As a result, the Air Force devoted a disproportionate amount of its procurement funds to aircraft for the decade to follow. As late as 1954, the ratio was ninety percent for aircraft and ten percent for missiles. Four years later, however, the balance had shifted to about twenty-five percent for aircraft and seventy-five for missiles, because of the Soviet missile threat and the concomitant high priority for the Air Force's ICBM program. In fact, the actual forerunner of the ICBM was canceled in 1947 and not fully reinstituted until six years later.

The first tangible recognition of the increasing importance of research and development to the Air Force mission was the recommendation by a group of sci-

Convair's B-36 strategic bomber, which eventually attained 10,000-mile range, employed six reciprocating and four jet engines. It was the world's first truly intercontinental strategic bomber and, for years, the only vehicle capable of delivering nuclear weapons.

entists, headed by Dr. Louis R. Ridenour, meeting at the Air University in 1949, that R&D be assigned to a special, full-fledged command. Previously, the Air Materiel Command had performed this function, in addition to its responsibilities in procurement and related fields.

Twin milestones of far-reaching consequence were reached in January 1950, when the Air Force established the Air Research and Development Command (ARDC) and created the office of Deputy Chief of Staff for Development, in Hq. USAF, to streamline and manage technology as a distinctly separate and vital entity. This was followed a year later by the opening in Tennessee of the Arnold Engineering Development Center, initially proposed by von Kármán as a key element in a national test and evaluation complex.

In 1963, another milestone was reached when the Air Force Laboratories became a separate component of the Air Force Systems Command, the successor of ARDC.

The Air Force and the Aerospace Industry

A significant turning point in terms of the systematic management of technological resources was reached in 1949 when Hq. USAF staged a pioneering meeting with about 150 key industry executives representing both prime and subcontractors and outlined to them a then novel approach for developing and building combat aircraft. In place of the previous technique of first building an airframe and later mating it with the subsystems needed to perform the overall mission, the Air Force advocated "systems engineering" the entire weapon system from the outset. This meant optimizing the airframe, the engines, the weapons, and the avionics for one another on a concurrent basis.

In a practical sense, the integral involvement of industry in Air Force R&D is generally seen as beginning at that time. (There had been prior, tentative cooperation with industry in research such as in the case of the missile study program in 1946, which resulted in the radar-equipped Falcon air-to-air missile. The fact that this was done by industry rather than by a Signal Corps or other government laboratory constituted a definite break with military R&D procedures. During the same period, the Air Force also established stronger ties with the academic community, when MIT developed inertial guidance for aircraft and missiles.)

The Air Force's reliance on industry came about in part because of the limited in-house R&D capability of the new service. The Army had to develop its arsenal concept and the Navy its policy of naval gun factories and yards and docks during a time when American industry lacked the ability, size, and inclination to produce the weapons needed by the two services.

By the time the Air Force came into being, one important lesson with regard to the relationship between the military and industry had been learned: During periods of national crisis, when weapons have to be mass-produced, the need for industry involvement becomes categorical. Conversely, retaining the broad in-house capabilities inherent in the arsenal approach in peacetime is neither necessary nor economical if there exists a healthy, vigorous defense industry. As General Ferguson put it, "The Air Force by design depends heavily on industry for its weapon systems because an in-house manufacturing capability is too expensive to maintain."

But industry can mass-produce the Air Force's weapon systems best when it is involved in the R&D progression relatively early. The transfer of knowledge and expertise from one organization to another, the Air Force has learned, involves a great deal more than just the turning over of blueprints, and must take place on a step-by-step basis. This is true whether the transfer is from government to industry, or from one industrial contractor to another.

The relationship between the Air Force and industry has varied both in nature and extent, over the years. In many instances, the degree of industry involvement in USAF R&D was dictated simply by the absence of an in-house capability, a condition especially prevalent during the first decade of the Air Force's existence as an independent service.

During that period, the ability to perform in-house tasks was curtailed because facilities and personnel were being assembled, a process that took a great deal of time and money. The second decade, by contrast, was marked by the attainment of substantial in-house capabilities involving both staff and facilities. But, even today, development of appreciable in-house capabilities in new areas normally requires at least three to five years and depends on the availability of trained manpower.

During the stewardship of Secretary of Defense Robert S. McNamara, in-house capabilities were emphasized to an unprecedented degree and culminated in the so-called building-block concept. This was hailed as a cost-saving shortcut to system development but, in reality, bogged down frequently because techniques and components that were rated ready for "off-the-shelf" use turned out to be "verified" only in a basic scientific sense and encountered major difficulties during the development, engineering, and manufacturing phases.

This condition was made worse by the prevalent aversion to building prototypes and demonstration systems. This attitude overlooked the fact that experimental research often leads operational capabilities by as much as fifteen years, during which theory has to be translated into mass-producible hardware. It took twelve years, for instance, from the time the Air Force fully established the laboratory qualities of titanium to its first use in the compressor section of an operational jet engine.

In the view of many Air Force technology managers, "a good rule of thumb is that the quality of the manufactured product bears a direct relationship to the amount of engineering done at the place you buy from." For this reason, the Air Force's golden rule now is that in-house activities should not reach beyond the preprototype or "brass-boarding" stage.

A third factor also shaped the peculiar nature of relations between the military and the defense and aerospace industry during the McNamara era: the concept of "disengagement." In a break with Air Force management philosophies in effect before and since, the so-called total package procurement concept, in vogue during that period, stipulated that the prime

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The YF-12A, a record-breaking Mach 3 interceptor, was developed rapidly under a tightly structured, orderly management approach.

contractors develop and manufacture complete weapon systems with only a modicum of direct government supervision, but in rigid accord with the specifications stipulated when the contract was let.

A more prudent approach has proved to be reliance on "engaged" cooperation between the government and industry, which was practiced during the 1950s and which has now evolved into the so-called "milestone" approach. It relies on a constant interchange of the best ideas and approaches that can be generated in-house and by industry.

A major, direct influence on the relationship between the Air Force and technology is also the makeup of the governmental management structure. Major changes in this regard occurred frequently during the past twenty-five years and some have had deleterious effects. In the early days, the Air Force could launch development programs simply by presenting the request to do so, with proper documentation, to the Research and Development Board, comprised of the three services and NACA, forerunner of the National Aeronautics and Space Administration (NASA). Industry "accountability" was simple and direct. But as layer upon layer of new authorities and reviewing agencies were superimposed, industry had to match internally the complexity of the "buyer's" management structure, in order to meet the "paperwork" requirements. At the same time, the tendency to furnish either muddled or constantly changing instructions to the program director and industry increased.

The results, of course, were often higher costs as well as technological problems. An often-cited case history of how constantly shifting guidelines can affect systems development is a comparison of how the government managed the A-11 (later designated the YF-12A, and its close kin, the SR-71) and the B-70 programs. In the first case, the contractor was furnished precise and reliable information by one central authority; in the latter example, industry was subjected to a constantly changing set of instructions and guidelines emanating from not only various USAF and DoD echelons, but also from the Congress.

The Need for In-House Capabilities

In order to manage technology and to direct its movement, the Air Force needs a strong and comprehensive in-house capability, in the view of General Ferguson. One principal reason is the need of "pump-priming" industry in areas of high risk. Typical recent examples include the areas of microelectronics, laser, and advanced composites.

Equally compelling is the fact that only government has access to new developments in all phases of technology produced by competing industries and laboratories and, therefore, must be able to evaluate and guide these efforts. This cannot be done without in-house expertise. Intelligent procurement also requires sufficient expertise based on in-house work, to "at least be able to argue with the contractor."

Further, in-house facilities and personnel permit exploratory research in promising areas, without the need to activate the slow and cumbersome contract process involving several Air Force echelons, DoD, the Bureau of the Budget, and Congress.

Secretary of the Air Force Robert C. Seamans linked the need for in-house research to the present funding squeeze, which requires the most careful husbanding of all Air Force resources. This, he said, warranted that "the Air Force must retain a high-quality in-house cadre of scientists who are engaged in scientific research. Their responsibility will be to enlarge the scientific base in areas important to the Air Force, to act as the eyes and ears of the Air Force for the implications of new developments in science elsewhere in the nation and the world, and to provide expertise to our

Secretary of the Air Force Robert C. Seamans, Jr., advocates that USAF retain a high-quality in-house cadre of scientists to enlarge the scientific base in areas important to the Air Force and to guide Systems Program Offices and other users of technology.

Systems Program Offices and other Air Force customers of science."

He cited as an example of the importance of the in-house engineering know-how that "in every accident or failure of an aircraft, experts from our Materials Lab are brought in immediately. They may find that the threads in a bolt were machined rather than pressed into the bolt, thereby setting up stresses which ultimately caused failure. Or they may find that a panel cracked in fatigue because of vibrations, and that it can be corrected by the appropriate incorporation of viscoelastic dampers into the structure. And, while we most assuredly would have preferred never to have had the technical problems that arose with the F-111 and the C-5, these scientists and engineers in the laboratory played a key role in achieving successful solutions. There are literally hundreds of cases where expert scientists and engineers from the Materials Laboratory have been essential to the correction, or avoidance, of problems of this nature."

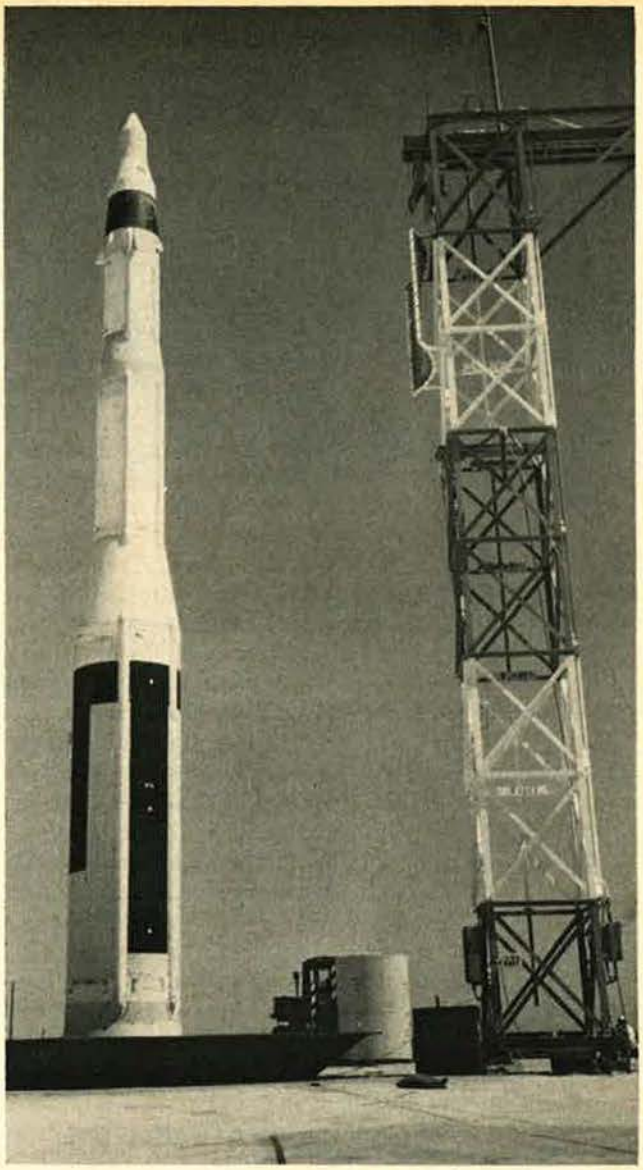
In the aggregate, the "mix" between in-house and contracted research has remained relatively stable from the time the Air Force completed its laboratories and test centers; the average is less than fifty percent for in-house activities. In specific areas, such as in advanced laser technology, the work by Air Force labs will at times reach a much higher percentage.

Air Force experience to date has not yielded any definite information on what constitutes an ideal mix between how much R&D should be conducted in government facilities and how much should be contracted out, except for two general rules: The mix should be kept within ranges that assure both the government and industry of meaningful participation in what the other partner is doing. The general yardstick informally followed by Air Force technology managers is that eighty percent represents the "outer limits" of what can be allocated to in-house activity; conversely, in order to control research programs assigned to industry, the Air Force usually retains a small fraction of the effort for its own facilities and staff.

The other guideline followed by Air Force managers is that of avoiding direct manufacturing involvement in development efforts, beyond the so-called brass-boarding stage, except for isolated, one-of-a-kind systems. Brass-boarding means testing a technology under development in a realistic environment, such as flight-testing the new engine aboard an existing aircraft. This policy is based on the observation that industrial contractors will be hindered in setting up the manufacturing process if they have not had at least prototype fabrication experience.

