

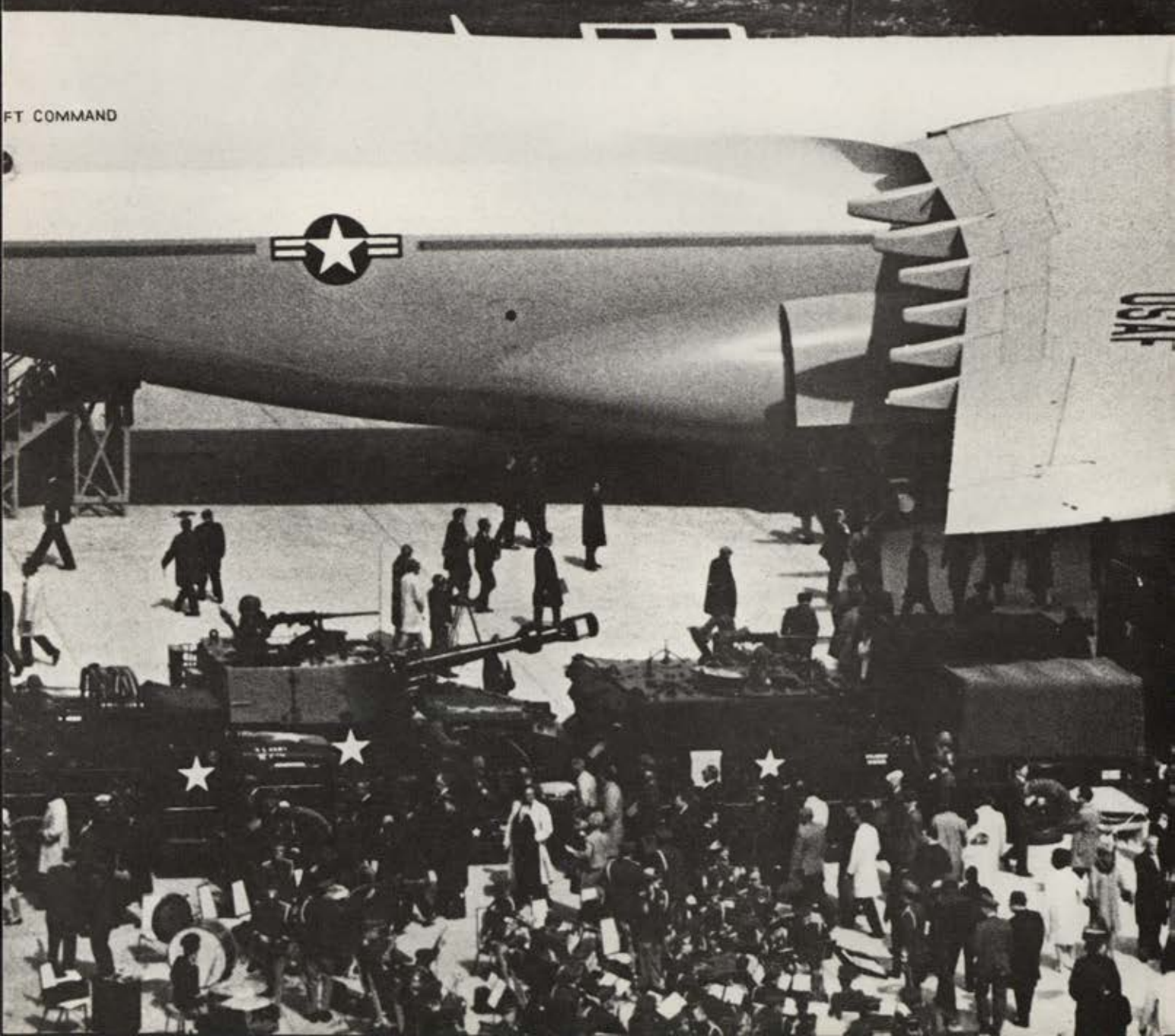
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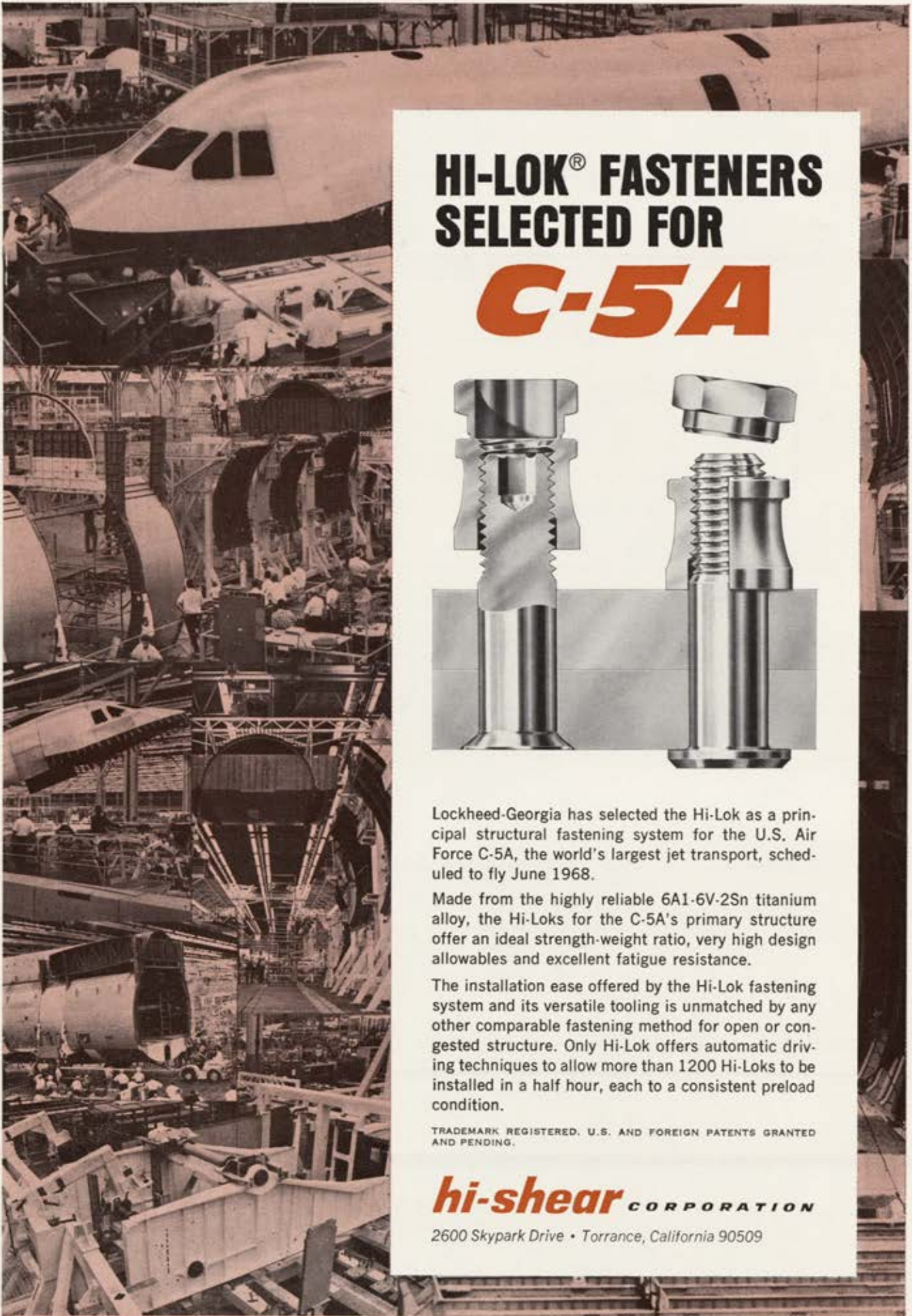
and **SPACE DIGEST**

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

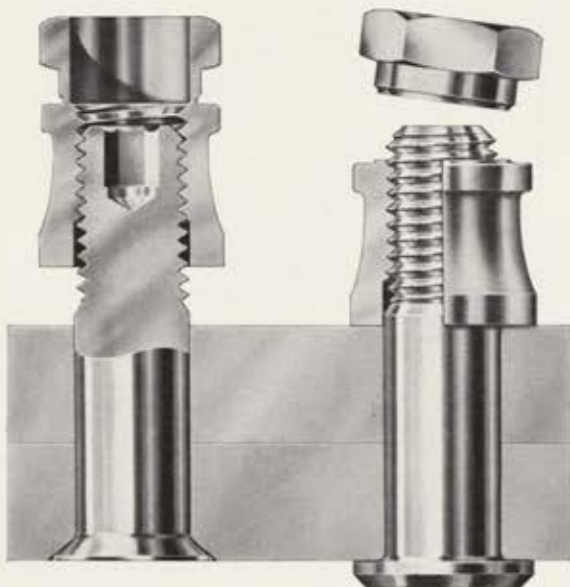


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the vast cargo hold opens both forward and aft and the plane "kneels," lowering its entire cargo floor to ideal levels for access. A high-flotation landing gear system enables the C-5 to use many unimproved, support-area airfields previously inaccessible to such large aircraft. And Lockheed's on-board MADAR (malfunction detection analysis and recording) subsystem will monitor all functions to assure fast service, maintenance, and turnaround time.

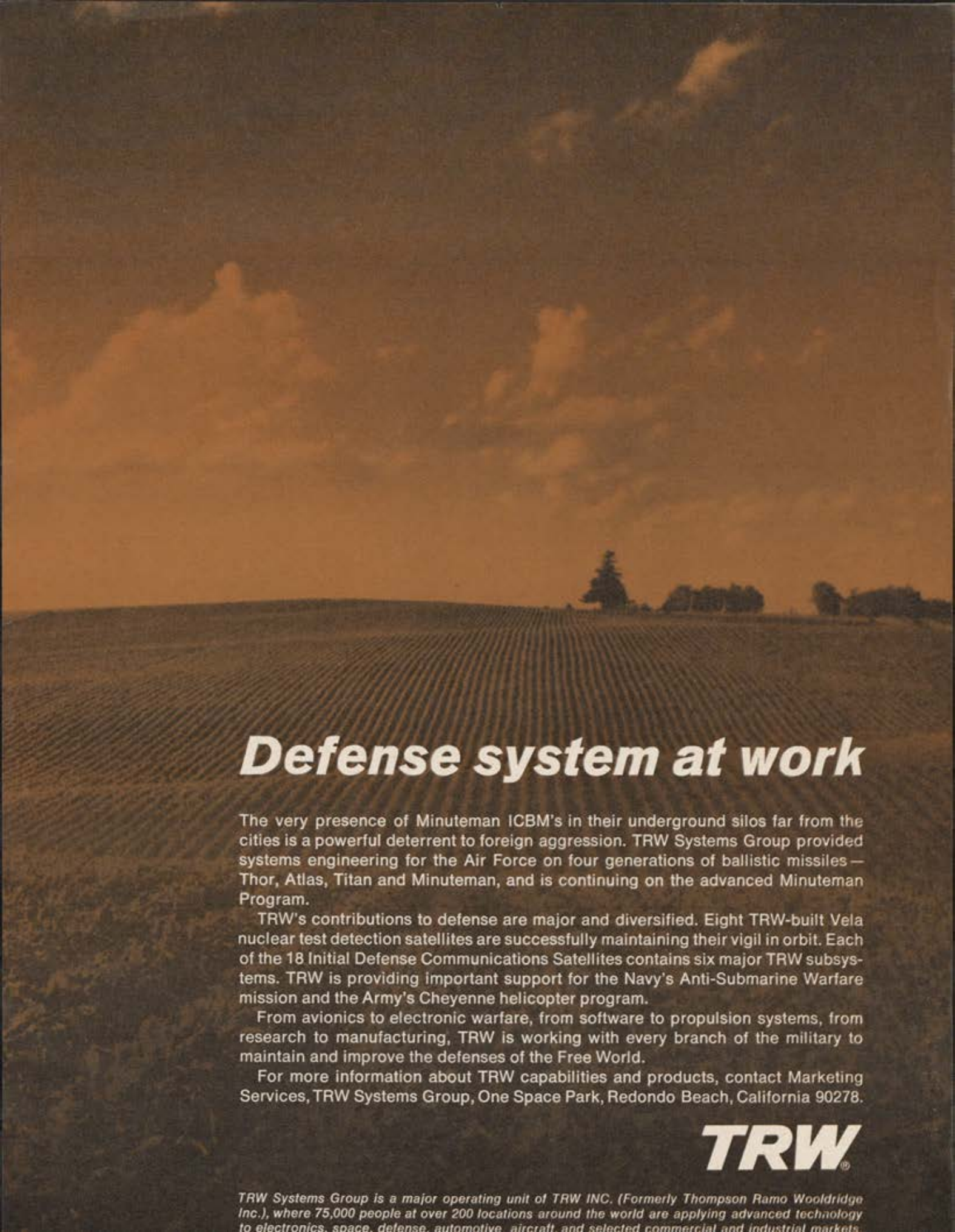
The Air Force called for a big plane for big jobs. Lockheed has answered with a craft as versatile as it is huge. In another configura-

tion, for example, the C-5 can become an airborne command post with 3 full decks, able to refuel in flight and stay on-station 72 hours. Or it may serve as an aerial tanker or missile-launching platform. Potentially, it can handle a variety of military and scientific jobs.