The Changing Approaches to Technology

It is axiomatic that technology begins with and is undergirded by scientific knowledge. It is also usually true that this scientific knowledge bank, in its basic form, is publicly available, and therefore accessible to friend and foe alike. As a consequence, the race toward technological achievement, by and large, starts out on an equal footing. This makes paramount the manner and degree to which technology is exploited and clearly establishes them as the criteria that determine the outcome of the race.



USAF's ICBM program, involving Atlas, Titan, and Minuteman (shown here), was concurrent in development and procurement.

Air Force technology managers use this line of reasoning to demonstrate that the complexity of their task increases as rapidly as does scientific knowledge.

Over the past twenty-five years, this increase has been explosive. Immediately following World War II, the technology potential was relatively narrow. This made it easy to target on specific areas of technology and exploit them for a military objective. Also facilitating the task was the fact that the US, as well as the rest of the world, had only limited research capabilities.

Research staffs were small and close knit, not fragmented into a multitude of areas of specialization. But growth, much of it germinated during the massive technology efforts of the 1950s and leading to a vast expansion of the technological potential in the 1960s, multiplied the complexity of R&D management.

With the number of technological options constantly increasing, and economic constraints permitting exploitation of only a few, selectivity became paramount. At

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The F-111 program was subjected to an unusually high number of requirement changes during the aircraft's development phase which, because of the peculiar nature of total package procurement, led to much adverse publicity.

the same time, the technological structure had to be diversified and specialized not only into various research phases, such as advanced development, engineering development, and production, but also within a multitude of technological disciplines and categories.

As a result, the integration of research with component technology, and component technology with systems technology, became more difficult. Lead times increased and, with them, the need for crash programs. The ICBM program of the 1950s stands out in this regard. It consolidated a number of earlier, incipient management philosophies into a sophisticated systems approach involving about 14,000 scientists from the academic community and industry, some 1,500 military officers, and an additional 76,000 engineers and support personnel of twenty-five major prime contractors and 200 subcontractors.

Coming to fruition late in the 1950s, it assured the US lead in strategic posture for the ensuing decade. Its key feature was concurrency; all elements and phases of the program were tackled at the same time, including research, development, test, and production. Launched as a top-priority program by the Air Force in 1954, the first operational ICBM squadrons entered the SAC inventory only four years later. On a conventional basis, this would have taken at least ten years. Yet, the program's high technical risks were more than justified in view of the alternatives.

But viewed in retrospect, the program was perhaps too successful: It became the model for later development programs of USAF aircraft and, as General Ferguson puts it, "Unfortunately, the bold idea of concurrent development and procurement, required for the ICBM program because of its overriding importance to the nation's defense need, was adopted for less pressing programs."

It essentially eliminated the "fly-before-you-buy" concept and represented a radical departure from the development approach practiced by the Air Force between 1945 and 1955. During that period, General Ferguson emphasized, the Air Force developed thirty-three fighter and twenty-two bomber prototypes. The underlying philosophy was that "we should select from the available designs the best ones, develop them into test articles, and then flight-test the prototypes, often on a competitive fly-off basis, and ultimately enter the winners into actual production."

General Ferguson went on to say, "In retrospect, we recognize that we would have been much better off if we had utilized the prototype route on a number of aircraft systems that are currently suffering from growing pains, among them the F-111 and the C-5. Rather

The world's largest aircraft, USAF's C-5 Galaxy, was developed and produced in response to national policy requirements of five years ago, and, as a result, incorporated features and capabilities now deemed unnecessarily sophisticated and costly.

than making a major production commitment at the outset of the program, it would have been more prudent to commit ourselves only to a small test quantity and then fly and test these aircraft."

The advantages over total package procurement, General Ferguson added, are that "this way you can ascertain exactly what the aircraft really can do and, further, you have a chance to see if the world for which it was designed has remained the same. The F-111 concept was formulated when the name of the game was massive retaliation and the focus of attention was Europe. Its basic features were geared to low-level penetration for the delivery of nuclear weapons. We selected a design tailored for this role, selected a contractor, and announced a commitment for several thousand of the aircraft, with a dollar value sufficiently large to attract an awful lot of attention. While we had many technical growing pains with this aircraft, its real problem stems from the tremendous number of changes that had to be made because of requirement changes and technology advances that emerged during its development."

A similar fate befell the C-5 transport, designed in response to the national policy requirements of the mid-1960s. This required the ability to airlift complete units, with their equipment, to remote, underdeveloped parts of the world. The C-5 had to incorporate, in addition to size and range, many extraordinary capabilities with regard to navigation and operation from unprepared sites, including a kneeling landing gear, General Ferguson pointed out.

Some of these features are now being viewed as overly sophisticated and unnecessary because the role the aircraft is now to play [in light of the "Nixon Doctrine"] has changed, the General added. "But, because of the concurrency of the C-5's development and procurement, the responsiveness of the government to changing requirements was impaired, compared to what would have been possible under a normal prototype approach," he said.

The abandonment of an orderly development progression based on prototypes and brass-boarding during the 1960s has proved disadvantageous in two other important areas. It hinders incorporation into the production system of technology advances that may occur during the program's development phase. Also, demonstration programs often prove as vital to correct formulation of concepts and doctrine as they do to technology, in the opinion of many Air Force technology managers. Actual demonstration of a weapon system before its design is frozen, and, before it is committed to production, allows the "user" to modify the way in which he plans to use the system, which may introduce changes elsewhere.

Because the prototype approach reduces the possibility of prematurely freezing the final production design, it can be better adapted to changes in the enemy threat. Air Force technology managers are resigned to the "historic fact" that a major share of cost increase, schedule delay, or performance problems incurred during the development and procurement cycle are induced by changes in the requirement and threat or other reasons outside the purview of the technologist but for which he nevertheless is blamed.

Gen. James Ferguson, retiring Commander of the Air Force Systems Command, terms the "much more vigorous" technology efforts of the USSR "alarming" and warns that, in the case of a Russian technological breakthrough, there "is no way of buying time" to catch up.

The Contracting Lesson: Flexibility

One of the principal tools of the beleaguered Air Force technology manager is the contract structure he evolves, or, at times, is ordered to use by higher authority. The absurdities and shortcomings of the total package procurement concept—acknowledged by a strong recommendation against its further use, in the report of the Blue Ribbon Defense (Fitzhugh) Panel—need no further elaboration here.

Two decisive lessons have been learned by the Air Force during the past quarter century with regard to contracting: Different programs require different contracts, and the higher the risks involved in a given program, the greater the need for flexibility and application of a step-by-step contracting approach.

Translated into contractual realities, this means that a program's initial phases will often be premised on a cost basis, while subsequent ones tend toward the fixed-price mode.

The principal lessons learned in contracting by the Air Force over the past two decades found their condensation in the Air Force's contract structure for its F-15 air-superiority fighter, according to General Ferguson. (Variations of this contracting philosophy, keyed to different conditions, are the B-1 and AWACS contracts; the former is geared to cautious prototype development, with the full-scale development of the avionics phased in last, while the latter provides for a competitive fly-off of the system's most critical component, the radar, at the earliest possible moment.)

The F-15's incremental or "milestone" approach enables the government to retain better financial control over the program while also keeping it on solid technical ground and in step with changing requirements.

"The F-15 program is a modern approach to development management, structured to be as fail-safe as is humanly possible. It prevents the government from being stampeded into premature commitments and provides sufficient exposure and experience, so both the Air Force and the contractor may deliberately and safely progress from one development step to the next. The contracts are tailored to the work to be accomplished.

"The software, design-engineering part of the con-

(*Continued on following page*)

tract is a cost-plus-incentive arrangement to encourage the contractor to put forth his best effort the first time around. The R&D phase, involving twenty aircraft, is on a fixed-price-plus-incentive basis because, by that time, the contractor is sufficiently experienced to make a reasonable contractual commitment in terms of price.

"The actual procurement contract also will be on a fixed-price basis but will be negotiated incrementally. We will contract for each wing incrementally, negotiating the price as our experience in true costs and the benefits of the learning curve increase. This places both the government and the contractor on a financially sound contractual basis," General Ferguson explained.

The Unpredictable Requirements

In the view of the experts interviewed by this reporter, nothing has happened in the past twenty-five years to justify the assumption that the broad planning and forecasting functions on which technological emphases are placed will be less inaccurate in the future than they have been in the past. Two of the principal planning factors affecting the technology effort are whether the inventory should be optimized, over a given development period, for nuclear or conventional weapons, and whether for aircraft or missiles. Indirectly, a third factor also has played a role—whether the nation could look forward to a period of peace or not. The forecasts have proved less than infallible; the emphasis during the first five years of USAF's existence was on nuclear-delivery capabilities, but the Korean War, although undoubtedly confined to a localized confrontation by the US's nuclear deterrence, was fought exclusively with conventional technology. The Southeast Asian conflict caught the development planner off guard on both criteria.

The preceding development emphasis had been on nuclear weapons as well as on missiles, while the requirement, of course, was confined to conventional aircraft and munitions. Development efforts on aircraft fire-control systems, possibly the most pressing need of the Vietnam War, had been reduced to almost zero during the preceding five years, for instance.

The Relevancy Dilemma

These vagaries and the inability to forecast correctly are neither surprising nor, from the standpoint of technology, disastrous, so long as a broad-based, strong technology effort is maintained. A comprehensive research program, in General Ferguson's view, is the basis for the qualities most often asked of the Air Force's technology effort—"flexibility and responsiveness."

Historically, two principal obstacles stand in the way of sustaining comprehensive and thorough technology efforts. One is money and the other *relevancy*. The first is obvious: Inadequate funding because of either a real or presumed diminution of the threat or for reasons of national fiscal policy, of course, impairs or vitiates the technology effort. The ups and downs in the Air Force's technology and research budgets, depicted on this page, serve as a gauge for measuring the breadth of the Air Force's R&D programs since 1947.

The second factor, relevancy, is harder to interpret. It is generally invoked more frequently during periods of reduced budgets. Its strictures apply in cases where other government agencies have been given primary responsibility over areas of technology of specific interest to the Air Force. This applies to nuclear-weapons research, for instance.

While the Air Force's strategic mission pivots on nuclear weapons and their characteristics, research in this field is not within its purview but is assigned to the Atomic Energy Commission. (The Air Force recently had to drop a promising research program—involving thermonuclear fusion, clearly pertinent to its mission and meant partly to "prod" AEC into a more active pursuit of this field—because the latter has primary responsibility in all nuclear developments.)

Another constraint on the Air Force's R&D effort in terms of relevancy results from the enactment into law last November of "Section 203," which calls for a "direct and apparent relationship" of all research to a specific function or operation. About seven percent of the Air Force's research projects in progress when the law became effective had to be dropped. Air Force Secretary Seamans described the impact of Section 203, in recent congressional testimony, as "not uniform."

He explained that "virtually all projects in the elec-

USAF RESEARCH & DEVELOPMENT OBLIGATIONS BY FISCAL YEAR

(IN MILLIONS OF DOLLARS)

FISCAL YEAR	TOTAL TECHNOLOGY*	RESEARCH
1947	$ 112.7	$ 22.6
1948	140.8	28.2
1949	213.5	43.7
1950	223.1	44.6
1951	368.6	73.7
1952	498.6	99.7
1953	1,016.9	203.4
1954	941.4	188.4
1955	939.3	188.0
1956	1,142.8	246.6
1957	1,643.9	184.7
1958	1,858.6	217.9
1959	2,440.0	195.4
1960	2,815.5	367.3
1961	3,588.9	568.3
1962	3,569.8	587.5
1963	3,944.7	644.7
1964	3,784.0	645.1
1965	3,351.0	667.4
1966	3,342.3	827.4
1967	3,794.3	599.2
1968	3,621.7	610.0
1969	3,498.5	516.4
1970	3,220.8	568.1
1971	3,070.9	592.3

Total technology includes Research, Exploratory Development, and Advanced Development. Also included are pay allowances of military R&D personnel, beginning in Fiscal Year 1953, and support from procurement appropriations of development, test, and evaluation, starting with Fiscal Year 1954.

USAF technology effort is largely determined by budgetary constraints. In terms of research and combined R&D, Air Force technology budgets since 1947 show wide fluctuations.

tronic sciences demonstrated a direct relationship to specific military functions, while many in physics and astronomy were deemed too indirect to meet Section 203. For example, the physics of energy processes in stars, which was supported because it could ultimately lead to improved means of aerospace propulsion or to new energy sources, was deemed to be too indirectly related to an Air Force military function. If the research should lead to an understanding of the process, it would next have to be demonstrated experimentally. After successful demonstration, the development project would become the responsibility of the Atomic Energy Commission, and only then would it be ready for a presently unknown Air Force application. We recognize the parallel between this example and the research on the carbon cycle in the 1930s, which subsequently was 'clearly identified' with nuclear fusion, but we still cannot call such research 'direct and apparent' under present criteria."

Combined with the broad reduction in funding experienced by the Air Force during the past few years (USAF's research, development, test, and evaluation budgets were reduced, if inflation is allowed for, by about forty percent over the past five years), the stringent application of the relevancy standard creates, as Secretary Seamans testified, "the danger that we will innovate modest improvements but fail to achieve major breakthroughs." History, he added, "is filled with instances where apparently irrelevant scientific inquiry completely eclipsed carefully directed programs."

To compensate, at least in part, the compartmentalization of the technology effort, which began twenty-five years ago, is being reversed within the Air Force at this time. The research community and the development community, Dr. Seamans said, will be "brought into closer contact to achieve a more effective and economical interaction."

The recent merger of the Office of Aerospace Research (OAR) into AFSC constitutes a first step in this new direction, Secretary Seamans said. At the same time, the Air Force will seek to reinvigorate the cooperation with the nation's universities, which in recent years has suffered severely because of campus opposition to "war research," he promised.

The Technological Outlook

The level of this country's defense-oriented research, when related "to the much more vigorous research and development program of the Soviet Union," is, in General Ferguson's view, "alarming." He termed it "disconcerting when you discover that somebody else is willing to explore the unknown, dynamically and energetically without having to relate these efforts to a given weapon system."

As the spectrum of the technological potential widens—General Ferguson dismissed the idea of a technological plateau as false—the possibility of an intensive research program yielding "breakthroughs of monumental importance" increases, he said.

"Twenty-five years ago, when the technology spectrum was narrow, the potential for breakthroughs was limited to a few areas. Today, the interplay of various technologies creates an almost infinite potential for advance and, if the other side is successful, there just is no way of buying time" to catch up, General Ferguson warned.

An example of the disparity in R&D achievements was the revelation by Russian scientific publications almost two years ago that the USSR had achieved controlled thermonuclear fusion, employing laser technology. Verification of this Russian claim by duplicating the achievement took the US a whole year. If the Soviet Union sees fit to publicize a breakthrough of "such stupendous importance in the field of controlled nuclear fusion," General Ferguson felt, "it must be assumed, on the basis of past performance, that they are really many years beyond that point."

The laser's defensive and offensive potential, he said, typifies "some of the technologies that appear to offer the same kind of revolutionary capability on how wars are fought, or deterred, that nuclear weapons provided at the end of World War II.

"Also, the ballistic missile clearly is gaining major new strategic dimensions through the interrelationship with its own hardpoint and area defense, as well as its mobile basing. Space is another area that might well reshape military strategy in the future," he said.

The impact of space exploration on strategy, he intimated, is already being felt. Until recently, the presence of US troops in many remote parts of the world was deemed vital to the defense of the United States, General Ferguson said, adding, "However, space technology, as now evolving and being applied, makes it feasible to consider the long-range defense of the country with a significant reduction in the number of American troops stationed outside our borders."

Despite curtailed research programs and the "complacent" national mood regarding defense, the retiring head of the AFSC, who has held key technology management positions for the past fifteen years, remains "sanguine" about this country's ability to maintain R&D at a level sufficient to meet national security needs.

One way to extend the buying power of available funds, he believes, is through the systematic "lateral transfer of technology, from one service to another, from one government agency to another, and between defense and the commercial sector. We are making good progress in this field, and more is possible." He cited such areas as joint development of commercial and military STOL aircraft currently under review, as well as joint use of air traffic control satellites to serve the Air Force and commercial aviation.

The other method, already widely implemented, hinges on management philosophies geared to a more efficient utilization of available resources. In both cases, he said, "we are closing the loop back to where we started. Von Kármán strongly urged a unified national approach to major technological resources and test facilities. I think we are finally moving in this direction. At the same time, we started out with a flexible, incremental approach to building systems, and we are back on that same road."

Seemingly, so far as twenty-five years of Army Air Forces- and USAF-sponsored technology is concerned, there is merit in the saying that history repeats itself. As a result, the search for panaceas has given way to the wisdom of such early leaders as General Arnold and Dr. von Kármán.—END

The Arsenals of Peace

BY KARL G. HARR, JR.

President, Aerospace Industries Association

THE aerospace industry of 1970 is a lineal descendant of World War II's aircraft industry, but there is little in the way of family resemblance. A quarter century of transition has completely changed the face of aerospace manufacturing.

Change, of course, has been a way of life for the industry since its origins in the years preceding the first world war. But in the past quarter century, particularly in its latter years, the *rate* of change has accelerated at an incredible pace. The impact has been felt in every sector of the industry's operation, from the product line to the type of facilities required, from research through production, from factory worker to top management.

The transition has not been easy. Each increment of technological progress demanded massive technical adjustments in the industry's method of operation. The technical problems were compounded by fluctuating government budgets and policies that frequently brought on program cutbacks, stretchouts, and terminations. From the hectic and often chaotic quarter century of advance and adjustment, however, there has emerged the greatest industrial technological capability the world has ever known—a national bank of know-how whose resources can be channeled into stronger defense, further strides in space, and a wide range of other activities addressed to the betterment of society.

The Postwar Decline

The quarter century of transition started even before the end of the war. When victory was in sight, the future seemed free of further conflict, except to a visionary few. Understandably, and in accordance with our traditions, the nation was in a hurry to reconvert to plowshare production, and the general attitude toward the aircraft industry was, "Who needs it?"

With the abrupt cancellation of some $20 billion worth of contracts, the aircraft production curve plummeted in a near-vertical dive that was to continue for more than two years. Hundreds of facilities that only months earlier had bustled with round-the-clock activity became ghost plants. More than a million aircraft workers were laid off in the span of one year, and the industry that had been top-ranked employer among manufacturers of durable goods in 1944 slipped to sixteenth place in 1946.

Industry optimists had hoped that manufacture of commercial aviation equipment would take up some of the slack. There had been forecasts of great booms in both civil air transportation and personal flying in the postwar years. One enthusiastic prediction made in 1945 held that civil-plane production would reach 500,000 units over the first five years after the war.

But this shining promise proved illusory. The predicted upsurge in airline travel did materialize, but its thrust was gradual. Real momentum was deferred to later years. Many new commercial operators entered the aviation field, offering nonscheduled passenger and cargo services, but, due to the availability of thousands of war-surplus transports, they constituted a negligible market to the aircraft industry. Although the lightplane-building segment of the industry experienced a flurry of activity in the immediate postwar period, it was short lived. Moreover, it did not begin to compensate for the drastic reductions in military plane procurement.

In the years 1946–47, production of military aircraft dipped to an annual average of fewer than 1,800 units, a rate lower than that of 1938. Struggling to keep their major production facilities in operation and to preserve the invaluable know-how of their engineering teams, aircraft manufacturers branched out into such nonaviation efforts as fabrication of trailer homes, plastic products, office furniture, motorcycles, and boats. It was not enough; plants designed for mass production could not be supported by a trickle of output, and

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most of the leading companies recorded substantial losses. The aircraft industry was at a low ebb, its survivability very much in question.

By 1947, however, the American people began awakening to a new need for a strong defense system. As East-West tensions became increasingly manifest, considerable alarm developed at the extent to which both industrial and operational airpower had deteriorated, and this, in turn, produced a general demand for a reversal of the trend.

One result was the formation, in 1947, of two separate committees—the President's Air Policy Commission and the Congressional Aviation Policy Board—charged with making comprehensive assessments of America's air status and with recommending reconstruction plans. Reporting in 1948, the study groups were in accord on some major points: that the newly independent Air Force and the aviation arms of the Army and Navy should be expanded and modernized; that the operating forces should be backed by a healthy aircraft industry producing equipment at a rate sufficient to allow quick mobilization in an emergency; and that a far more intensive program of aeronautical research and development should be undertaken to assure continuing improvement in aircraft performance. These recommendations found strong support within the Administration and the Congress, and in 1948 funds were appropriated for the initiation of a new airpower buildup toward a planning target of seventy modern Air Force groups and a commensurate Naval aviation strength.

The Buildup and Its Problems

The aircraft industry had a dual assignment in the new airpower buildup. First, it was to supply the military services with modern aircraft in increasing numbers. At the same time, it was to improve its own capability for rapid mobilization through a program of "industrial expansibility," in which existing production lines were to serve as nuclei for far greater output, should it be required.

One major factor posed enormous complications. Even though quantity production had dropped to rock-bottom levels in the immediate postwar years, government and industry had maintained a moderately funded but progressive program of research and development. This program had made available for production a variety of aircraft which, though unimpressive by today's standards, offered substantially improved performance over World War II types. This marked the real beginning of the jet age. Although there were only a few jets in production at the start of the buildup, there were some thirty in various stages of development, and more than a score of these were to be tagged for quantity production within a few years.

But increased performance also inevitably means increased complexity. There was a new emphasis on electronic systems. Where the average 1944 combat plane had carried half a ton of avionic gear, its 1948–50 counterpart needed three to five times as much. This, together with stronger structures, better armament, greater fuel loads, and a multiplicity of other considerations, made the new breed of airplane much bigger and heavier than its wartime predecessor. Its construction also required roughly four times as many man-hours. The same factors combined to stretch "lead time," the time between placement of an order and delivery of the unit.

This increased complexity plunged the industry into the first of several major postwar transitional phases, and its impact affected several aspects of the buildup program.

Industry employment, which had dropped to a low of 237,000 during the decline, began to climb, but the climb was a slow one because the types of skills needed were in short supply. Development and pro-

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By 1946–47, production of military aircraft had fallen to 1,800 units a year. Jet engines excepted, design and materials were not far advanced over wartime years. Less than ten years later, the contract for the rocket-powered X-15 was awarded. Pioneer X-15 pilots Joe Walker, Bob White, and Scott Crossfield first flew the aircraft in 1959, demonstrating its tremendous advances in design, materials, propulsion, instrumentation, and production methods.

duction of the new breed of aircraft demanded a greater proportion of highly skilled personnel. Scientists and engineers, for instance, had comprised only 2.2 percent of the World War II work force; by 1950 they accounted for nine percent of the total. There was a similar proportional increase in other high-skill categories, a trend that was to continue throughout the postwar quarter century.

There was a concurrent change in the types of tools and machines needed for production. They had to be infinitely more complex than the equipment they replaced. Such machinery was not available "off the shelf." Its design, production, and installation required considerably more time. And, although this machinery would eventually effect savings through more efficient production processes, its acquisition was expensive.

Military aircraft costs rose dramatically. More elaborate airborne equipment, more man-hours per unit, a higher average payroll due to both inflation and skilled-worker emphasis, increased prices of materials and machinery, etc., meant that appropriated funds bought fewer aircraft. In 1948, the industry's military sales topped the billion-dollar mark for the first time since World War II. In 1949 they rose to $1.8 billion, and in 1950 they reached $2.6 billion. Yet the number of military aircraft delivered remained relatively constant throughout those years: 2,536 in 1948, 2,592 in 1949, and 2,680 in 1950.

Costs, in turn, affected the industry's ability to broaden its base for possible mobilization. Plans to provide extra tools and facilities for emergency activation had to be subordinated to the primary job of modernizing the military air forces with available funding. Further, the expansion capability was dependent upon the industry's rate of production, a rate more accurately measured in terms of airframe pounds than units. The Congressional Aviation Policy Board had recommended an annual output of 111,000,000 airframe pounds, but mounting costs precluded even an approach to that lofty goal without a massive increase in a funding level already considered high. During 1948–50, the industry was producing only 30,000,000 to 36,000,000 military airframe pounds a year.

Korean War Production

With the outbreak of hostilities in Korea in June 1950, Congress elevated the Air Force strength target to 143 wings and appropriated vast sums for military aircraft production. Despite repeated warnings that plane production could not be turned on like a water spigot, the feeling prevailed that the aircraft industry could easily duplicate its World War II feat of tripling output within a single year and tripling it again the following year. In fact, one unrealistic goal called for a *fivefold* increase the first year.