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AIR FORCE

and SPACE DIGEST

The Magazine of Aerospace Power
Published by the Air Force Association



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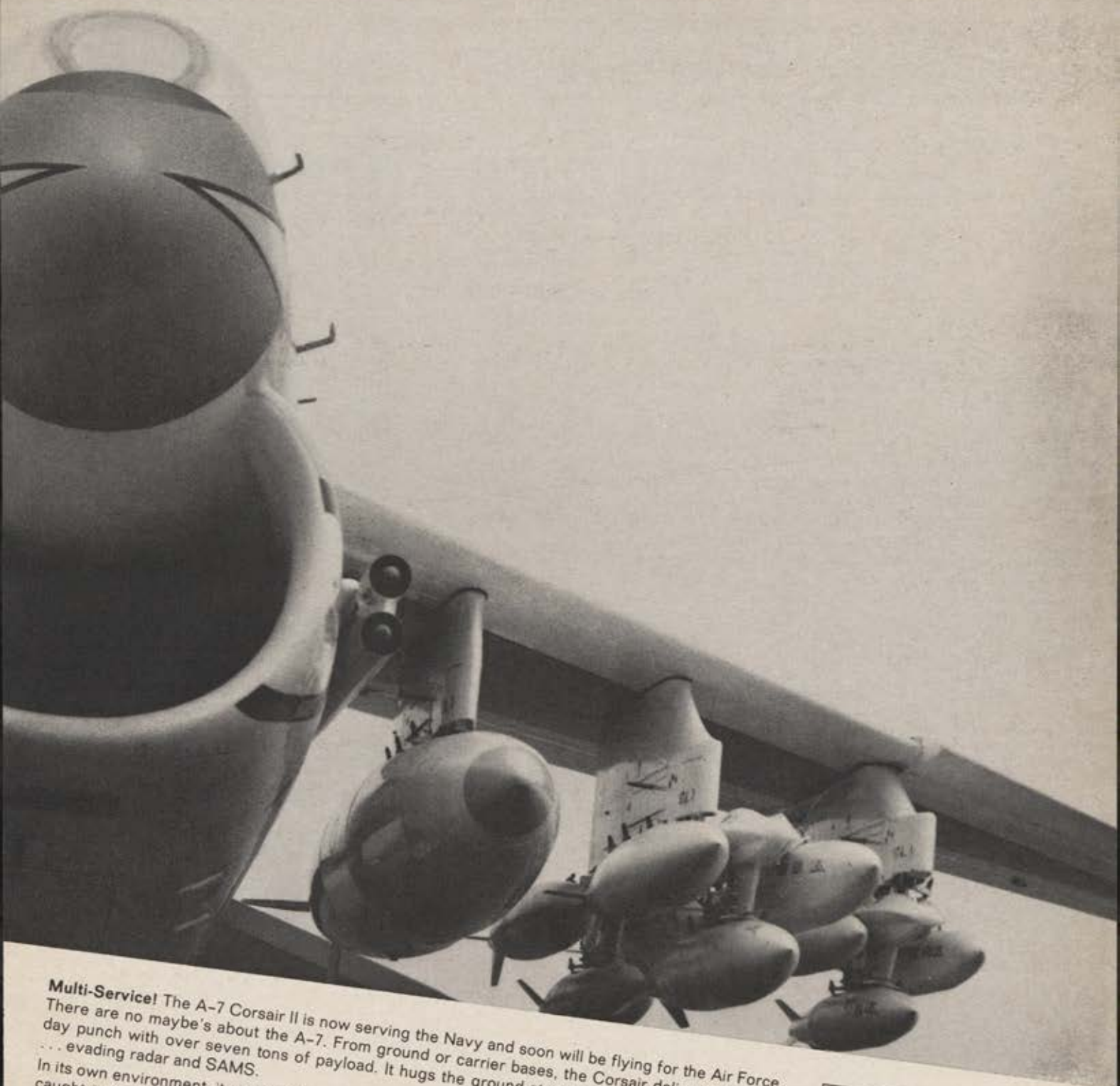
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The Tormentors Tormented

By John F. Loosbrock

EDITOR, AIR FORCE/SPACE DIGEST

THE National Broadcasting Company, which on March 11 and 12 broadcast the entire ten hours and forty-one minutes of Secretary of State Dean Rusk's merciless inquisition by the Senate Foreign Relations Committee, claims that six million sets were tuned to the Senate caucus room at any given moment during the two sessions. A total tune-in/tune-out figure of twenty-three million plus sets was given by the network.

We hope that NBC's count was not inflated. In fact, we wish it had been even higher.

For our money, Dean Rusk was magnificent. He was up against a cold deck and he knew it. He was brought to the Hill to be publicly browbeaten under the hot and pitiless glare of the television floodlights and the searching eye of the camera. He was to be the bull at the bullfight, the sitting duck, the patsy.

But the Rusk brain was not for washing. He was great. He kept his cool. He was patient, polite, even inspiring in his own dogged fashion. And in the process he reminded us all of what tends to be forgotten or conveniently overlooked in the spate of politically contrived charges and countercharges about the conduct of the war in Southeast Asia. Simply, he told us why we were there, why we must stay and prevail, why the consequences of any policy short of staying and prevailing are too risky to be borne, even by those who deplore the soaking up of American blood and treasure in a far-off land to help a people who often seem unwilling to be helped.

Some of what he said should be repeated here, in our judgment, if only to provide factual and intellectual sinew for the beliefs we trust our readers share with us.

On the critical nature of the confrontation in South Vietnam:

"This is not just a problem of South Vietnam, although that is where our major responsibilities lie and where our major effort is being made.

"South Vietnam is one of the three principal divided countries in the world: Vietnam, Korea, Germany. If these divided countries attempt to solve their problems by force, the consequences surely would be war. We believe that the problems of divided countries should be settled by peaceful means, rather than by force."

On domestic problems vs. the war:

"I do not believe that Vietnam is an excuse not to do our best here at home. I do not believe that our requirements here at home are an excuse to abandon our commitments in South Vietnam. . . .

"Our objective is and must be an organized peace, but it is also true that we have a basic commitment to freedom for ourselves, and that requires an environment in the rest of the world in which freedom can survive. . . ."

On US overtures, rejected by Hanoi:

"The reconvening of the Geneva Conference on Vietnam, wholly acceptable to us, rejected by Hanoi.

"The reconvening of the Geneva Conference on Laos.

Or the conference on Cambodia . . . or a role for the UN Security Council. Direct talks with ourselves or through intermediaries. We tried very hard to demilitarize the Demilitarized Zone without success, and that is now a one-way street for troops from the north coming south. The interposition of international forces between the combatants is an idea that we have accepted, rejected by Hanoi. . . . At Manila the seven nations with troops in South Vietnam made it clear that we can withdraw our forces when the forces from the north are withdrawn and the violence subsides. We have tried on several occasions to stir up some interest in the cessation of bombing and reciprocal de-escalation. . . . We have offered to stop our augmentation of forces if they would do the same."

On whether the conflict is simply a local civil war:

"We can't accept the view . . . that this is just a civil war. If West Germany were to go after East Germany or East Germany after West Germany this would not be looked upon as just a family affair between Germans. And the same thing in Korea."

On bombing and negotiations:

"If North Vietnam were to sit there safe and secure and untouched while they sent their armies into South Vietnam and Laos at whatever pace and whatever numbers they wanted to, I don't quite see what incentive they would ever have for making peace. . . . They talk about a fightable negotiating strategy in which their side of the war is maintained full blast while North Vietnam is to be safe and secure from any attack whatever. That isn't a good indication of a desire to achieve the kind of peace that the nations of Southeast Asia and their allies could accept."

On free elections:

"The other side has not accepted free elections as a solution for the political future of South Vietnam. They have not accepted that free elections will settle the reunification problem. They want the domination of South Vietnam, and when we test it that is the answer we get bouncing back to us all the time."

On the morality of the war:

"I think there is a moral question in the attempt of North Vietnam to send tens of thousands of its armed forces down to impose a political solution on South Vietnam. I think there is a moral question involved in coming to Geneva and signing the Laos agreement of 1962 and treating it with contempt and having 40,000 of their troops in Laos today.

"I think there is a moral question involved in Peking and Hanoi, or whoever else is responsible in not letting Cambodia live the way it wants to live without that outside interference. But I think deeply that the chief moral question is to be faced by those who are not prepared to sit down and make peace."

The national policy which Mr. Rusk helps implement is flexible response. But his performance before his critics and tormentors was more like massive retaliation.—END

"Technical Momentum is our name for that dynamic combination of management, experience, and skilled people which gives us unique expertise across a broad spectrum of aerospace technologies. It's not something developed overnight. We've been at it since 1954."

R. W. Detra

Dr. R. W. Detra, V.P. and General Manager

There's no way we know of to score a run in baseball without touching first, second, and third base first.

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As we have.

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Technical Momentum has brought us all the way from the early Titan reentry vehicle to the current series of Mark 11 reentry systems. And is one

of the reasons the present force of 1,000 Minuteman II ICBM R/Vs are produced by Avco.

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We've been building airborne navigation systems for twenty years. We built the astroinertial system for the

Air Force/Lockheed SR-71, the world's fastest and highest flying airplane. But the navigation system we're building for the USAF/Lockheed C-5 is one of the biggest jobs we ever tackled.

It's the first inertial doppler system designed into a transport. And the first operational system to use a



floated inertial platform with no gimbals.

Its two systems, inertial and doppler, are capable of independent operation, but are most effective in unison.

It's the first system that can accept all available navigation aids: TACAN, LORAN, or conventional radar. But it doesn't have to. It can do its job in any weather, without any ground-based aids.

The inertial element alone has an accuracy of better than one nautical mile per hour. And the system is even

more accurate when checked and corrected by doppler.

Our system does all the routine navigation work connected with flying this gigantic airplane. It shows the crew where it is at all times, feeds steering information to the autopilot, checks on itself and diagnoses any faults, and verifies all the related avionics. Considering all it can do, it's quite small in size.

And that's one of our biggest accomplishments. **NORTHROP**

New Dimensions

Gentlemen: . . . I have never read an article or a memorandum by Anne Jonas which did not provide important insights and make a significant contribution to our national security. Her piece in your January issue was no exception. She deserves a nation's deep appreciation for her courage and clarity, and your publication is to be congratulated on its wisdom in providing this space to her views.

LEO CHERNE
Executive Director
The Research Institute
of America, Inc.
New York, N. Y.

Gentlemen: Re "New Dimensions in Soviet Strategy," by Anne M. Jonas, it would appear the expenditures indicated in the graph, "US and Soviet Expenditures in Military RDT&E" are in error. The \$ indicates approximately thirty percent of the US national expenditure (Vietnam included), which is obviously too high. I would suspect the "expenditure" axis is mislabeled by a factor of ten.

COL. H. M. SCHADEL, JR., AFRES
Pittsburgh, Pa.

Gentlemen: I am grateful to those alert readers who called to my attention the error in the graph accompanying my article, "New Dimensions in Soviet Strategy," in the January '68 issue of AIR FORCE/SPACE DIGEST. As they point out, the graph on page 23 was miscaptioned. It, indeed, represented one comparison of estimated total US and Soviet military expenditures, 1956-1966.

Available statistics do show that the USSR has increased its military RDT&E expenditures steadily since at least 1958. By contrast, more and more of this segment of the US military budget now is being allocated to Vietnam-type requirements, leaving less funds for RDT&E on follow-on strategic offensive and defensive systems.

I believe that those economists in this country who have done pioneering work in improving the methodology of ruble-dollar ratio conversion should redouble their efforts to pro-

ject and to publish regularly detailed, sophisticated studies of comparative US-Soviet military expenditures, including investment in RDT&E. This is not an easy task. Statistical data released by the Kremlin are amorphous and sometimes contradictory. But we have been warned. We know the trend. We need more details.

ANNE M. JONAS
Washington, D.C.

A-7D Corsair II

Gentlemen: Your fine article "Corsairs for the Air Force" [by Norman Polmar, February issue] failed to mention the System Safety engineering effort being applied to the A-7D. It is believed that application of the relatively new engineering discipline will make the A-7D one of the safest and most reliable of its type in the USAF inventory.

LT. COL. DONALD J. FORSYTHE,
USAF (RET.)
Arlington, Tex.

Gentlemen: In the February issue of AIR FORCE/SPACE DIGEST, the article "Corsairs for the Air Force" mentions the mutual use of the A-7D Corsair II. This is certainly a step in the right direction on cutting military spending. I have often wondered why all the air departments of the various services did not universalize their aircraft. The average layman cannot fathom the costs involved in the upkeep of an airplane. Spare parts alone can make the difference of a plane being up or down. The need for an

inventory with so vast a variation of parts for all the different types and models is insurmountable. Can you imagine the amount of money saved and the convenience factor in just the Corsair alone? . . .

The only change that I am not in agreement with is the automatic carrier landing system which will be eliminated on the Air Force A-7D. With this system an Air Force A-7D could conceivably land on a carrier in an emergency or to refuel and re-arm.

E. F. VALLONE
Air Products and Chemicals, Inc.
Allentown, Pa.

Where to Get Your ERs

Gentlemen: There is one error in my story ["How to Retire for Fun and Profit," February issue] which was inadvertent at the time I wrote it.

On page 93, I said that copies of effectiveness reports could be obtained from the Personnel Center at Randolph AFB. That was what [Congressman] John Moss wrote me and what USAF Headquarters said at the time. When I sent my check [to the Personnel Center], they advised me that retired people can get their records from the National Personnel Records Center, 9700 Page Boulevard, St. Louis, Mo. 63132. I know that is correct because I sent the check there and received copies of all my ERs from 1950 until my retirement date.

HARVEY F. YORKE
Novato, Calif.

The Real Source of Trouble

Gentlemen: . . . I am deeply concerned about excessive coverage given antidraft and anti-Vietnam spokesmen. As the only Negro to make the Air Force Chief of Staff Reserve Forces inspection tour of Europe, I received a completely new perspective of what the cold-and-hot war was really all about and how it affects the Negro—both good and bad. . . .

The Communists will attempt covertly to aid RAM, SNCC, or the Birch Society, and KKK for that matter, if the end result will create turmoil within our democracy. In NATO
(Continued on page 15)

CORRECTION

In the blurb accompanying the article "A Welcome Lift from the Airlines," by Edgar E. Ulsamer, in the March issue of AIR FORCE/SPACE DIGEST, we said that the air carriers transported 10,500 reinforcements to Vietnam in February. The fact is that MAC itself actually performed this mission. The airlines increased their contributions to military airlift in other areas, thereby freeing MAC to concentrate on rushing the reinforcements to Southeast Asia.

—THE EDITORS

SCIENCE/SCOPE

The extraordinary longevity of Hughes-built synchronous communications satellites is causing a continuing downward revision of cost estimates for operating satellite networks. Syncom II, originally designed for one year of service, is still at work five years later. The Hughes satellites, including two Syncoms, three Intelsats (Early Bird, Lani Bird, Canary Bird), and two Applications Technology Satellites, now have a combined service life of over 18 years. Every satellite in synchronous orbit around Earth was built by Hughes.

A daily bunching pattern of the high-energy electrons that orbit Earth in the outer Van Allen belt was revealed recently by the energetic-particle detectors aboard the Hughes-built ATS-1 satellite. The electrons move to lower altitudes on the night side of Earth, higher on the day side. Changing pattern seems to be caused by distortion of Earth's magnetic field due to sharp variations in the solar wind.

The Air Force Avionics Laboratory recently used ATS-1 for a successful demonstration of satellite-relayed voice communications for helicopter/ground and helicopter/aircraft links, using a small helicopter-mounted antenna. Tests also showed that the rotating blades weakened the signal on the helicopter/satellite link; in future tests, antennas will be placed above the main and tail rotors.

Communications via satellite with a jet airliner flying scheduled routes between North and South American points was demonstrated successfully for the first time in a new series of experiments with ATS-3 (in synchronous orbit over Brazil).

Twelve Mark 1B satellite communications ground terminals, positioned around the globe, are providing fast, reliable voice and teletype communications via DOD's satellite network. Hughes has built a total of 14 for the Army Satellite Communications (SATCOM) Agency, to be used by the Army, Navy, and Air Force.

Thirty new seagoing command-and-control display systems, designed by Hughes, will completely automate the combat information centers aboard naval ships of France and the Federal Republic of Germany by the early 1970s. Representing the latest in radar data display equipment, new systems will enable the French and West German ships to interchange tactical data for the first time.

The new shipboard systems, a cooperative effort between the two navies, will be built by SEMS (a joint-venture company formed by Hughes and Thomson Houston-Hotchkiss Brandt of France) under license from Hughes.

The 16,000 channels on the Manpack radio Hughes is now delivering to the armed services make the compact, solid-state combat radio virtually jamproof. It uses ground waves to penetrate dense jungle and hurdle rough terrain at close range; at ranges of 25 to several hundred miles it bounces high-frequency signals off the ionosphere. Manpack weighs 29 lbs., operates on dry or wet cells.

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The men of the Special Air Warfare forces — the Air Commandos — stand ready to operate in the national interests anywhere in the world, anytime. Constantly on the alert to oppose aggressive challenges to the freedom of the U.S. or its allies, these brave, skilled and dedicated men serve in

A salute to the SAW forces

the high tradition of generations of Americans who have been willing to serve to the last full measure of devotion.



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they pit one ally against another. In the US they exploit the poor white against the poor Negro. If more responsible and concerned Afro-Americans are heard, maybe the real threats—racism from within and communism from without—can be abated. . . .

CAPT. FLEM B. OTEY, III, AFRES
Nashville, Tenn.

Unexplained Aerial Phenomenon

Gentlemen: Lt. Col. Robert G. Hill makes a number of quite valid points in his communication, "Some UFOs Identified," in the February *Air Force/Space Digest*.

The second instance that he describes, however, warrants some further discussion. Colonel Hill gave a rather detailed account of that observation, but to get additional details I telephoned him recently. He reiterated the point that it was a clear, calm evening without any haze or clouds and that he carefully checked in all directions to rule out the possibility of searchlights causing the peculiar phenomenon that he so carefully described. The date of the event was November 6 of either 1961 or 1962, as nearly as he could recall. He emphasized that those four circular, luminous objects or patterns were entirely distinct, with sharp edges and with a uniform luminosity that did not vary as they moved through an azimuthal range of about 120° (from his south to his north-northeast). Their apparent course was toward the northwest.

It is extremely significant, from the point of view of possible atmospheric-optical effects, to note the angles of elevation that he spelled out in his communication. That is, they were first seen at an angle of elevation of about 20°, they were at an angle of elevation of about 60° when they passed nearest to his position, and they vanished at an angle of elevation of about 45° as they flipped into what he described as a climbing attitude.

The point that needs to be emphasized strongly is that his suggestion, at the close of his remarks on the sighting, that this phenomenon might have been "the result of some atmospheric phenomenon that caused two interfacing layers of air to reflect the lights from a nearby source, such as the mercury vapor lamps illuminating the parking lot at the shopping center," simply cannot be accepted because of its strong contradiction with optical and atmospheric-physical considerations.

There appear to have developed very serious misconceptions about the

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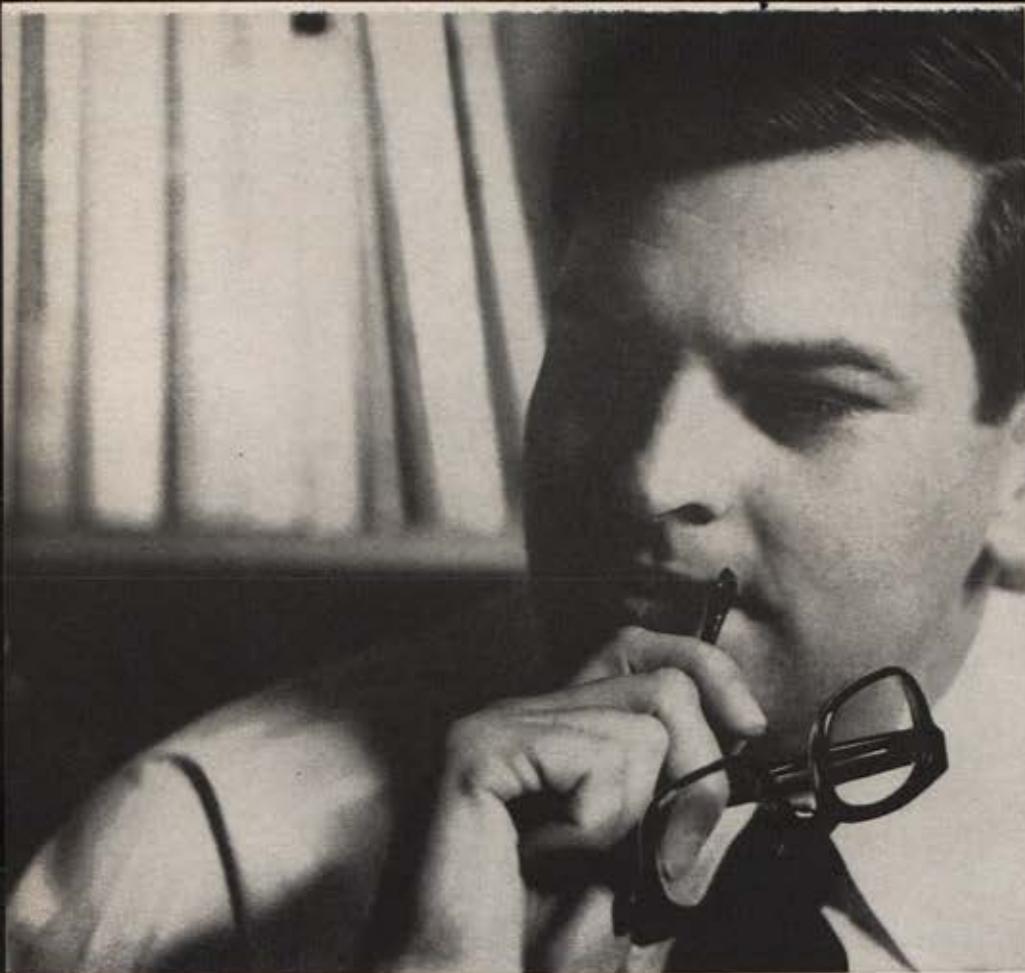
extent to which atmospheric inversion layers and other discontinuities can reflect light. Mirage phenomena, and other grazing-angle refraction anomalies, are well known and well understood. But, for lines of sight that strike at angles of incidence to the horizontal so far from grazing angle as the lines of sight involved in the Hill observation, reflection at atmospheric discontinuities is negligible.

For example, one can show that for as unreasonably strong a discontinuity as a 20° C jump in 1 cm, the reflectivity is only of the order of 10⁻¹⁰ for near-normal incidence. Not

until one gets extremely close to grazing incidence would any perceptible reflectivity develop.

In addition, a little thought about the suggested geometry of shopping-center lights yielding this reflection phenomenon will disclose a difficulty. Since Colonel Hill's line of sight swept through an azimuthal range of 120°, one requires either a moving set of light sources on the ground or a completely improbable propagation of some kind of a smooth disturbance on some atmospheric discontinuity.

Hence, that observation which
(Continued on following page)



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AIRMAIL CONTINUED

Colonel Hill has so vividly described cannot so easily be explained in terms of atmospheric physics. It might be remarked, in passing, that, under the kind of weather conditions that he described, any other possibility such as ball lightning or any electrical anomaly seems to be ruled out, too.

Thus it appears necessary to regard it as an unexplained aerial phenomenon.

JAMES E. McDONALD
Senior Physicist
Institute of Atmospheric Physics
The University of Arizona
Tucson, Ariz.

Incomplete Story

Gentlemen: I appreciate the fact that you printed my letter in the January issue. . . .

I am sorry, though, that you did not read my letter more carefully. You did head my letter "History Omission," but then you proceeded in the footnotes to tell me and your many readers that the facts in the article are 100 percent accurate. I quite agree. Nowhere in my letter did I challenge facts as stated; I objected to omission of facts which distort the article. . . .

Your own headlines state that this is "The story of the Flying Tigers. . . ." and "Here its story is retold by a veteran Flying Tiger. . . ." NO story about the 23d Fighter Group is a complete story without the name of my brother [Brig. Gen. Robert L. Scott, USAF (Ret.)] appearing therein. . . .

LT. COL. ROLAND B. SCOTT,
USAF (RET.)
Sherman Oaks, Calif.

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90th Tactical Fighter Squadron

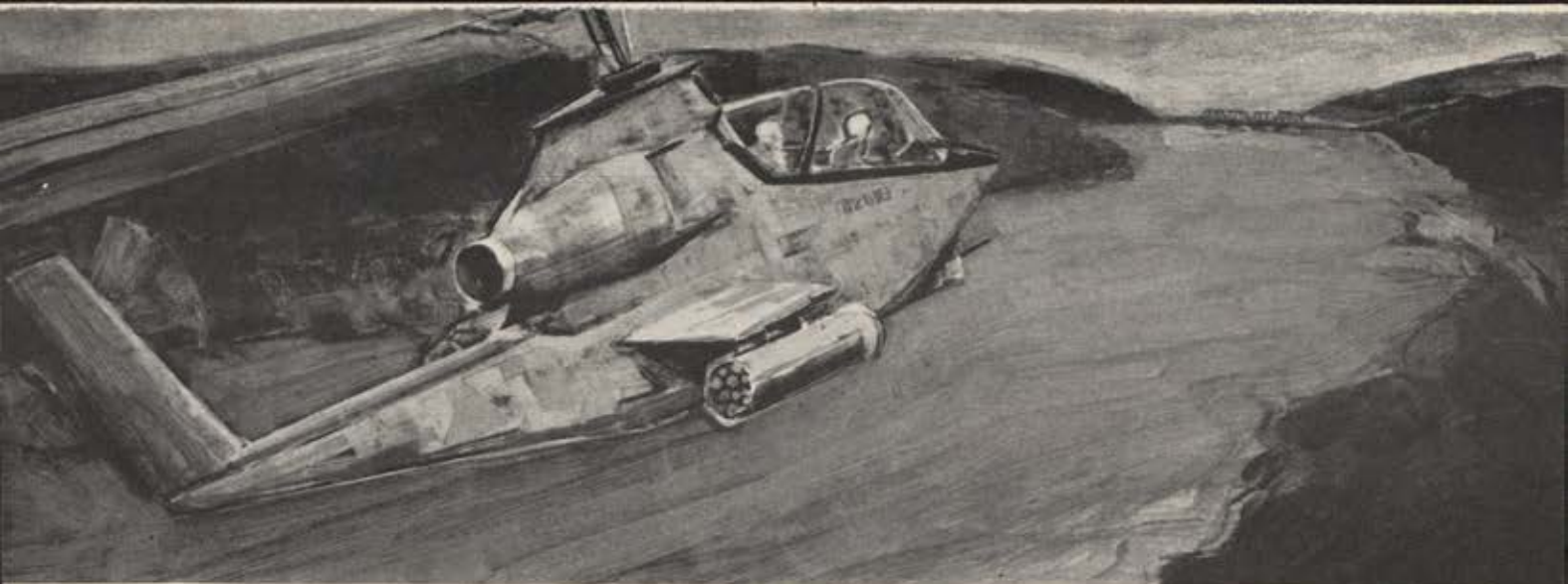
Any ex-pilots of the "Pair-a-Dice" Squadron who might be interested in attending a reunion in Las Vegas the last weekend of May, or if not able to attend and wish to send a message to the troops, please contact

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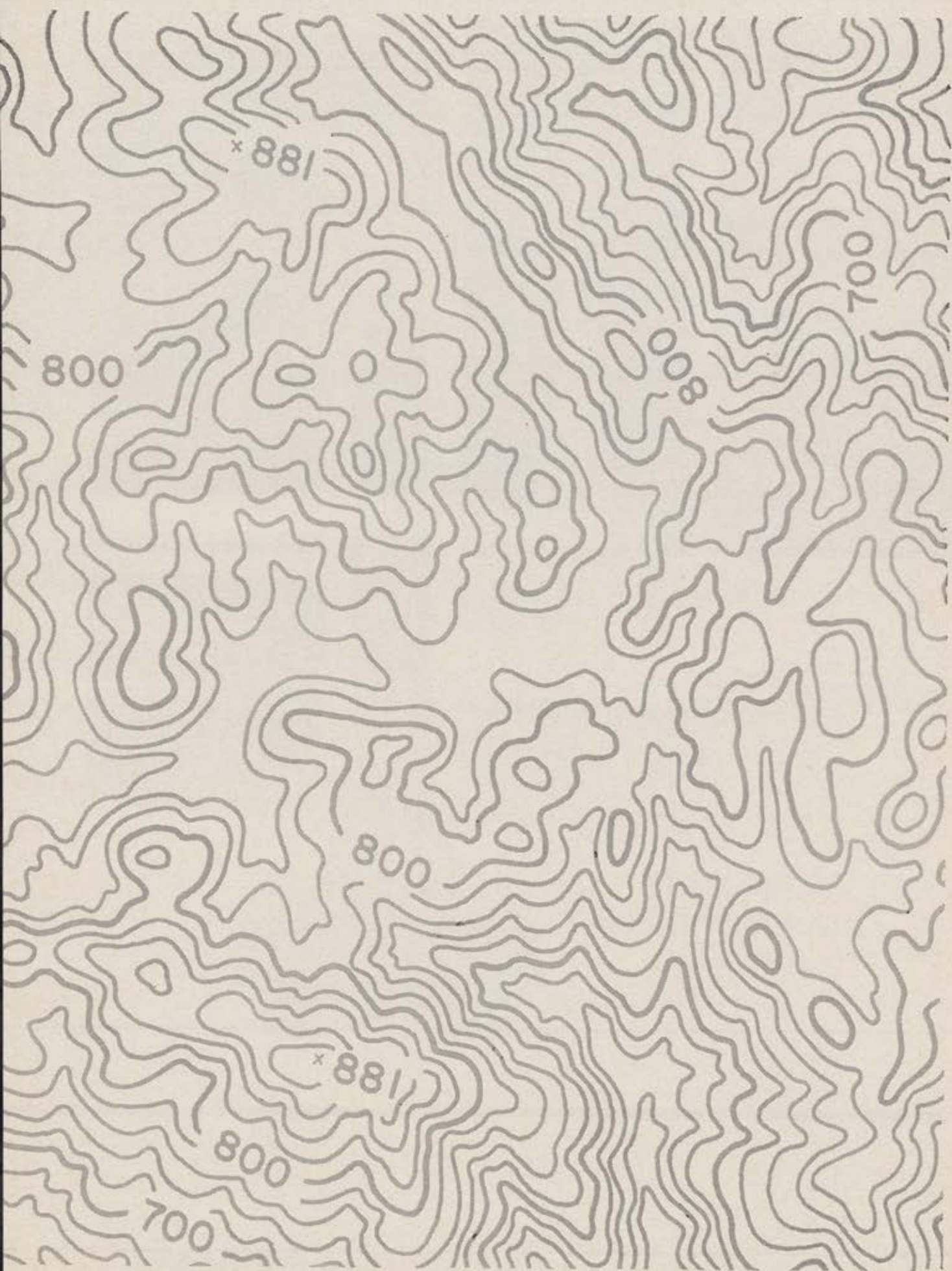
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BOEING



AIRPOWER in the news



By Claude Witze

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

Why Not Take a Vote?

WASHINGTON, D. C., MARCH 12

There are citizens casting votes today, in places like New Hampshire and Mississippi, but the contest unfolding here in the nation's capital appears more critical. By this time next month the Air Force Association will have completed its annual convention, in Atlanta, Ga., and the delegates will know more than can be reported here about the destiny of America. It has been clear for a few weeks, ever since the smoke cleared from the Tet offensive in Vietnam at the end of January, that there is going to be a change in our strategy. The reappraisal is an agonizing one, as every commentator has said since Gen. Earle G. Wheeler, Chairman of the Joint Chiefs of Staff, returned from his inspection of the battlefield at the end of February.