Even scaled-down production schedules proved optimistic. The mobilization base of 1950 simply was not sufficiently broad for large-scale turnout of complex aircraft. Lead time could not be appreciably reduced. Because of the shortage of trained personnel, it became necessary to train unskilled workers in highly skilled jobs and to provide engineering training for qualified technicians. Directing the efforts of more than 60,000 subcontractors and suppliers strained the available nucleus of management personnel. Under the government policy of "partial mobilization," an effective system of priorities was slow in forthcoming, and lengthy delays were experienced in obtaining scarce raw materials and machine tools.

In spite of these problems, the industry managed to double its aircraft output by the end of 1951. The planes coming off the line, however, were those ordered during the pre-Korea buildup. Moreover, their numbers were insufficient to meet requirements. The operational lifetimes of aircraft long slated for replacement had to be extended. Said Gen. Nathan F. Twining, the Air Force Vice Chief of Staff: "The Air Force we have today is the one we bought three and four years ago. The Air Force we need today is the one we failed to buy at that time."

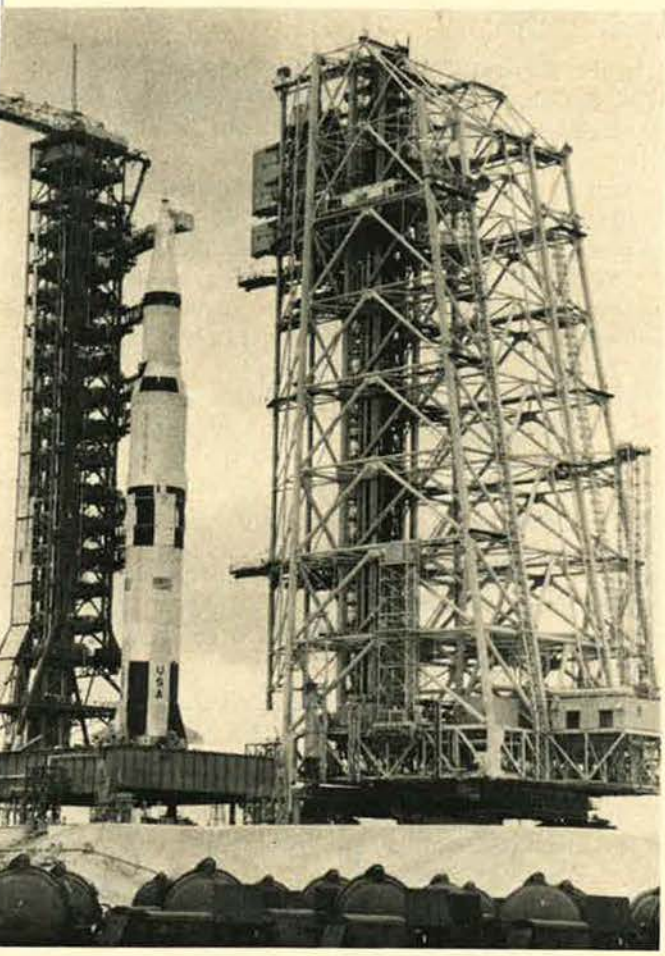
Production moved into higher gear in 1952, and, de-

spite myriad difficulties, the aircraft industry wrote one of the brightest chapters of its history in the three years of the Korean War. Military aircraft output climbed from about 200 planes a month at the start of the conflict to more than 750 at the time of the cease-fire. In all, the industry delivered to the armed services well over 16,000 new, high-performance aircraft. The USAF's air combat record in "MIG Alley" testified to the fact that manufacturers had maintained quality and reliability while coping with the monumental task of increasing output.

Revolution in Evolution

The Korean cease-fire by no means ended international tension; in fact, the cold war took a turn for the tepid. This time there was no sudden dismantling of the industry. The airpower buildup continued, but the nature of airpower took on an entirely new face.

In 1954, the aircraft industry embarked on another phase of its postwar transition, or perhaps more accurately, a series of phases. In the next five years—through 1958—the industry was to undergo its most sweeping transformation. A "revolution in evolution," one industry official termed it, meaning that although adjustment to changing requirements had become a life-style in the industry, the *rate* of change now accelerated markedly.



Missiles and boosters, culminating in the Saturn V (above), projected the industry into a new technical/management era.

The greatest single influence on the new transition was the government decision to proceed with development and production of long-range strategic missiles. The vastly greater destructive capability of the ICBM and other nuclear weapon systems initiated a trend away from mass application of force by numbers and toward greater reliance on the individual weapon.

The knowledge that the Soviet Union was moving in the same direction dictated a reorientation of the industry's role as partner in defense. The premise that any future all-out war would have to be fought with the resources on hand at the outset made obsolete the concept of industrial expansibility. Thus, the industry's assignment became that of supplying the military force in being with the most advanced weaponry it was possible to build, and to compress, to the extent feasible, the time span between concept and delivery. This brought about not simply another increase in research and development but a general elevation of the R&D function, from preproduction ancilla to a status coequal with the production job itself.

Predictions to the contrary, the weapons revolution did not signify the end of the manned airplane era. It did, however, bring forth a new family of aircraft of substantially improved capability. The first operational, barely supersonic fighter of 1954 was followed by a succession of still more advanced types capable of flying at twice the speed of sound. Major performance gains—such as range and payload—were demanded for other military aircraft. The complexity curve took a sharp upward turn, taking the cost curve with it.

There was a corollary decline in numbers of aircraft produced. Cost, of course, was one factor; the military services, of necessity, drifted away from the earlier custom of building several types for one job as insurance. Moreover, fewer aircraft were needed because of the individual plane's far superior performance and punch.

Concurrent with the advent of supersonic aircraft production, guided missile output became a truly significant portion of the industry workload. The Korean War had provided impetus to an extensive program of research and development of a variety of shorter-range missiles—airborne weapons, ground- and ship-launched air defense weapons, battlefield weapons, and pilotless tactical bombers. A few such types had achieved production status during the Korea years, but the big push came in 1954 when missile procurement topped the billion-dollar level for the first time.

The industry was thrust simultaneously into a massive R&D program on strategic missiles. The Department of Defense ordered development of the first ICBM in 1954. The second ICBM project was initiated in 1955, along with two intermediate-range ballistic missile programs. Work was started on the first fleet ballistic missile in 1956 and on a solid-fueled second-generation ICBM in 1958. An example of the efficacy of the industry's compression of developmental time was the fact that the first ICBM made a completely successful initial flight just three years after the start of the program.

Missile development and production shared a number of commonalities with aircraft manufacture. But there were as many differences. New fabrication tech-

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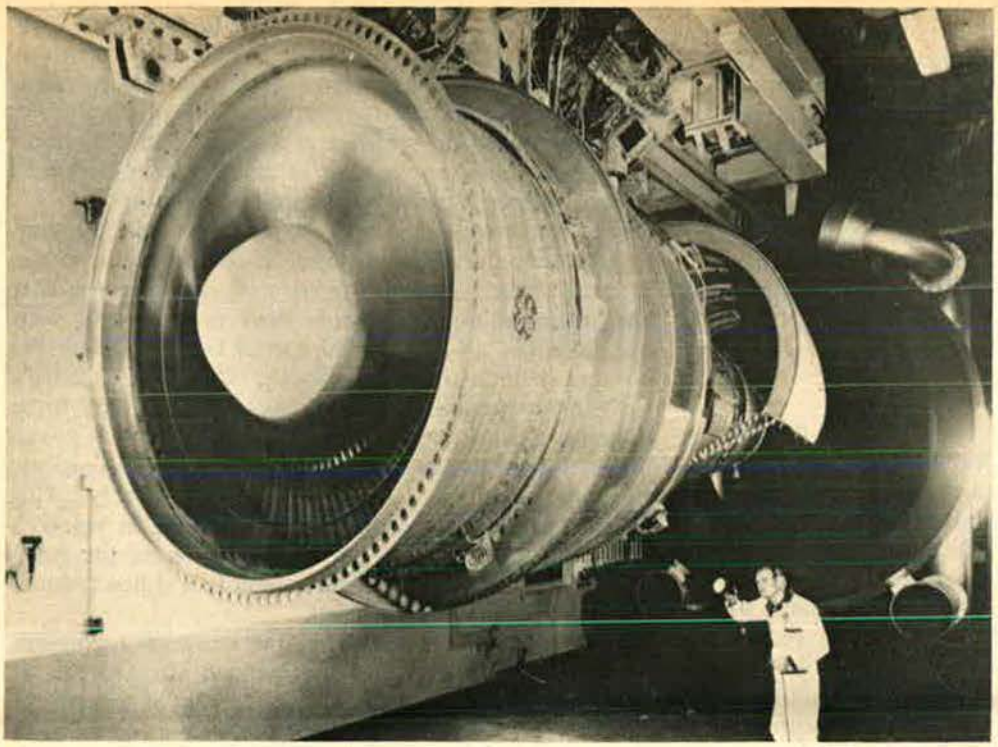

The skills needed for design and production of supersonic aircraft, missiles, space systems, and engines such as the General Electric CF-6 turbofan drastically altered the manpower balance of the aerospace industry. In the mid-1940s, eighty percent of the employees were production workers; today they make up only half of the work force.

niques were required, particularly for the larger weapons; rocket rather than jet engines supplied propulsive thrust; ultrareliability of equipment was a must for a one-shot system that operated without human guidance; new, hospital-like clean-room facilities were needed for assembly. The industry found itself in the paradoxical position of building new facilities, mostly financed from thinly stretched company funds, at a time when it was retiring some mass-production plants that were no longer needed.

In the midst of the weapons revolution, the industry moved into still another transitional phase in commercial aircraft production. Air transportation had snowballed in the latter 1940s and early 1950s, and new technology made possible a major breakthrough in commercial aviation—the jet transport. Manufacture of supersafe, high-capacity, high-subsonic airliners posed its own separate set of technical problems and one major nontechnical difficulty—financing. Transport builders had to put out $1.6 billion in research, development, testing, facilities, production, and other miscellaneous costs before the first airplane was delivered to an airline.

This five-year period of major transition was one of considerable growth for the industry. Overall sales climbed from $12.5 billion to more than $16 billion. Early in the period, in mid-1954, the industry regained its position as No. 1 employer among manufacturing industries, with 823,000 people on the rolls. By the end of 1958, employment was well over the million mark and the composition of the work force had undergone another major change. The need for a still greater proportion of scientists, engineers, and technicians in an era of dramatic technological advance needs no elaboration, but there was, in addition, a new emphasis on more and better managerial talent, due to intensified competition for fewer projects, a heightened demand for cost-cutting productive efficiency, and the increased complexity of program management.

The Space Age

In the decade of the 1960s, the industry—which in 1959 had become the "aerospace" industry—experienced one more major transition as the national space program moved into advanced stages.

Actually, industry's role in space research dates back to 1955, when the government ordered development of a launch vehicle and satellite for US participation in the International Geophysical Year. But prior to 1960 the industry's space effort was not significant, as evidenced by the fact that it constituted only a fraction of one percent of total sales in 1959.

The industrial space effort gathered momentum in the 1960s, particularly in the years following the national commitment to put men on the moon "within the decade." The lunar program, termed by one publication "a near miracle of engineering and production," taxed contractors' capabilities to their limits. In addition, the industry developed and built, for both NASA and the military services, a variety of increasingly complex, unmanned space systems, each of them technologically demanding.

Undoubtedly, the space program was the dominant influence in history's most explosive decade of technological advance. There were two primary contributing factors: breadth and acceleration. The breadth of the program required continual probing of new research frontiers, not simply in aerospace areas but across the spectrum of almost every scientific and technological discipline. The acceleration of effort imposed by the lunar-landing timetable necessitated a *forcing* of technology, compressing into one decade the normal advance of several.

While carrying out its space assignments, the industry continued to move forward on its other fronts. Military aircraft top speeds moved from the Mach 2 to the Mach 3 level. A new breed of airliner, the wide-body or advanced-technology jet, entered production. Missiles progressed through second, third, and fourth generations. With each increment of progress, the industry built a broader base from which to proceed to new levels, but each step of gain was possible only through greater and greater accent on research and development. A quarter century of transition can be summed up in the statement that aerospace has changed from a production-oriented industry to a research-and-development-oriented industry.

Then and Now

The extent of the industry's transformation is best illustrated by a few 1945–1970 comparisons of some major facets of the industry's operation.

• **Product Line.** Except for a few primitive missile experiments, the 1945 aircraft industry's output consisted entirely of aircraft, engines, and components. Today, the major portion of the industry's sales—including research and development contracts—still comes from aircraft work, but it has declined dramatically as a percentage of the total. Aircraft accounted for fifty-five percent of sales in 1969; thus, almost half of the industry's sales involve products that did not exist twenty-five years ago.

Commercial aircraft production has grown substantially. In the immediate postwar years, commercial sales ran from ten to twelve percent of the total, but only because military production was at the nadir. During the Korean years, commercial volume dipped to five percent, but it began to rise in 1956 when output in terms of units outstripped military plane manufacture for the first time. Dollar value of commercial production was still low in that year—8.5 percent of the total—because most of the output was in lower-priced general-aviation planes.

Deliveries of general-aviation aircraft have mounted steadily since 1956. Turbine-powered airliners had an even greater impact on the military/commercial sales ratio. By 1960, commercial dollar volume had climbed to 12.5 percent of total sales, and last year it fell just short of twenty percent.

In 1969, the industry built close to 12,500 general-aviation planes and about 500 jetliners, which compares numerically with about 4,000 military aircraft. Jetliner backlog at the end of the year was well over $8 billion, most of it in orders for the new wide-bodied jets. Of trade-balance importance to the nation was the fact that $2.7 billion of the backlog represented orders from foreign airlines.

The missile effort currently generates 18.5 percent of the total sales, while space equipment and research generate more than sixteen percent. The remainder, more than ten percent, comes from nonaerospace products and services, an area that has become increasingly significant over the past several years. These latter sales stemmed from the broad technological capability built up by the industry, particularly in the last decade, as it carried out its multiple governmental responsibilities. The acquired know-how has found wide applicability in such fields as civil uses of nuclear energy, marine sciences, water desalinization, crime control, urban transportation, and pollution control.

The product line of the individual company has changed appreciably from the years of World War II, when a firm concentrated on one type of product. The switch had its origins in the mid-1950s with the introduction of guided missiles and the growing complexity of aircraft, which demanded an array of new systems. Production capability for many of these systems did not exist, so manufacturers who had long been one-product firms began to branch out into guidance, propulsion, and other areas of specialization. Most major manufacturers today are organized on a multiproduct, multidivisional basis.

• **Employment.** It is an interesting fact that employment in the aerospace industry at the beginning of 1970, at approximately 1,350,000, coincided almost exactly with peak employment of the aircraft industry in World War II. Numbers, however, are the only similarity.

In 1943–44, eight out of every ten employees were production workers, many of them in the low-skill

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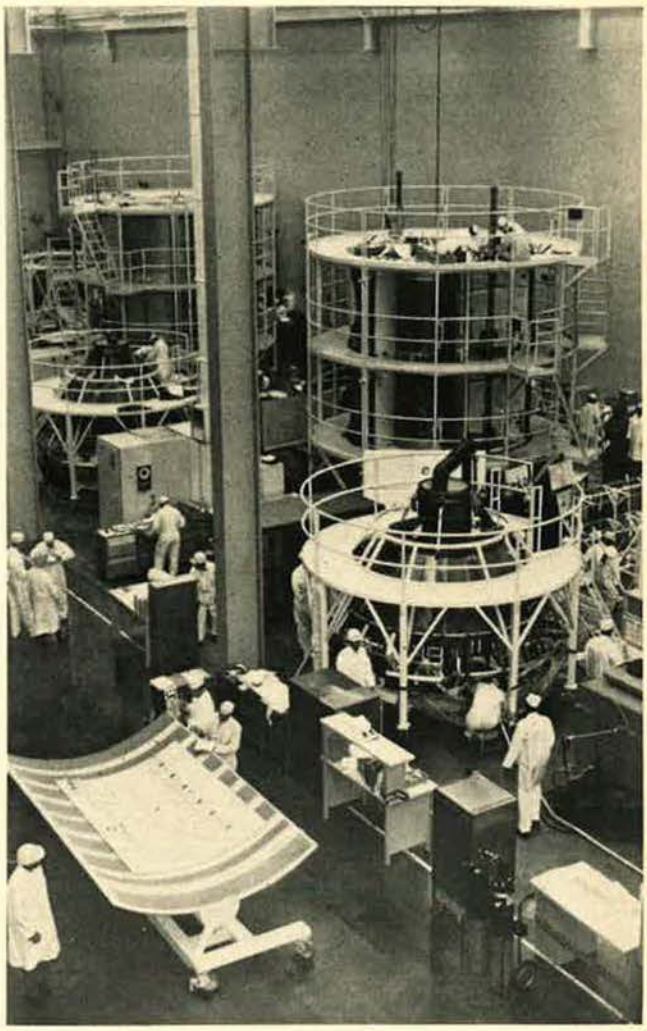


Systems reliability advanced by orders of magnitude as the space age matured. Here, an Apollo command module is assembled in one of the "clean rooms" at the North American plant.

Electronics, a World War II infant, became a key factor in the aerospace world. Spurred by a continuing threat, postwar technology started at high speed, then increased its pace. This BMEWS site at Thule AB is one of its greatest achievements.

categories. Only one in fifty was a scientist or engineer. Today, production workers make up only half of the total work force, and the average skill level is appreciably higher than it was in the war years. The proportion of scientists and engineers has climbed to sixteen percent, technicians to six percent.

• **Manufacturing Methods.** World War II was what manufacturing people call the "tin-bending era." Performance requirements of the day permitted relatively simple construction out of aluminum, which in some cases could be cut by a pair of shears. Manufacture of today's aircraft admits of no such simplicity; modern planes, particularly supersonic craft, need stronger structures and better skins for protection from their operational environment. Hence, aluminum has given way to new materials.

In wide use is titanium, a metal that is stronger than aluminum yet affords a weight saving. But titanium is a superhard material, extremely difficult to drill, weld, and forge, and, of course, it is more expensive. Now coming into production usage are the new composite materials, compounds of very tough fibers embedded in plastic matrices. At the same strength, composites offer twenty to forty percent weight savings over titanium, a very important factor in the continuing demand for greater performance. But, as did titanium, they pose a new set of problems, and their wider usage requires extensive research in manufacturing methods.

New materials dictate changes in plant machinery. The welder of World War II would not even recognize his modern counterpart, the multimillion-dollar automatic electron-beam welder. Rosie the Riveter's job is handled by computer-directed or numerically controlled machines, as are a number of other manufacturing processes.

In the constant quest for greater production efficiency, the industry is taking numerical control a step further. Now in development is CAM (for Computer Aided Manufacturing), a completely automated manufacturing facility that could handle automatically almost every step of the fabrication process, from design through inspection of finished parts. It will be enormously expensive to develop and place in operation, but for the long run it offers tremendous increases in productivity as well as large-scale dollar savings.

• **Procurement.** Prior to World War II, practically all defense contracts were awarded, as required by law, through formal advertising procedures, a method effective in its proper arena—where procurement involves standard, low-technology items and where complete and realistic specifications can be cited, permitting bidder selection on the basis of price alone. Despite the evolution of Department of Defense requirements from "off-the-shelf" items to highly complex systems, purchasing by advertisement and bid remains to this day the only procurement method formally recognized in the Armed Services Procurement Act.

The inference is that the advertising method is universally applicable and is the "one best way," but it clearly is impracticable in cases where the item being procured is an extremely complex defense system demanding the utmost in the contractor's managerial competence, technical skills, and elaborate facilities. Accordingly, during World War II, the military services were granted exceptions, allowing them to negotiate contracts with industrial firms selected for their demonstrated capabilities. Aerospace procurement by negotiation has been continued, in cases where the advertising approach is unrealistic, throughout the postwar quarter century. There has, however, been a significant swing in the type of contract awarded aerospace manufacturers.

In World War II, and for most of the quarter century, the primary emphasis in government/industry

contracting was on the cost-plus-fixed-fee contract, in which the government absorbed the costs and the manufacturer received a fee for the work involved. In the early 1960s, the emphasis shifted toward the use of a type of contract under which the manufacturer was required to quote a fixed price for major development/production projects, and the fee earned depended upon meeting the fixed price. Due to the many technical and pricing unknowns in highly complex programs that might take five to eight years to carry out, this proved to be an inappropriate procurement technique. In effect, it transferred an inordinate risk from government to industry.

Recently, the pendulum took another swing with the adoption by the Department of Defense of new rules to correct the inequities of fixed-price contracting. The fixed-price contract will still be employed where practicable, but, in general, the type of contract will be tailored to the risk involved.

• **Finance.** If there is one thing that has remained relatively constant throughout the quarter century, it is the industry's profit level, traditionally the lowest among all manufacturing industries. Although the reasons for low profits have varied with changing times, earnings as a percentage of sales have ranged from 1.4 to 3.2 percent. Last year's 3.0 percent compares with the 4.6 percent average for all manufacturing industries.

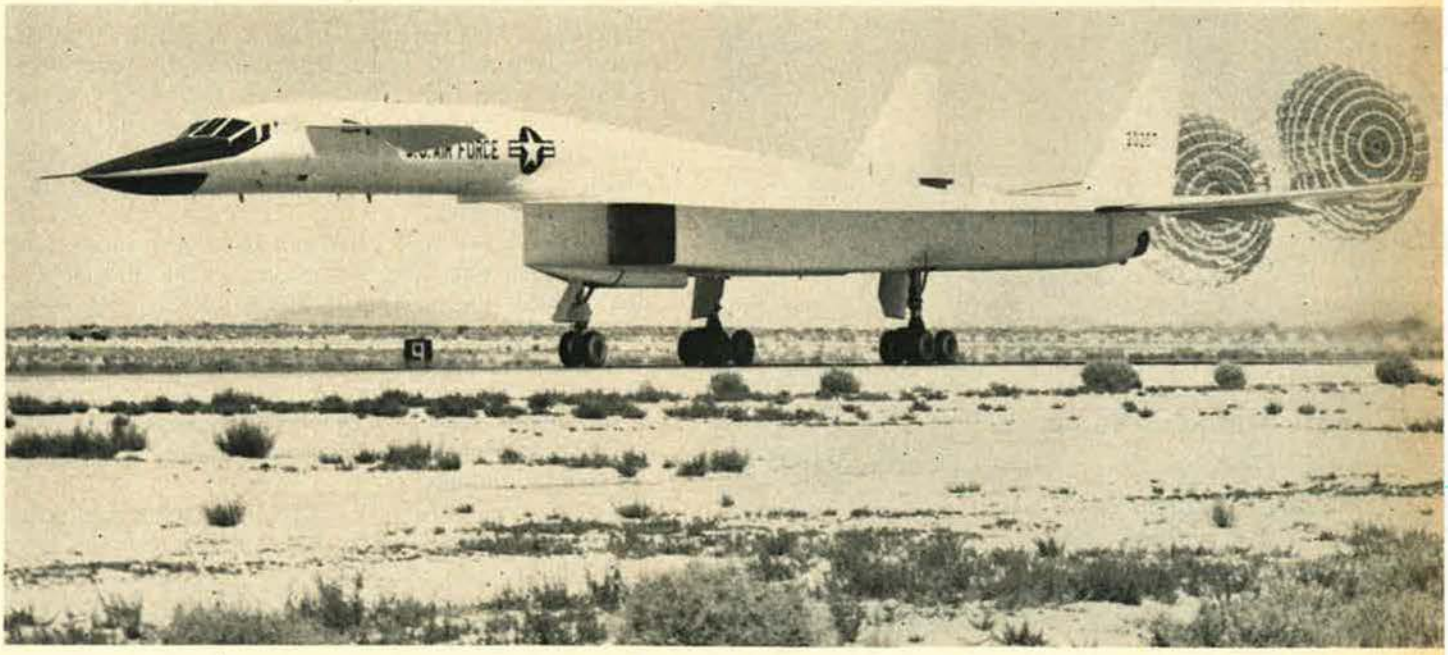
Explosive technological progress, with its attendant increases in complexity, has had an influence on profits. The dollar-volume magnitude of major programs requires large-scale financing at high interest rates. Facilities turnover has increased enormously; where an old-type aircraft plant could be used for many years despite model changes, a modern facility may become obsolete within the span of one project. Intense competition for fewer and fewer programs drives down contractors' bids. Compounding all these influences are the government's over-stringent contracting procedures and, in recent years, disallowances of many costs which the industry regards as reasonable and necessary.

All of these factors similarly influence the contractor's risk. To remain competitive, a company must invest more of its earnings in facilities; the industry total in 1969 was $800 million. The detailed effort that goes into a competitive proposal for a major system may cost a company tens of millions of dollars. And even a successful bid is a gamble rather than an assured profit. The extraordinary risks of government production have forced manufacturers to probe new areas and diversify their product lines, and some companies have even decided that they can no longer afford to work for the government.