In Washington, while the White House struggles, the verbiage comes from the US Senate. Again, as last winter and the winter before, the Administration's nemesis is J. William Fulbright, the Arkansas Democrat who heads the Senate's Foreign Relations Committee. You will remember him. He is the man who once said he could see no moral difference between Viet Cong terrorist attacks on Vietnam hamlets and the American fire-bombing of Tokyo in World War II.

Kenneth Crawford, the *Newsweek* columnist, once wrote that Mr. Fulbright always seems to be wrong, and asked: "Does he have to keep proving it?" The answer seems to be yes, and he cannot resist an opportunity to bait the Executive Branch of the government. Most recently, he has held hearings to rehash the Tonkin Gulf incident of 1964 on the suspicion that Congress was not given all the facts at that time about the attacks on the destroyers *Maddox* and *C. Turner Joy* off the coast of North Vietnam.

That is when Congress adopted a resolution supporting "the determination of the President, as Commander in Chief, to take all necessary measures" to repel the foe in such circumstances. The resolution also said the United States regards the maintenance of peace and security in Southeast Asia as "vital to its national interest and to world peace."

Mr. Fulbright, who fathered the resolution in the Senate, now fears he gave the Administration too broad a license to escalate the war. He has said nothing, to date, about the fact that Section 3 of the resolution says the whole shebang may be "terminated" by "concurrent resolution of Congress." Mr. Fulbright has sought no such vote.

This brings us to the main point of the most recent hearings, concluding today, in which Secretary of State Dean Rusk has taken an almost unmerciful beating before the television cameras. The upshot, at this writing, is that Senator Fulbright demands, as he did when he started the fight on the Senate floor on March 7, that he be consulted before the Executive Branch makes a war decision.

"There are rumors," he told his colleagues, "that very significant decisions are being considered by the Executive Branch of our government, decisions involving a major new buildup of American forces in Vietnam . . . not only a buildup of troops, but also there is the possibility of the extension of the war beyond the geographical limits of Vietnam."

Mr. Fulbright then said the situation is grave, that it concerns "every member of this body, regardless of whether he supports or disagrees with the Administration's war policy. This issue is the authority of the Administration to expand the war without the consent of

(Continued on following page)



Secretary of State Dean Rusk faces Senate Foreign Relations Committee in his televised appearance. Foreground, left to right, are: Chairman Fulbright and Senators Mundt and Aiken. Congress is considering action on war in Vietnam.



Dean Rusk spent more than ten hours on stand under hot lights. He urged restraint on war discussions in public.

Congress and without any debate or consideration by Congress."

Then, the crux of the argument:

"If the Administration contemplates an expansion now, a major expansion, it has the obligation, in my opinion, to consult with Congress, especially with the Senate, and to obtain its advance approval."

There has been no citation of any law that says such an obligation exists. Dean Rusk, who looks today like the noblest American of them all, has just concluded more than ten hours before the television lights assembled by the Arkansas Senator. Nobody gave an inch. The Administration's hunt for alternatives, it is clear, so far has not found the answer, and Mr. Rusk is not about to make a prophecy or ask Senator Fulbright to help him make one.

The persistent committee chairman, who does not seem to understand how seriously Mr. Rusk takes the American pledge to defend freedom, keeps asking to be taken into "confidence" before a decision is made and demanding that he be told in advance "what you are going to do."

The Secretary of State has a simple protest. He is not going to sit in front of the television cameras and tell Hanoi, which Mr. Fulbright does not seem to recognize as an enemy, what to expect. Mr. Rusk says he will discuss the matter in executive session and argues that no recent President has confided more in the members of Congress than Lyndon Johnson. He drove the point home by quoting Dwight Eisenhower, who is familiar with the decisions now under consideration and says, "Giap would love to know."

Giap would love to know whether or not the United States will send another 206,000 men to join the 525,000 troops it already has in Vietnam. Mr. Rusk is not about

to make such an announcement. Here is his statement:

"Obviously, the so-called Tet offensive calls for an examination of many subjects, including the tactics and strategy of the enemy, the impact on the pacification program, and on the military side."

"As you may know, at the end of this month and early next month certain units that had previously been scheduled under existing plans will be going out in the general level of that 525,000 that the President talked about. But he has not made any fresh decisions or come to any new conclusions, and I think it would not be right for me to speculate about numbers or possibilities until the President has had a chance to look at all the information and consult with his advisers and determine how and on what basis he would wish to consult with the members of Congress if any congressional action should be indicated."

This reply aroused Senator Fulbright.

"What," he demanded, "would indicate the need for congressional participation in the decision to enlarge the war?"

Mr. Rusk came back with a reply that contained the key to any action Mr. Fulbright, or other members of Congress, might contemplate:

"The President doesn't have a man or a dollar that is not made available to him by the Congress by law."

He could have added, but did not, that the last supplemental budget for Vietnam was passed by the Senate about a year ago. There were three dissenting votes, and the name of Mr. Fulbright does not appear among them.

Mr. Rusk added this justification for his stand:

"The entire situation is under consideration from A to Z. The President, as you know, does keep in touch with the leaders of the Congress and the leaders of committees. I just don't think there is anything more I can say on that. I would add, and call your attention to the fact, that the distinguished Majority Leader [Senator Mike Mansfield] said the other day that President Johnson has tried to consult with the Congress more than any President he knows of, and these are matters that are being examined. I think the facts and problems and opportunities are to be looked at, but I can't speculate about decisions that have not been made or conclusions that have not been reached."

At the next day's session, Mr. Fulbright continued to press the Secretary. He demanded that his committee have the right to approve or disapprove any decision to ship a substantial number of new soldiers to Vietnam. The witness suggested, at this point, that the televised hearing in itself was a form of consultation. He could not miss, nor could the audiences at home, the alacrity with which the chairman and committee members put their opinions on the record in front of the cameras. When Secretary Rusk referred to this, Mr. Fulbright sounded incredulous. Did Mr. Rusk think he was finding out how the committee members felt about the war in Vietnam from their speeches at this hearing? Replied the witness:

"We know a good deal, now, don't we?"

Mr. Fulbright persisted again.

"I am trying," he said, "to find a way in which Congress can contribute to the decision."

Mr. Rusk made it clear again that this could not take place in a televised session without betraying a good deal to the enemy. And he repeated what may be his most important message to the Congress:

"The President has only the men and money that Congress makes available."

It was here he pointed out, saying "this is not a challenge," that Congress also can rescind the Gulf of Tonkin resolution if it wants to.

(Continued on page 25)

"Don't Worry—I'll Let You Know How I Pulled It Off . . . After November."



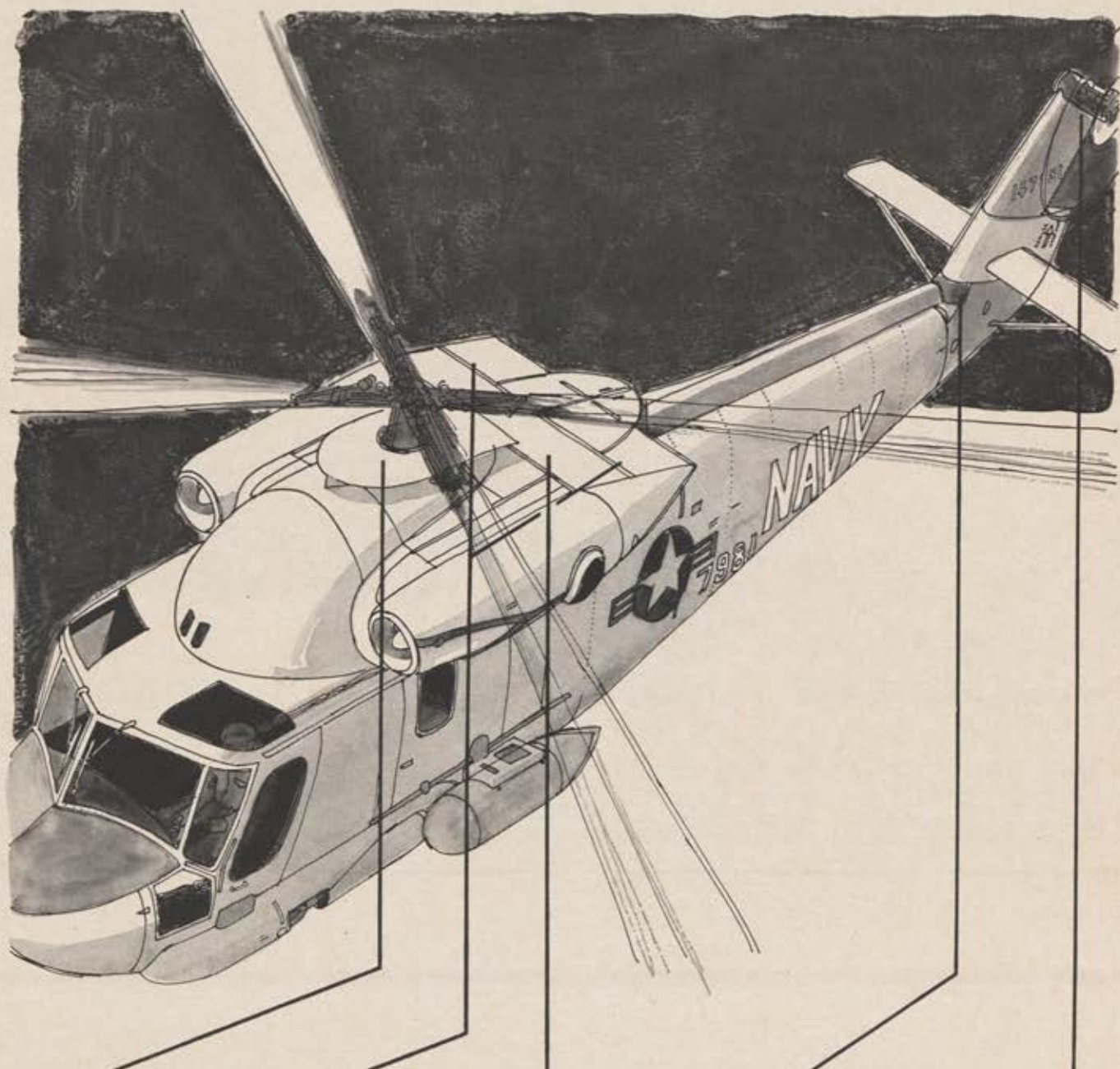
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AIRPOWER IN THE NEWS

CONTINUED

The only member of the committee to take this seriously was Democrat Frank J. Lausche of Ohio, who suggested that opponents of the Administration offer a resolution to Congress—there is one in the House hopper—calling for retreat, if that is what they want, or for repeal of the Tonkin resolution.

During the entire ordeal Mr. Rusk was called upon time and time again to tell how stubborn the Hanoi government is, how it refuses to negotiate, or take steps in that direction. Some committee members seemed to find it hard to believe that North Vietnam rejects all efforts to find peace. Mr. Rusk said several times that he would like nothing better than to demilitarize the demilitarized zone, but the foe will have none of it. He disclosed, at one point, that the United States has tried to find a "common set" of points as a basis for negotiation. This would not be Hanoi's points, or our points, or the points proposed by South Vietnam. Just a "common set" of points. There is no acceptance. We are willing, the Secretary said, to talk without conditions or to talk about the conditions under which we can talk. The replies are fully negative.

Of the panel members, it was Senator Karl E. Mundt, a Republican of South Dakota, who brought up a couple of the more important questions. For one thing, he said his constituents cannot understand why other nations of the free world persist in trading with Soviet Russia, supplying it with war materiel that ends up killing American youths in Southeast Asia. There was no satisfactory reply.

Then Mr. Mundt fingered a matter of deep concern to the diplomats. He pointed out that our enemies have a long history of miscalculation. They never seem to understand how the United States will react. The Kaiser made the error that led us into World War I. Hitler and Japan

repeated the performance. So did the North Koreans, stimulated by China. Is it not possible, he wanted to know, that some part of the Communist world will make a similar miscalculation if we hesitate or retreat in Vietnam?

Secretary Rusk recalled the eyeball-to-eyeball meeting of President John F. Kennedy with Moscow's Nikita Khrushchev. It was in Vienna that the Russian presented his position that the Western Powers had to get out of Berlin. If they did not agree to this, there was the possibility of war. According to Mr. Rusk, the reply of the American President was that "it's going to be a cold winter."

The Secretary of State held that this example, and Senator Mundt's query, brings up the entire question of the "fidelity of the United States." He said this country must show determination, because if it displays doubt, it means war.

The worrisome subject of American airpower, land- and sea-based, and the restraints that have been placed on it in Vietnam, was brought up by Senator Stuart Symington, the Missouri Democrat who served as first Secretary of the Air Force more than twenty years ago. Mr. Symington suspects that the critics who want the bombing stopped in the North, but do not want to abandon the Vietnam effort, are in favor of a bigger ground war, the kind that is most fatal. He suspects they are more concerned about casualties in North Vietnam than they are about American losses in South Vietnam. There was no other important mention of airpower and our failure to utilize it as an efficient military weapon.

It is difficult to see, at this point, what has been gained
(Continued on following page)

by the televised session before Mr. Fulbright's committee. Even he cannot be satisfied. A local newspaper, the Washington *Daily News*, already has compared the session to a bullfight, but not a good bullfight. Dean Rusk was tortured by Senate picadors and banderilleros but he was not slain. It was Mr. Fulbright who pleaded weariness and Mr. Rusk, in the role of the bull, who wanted to keep fighting.

Late today, in a White House Medal of Honor awards ceremony, President Johnson took a moment to reassert his determination to see the war through. He pleaded with Americans to put everything into the effort and not be the victims of their own despair. The President said he knows we are right. Clearly, Mr. Fulbright does not think we are right.

The March 7 debate on the Senate floor, which consumed more than twenty pages in the *Congressional Record*, was no more conclusive or educational than the committee hearing. If anything, it reflected only the sensitivity of Congress to what comes out of the mailbag. According to the Gallup Poll, forty-nine percent of all Americans now think their country made a mistake to get involved in this war. That is a new high for this reaction to the question. Only thirty-three percent think we are making progress, compared with fifty percent in a survey made last November. There was no effort to find out how the public feels about the way the war is being fought.

The Senate debate and most other public discussion at this moment centers around the reported request for another 206,000 troops. Added to the already authorized 525,000, this would give General Westmoreland a total of 731,000.

There is a requirement here to recall that in the sum-

mer of 1966 Gen. Wallace M. Greene, Jr., then Commandant of the Marine Corps, went to a garden party in Saigon where he chatted with the press. He had just finished a survey trip to the battlefield and was asked, for use without attribution, how long he thought the war might last and how many men would be needed to win it. General Greene's speculation ran to 750,000 men and five to eight years.

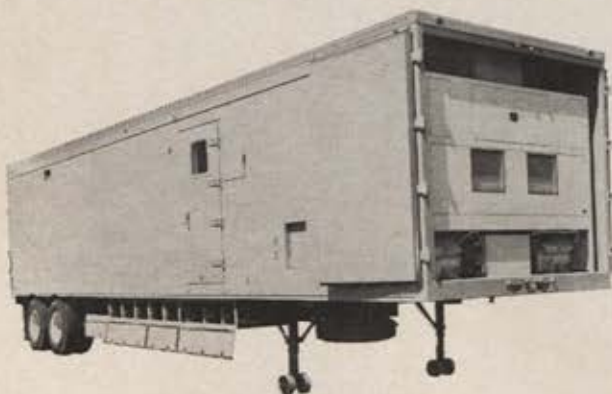
These figures got into print before the Commandant got back to his desk in Washington. There, under orders from his civilian superiors, the General was forced to hold a press conference at the Pentagon and announce that he did not know of any study drawing the conclusions reported in dispatches from Vietnam. It was a humiliating experience for a competent member of the Joint Chiefs of Staff. His conjecture, of course, was professional and highly accurate.

It is difficult to believe that no member of the Senate Foreign Relations Committee knew about General Greene and his requirement to don a hair shirt. It is equally unlikely that Mr. Fulbright is nonplussed by General Westmoreland's expressed requirement, considering the kind of war this has become.

As all the headlines point out, there is no indication that President Johnson, in this election year, will accept a compromise that amounts to a repudiation of the policy he has been following.

As pointed out, at least by Dean Rusk and Senator Lausche, any member of Congress who has the conviction and the courage can find an issue on which to cast his vote against continuation of the war. It was not a bullfight they staged today in New Hampshire and Mississippi—it was a ballot fight.—END

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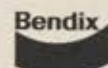


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Letter from Europe

Prime Minister Harold Wilson's announcement that Britain will withdraw from east of Suez will have far-reaching significance for the US and Europe. For it means that Britain's still-powerful military and political forces, if her economy can be strengthened, will now be concentrated on vying with France for European leadership . . .

RETREAT TO EUROPE

Speculation on the Future

By Stefan Geisenheyner

AIR FORCE/SPACE DIGEST EDITOR FOR EUROPE

A tense House of Commons listened to Prime Minister Harold Wilson on the sixteenth of January as he announced the British withdrawal from Southeast Asia and the Persian Gulf to base its future role in the world on Europe and NATO. Instead of 1975 or possibly later, as originally planned, the withdrawal will take place in 1971. Since their long-range capabilities will no longer be needed, the contract for fifty F-111s was canceled. The aircraft carriers of the Royal Navy are also to be phased out, since they will be of limited use once the withdrawal has taken place. In addition, the British armed forces will be cut by 75,000 men.

Significantly, these military decisions raised no comments in the House of Commons. But when Mr. Wilson announced a sweeping program of slashes in the benefits of the British welfare state, cries of "Resign! Resign!" erupted from his own Labour Party. The whole package, Mr. Wilson said, was necessary to enable the island kingdom to stay alive within its means. He explained that these moves were an obligatory follow-up to last November's devaluation of the pound. More than 300 million pounds will be saved in the fiscal year beginning this April and 441 million pounds in the following fiscal year. Together with the cuts announced at the time of the devaluation, savings of more than one billion pounds will be realized in the next few years. Mr. Wilson's historic announcement will have far-reaching effects on world politics in the next decade and beyond, since they entail a shift in the global power structure.

The more obvious conclusions are

easily drawn. Great Britain is cutting back on defense to save the present welfare society structure at home, which takes an ever-increasing amount of money. Britain is withdrawing from its positions in the world, which under the circumstances cannot be adequately maintained and defended. It is canceling worldwide responsibilities the nation has held for centuries. All this was induced partly by a steadily decreasing industrial productivity at home, which Mr. Wilson said was due to "sheer damn laziness." Britain is tacitly withdrawing from world politics and is beginning with the abandonment of its "east of Suez" policy. It is ironic that only a few years ago the same Labour Government stated that the then newly acquired "east of Suez strategy" was a powerful but civilized form of British world power. Now Britain is retreating to Europe and in Asia will maintain only its crown colony, Hong Kong, as an outpost for its mercantile endeavors in the region. Whether this position can be held, indefinitely or at all, will depend on Red China. After the scrapping of the aircraft carriers and the 1971 withdrawal from Malaysia and Singapore, Britain will have to rely on the US to defend free world interests in Asia.

Much has been written about how the vacuum created by Britain's withdrawal in Asia is going to be filled. By Russia or by the US? Europe is going to care little about this. These events take place on the other side of the world and carry little weight in Central European politics. However, the reappearance of a strong Britain on the European scene will have major repercussions.

Militarily, Britain will be capable of dominating the continent. The RAF is, without doubt, the best European air force; the Royal Navy is the strongest afloat in European waters; and the British Army, though smaller than the French or German, is better equipped and trained. Furthermore, it is generally forgotten that Britain is an atomic power, with thermonuclear warheads in her arsenal—something France does not yet have, but possibly will in the 1970s.

After the devaluation of the pound, exports in Britain increased by leaps and bounds, and, if the general lethargy of the island's population can be overcome, there is no reason why Britain should not become the strongest element in the European community.

France views this possibility with misgivings. De Gaulle wants a leading position in Europe for France and will do everything to block British progress. A rebirth of British economic power, coupled with its military power, might endanger de Gaulle's plan. This is why he does not intend to let Britain enter the European Common Market now, since France itself would be contributing to the recovery of Britain. A weak Britain is acceptable, but a recovery-bound United Kingdom cannot be admitted.

All this has a great bearing on US foreign policy. If an economically recovered Britain is willing, it can take over the roles the US has played in Europe for the past twenty years. Militarily it should be well capable of doing so, and economically the ties between the US and Britain are so

(Continued on page 31)

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U.S. Army Photo



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Typical of the European press reaction to Britain's withdrawal is this German cartoon which shows Prime Minister Wilson selling the Empire—cheap—in a winter sale. The lion carries a sign which says: "Take your pick now!"



close that even in this sector the US would lose little in case of a general withdrawal so that it could concentrate its power elsewhere. The US troops, freed by a stronger British presence in Europe, could well be used to fill the vacuum created in Asia. All this becomes feasible, however, only if Britain is admitted to the European Common Market. Otherwise, a further slow deterioration of British influence and power cannot be prevented.

The other factor in Europe is the USSR. Some time ago, France embarked on a cooperative venture with the Soviet Union. It includes exchange of technical information, trade agreements, and even on the military level a certain cooperation cannot be denied by either side. Toward the end of last year it was affirmed by the French government that Soviet paratroopers were training together with their French counterparts. It is astonishing that this news item did not get wider coverage. There is definitely an even closer cooperation between the two nations shaping up, and it is anybody's guess where it will end. The French, however, are emphatically willing to defend their independence and neutrality. Just recently Defense Minister Pierre Messmer said that France will decide this year whether to equip itself with intercontinental missiles to give substance to the new French nuclear strategy aiming at "all points of the compass." This strategy was formulated by the late Gen. Charles Ailleret, CinC of the French armed forces, on the basis that the Soviet threat had diminished, and, as a consequence, France could no longer base its strategic planning on a single enemy.

As a professed adherent of NATO, Britain surely does not intend to go so far, but there are signs that it might be willing to follow a similar path. The Labour Government concluded a couple of trade agreements with the Soviet Union and just recently signed a paper which guarantees close tech-

nological cooperation between the two nations. France a few years before had started the game the same way. It goes without question that Western Germany cannot become the leading element in Europe, though it has by far the strongest economy on the continent and could develop its military system easily. The neighbors in the East and in the West would not allow it and would quite conceivably go to war to prevent it.

Thus, the retreat of Britain to Europe from the last strongholds of the former empire will initiate a power struggle with France for the leading role on the Western half of the continent. France has a head start and holds some of the best cards. Some of France's trump cards are her close cooperation agreement with the Soviet Union, the friendship and cooperation of West Germany—the strongest industrial nation in Europe—and a workable defensive system. The assets of Britain will be: a stronger military presence in Europe; better chances to compete on the world markets with a—hopefully—stable pound; and, last but not least, the latent ability of the British nation to generate a magnificent burst of energy when it is really needed.

If a working agreement between France and Britain can be achieved in the next decade, Europe can look forward to a prosperous future because this understanding between the two major military powers would assure the continued existence of the European Economic Community and close ties with the US, while keeping the East at bay. If such agreement cannot be reached, then either the US will have to stay in Europe to defend its positions here or Europe will fall completely under the influence of the Soviet Union.

Premier Wilson's speech on the sixteenth of January will indeed have far-reaching repercussions, and Europe is hoping that the short-range goals of

the move—revival of the British economy and a stronger military presence on the continent—are fully realized. If they are, Britain will have done more for stability in Europe than anybody else during the past twenty years, and gives the continent a reason to hope for a bright future.

Germany and Vietnam

At the end of February, when the battle of Hué was raging and the bombing of North Vietnam had just started again, a well-known German institute polled German public opinion on Vietnam. The results surprised almost everyone.

The first question asked was: "Do you believe we are being told the truth about the military developments in Vietnam?" Ninety-three percent answered with a straightforward "No." Sixty-eight percent of these thought that they were fed strongly colored news.

The next question centered around a subject very dear to the heart of any American abroad: Does the US lose some of its image in view of the slaughter in Vietnam? Eighty percent answered with "No," thereby indicating that they believe the US is doing a valuable service to freedom and democracy in Vietnam.

When asked, however: Should Germany financially support the US effort in Vietnam?, seventy-nine percent gave a negative answer, which reached ninety-eight percent when asked whether the nation should offer military help. The German people obviously believe that the Vietnam War is not their doing and that the nation has enough troubles to cope with, so why add another one?

During recent months many demonstrations against the Vietnam War have taken place in several German cities. These were mainly supported by the Communist underground and students of the radical Left. When Mr. Average Citizen was asked: Do you believe that such demonstrations should take place?, eighty-nine percent answered "No!" The demonstrations are a waste of time and serve no good purpose.

The picture changes slightly if this question is asked of the younger set under twenty. Seventeen percent of them are for the demonstrations.

When asked whether there will be any repercussions of the Vietnam War in Europe, seventy-two percent did not think so. When asked whether the US should continue the war at the present level, forty-five percent answered "No!"

(Continued on following page)

collage 31



How To Be The Life Of The Party

(without digging Marienbad)

Just because you're in some peripheral phase of the aerospace biz, all your non-industry cocktail-party friends expect you to be the reigning expert on all aspects of the Apollo Mission, right? And, often as not, you find yourself bluffing and bungling your way ineffectually before changing the subject to an area in which you can demonstrate more expertise, like the real significance of the match game in "Last Year at Marienbad," right? Well, let Motorola re-establish your brilliant image, if it's not too late already.

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dane, Clint Murchison, Chow Mein, Conrado Marrero, Common Mistake, Calculating Mother or Constantly Malfunctions?" Well, after removing his \$45.00 slide rule from the upper entrance to our thoracic cavity it was suggested by the engineer that the waiting world be told simply that CM stands for the world's best line of VHF and UHF solid state transceivers, receivers, and transmitters for ground-air communications. Interested parties should write our Chicago Center for the data to prove this wild claim. In the meantime, COLLAGE still doesn't know what CM stands for. If you have any ideas, let us know and they might wind up in print one of these days (and don't submit Complete Madness).

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MOTOROLA

Government Electronics Division

EUROPE CONTINUED

swered with "Yes!" Eleven percent wanted escalation and the use of nuclear devices if necessary. Only forty-four percent suggested a speedy withdrawal from Vietnam.

The results of the poll are astonishing in that they show a measure of general popular support for the US cause which just could not be expected if the press is used as a yardstick. The average German daily has blasted the US effort for years. Cartoons, editorials, and pictures should have indoctrinated the public thoroughly if the basic rules of public relations hold true.

Why the Germans think the way they do is not clear, but this attitude certainly must be most gratifying to the US government. The best example for this feeling came late in February in Berlin when, one Sunday, 10,000 demonstrators from all over Germany marched against the war in Vietnam. Just two days later, 150,000 Berliners demonstrated in support of US policy.

—END



A recent poll of the German people showed much more support for the war in Vietnam than reading the newspapers, which have been violently opposed to the war, would indicate. Evidence of this journalistic opposition is this West German cartoon headlined "Message to the American People." The sign the Statue of Liberty holds says, "Give your all for Vietnam!"

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Illustration below shows AHI Precision Approach Radar Display and the AZ-EL Display which provides approach sector overview. Both are elements of the AN/TPN-19 system.

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AEROSPACE WORLD

By Judith Dawson

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D. C., MARCH 13

Dragons just may *not* live forever, contrary to what folksingers Peter, Paul, and Mary have been telling us for years. "Puff the Magic Dragon," more recently known as "Spooky," will eventually retire, after a colorful career in Southeast Asia, and will be succeeded by two more modern gunships.

The AC-47, military version of the pre-World War II vintage DC-3 airliner, was originally nicknamed "Puff" in South Vietnam because its tracer rounds, mixed with conventional ammunition, gave the effect of a continuous stream of fire reaching to the ground when all three 7.62-mm Miniguns were firing.

Now AFLC is developing a modified C-119 gunship that will have even greater firepower—four Miniguns instead of three, plus a pair of 20-mm cannon—and greater load-carrying capacity than the AC-47. Fairchild Hiller's Aircraft Service Division has received the contract for the first prototype, after which at least fifty-two such aircraft will be modified. The

first twenty-six C-119Gs will be two-engine aircraft, firing four GE Miniguns, with added electronics and armor protection for the crew. The next twenty-six, designated C-119K, will have two jet engines added, increasing takeoff capability to 77,000 pounds.

TAC has announced testing of its follow-on gunship to "Spooky"—a C-130 carrying high-intensity lights and flares and advanced detection devices. It, too, carries four Miniguns, plus four Vulcan 20-mm cannon.

The firepower of the AC-47 gunships, first introduced in Vietnam in 1966, is said to be equal to having an extra seventy-two riflemen and six M-60 machine guns firing simultaneously. The Dragons regularly fly four- to six-hour missions, often two a night, providing light from 2.5 million candlepower flares.



The Soviet Union, continuing to push ahead in aeronautical development, has been conducting a crash program to build up its force of advanced fighters. In contrast to this

technological zeal, the United States has been standing around, watching the last of the Air Force-developed Century-series fighters near the end of their first-line lives. Either a slow death or an extensive, expensive modification program seems in store for these once-superior aircraft.

Reflecting the concern of all three services over the Soviet emphasis on advanced fighters, Gen. John P. McConnell, Air Force Chief of Staff, drew a bleak picture of the situation for the Senate Armed Services Committee in his annual defense posture statement. He said the US, in the face of the Soviet threat, has a compelling need to bring a modern fighter aircraft with superior air-to-air performance and substantial air-to-ground capability into the 1975-1980 inventory.

(Continued on following page)



Follow-on to Vietnam veteran dragonship, AC-47, is the AC-130 gunship, which will further increase US ability to hit targets on first pass despite poor visibility. Integrated attack system effectively combines reconnaissance with strike capability.