The Technological Base

A quarter century of aerospace gain has paid the nation a valuable dividend in an immeasurably broadened technological base that represents the loftiest plateau of advancement ever attained by man. The know-how acquired is not only technical; it embraces the wealth of managerial experience developed in the course of directing complex programs. Nor is it just aerospace lore, because the extraordinary performance dictates of defense and space goals have spurred research on a hundred separate fronts.

This reservoir of know-how can be tapped to help solve many of the nation's—and the world's—most-pressing social and economic problems: air and water pollution control, waste disposal, urban transportation, crime control, food supply, housing, and education. Technology alone cannot remedy these matters of vital concern; the solutions must originate in real public determination, backed by governmental organization of the attack. But, to the extent that technology can contribute, twenty-five years of revolutionary aerospace progress have provided the capability.—END



The B-70 program challenged industry in every area of high-speed bomber operations. Although the program was canceled after only two aircraft had been produced, it contributed significantly to the advancing technology of supersonic flights.

The Air Force and Space

BY WILLIAM LEAVITT

Senior Editor/Science and Education

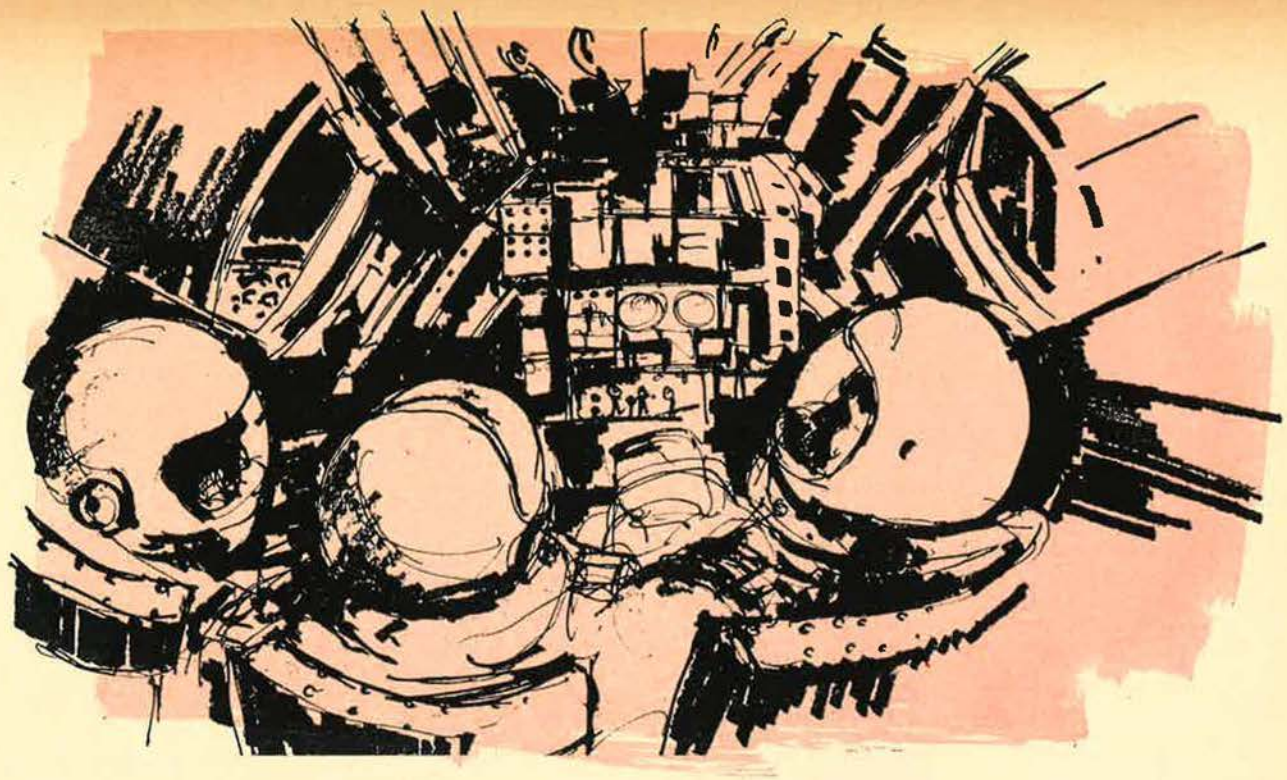
A centuries-old dream fulfilled: Men walk on the moon July 20, 1969, while on earth millions watch the feat on video screens.

ON May 2, 1946, the Air Force's fledgling "think tank," Project RAND, then housed in Douglas Aircraft facilities in Santa Monica, Calif., produced its first Air Force-requested study. The study carried the title "Preliminary Design of an Experimental World-Circling Spaceship." The report was mostly hardware-oriented. But its authors, in some comments projecting social and political implications of such a project, showed significant insight:

"The achievement of the satellite craft by the United States," they predicted, "would inflame the imagination of mankind, and would probably produce repercussions in the world comparable to the explosion of the atomic bomb." A companion report, dated October 18, 1946, declared, "Since mastery of the elements is a reliable index of material progress, the nation which first makes significant achievements in space travel will be acknowledged as the world leader in both military and scientific techniques. To visualize the impact in the world, one can imagine the consternation and admiration that would be felt here if the US were to discover suddenly that some other nation had already put up a successful satellite."

The RAND people could not have been more right. Their predictions were borne out, to the massive embarrassment of the United States, eleven years later, when it was the Soviet Union that launched the first man-made satellite into orbit around the earth. The Soviet "first" need not have happened. Why it happened is a complex story that can probably never be told in its entirety. But it is a chronicle that can be traced in its general outlines.

In the quarter of a century that has passed since the RAND report, enormous technological strides have been made. And in the thirteen years since Sputnik, what had been considered the fantasy of space travel has become reality. Already man has walked the surface of the moon. Later in this decade or early in the next, there will be operational space stations,



both American and Russian, in which highly trained crews of space engineers and scientists will perform significant observational tasks in orbit. As the years go by, man will explore the moon in considerable detail, tramping its surface, overflying its wastes in rocket craft, and observing man's neighbor world from lunar orbit. There will be lunar bases, American, Soviet, perhaps even international. And eventually, unless the experience of coming years reveals some presently unknown impediment to further-out manned excursions, men will travel in spaceships to Mars and land on that planet. The cost will be high and the direct economic returns difficult to calculate. But the knowledge attained of the cosmos will be priceless.

The manned aspect of spaceflight, as dramatic as it has been, is in many ways dwarfed by the achievements on the *unmanned* side. For up to now, manned spaceflight has primarily been by way of dramatic demonstrations. Unmanned astronautics, almost from the start, has been *productive*, not only in the scientific sense (the discovery of the radiation belts around the earth, among many other revelations about "empty space") but also in terms of usable spaceborne weather observation, communications, and—an achievement of monumental importance in a world weary of war—strategic reconnaissance. It can fairly be said that the promise of unmanned space technology, the future yield of robot spacecraft coursing through the void, is potentially enormous. As the reliability of space hardware increases, we can expect to see, as products of space technology, really long-range weather forecasting, air and sea navigation, extensive use of communications satellites for regional and, possibly, global educational purposes, the relay of huge amounts of computerized data of the business world, and large-scale survey of earth resources in a world threatened by despoilment at the hands of man. In the military field, we may expect even more complex and useful spaceborne strategic reconnaissance, plus missile-attack warning satellites, all of them contributing to the world's hope for viable conflict control.

Beyond flight itself, whether unmanned or manned, there are the less tangible, but in the long run equally important, *influences on earth*, of space technology. Space technology has not only placed great new demands for precision on American, Soviet, European, and Asian industry. But also the space revolution has had a major impact on education, particularly in the United States. Sputnik set off a spate of public questioning of the validity of the American educational system that thirteen years later is still having its effects. Although the words and the music have changed—"relevance" is the buzz-word today—the main question is still being asked: Is American education preparing children for a complex technological age in which science and technology need to be understood so that they may be properly harnessed for the good and safety of mankind? The question applies in suburbia, as well as the ghettos.

The earthbound effects of the advance into space have included, too, no less than the creation, here and in the Soviet Union, of vast new industries, built on the foundation of the aviation industries that had existed previously, but different in so many ways from their antecedents as to qualify for consideration as something very new in the world of work. This industry, as it has evolved, sometimes painfully and at great expense, represents what, for lack of a better term, might be called a group marriage of the arts of electronics, propulsion chemistry, computerology, nuclear physics, guidance, optics, materials—to mention only a few of the skills that have been combined in order to build the boosters and spacecraft in the hundreds that have been launched into space since 1957.

The aerospace industry, which didn't even have a name a few short years ago, has become, certainly in

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Rocket genius Robert Goddard, unsung in his own time, helped lay foundations of the space age but didn't live to see it.

this country, a major economic force, employing hundreds of thousands of people of various skill levels. Through its "multiplier effects," the economists' term for the ancillary enterprises—the supermarkets, the shoe repair shops, the restaurants, and the like that have crowded around the space installations to serve the technologists and production people of the aerospace industry—it has created a sizable amount of new wealth. In the years since Sputnik, in this country, whole communities have been transformed economically and politically by the space enterprise. They have boomed, and now many slump, as a measure of the economic health of the industry.

Roots of the Space Age

All this is recent history. It happened, almost literally, yesterday. But the space era, which we have tended to date from Sputnik and the American response to that shock of shocks, has historical roots that go back a good deal further in time: American roots, Russian roots, German roots, and British and French roots.

For every dream there is a dreamer. And, for such a vast dream as man's flight into space, there was an army of dreamers. Some of them were hard-headed engineers and theoreticians: America's Robert Goddard, Russia's Konstantin Tsiolkovsky, Germany's Hermann Oberth, Walter Dornberger, and Wernher von Braun. Others were far-seeing physicians like Hubertus Strughold, the transplanted German who, after World War II, settled in at the Air Force's School of Aviation Medicine at Randolph AFB, Tex., and, on a shoestring, in 1949 established the Air Force Department of Space Medicine, in the conviction that someday men would indeed travel in space and that medical preparations needed to be made.

All these and many others saw the potential of rocketry. The Germans did it most dramatically by building and launching the V-2s, the world's first ballistic missiles, against England in the last, desperate days of World War II.

There were others too, the imaginers, the writers of science fiction like Britain's H. G. Wells and France's Jules Verne. In exciting novels that thrilled generations of readers earlier in this century, they asked the question: What if? There were others, those who combined their artistic skills and scientific training in their writings to come up, as did the remarkable science-fiction master, Britain's Arthur C. Clarke, with feasible proposals for space technology far ahead of their time. It was in 1945 that Mr. Clarke proposed a viable system of communications satellites. It was an idea that was hard to patent at the time but a concept that he has, to his delight, lived to see become reality. As a leading proponent of space technology, it is Arthur C. Clarke who most eloquently and persuasively advocates space technology as a kind of positive substitute for war, as an enterprise that in the future can harness the energies of men and nations in a nonaggressive and international mode.

The roots of the space age, which has blossomed so spectacularly since 1957, were delicate indeed. Despite what they could show by way of the practicability of rocket propulsion, the pioneers like Goddard in the US and his counterparts in Europe received little support in their own countries, although they appear to have kept track of each other's work. Goddard died in 1945, a disillusioned man, at just about the time the first real stirrings as to the potential of rocketry for military purposes were beginning here. Before and during World War II, Goddard's rocketry studies and demonstrations had been closely analyzed by the band of Germans at Peenumünde, led by General Walter

Now a top US space planner with NASA, German-born Wernher von Braun was on the World War II team that built the rocket weapons Germany hoped would stave off defeat. After World War II, working for the US, von Braun fought hard for establishment of an American satellite program.

Dornberger and Wernher von Braun who, with little support from Hitler, had tried to reverse the inevitable defeat of Germany with the first real space-traveling weapons, the V-2s.

Postwar Rocketry

It was only after the war, with Europe in ashes, America triumphant, and the Soviets battered but victorious, that slowly but surely the space idea began to germinate. And even then, to be accurate, it was not so much a *space* idea as a rocketry idea, a conviction that military purposes could be served, as they had been in Germany, by rocket weapons. Out of such ruminations and small beginnings, assisted in the United States by the group of German scientists collected in shattered Germany after the war and brought to this country, developed the US Army and Air Force ballistic missile programs. These programs were lineal descendants of the Nazi V-weapon efforts but were heavily bolstered by American technology of the postwar period. The "Chinese copies" of old German V-weaponry, tested by the US military on western deserts after the war, showed the way to the Thors, Atlases, Titans, and Saturns of the future.