This F-105 Thunderchief picked up some enemy hardware while on a mission over North Vietnam and brought it back to base. Airman points to a missile's tail protruding from aft section. F-105s fly seventy-five percent of USAF missions over North. With new tail, this aircraft is back in action.



Minuteman's journey into the sunset was captured by photographer Charles E. Harne, III, at Vandenberg AFB, Calif. As the best SAC news photo of 1967, it has won Airman Harne an engraved trophy. Annual contest is open to all SAC-associated photographers employed by DoD and their dependents.

Such an aircraft is the FX, which is now in the process of concept formulation and, if it is approved, could probably be in its contract-definition phase before the end of Fiscal Year 1969.

Current technology in the areas of variable-sweep wings, improved avionics, increased engine thrust, and airframe design can indeed yield an air-superiority fighter that could more than match Soviet aircraft. Both the Air Force and Navy have asked for about \$30 million each for work on the aircraft during the current financial year. Plans for the Navy fighter, designated VFAX, are closely linked to

those of the Air Force, since throughout the concept-formulation phase, the services were strongly urged by then Defense Secretary Robert McNamara to come up with a common design, as was the case in the TFX, now F-111. Whether the new Defense Secretary, Clark Clifford, will see the need for separate fighters is a matter for conjecture.

A year ago, USAF sought \$14 million for the contract-definition phase, received only \$4 million, just enough to keep the project alive, and subsequently awarded two sets of study contracts. Firm decisions on the design are expected later this year.

The importance of the FX project had been emphasized by Gen. James Ferguson, Commander of Air Force Systems Command, in a speech to the Air Force Association's 1967 Fall Meeting. "In the past twenty years there has been much debate about tactical doctrine—its validity and its application to so-called limited wars," he said.

"Korean and Southeast Asia experience reconfirms our conviction that the ability to establish air superiority is vital to the success of conflict at any level. . . . Accordingly, we're pursuing studies on fighter aircraft that are tailored to the air superiority role, with the added capability for ground attack. The outgrowth of these studies will be the tactical fighter currently designated the FX."

As an encouraging footnote to the arguments for the FX, General McConnell told the Armed Services Committee, "Through this examination of our general-purpose forces, both in terms of their heavy commitment to operations in Southeast Asia and in terms of their worldwide activities, we can perceive one point of overriding importance: the increasing versatility and effectiveness of these forces in limited conflict are progressively foreclosing the Communists' opportunities for achieving their objectives through aggression at any level."



Man's insatiable curiosity about the wonders of nature has generated a series of research satellites making the
(Continued on page 40)

NEW BOOKS IN BRIEF

Crisis in Credibility, by Bruce Ladd. Government statements should never be trusted; the press pursues and prints only fact; and authors are always objective—or so Mr. Ladd passionately reminds us here. New American Library, N. Y. 256 pages. \$5.50.

The Farther Shores of Politics. The American Political Fringe Today, by George Thayer. Interesting personal observations, backed by research, on such prominent extremist groups as the John Birch Society, Ku Klux Klan, and Neo-Nazis. The author is not ready to label them all lunatics, however. Simon & Schuster, N. Y. 610 pages. \$7.95.

The German Atomic Bomb, by David Irving. A non-technical explanation why Germany failed at this project during WW II. Interesting and informative for the general reader. Simon & Schuster, N. Y. 329 pages. \$6.95.

GI Diary, by David Parks. Clipped notes and two dozen pages of not-fantastic photos by this young draftee aren't likely to give the reader new insights on the Vietnam War—though done by the son of famous photo-journalist Gordon Parks. Harper & Row, N. Y. 133 pages. \$4.95.

History of the Cold War: From the October Revolution to the Korean War, 1917-1959, by André Fontaine. After analyzing the power struggles since the first World War in

detail, this author proposes that an alert diplomat, while maintaining a defensive guard, will surely find opportunities for negotiation, eliminating the sort of mistakes that fill recent history. Pantheon Books, N. Y. 432 pages. \$10.

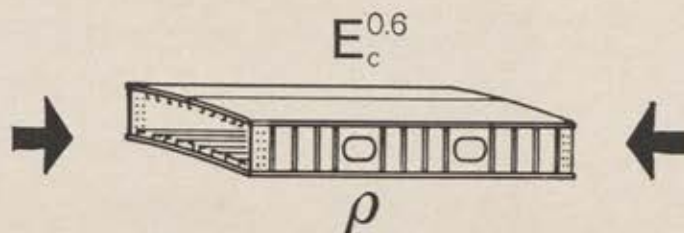
Presenting Technical Ideas, by W. A. Mambert. An IBM executive gives advice on achieving audience rapport by effectively using outlines, visual aids, and rehearsal. This textbook should be helpful in organizing complex presentations on many subjects. John Wiley & Sons, Inc., N. Y. 216 pages. \$6.95.

Sanity and Survival. Psychological Aspects of War and Peace, by Jerome D. Frank. A look at man's violent impulses—biological and social—by a leading psychiatrist who concludes that if man understood his world neighbors better, hostilities would tend to vanish. Random House, N. Y. \$5.95.

The Strategy of Corporate Research, by Cyril O'Donnell. The proceedings of a seminar for members of aerospace and industrial corporations, the Defense Department, and universities to discuss management of their highly organized and competitive research departments. Science Research Associates, Chicago, Ill. 205 pages. \$5.

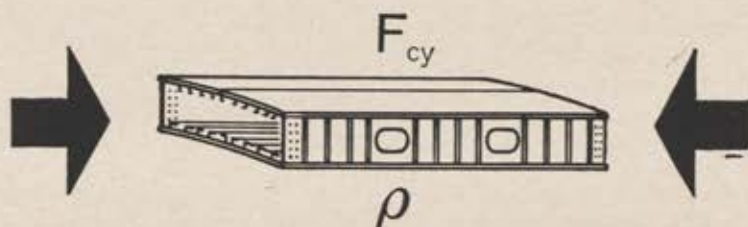
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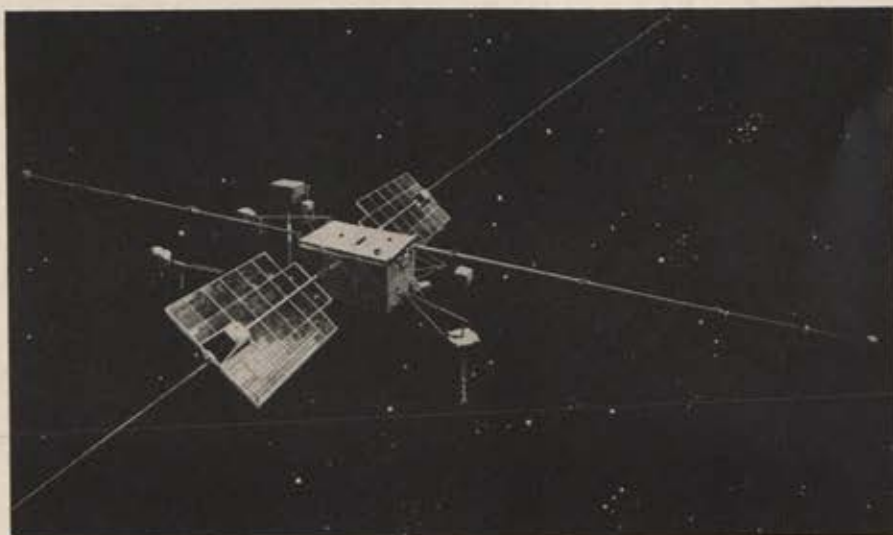
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An Atlas-SLV-3A Agena launch vehicle sent a 1,347-pound Orbiting Geophysical Observatory into orbit March 4.



Insect-like OGO-5 is shown in an orbit around the earth in this artist's conception. The twenty-four experiments aboard are designed to study the relationship between sun and earth's environment during a period of maximum solar activity.

most comprehensive studies yet of space phenomena.

NASA's fifth OGO (Orbiting Geophysical Observatory) spacecraft was successfully launched March 4 by an Atlas-Agena rocket and achieved an elliptical orbit ranging from 175 to 92,000 miles high. The satellite carries a record number of scientific experiments, twenty-four in all, two more than carried by any previous satellite.

OGO-5 is providing information on the sun's thermonuclear flare eruptions and how the resulting radiation affects the earth's atmosphere, weather, and communications, allowing more accurate weather forecasting and better scheduling of manned spaceflights. Another experiment will detect and measure plasma waves, aiding in the understanding of growth and decay processes that occur in space.

Built by TRW, Inc., OGO-5 has joined four other OGOs, all returning data on such phenomena as the aurora borealis (northern lights), aurora australis (southern lights), solar flares, mysterious radio transmissions from Jupiter, and radiation coming from sources other than the sun. Each OGO sends back to earth 64,000 bits of information per second. To date, scientists have prepared more than 200

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detailed technical papers based on the OGO's findings.



A new FAC (Forward Air Controller) aircraft will soon replace many of the familiar O-1 Bird Dogs in South Vietnam. It's the OV-10A, the first two of which were delivered to the Air Force and Marine Corps in late February.

USAF's Special Air Warfare Center accepted its first OV-10A "Bronco" during ceremonies at Hurlburt Field, Fla. The OV-10A, built by North American Rockwell Corp., is a rugged, two-place, twin-engine, STOL (short takeoff and landing) aircraft which will be able to operate at longer ranges with a slow loiter speed and, at the same time, have added climb and dash speed to increase survivability.

Its armament includes four M-60 machine guns. The new aircraft was designed to fill the performance gap between jets, which are too fast for most aspects of counterinsurgency warfare, and helicopters, which are too slow or vulnerable for many missions.

Painted Air Force gray, the first Bronco was flown by Maj. Gen. Thomas G. Corbin, SAWC Commander, and Capt. Gary Sheets. It was delivered to the 4410th Combat Crew Training Wing, USAF's first OV-10A Squadron. The Marine Corps's Bronco, painted light green and white, will be used in light armed reconnaissance, helicopter escort, and other missions. The Columbus, Ohio, Division of North American Rockwell expects to be producing ten aircraft a month for each service by this summer.



Since the *Pueblo* incident and the concurrent attempted assassination of South Korean President Park Chung Hee, the US is raising its annual military assistance to South Korea by \$100 million, bringing the total US military grant aid for Fiscal 1968 to \$640 million. Part of the additional money is expected to purchase a squadron of McDonnell Douglas F-4C Phantom jets to reinforce the Korean Air Force (ROKAF).

In his budget request to Congress early this year, President Johnson said the additional Korean aid funding was required for "the acquisition of aircraft and anti-aircraft equipment, naval radar, patrol craft, ammunition, and other supplies." Large-scale aid to South Korea will likely continue since 48,000 Korean troops are currently serving with American forces in Vietnam.

(Continued on following page)

(four) 1/4" BURST DISC RELIEF ASSEMBLIES

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At the time of the *Pueblo* seizure, South Korea had only 200 combat aircraft, including F-5 tactical fighters, F-86 interceptors and fighter-bombers, RF-86F reconnaissance aircraft, C-46 and Aero Commander transports with a few Chickasaw helicopters, and T-28 and T-33 trainers. North Korea, on the other hand, had twice as many combat aircraft, all Soviet-built and including modern MIG interceptors and fighter-bombers.

Most recent US aircraft deliveries to the ROKAF have been nearly fifty Northrop F-5 light strike fighters.

The F-4C is a sophisticated, multi-mission aircraft with a speed of Mach 2.5, range of more than 2,000 miles without refueling, and can carry Bullpups, Sidewinders, Sparrow IIIs, napalm, and can be fitted with 20-mm Gatling guns externally. F-4Cs have performed extensively in Southeast Asia both in close-support missions and against targets in North Vietnam.



A large manned space station carrying a mixed crew of scientist-astronauts and military men has been championed by many who see the duplication of manned stations by NASA and the Air Force only as a waste of time and money. As Senior Editor William Leavitt pointed out in this magazine last month, NASA's Orbital Workshop (worth nearly \$400 million) and USAF's Manned Orbiting Laboratory (for which \$600 million is being asked) are similar programs with similar capabilities to perform similar experiments. But NASA's Administrator James Webb has consistently pushed for separate programs and, presently, the Space Agency and the Pentagon are each proceeding with development of different workshops.

In early March, however, the Associated Press's Howard Benedict reported from Cape Kennedy that the two agencies are now studying the possibilities of partially merging their efforts, in utilizing the same hardware and eliminating two entirely different systems. This could mean that, by 1973, a manned orbiting space station could be launched by NASA's Saturn-5 booster and could accommodate as many as twelve men. Then, a ferry vehicle, launched by USAF's Titan III rocket, could rendezvous with the space laboratory, permitting change of crewmen, with some remaining in space for as long as a year.

While Administrator Webb conceded that NASA is "in close association with the scientists as well as the military authorities," he maintained that a com-

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on
your
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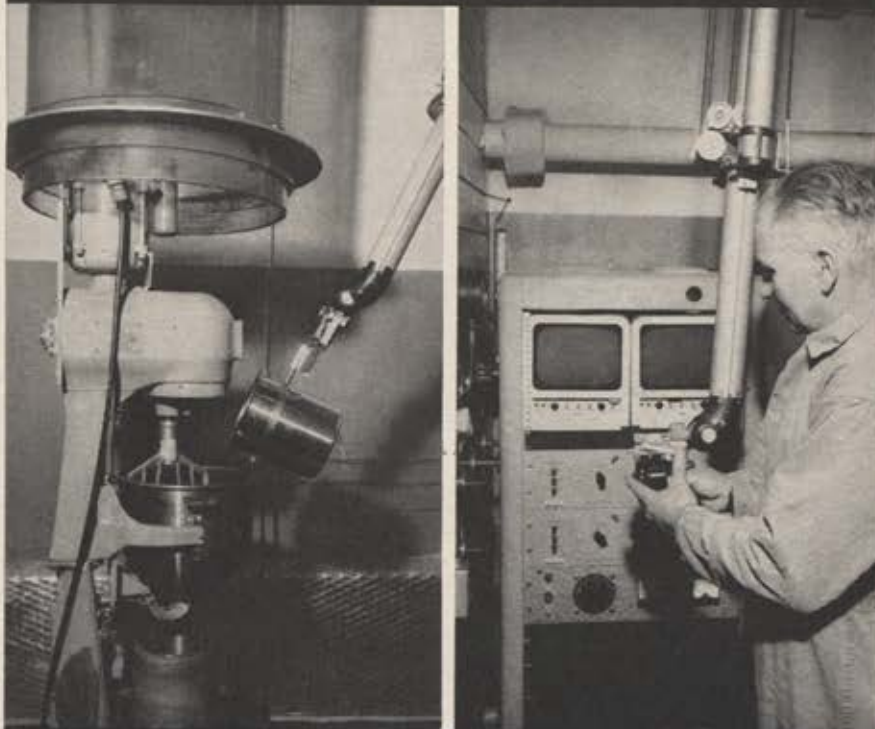
bined scientific-military crew may not prove feasible and continued to hold out for his own separate space station.



NEWS NOTES — Its first Zond space-probe satellite in two and a half years was launched by the Soviet Union in early March; the Soviets say the Zond-4 will study outlying regions of near-earth space. . . . While SAC's B-52 armed alert was being quietly eliminated, Dr. John S. Foster, DDR&E Director, announced DoD is considering the use of long-endurance Boeing 747s and eventually the new Lockheed C-5 (see page 97) in the airborne command post role. . . . NASA will use a mixture of nitrogen and oxygen, rather than pure oxygen, in Apollo spacecraft cabin during launch to reduce risk of fire. . . . F-111A tactical fighter-bombers will now get a chance to prove their superiority in Vietnam combat; six were to be deployed in mid-March to Thailand, from where they will conduct solo missions over the North.—END



Britain recaptured a bit of glory in mid-February when it successfully test-fired its first Polaris missile from the submerged submarine, HMS *Resolution*, thirty miles off Florida's coast. Britain will have four Polaris submarines by the early 1970s, under US-British sales agreement signed in 1963.



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Air missions go on night and day in Vietnam, without end. Mission follows mission, and aircraft answer the calls for help from ground troops as they are received, says AF/SD Associate Editor Allan Scholin, reporting from Vietnam. But the scope of a day in the air war in Vietnam is broad—from General Momyer's 5:00 p.m. planning session to night recon missions to the next day's series of air strikes, and finally to a Jolly Green Giant rescue . . .

No Beginning, No End— No 'Typical' Days

By Allan R. Scholin

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

THERE is no beginning or end to the day or the week in Vietnam. Operations continue around the clock, one mission taking up where another leaves off.

But, for purposes of this report, covering a series of events occurring in twenty-four hours of Air Force operations across Southeast Asia, a starting point might be the meeting Gen. William W. Momyer, Jr., Deputy for Air to the MACV Commander and Commander of the Seventh Air Force, holds at 5:00 p.m. each day with key staff members to go over the day's progress and plan the next day's work.

At that meeting, General Momyer issues instructions to guide his operations staff officers in drafting "frag" orders to all Air Force commanders in Vietnam and Thailand, specifying which targets are to be attacked and at what times, designating alternate targets if the primary ones are obscured by weather, allotting a portion of the fighter force to immediate requests for support from ground units who make contact with the enemy, and designating requirements for tankers, air rescue, and other support functions.

Early the following morning, General Momyer will again meet to review the day's operational program and to make needed adjustments. If the weather should break over Hanoi, more missions may be directed there, or, if the weather is impossible, missions fraggled for that target may be shifted elsewhere. Other changes are made to exploit ground advances or to blunt



AF/SD Associate Editor Allan R. Scholin left for Southeast Asia in mid-January to cover all aspects of the air war. Here he talks with F-4 pilot Capt. John P. Heffernan, USAF's only exchange officer aboard the *USS Enterprise*.

enemy thrusts, or to strike lucrative targets uncovered by air and ground reconnaissance.

There is no typical day in the air war in Southeast Asia. But the following random episodes I've discussed, observed, or participated in during more than a month in the theater may offer some indication of its scope.

• • •

As darkness falls in Southeast Asia, several species of Air Force night birds take to the air. One is the AC-47 Spooky, which rises from a dozen bases in South Vietnam to take up the close-support mission over known or anticipated combat zones when other tactical fighters have been bedded down. Spookies no longer fly during the day; with their limited speed and maneuverability, they prove too inviting a target. But at night in the South where enemy radar-guided anti-aircraft weapons are scarce, they are highly effective. Normally they fly six-hour missions. When a fire-fight is in progress, they land as often as they need to reload. In one particularly hot engagement, a Phu Cat-based AC-47, piloted by 1st Lt. Gary W. Jackson, fired 111,800 rounds of 7.62-mm ammunition in five turn-arounds.

• • •

Silhouetted in the banks of lights which enable maintenance and armament crews to work through the night, two two-man RF-4C crews, each wearing a holstered revolver on a bullet-studded pistol belt, and carrying a mass of other combat flight gear, climb into their reconnaissance aircraft at Udorn, Thailand, for a night photo mission over North Vietnam. The flight will take only two hours, but they have been preparing for it since noon. They have been assigned as

many as six targets to be photographed—a stretch of railroad leading into Hanoi from Red China, bomb-damage assessment of a bridge hit earlier in the day, a long-abandoned SAM site suspected of having been reactivated, truck traffic in the Mu Gia Pass, and potential troop and supply concentrations. Each requires detailed study of target folders, planning for the best approach and escape route, types of cameras to be employed, expected weather conditions, and a dozen other factors. The crews climb aboard, taxi out, and vanish into the black.

• • •

At regular intervals throughout the day and night, a C-130A, bristling with antennae, takes off from Udorn. This is the AB Triple C (Airborne Command and Control Center), code-named Hillsboro, one of which orbits over a central location where it can keep in contact with all US military aircraft and helicopters in the air. Hillsboro performs many functions, summoning FACs and fighter planes when ground forces need immediate support, coordinating rendezvous between tankers and thirsty fighters, logging fighters in as they head over the North and checking them off as they come out, overseeing search and rescue efforts, and in other ways acting as an extension of General Momyer's operations staff.

• • •

It is midnight, and in the inky sky above Hué a C-130 pilot responds to directions from a ground controller. It is raining, and the ceiling is barely 200 feet above the dimly lit runway. But the transport is carrying a cargo of Army vehicles and their drivers, *(Continued on following page)*



—Staff photo

McDonnell Douglas F-4 Phantom IIs head for North Vietnam almost every day from bases in Thailand at Ubol and Udorn. They perform bombing missions and fly MIG Cap for F-105s, protecting the heavily laden birds from sneak attacks by North Vietnamese MIG-17s and MIG-21s. The F-4 above is readied for such a mission. Located in Thailand, it already has two red stars painted on its fuselage, indicating two North Vietnamese MIGs killed in air-to-air engagements.



A B-52 Stratofortress at U Tapao Air Base on the Gulf of Thailand below Bangkok is readied for takeoff. The bombs it carries will likely be unloaded on North Vietnamese Army positions around Khe Sanh.

—Staff photo

urgently needed in mopping up operations now that the Marines and Army have succeeded in wresting control of the ancient capital from a stubborn enemy. Besides, this is barely the halfway point in the C-130 crew's all-night cargo schedule. But this crew won't complete its schedule tonight. Somehow, the plane drops from the clouds well short of the runway. Its tail snaps off as it hits a bunker and bounces high into the air. Beyond control now, it pancakes almost crosswise on the runway, skids to a stop with its nose pointed in the direction it had come, and bursts into flame. The flight crew, cut off from the cargo compartment by the mass of vehicles, scrambles through an overhead hatch to safety. The Army drivers and their vehicles are enveloped in the holocaust.

• • •

In the night, a few miles beyond the perimeter of Tan Son Nhut Air Base at Saigon, housing 55,000 USAF and Vietnamese Air Force personnel, what looks like a patch of earth is rolled back by Viet Cong guerrillas, exposing a 122-mm rocket on its launcher. Moments later the rocket shoots from the pit, directed at the scores of aircraft on the Tan Son Nhut flight line. The rocket misses its mark, landing harmlessly between the runways as well-bunkered sentries nearby crouch to escape the jagged steel fragments. (At another base, well to the north, other rockets rake a site where ammunition had been stored a month ago. The VC intelligence is faulty. Nothing is there now.) At Tan Son Nhut, the flash of the launch has been seen by an AC-47 gunship. But long before it arrives to stitch the area with 7.62-mm slugs, the Viet Cong crew had crawled deep into an underground shelter. By morning, when an armed patrol reaches the site, the enemy has gone.

• • •

You'd really have to be dead to the world to sleep through the early hours before dawn at U Tapao Air Base on the Gulf of Thailand below Bangkok. From here, B-52 bombers, their fuselage and wing mounts loaded with up to 60,000 pounds of high explosives, are lumbering down the longest runway in Southeast Asia, the noise of their eight jet engines reverberating among the surrounding hills as they take off to deliver a devastating pre-breakfast strike on North Vietnam.

ese Army positions around the US Marine base at Khe Sanh. They will be followed over the target by another force of B-52s nearing the end of their 2,000-mile flight from Guam, and at intervals throughout the day by more Stratoforts from both bases. In a twenty-four-hour period, ground crews will pour a million gallons of jet fuel into the B-52s and KC-135 tankers operating from U Tapao. As soon as the bombers return, armament crews will roll up with racks of bombs to ready the planes for another mission.

• • •

At 5:00 a.m. the alarm goes off in the trailer of Col. Paul P. Douglas, Jr., Commander of the 388th Tactical Fighter Wing at Korat, Thailand. I join him there, heating water for instant coffee as he hastily dons his flight suit. Then, after a few sips, we go out, past the blue-and-white sign that says "President Lyndon B. Johnson slept here Dec. 23, 1967," and drive off in



—Staff photo

Ground-crew personnel load a B-52 at U Tapao Air Base, Thailand, with the 60,000 pounds of high explosives its wing mounts and fuselage will carry prior to a mission.

Just before takeoff one ground crewman pulls pins from bombload of an F-105, while another removes nosewheel block at Korat, Thailand, where 388th Tactical Fighter Wing is stationed.



—Staff photo

his staff car. Our destination is the flight line, where he slowly cruises between the lines of revetments, watching his pilots and crew chiefs as they preflight their F-105 Thunderchiefs. At the far end we wait as, one after another, the Thuds start their engines and taxi out. We follow them to the arming area at the end of the runway, where ground crews wearing noise suppressors over their ears pull the pins to arm the bombs and check each plane for hydraulic or fuel leaks, worn or cut tires, and other possible flaws. In the din, we put on noise suppressors too. One by one, ground crews give pilots the thumbs-up signal. So does a chaplain, standing with the armament men, seeing each mission off.

Orange is tinting the horizon as the four-plane flight lines up abreast on the runway. Even with noise suppressors, the sound is deafening as all four pilots run engines up to full power. Then No. 1 starts to roll with a sharp explosion that vibrates the car as he lights his afterburner. At fifteen-second intervals the others follow. By now a second flight has reached the arming area, soon followed by a third, and a fourth. The day's bombing of targets deep in North Vietnam is under way. Colonel Douglas swings the car around and we head to the club for breakfast.

• • •

Orbiting at 1,500 feet in an O-1F Bird Dog over the hills northeast of Kontum, Capt. Barry Bielinski, a Forward Air Controller (FAC), talks with Gulf Six, the commander of G Company, in a well-bunkered position below. "Just beyond the major terrain feature at 838537," says Gulf Six (the figures denoting a point within grid squares on Captain Bielinski's map), "there's a saddle between two hills and a draw running down to the southeast. I'd like you to put the strikes in there, starting at the top of the draw and running down to the bottom."

I can't see any "major terrain feature," only a series of hills and ravines, but Captain Bielinski has apparently fixed the location. To establish it beyond any doubt he asks Gulf Six to mark his position with colored smoke.

In a few moments we see a bright red plume rise from the trees.

"I see red smoke," says Captain Bielinski, and Gulf

Six confirms that that's the color he used. Switching to UHF, the Captain talks to Devil 71, leader of a three-plane F-100 flight overhead.

"Marking target," he says, and as he swings the O-1 into a shallow dive he fires a smoke rocket from his wing racks. Seconds after we bank to the left, a blast obliterates his smoke marker and Devil 71 pulls out of his dive.

"That's fine," says Captain Bielinski. "Now ten meters to the left and below that one." An iridescent sparkle shows through the trees as the second F-100 delivers his bomb.

Gulf Six comes back on. "I can't see where they're hitting from my position," he says, "but from the sound I'd say they're right on the money."

The third F-100 rolls in, hitting just below the other two. Then all three hit the draw again, this time with napalm, and in a third pass strafe the area with 20-mm cannon.

"That's all we have," says Devil 71.

We fly low over the draw, as Captain Bielinski assesses the effect of the strikes. "One hundred, one hundred," he tells Devil 71. "One secondary. No KBA observed."

All strikes have been on target, he's saying, causing one secondary explosion, but in the dense foliage he can spot no enemy casualties. Gulf Six will report KBAs later when his company advances into the strike area. Captain Bielinski acknowledges a thank-you from Gulf Six, bids Devil 71 good day, and we move on to another target.

• • •

At Pleiku, I meet Maj. Ronald Bond, commander of the Cessna A-37 Dragon unit. He explains he's on alert, but offers to show me around the flight line and describe his plane's characteristics. He brings along his flight gear, just in case. Sometime later, I've just about exhausted my questions when a crew chief runs up, shouting that Major Bond and his wingman are to scramble immediately.

Within thirty seconds, Major Bond is strapped in his plane, engine started, and he wheels out onto the taxiway. Halfway down, he swings onto the runway and is gone. An hour and a half later, as I'm finishing

(Continued on following page)

THE AIR WAR IN VIETNAM

a cheeseburger at the club, Major Bond walks in for lunch.

"Had a very good mission," he reports. "Friendlies were entirely surrounded by VC. We dropped within fifteen meters, and sprang them loose."

That night I was rolling for beers with a group of FACs. One happened to mention a particularly satisfying strike he had directed that day.

"The friendlies were entirely surrounded," he said. "They were even asking for artillery to be fired into their position. I called for fighters and two Dragons showed up within a few minutes. They zapped the VC only a few meters from our Grunts [Army troops] and broke up the attack."

The time, I found, coincided with Major Bond's scramble and I told the FAC so. "I've got to find that man," the FAC said. "That was the best strike I've seen in a long time. The ground commander said there's no question he saved their lives. Let's go find Major Bond."

• • •

On an average day, 1,500 US servicemen complete their year's duty in Vietnam and depart for the States. Another 1,500 arrive to replace them. Four times that many, or about 6,000, will be heading for, or returning from, R&R (rest and recreation) in more peaceful surroundings from Hawaii to Sydney, Australia.

Aside from these travelers, many other personnel are going from one base to another in Southeast Asia—including more than 500 newsmen, photographers, and radio-TV commentators. Surface travel in Vietnam is almost nonexistent. Since everyone goes by air, the passenger terminal at every major base is always crowded. Those on R&R or en route home will travel in jet transports operated by commercial air carriers under contract to the Military Airlift Command.

But in-country travel is entirely handled by tactical airlift—C-130 Herks, C-123 Providers, and C-7A Caribou. The C-123 and C-7 spend every day hauling men and cargo in and out of innumerable strips, but they usually come to rest somewhere at night. The C-130s,

which can land with a 40,000-pound cargo in narrow strips less than 3,000 feet long, handle the major share of in-country transport, and keep going around the clock. Tactical airlift crews seldom merit more than a sentence or two in the Seventh Air Force daily mission summary, but they have taken their share of losses and, considering that they, more than any other Air Force element, are absolutely indispensable to the war effort, they've received somewhat less than their share of medals.