These small but important movements were occurring in the late 1940s. World War II was receding into the past. But already the cold war had begun, and the Korean War, which led to US rearmament, was but a few years in the future. Although most of the US rocketry effort of the early postwar years was in terms of ballistic weapon development, there were those who, even as they worked on the weapons, continued to dream of manned spaceflight and earth satellites. Among them was Wernher von Braun, then working for the US Army. In 1952 and 1953, with other space enthusiasts, he put his name to an imaginative series of feature articles in *Collier's* magazine, on earth satellites, space stations, and manned flights to the moon and Mars.

By the early 1950s, as has been recorded on these pages many times, prescient voices in the US Air Force were urging a top-priority ballistic missile program. Despite the fact that the intercontinental ballistic missile had been pooh-poohed by such scientific luminaries as Dr. Vannevar Bush, who had been chief marshal of the World War II US scientific mobilization, the Air Force missiles advocates, led by the Air Force Assistant Secretary for Research and Development, Trevor Gardner, and then-Col. Bernard A. Schriever, were able to persuade the Eisenhower Administration of the need for what became the Air Force ICBM effort. These men, and many others, battling resistance to new ideas within the Air Force itself, were able to convince the decision-makers that the Soviet Union was seriously engaged in ballistic missile development and that, for our own safety, the US also had to commit itself to an ICBM effort. Thus, after earlier on-and-off starts, was the Air Force ballistic missile program born.

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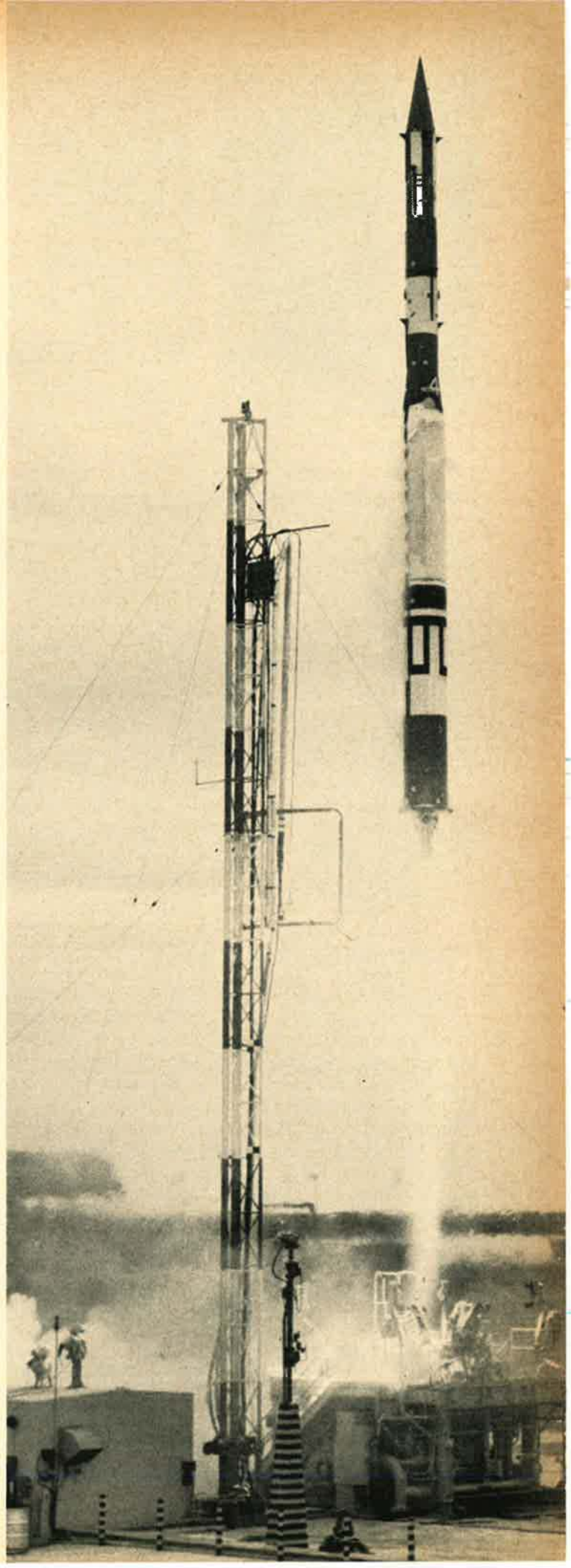

After a disastrous debut, the Vanguard satellite effort, designed for the US IGY program, finally succeeded. But the Russians had already beaten us with Sputnik.

An Air Force officer who risked his career by battling for an Air Force ballistic missile program, B. A. Schriever rose to four-star status and headed the Air Force Systems Command after directing the multibillion-dollar USAF missile program of the 1950s. USAF missilery provided space boosters once space got the green light.

Out of that program came the rockets that later became workhorse boosters for the US space program. While the Air Force ballistic missile program proceeded, so did the Army's, spurred by von Braun, Army missile general John Medaris, and their corps of rocket experts at the Army Ballistic Missile Agency at Huntsville, Ala.

There was a peculiar irony in their triumph that would come to light only later, after the Soviet Sputnik. One of the technical bars to ICBMs had originally been the great bulk of nuclear weapons. It was not really until technical breakthroughs reduced that bulk that the ICBM was viewed as practical. The Russians, in *their* missile effort, had apparently not been concerned with this problem and therefore worked away at much more powerful boosters for their missile weapons. This gave them the early space-age lead in the satellite-launching business, a lead that was overtaken only with great difficulty and at sizable cost by the United States.

International Geophysical Year

Yet even then, with Sputnik only a very few years in the future, space per se was still of minimal interest and indeed unmentionable in the Pentagon. An odd and unexpected turn of events changed everything and led to the real beginning of the space age. The world scientific community deserves the credit. For it was the scientific community, living as it does in the hope that peaceful cooperation in science can help bring international collaboration on broader fronts, that persuaded governments, including the US and Soviet governments, to take part in what would be called the International Geophysical Year—IGY for short. In 1955, the US announced that, as part of its contribution to the IGY, it would launch a small scientific earth satellite, the later-to-be-maligned Vanguard, using a Navy-developed booster. IGY was to run from July 1, 1957, to December 31, 1958. Its purpose was to encourage a vast international effort of research on the earth and the atmosphere, with scientists around the world contributing what they could by way of experimental studies.

As it turned out, the Soviets themselves were quietly proceeding with a considerably more impressive IGY earth-satellite program than the US was contemplating. They beat the US to the punch, with Sputnik, on October 4, 1957, and the world was never quite the same again. The history of the US decision to proceed with the miniscule Vanguard—the first of which failed *after* the Soviet Sputnik had startled the world—is still being gone over. The irony is that in 1957 the US *did* have the skills and hardware to be first into space. Either the Army's von Braun missile team in Alabama or the Air Force's ballistic missile group, headed by General Schriever on the West Coast, could have put a satellite into orbit, had they been given the assignment. Before Sputnik, von Braun had been warning his colleagues in the missile and space business that, unless the government gave the IGY satellite project high priority and used the Army's available booster power, the Russians would mortify the US by being first.

During the same pre-Sputnik period, the Air Force's General Schriever said publicly that the existing Air Force missile program was capable of providing the hardware for earth satellites. Longtime readers of this magazine will recall an article by General Schriever ("The Battle for Space Superiority") which appeared in the April 1957 issue of AF/SD. The article was based on remarks that the General had made earlier in the year at a Convair-sponsored astronautics symposium in San Diego, Calif. Having noted that the "compelling motive for the development of space technology is the requirement for national defense," the General went on to say that "the same propulsive unit that boosts a heavy nose-cone warhead to 25,000 ft/sec, could boost a somewhat lighter body to the escape velocity of 35,000 ft/sec, or to an orbital path around the earth.

"Using the same number of stages, the ratio of thrust to weight would be greater by using a lighter payload, and higher accelerations and velocities could be reached before burnout," he went on.

"Or with our present state of knowledge, it would be relatively easy to add another stage. . . . The same guidance system that enables the warhead of a ballistic missile to reach its target within a permissible accuracy would also be sufficiently accurate to hit a target much smaller than the moon. Or, if we are talking about a circular orbit around the earth, errors in guidance could be easily observed over a period of time

Interservice rivalries, particularly between the Air Force and Army, both trying for the missile mission in the 1950s, set back the US space program and helped set the stage for the unwise decision to build a special "civilian" booster for the Vanguard effort, according to the late Dr. Clifford C. Furnas.

and corrected, and the satellite kept on an accurate orbit. . . ."

In any case, the existing military ballistic missile capabilities of the Air Force *and* Army were not used for the US IGY satellite venture, and a heavy price was paid in American prestige. The story of why the military capabilities were not used is fascinating and illustrative of how political circumstances can lead to mistaken judgments. New light on the pre-Sputnik period has recently been shed by the posthumous publication of an account of the affair by the late Dr. Clifford C. Furnas, who from 1955 to 1957 was Assistant Secretary of Defense for Research and Development. Dr. Furnas' account appears in the Spring 1970 issue of *Research Trends,* the publication of the Cornell Aeronautical Laboratory, Inc., Buffalo, N.Y. Dr. Furnas was one of the founders of the laboratory.

Dr. Furnas makes several points in his account. He says that as early as 1955 US intelligence had indicated a significant satellite effort by the Soviets. He says that the Army was making a strong pitch for the IGY satellite assignment. And he says that the Air Force, while capable of the assignment and in possession of the biggest booster (Atlas), was preoccupied with its high-priority missile program. He says, too, that the Army had a good chance of winning the assignment, but that an extraneous matter, the embarrassment of the outgoing Air Force Secretary, Harold Talbott, over his use of official stationery for private business, led to a crucial moment of inattention by the man about to succeed Talbott, Donald Quarles. This in turn created circumstances in which the Army's bid for the satellite job was outvoted by the Navy and the Air Force.

The late Dr. Furnas' account, which may well be disputed by others, illuminates the moods and conflicts of the period. The Air Force and Army in the mid-1950s were locked in a struggle over the missile mission. At the same time, there *were* people in both services who were thinking in terms of *both* missiles and space operations. The Eisenhower Administration was remiss in not settling the missile-mission question definitively, and it was not until Defense Secretary Charles Wilson was succeeded by Neil McElroy that the Air Force won its struggle with the Army. The interservice battle was repeated after Sputnik, this time over the military space mission. And *that* struggle took several years. It was not until 1961 that the military space-mission question would be decided in favor of the Air Force. That, getting ahead of ourselves in this account, was by order of President Kennedy's Defense Secretary, Robert S. McNamara, who assigned military space-mission primacy to USAF while at the same time allowing for Army and Navy military space-system developments for those services' particular purposes.

In the pre-Sputnik period, not only were the Air Force and Army vying for the missile mission, a rivalry that was to cost dearly. There was also the policy error rooted in the scientific community's insistence on a *nonmilitary* cast to the US participation in the IGY program. This, combined with Air Force-Army rivalries, led to the decision, as Dr. Furnas points out, to develop, under Navy management, unnecessarily and, as it turned out, not very successfully, a new "civilian" booster for the US IGY Vanguard satellite. That was double-talk since the military *had* to be involved. It was also silly to have decided to develop a new booster for Vanguard when boosters, available from the Army or Air Force, could have done the job.

At any rate, the mistake was rectified, dramatically, but too late to save the country the embarrassment of the Soviet "first." After Sputnik, the Army and von Braun were given a go-ahead by Defense Secretary Neil McElroy to launch what became known as US Explorer I, on January 31, 1958.

The Post-Sputnik Shock

The rest is more recent history. The post-Sputnik political shock led to public recrimination and a set of major hearings on Capitol Hill. The legislative star of the hearings was then-Senate Majority Leader Lyndon Johnson. The scope of the Senate hearings was broad and covered everything from the confused missile/space organization in the Pentagon to the question of whether some superagency should be created to mount an American space thrust. (Meanwhile, a temporary device for coordinating the military's space capabilities, mainly Air Force and Army, the Advanced Research Projects Agency—ARPA—was set up, and plans were begun to devise unmanned shots at the moon by Schriever's and von Braun's teams.)

Congress decided that, rather than invent a new superagency to run the US space program to come, the old and respected National Advisory Committee for Aeronautics (NACA), which for years had done applied aeronautical research for the military services and industry, would be revamped, renamed, and recast as a new and expanded civilian agency to direct a space program for the United States. The exact nature of that space program was scarcely formulated at the time. Under the terms of the National Aeronautics and Space Act of 1958, NACA became the National Aeronautics and Space Administration and was given the major portion of the space task that would evolve. But at the same time, prudent legislators reserved to the Department of Defense the right to operate space programs "peculiarly associated with the national security." The concept of civilian supremacy was under-

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As a senator, Lyndon B. Johnson led the Capitol Hill investigation after Sputnik of the reasons for the stunning propaganda defeat suffered by the US. As President, LBJ pushed the Apollo moon-landing effort begun by his predecessor, the assassinated John F. Kennedy.

—Wide World Photos

scored in the Space Act, and the approach was generally accepted by the press and public.

But creating a new agency from an old one and developing a space program that transcended the US involvement with the IGY was easier said than done. The Eisenhower Administration was less than enthusiastic about space as a national goal, and only a public howl that "something be done" to recoup US prestige was enough to get the Eisenhower Administration to commit itself, in early 1959, to an American effort to orbit a man. The program was to be known as Project Mercury. Project Mercury itself evolved largely from the Man in Space Soonest (MISS) program under study in the Air Force (*see "Blueprint for Tomorrow's Spacecrews," by William Leavitt,* AIR FORCE/SPACE DIGEST, *May 1958*), with valuable additional input from the space task force assembled by the new NASA agency at Langley AFB, Va., a group that eventually established itself at what was to become the NASA Manned Spacecraft Center at Houston, Tex. Events and policies piled up. The Eisenhower Administration was headed into its last days. Its swan-song space report was quite conservative in tone as to the question of further excursions into space beyond the manned orbital program to which it had already committed the country.

But there was to be no turning back. The aggressive Democratic challenger in the 1960 presidential race, John F. Kennedy, made an issue of US prestige and added a claim that, beyond the space embarrassment, this country was behind the Russians in strategic missile development. The latter claim, after Mr. Kennedy's entry into office, was quietly buried, although to this day it is still argued.

Once in the presidency, Mr. Kennedy, at the outset, was rather conservative about starting any new large-scale US space programs. About all he did before April 1961 was expand the funding for the Saturn booster program, which was then in danger of collapsing. It was not until after the Bay of Pigs debacle in Cuba and the Soviet launching of Yuri Gagarin into orbit on April 12, 1961, that the new President became alarmed enough to ask his advisers for plans for major programs. But when they came, the plans were truly major, even startling. In May of that year Mr. Kennedy asked Congress to commit the country to a NASA-managed manned flight to the moon before 1970. The commitment was made with nary an argument.

Later that year, in December, the civilian space agency announced the Gemini two-man orbital program as a follow-on to the Mercury program, even though no American astronaut had yet been orbited and would not be until February 20, 1962, when John

Persuaded of the danger presented to the US by the Soviet ballistic missile program, President Eisenhower authorized a top-priority US program to develop ICBMs. In late 1957, Sputnik mortified his Administration and Eisenhower authorized a modest US space effort. But to the last, he was never a space enthusiast.

As modest a feat as it may seem today, the ride atop a Redstone rocket, in a sub-orbital flight, by Astronaut Alan Shepard in May 1961, boosted American morale. It happened after Soviet spaceman Gagarin had orbited the earth but symbolized US intent to catch up with and, if possible, to overtake the Russians.

After making a dramatic issue of Russian missile and space prowess during his aggressive bid for the presidency, John F. Kennedy was fairly conservative about US space commitments—until the flight of Russia's Yuri Gagarin, first human into orbit. Then JFK proclaimed the US intent to land men on the moon before 1970.

On February 20, 1962, Astronaut John Glenn became the first American into orbit. The successful mission further boosted the national morale and was the first of a series of US manned orbital flights in the Mercury and then the Gemini programs. Glenn later developed an interest in politics and ran for public office in the state of Ohio.

Russia's Yuri Gagarin and friends: At the 1965 Paris Air Show, national rivalries were forgotten for a time as Gagarin, seated left, greeted US Astronauts Edward White, third from right, and James McDivitt, as Vice President Hubert Humphrey and French Premier, now President, Georges Pompidou, second from right, flashed smiles. Gagarin was later to die in a plane crash, and White was to lose his life in a tragic fire on the pad at Cape Kennedy.

Glenn became the first American to achieve orbital flight. The only US manned flight achievements in 1961 were the brief May 5 suborbital flight of Alan Shepard, an event that glued millions to their TV sets to watch Shepard lift off atop a Redstone rocket for a fifteen-minute-long ballistic vault downrange, followed on July 21 by Virgil "Gus" Grissom's similar flight.

Step by Step Progress

From 1961 on, the US manned spaceflight program proceeded step by step. As the years rolled by toward the moon-landing target date, Mercury was succeeded by Gemini. In flight after flight, US astronauts demonstrated (as did their Russian counterparts) human ability to survive in orbit, to work in orbit, and even to "walk" outside their spaceships, tethered to their craft. During the same decade, from small beginnings, the potential of unmanned "working" satellites, scientific probes to the moon and Mars, and military observation satellites was being demonstrated. In America, the embarrassment of Sputnik had faded. Some critics of the space effort, particularly of the moon-landing program, were asking whether the "race to the moon" was a race at all, since it appeared that the Soviets had decided not to compete.

By 1964, during the presidential contest between Democrat Johnson and Republican Goldwater, new questions arose: Was the hugely expensive moon-landing program drawing money and talent away from military space programs, and were we risking near-orbital military technological surprise by the Soviets? By then there was a sizable body of criticism of the US space effort. Some critics were asking, too, whether trying to go to the moon *before* building manned space-station capabilities in near orbit was not putting the cart before the horse. Should we not concentrate on the near-orbit space station before going to the moon? The first set of criticisms about military space was responded to by the announcement in late 1965 of US intent to proceed with an Air Force Manned Orbiting Laboratory (MOL) program. That effort was to die in 1969, several hundreds of millions of dollars later, as a concession by the Nixon Administration to economy and to antimilitary critics.

By 1966 the Apollo program was moving apace, although under increasing attack from political and social critics who insisted that needed attention to domestic problems was being sacrificed on the altar of technological efforts. Then, on January 27, 1967, disaster struck. Three astronauts—Virgil I. "Gus" Grissom, Edward White, and Roger Chaffee—were killed on the pad at Cape Kennedy, Fla., in a flash fire during a test run of an Apollo crew module. The ensuing recriminations and investigations revealed cer-

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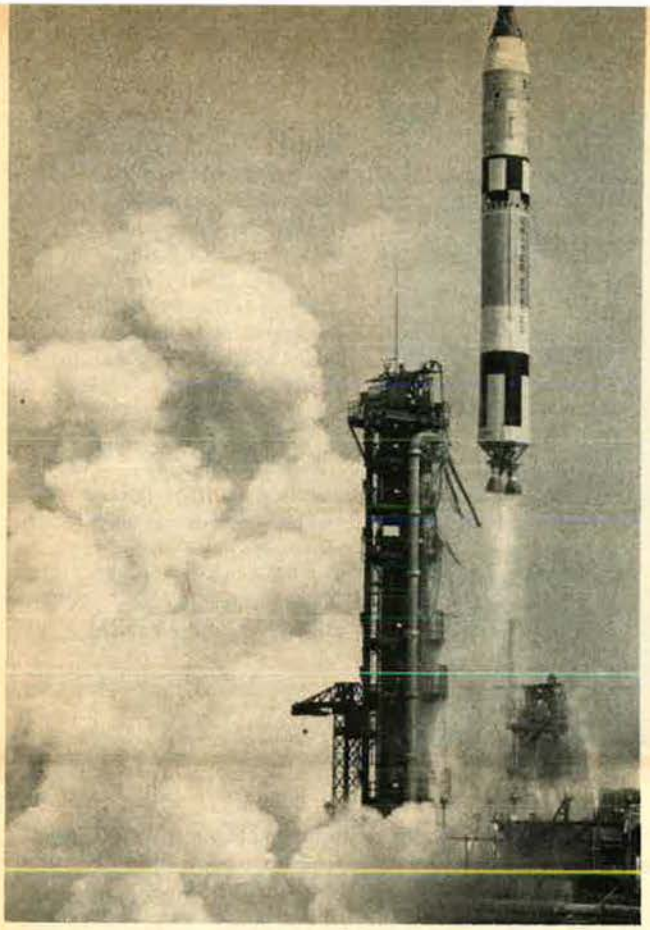
Beset by antimilitary criticism and budget pressures, President Nixon canceled the Air Force's Manned Orbiting Laboratory project in 1969, ending Air Force hopes for a manned space system of its own. However, Air Force is taking part in the NASA space-shuttle program for the 1970s.

—Wide World Photos



Sight of the sixties: With two astronauts aboard, an Air Force-developed Titan II booster, mainstay of the Gemini manned orbital spacecraft program, lifts off from Cape Kennedy.

tain management shortcomings in industry and NASA that seemed for a time enough to destroy the entire manned spaceflight program. But the pieces were manfully picked up, and before long the moon-landing effort was back on schedule. Americans circumnavigated the moon in December 1968, demonstrated the capabilities of the Apollo hardware in orbit in early 1969, and in July 1969 landed on the moon, followed in a few months by a second American crew. Disaster struck again when the third attempt, Apollo-13, was mounted. Faulty equipment caused an explosion aboard the spacecraft en route to the moon. Only a combination of incredible luck, coolness of the crew, and the skills of the flight controllers managed to bring the astronauts of Apollo-13 home safely to earth. No one is sure when the next Apollo flight will occur or how many more there will be.

Looking Ahead

Now it is 1970—twenty-five years since the end of the second world war. The impossible dream of man in space has been fulfilled. Unmanned satellites work away in the blackness hundreds and thousands of miles out. We are still at it. The Russians are still at it Western Europe is looking for ways to operate in space in cooperation with the United States while at the same time retaining some measure of technical and fiscal independence. Japan promises to become a space power. Red China has launched a satellite.

Here, while war still rages in Southeast Asia and domestic crisis has become routine, NASA and military space planners are finally bringing the space program back closer to earth. Coming are American manned space stations and a space shuttle that will carry men and supplies from earth to orbit. Coming are unmanned satellites whose complexity will dwarf the intricate hardware of today. Coming is a future the shape of which we cannot discern with precision but a future inevitably influenced by man's physical and mental leap beyond the planet he has till now called home.

The US Air Force's role in this vast effort has been, at the same time, staggering and often frustrating. Against a background of internecine rivalry among the services over the missile mission in the early 1950s, and relegated after Sputnik to a *support,* rather than dominant, role in the national space program, the Air Force has managed since 1957 to provide to NASA a major portion of the systems management and launch capability and the space-medical expertise without which the civilian agency could not have gotten off the ground. At the same time, the Air Force's own manned spaceflight programs have several times been shot down. The Man In Space effort of the 1950s, which was incorporated into Mercury, the Dyna-Soar orbital glider, and the Manned Orbiting Laboratory project of the 1960s, not to mention the unaccepted Air Force plan for a manned moon landing offered prior to the Kennedy Apollo commitment, all died. And today, on the manned spaceflight front, the Air Force is a junior but insistent partner with NASA in the projected space shuttle, campaigning for militarily useful capabilities on the craft.

But, withal, the Air Force, as prime space operator in the Defense Department since 1961, has developed a huge unmanned space program geared to strategic observation, early warning, and satellite-borne defense communications. For the most part, the Air Force's space program is based on the passive military use of unmanned spacecraft. Certainly the wild-eyed military moon-base ideas that infected some Air Force planners in the late 1950s have gone by the boards. But, at the same time, thought has to be given, and is being given, within the Air Force to the future. Active space weaponry, at least in terms of devices to counter hostile activity by others, has to be studied. Although not much is said about it these days, it is a fact that the Soviets have the devastating capability to attack the US from orbit with nuclear weapons. Counter techniques, perhaps laser weapons or other devices using exotic technology as yet unperfected, may well be needed in the future to protect the US against space-borne Pearl Harbors. What the Soviets can do now, the Chinese may be able to do the day after tomorrow—despite all the international proscriptions against the deployment of weaponry in space.

The Air Force's existing array of passive space devices—particularly the unmanned observation satellites that have been orbited since 1960—has already played a major role in the keeping of the peace in a space-age world still plagued with conflict. And in an era in which superpowers, fearful of their own strength, seem to be groping toward some sort of agreed-on standoff, for mutual protection, that role will probably enlarge during the uncertain years to come.—END