• • •

First Lt. Stephen L. Amdor won three letters as full-back for the US Air Force Academy before he graduated in 1965. Today he is flying No. 4 in a four-plane F-100 flight from Phu Cat, being directed by an O-2 FAC on a road-cutting mission. Lieutenant Amdor sees the road below, snaking through hilly terrain. The FAC wants the flight to hit it at a switchback. If they can hit it just right, he thinks, the entire road-bed will drop into the valley, and it will be days before a new road can be cut into the hillside. Lieutenant Amdor can see that. He can also see the flak sites protecting this vulnerable stretch of road. As the last man down the chute, he knows he will draw the most enemy fire. The gunners may keep their heads down for the others, but as he goes by they'll come up shooting. Worse yet, the location of the switchback and the surrounding hills offers only a narrow choice in direction of attack. All four will have to come in almost in trail.

The FAC clears them to attack and No. 1 rolls in, with the others just behind. Bringing up the rear, Lieutenant Amdor sideslips and jerks the stick up and down. For an instant he straightens out as his pipper zeroes on the target and he triggers his bombs. Then he is jinking again for all he's worth as flak explodes all around.

"Nice job," says the FAC. Lieutenant Amdor looks over his shoulder. The switchback has disappeared. He is surprised to find the plane responding to his controls.

"I thought they were going to get your No. 4," the



—Staff photo

Cessna A-37s, such as the one above, perform close-support missions in the South. A relatively new addition in the war, they are on call for ground troops in contact with enemy.



—Staff photo

Although larger C-130s are performing a large share of the tactical airlift mission, C-123s, such as the one above, are still essential where only very short strips are available.

FAC adds. "They really unloaded on him." "No sweat," says Lieutenant Amdor.

A pair of MIG-21s from North Vietnam and four F-4Ds from the 8th Tactical Fighter Wing at Ubon, Thailand, are playing a game of yo-yo northeast of Hanoi. The Phantoms have flown MIG Cap for a flight of F-105s which have now completed their run and are out over the water on their way home.

Radar reports the MIGs approaching at a distance of fifty miles. The Phantoms move toward them, missiles armed, their nose radar, capable of picking up the MIGs at a distance up to thirty miles, scanning in a 120-degree arc.

As the gap between the two elements narrows, the MIGs turn back toward Hanoi. They're trying to lure the Phantoms into SAM range, but the Phantoms turn away. Back come the MIGs, and the Phantoms swing around to meet them. Again the routine is repeated.

But now the MIGs, apparently low on fuel, are exiting to the north, but not toward Hanoi. The Phantoms give chase, closing steadily. The enemy pilots seem unaware they're being followed, apparently assuming the Phantoms had departed.

As soon as the F-4s are within range, Phantom Lead and No. 3 fire their Sparrows. One explodes right at the tailpipe of the rear MIG. The other MIG breaks and streaks away, but the plane that was hit goes into a spin. The Phantom pilots look for a chute. There is none.

The tedium of an HH-53 Super Jolly Green Giant crew on ground alert at a forward operating site is broken by a curt radio call. A fighter pilot has ejected from his crippled plane and is down in the wooded hills west of Hanoi. Even as the four-man crew runs for the chopper, a pair of Sandies—A-1E escorts—are taking off from Udorn to meet the HH-53, along with Crown, an HC-130H which not only refuels the HH-53 (and its older brother, the HH-3E), but coordinates all rescue activity at the scene. Other members of the downed pilot's flight are flying Rescue Cap, or Res-



In the USAF photo above, an HC-130P refuels an HH-3E Jolly Green Giant over Vietnam as four A-1 Skyraiders loiter overhead, a sight typical on long-range rescue missions.

Cap, marking the pilot's position and covering him from possible enemy captors.

The Sandies move in first. It's their job to find and positively identify the pilot on the ground before leading the Super Jollies in to make the pickup. No rescue helicopters may operate in the North without the Sandies.

With one Jolly Green hovering out of range of ground fire, the other moves in. If it's met with fire, it withdraws while the Sandies—aided by the Res-Cap crews, if necessary—stifle the enemy guns. Often the pilot may have been injured in ejecting, and the red-bereted pararescueman in the crew is lowered to administer first aid and help him to the rescue hoist.

This is a critical moment, for if the enemy has been holding its fire and opens up now, the Jolly Green may have to withdraw until the Sandies work over the area again. Today's downed pilot is lucky. The Super Jolly lowers its hoist. He hops on and is lifted aboard as the entire gaggle—ResCap, Sandies, Jolly Greens, and Crown—heads for home.

At his Tan Son Nhut headquarters, General Momyer has just returned from the Command Post where he followed every phase of the rescue effort. The rescue of a downed aircrew takes priority over any other Air Force mission in Southeast Asia among air elements which can contribute to the task. Whenever possible, General Momyer himself calls the shots, diverting crews from other assignments, ordering a follow-up search if the crew has not been found, and staying on top of the matter until the rescue is accomplished, or no further hope remains for recovery.

But now it's 5:00 p.m. and time to plan the next day's missions.—END



—Staff photo

Flying Forward Air Controllers (FACs) are still an important part of the in-country war, locating the enemy and directing strikes in O-1s or newer Cessna O-2s such as above.

History is replete with examples of nations that were led to disaster because their leaders did not establish realistic priorities for critical international and domestic problems, this author contends. Faced with domestic racial dissent, problems with the NATO alliance, a Soviet Union that is talking peace while increasing her strategic power and her influence all over the world, the US must take a penetrating look at her position in Vietnam and see if, despite the repercussions, it would not be better, perhaps absolutely necessary, to take drastic military measures, such as an invasion of the North, to bring that war to an early victory . . .

Debacle Road

By William R. Kintner

DEPUTY DIRECTOR, FOREIGN POLICY RESEARCH INSTITUTE, UNIVERSITY OF PENNSYLVANIA

DIRECTLY or indirectly, the Russian bear, the Chinese dragon, and the American eagle are locked in a struggle over the future of Vietnam that may shape the future of the world for generations to come.

Until quite recently, the United States has stressed the local nature of the conflict. Subsequently, US officials argued that we were fighting in Vietnam to defend our national interests against the expansionist designs of Communist China. With great reluctance, Washington began to concede that the Soviet Union was aiding Hanoi—but solely to thwart Peking's challenge to world leadership of the Communist revolutionary movement. The United States has asked the Soviets to help bring Ho Chi Minh to the negotiating table. We begged Moscow to ask North Korea to return the *Pueblo* after this United States ship had been seized in one of history's most flagrant examples of international piracy. Despite the failure of repeated US entreaties to Moscow, the United States appears to view the Soviet Union as a mellowing opponent on the verge of becoming a trustworthy friend.

American blindness as to the conflicting purposes of Soviet and Chinese Communist foreign policy may be leading us into a strategic trap from which escape will be difficult—if not impossible.

The idea that the Soviet Union views with satisfaction the American involvement in Vietnam, and elsewhere in Asia, has little currency in Washington. The coexistence strategy initiated by Khrushchev in the mid-1950s has been far more successful than the leaders of the Kremlin ever anticipated. The Sino-Soviet split, by creating the image of a moderate Soviet Union opposing the hard-line Communists of China, has reinforced Moscow's claim to the mantle of peace. Under the cover of peaceful coexistence, the Soviets have made considerable progress toward attaining their interrelated goals—disintegration of NATO, penetration

of the Middle East, and their quest for strategic superiority. Their progress has been aided by the magnitude of US involvement in Vietnam.

Soviet penetration of the Middle East already threatens to upset the delicate balance of power in that volatile region. Documents captured in the 1967 Israeli-Arab war revealed direct and indirect Soviet participation in that conflict. Since then, many of the Arab governments have become more dependent on the Soviet Union for military assistance. The Soviets appear to be displacing Egypt in Yemen. In late 1967, the Soviets sent MIG-19s to aid the Republican forces there, and with them came ground crews, pilots, and supporting equipment. Soviet pilots have raided Royalist positions. The newly independent South Yemen Peoples Republic, formerly Aden, is ripe for takeover. By moving into these countries, the Soviets could gain control of the Red Sea outlet to the Indian Ocean. The Soviet buildup of naval power in the Eastern Mediterranean Sea is a matter of public record.

Soviet inroads into the oil-rich Middle East are bound to have repercussions on energy-hungry Western Europe. Meanwhile, the erosion of Western concern about the Soviet threat is bringing about decreasing commitments to NATO. The widespread belief that the Soviet Union is mellowing and becoming more liberal has helped to remove the specter of a Soviet threat against Western Europe. The Sino-Soviet dispute creates the impression that Moscow is no longer interested in expanding Soviet influence westward. There is a deep-rooted psychological fear of China in the minds of the Russian people. But until China acquires modern weapons on a massive scale, the chances of overt hostilities developing between the Soviet Union and Communist China are quite remote.

The growing US involvement in Asia has abetted the Soviet Union. The US position in the strategically more vital areas of Western Europe and the Middle

East has weakened, and Chinese concern with the US presence in Korea, Vietnam, and Thailand reduces their ability to stir up trouble along the 4,000-mile Sino-Soviet border. Neither Peking nor Moscow, however, is anxious to help the United States escape from its Vietnamese dilemma. In fact, despite the Sino-Soviet dispute, Peking and Moscow have cooperated in their support of Hanoi.

Each big Communist power keeps a careful eye on its ideological and "nationalistic" rival, while conducting its sometimes competitive, sometimes complementary, drive to undermine the power and influence of the United States. Although the Soviets and Chinese both focus their hostility on the United States, the timing of their strategies is basically different. To put it simply: The Chinese can afford to wait. Meanwhile, the Chinese Communists must cope with the chaos of the self-imposed cultural revolution as well as the inevitable ending of Mao's dynasty. The Chinese Communists have proclaimed their doctrine of "Peoples' War" and have backed insurgencies in several countries of Southeast Asia, although suffering a disastrous setback in Indonesia. Their attitude toward the United States is almost paranoid, but their capacity to influence events outside their immediate frontiers will be limited throughout the next decade. The Chinese are a proud, homogeneous, and xenophobic people who, over time, may, and probably will, present a tremendous challenge to both the United States and the Soviet Union. But for some years to come, Chinese verbal belligerency will far exceed their military capacity.

Nevertheless, United States officials have consistently portrayed Communist China, rather than the Soviet Union, as the main supporter of the North Vietnamese campaign. For example, the January 1968 issue of the *Reader's Digest* carried an interview with Adm. U. S. G. Sharp entitled, "Stand Firm in Vietnam!" This article, which aimed to justify US policy toward Vietnam, repeatedly stressed the Chinese Communist role in that conflict but never once mentioned the Soviet Union.

For several years, US policy-makers have chosen to view the conflict in Vietnam as a local affair in which kindly Uncle Sam was concerned solely with preserving freedom and democracy for the Vietnamese living south of the seventeenth parallel. Only recently has it been suggested that America is in Vietnam to defend

its own self-interest. Yet the State Department has, for the most part, soft-pedaled Soviet support of Ho Chi Minh. And both the State Department and the Pentagon appeared to be mystified by Communist dialectical strategy and tactics. We, of course, cannot know what circumstances will induce Ho Chi Minh to negotiate. But unless the United States adjusts its conduct of the war in Vietnam to the realities of the global balance of power, it may win, at best, a Pyrrhic victory in that war-torn land.

The war in Vietnam has managed to upstage items on the American agenda which are intrinsically more important to this nation's future. Yet the very extent of the American commitment in Vietnam will make the outcome of the struggle there a vital factor in our ability to deal with fundamentally more crucial issues.

The United States is faced by five simultaneous problems, any one of which could swell to crisis proportion. These problems are:

- The war in Vietnam—a test of our power to contain communism in Asia.
- The Soviet challenge to US strategic superiority.
- The deterioration of the NATO Alliance.
- The prospect of renewed conflict in the Middle East.

- The social and racial unrest in the United States.

It is conceivable that some of these problems, four external and one internal, could peak simultaneously.

The United States presumably has enough will, wit, and means to deal with these problems, yet unless these resources are managed prudently they may be stretched beyond their limits.

Above all else, a sound national policy requires sound ordering of allocations and priorities to critical problems relating to national security and domestic stability. For the more time-urgent problems, resources must be applied more rapidly than for problems which can be dealt with at a more leisurely pace.

History is replete with examples of nations whose leaders failed to establish proper priority and in consequence led their peoples to disaster. The case of the Athenians in the Peloponnesian War is uniquely illustrative. In 414 B.C., during the midst of a long struggle against Sparta, the Athenians unwisely embarked upon a diversionary campaign against Syracuse, the largest city in Sicily. Not only did the Athenians commit their army in that remote and unnecessary encounter but they lost their priceless advantage—naval superiority.

General Gylippus of Syracuse described the import of this development: "When men are once checked in what they consider their special excellence, their whole opinion of themselves suffers more than if they had not at first believed in their superiority, the unexpected shock to their pride causing them to give way more than their real strength warrants; and this is probably now the case with the Athenians."^{*}

The Soviets know that Western cohesion weakens in an atmosphere of peaceful coexistence and détente. The presence of a bellicose Communist China on the world stage may even strengthen the belief of many Westerners that the Kremlin worries far more about im-

(Continued on following page)

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^{*}Britannica Great Books, No. 6, University of Chicago, 1957, Thucydides, *The Peloponnesian War*, p. 526.



The Soviet antimissile defense system may include rockets like these, the main purpose of which, according to the Russian Novosti Press Agency, is to "destroy objects of the enemy from any direction, which makes them practical and indispensable in antirocket attacks." The author estimates that USSR is as much as four or five years ahead of the US in the deployment of an ABM system.

—Novosti Press Agency

proving the Soviet economy and reducing world tensions than about world revolution. This, in fact, is what many Western officials in Washington and elsewhere appear to believe today.

The precondition for ultimate Soviet success in the dual struggle with the United States, the leader of the West, and Communist China, the Soviet's rival for leadership of the world Communist movement, is more adequate military power. Now and for the near future, the Soviet Union is vastly superior to Communist China in almost every attribute of power. Over the past several years the Soviet Union has rapidly narrowed the strategic gap between itself and the United States. It doubled its ICBM force last year and is as much as four to five years ahead of the United States in the deployment of an ABM system. The total Soviet defense budget is well above \$50 billion in ruble equivalents. The Soviet R&D budget has already surpassed that of the United States. Soviet expenditures for offensive strategic forces have been approximately double those of the United States for the past four years. Because of the lead-time problem, the United States may be approaching a strategic crossover—in which the net strategic advantage will pass to the Soviet Union. The Defense Department, of course, denies this possibility.

Concurrently, the rapid development of Soviet naval power and the extensive deployment of Soviet fleets in both the Mediterranean and the North Sea is undermining US influence in NATO's northern and southern flanks.

With respect to these five critical problems, the present priority of US resource allocation appears to be: first, the war in Vietnam; second, strategic forces; third, US commitment to NATO; fourth, the triservice general-purpose reserve earmarked for employment in the Middle East or elsewhere; and fifth, the social and racial crisis at home.

The most vital question is whether the specific effort we are now making in Vietnam is out of proportion to the importance of this issue? US decision-makers must ask whether a sober analysis of the American situation

might not indicate a different set of priorities. The maintenance of strategic superiority and an adequate response to the domestic social crisis would appear to be the two most important issues now facing the United States. If the United States should lose strategic superiority, our ability to solve any of the other problems would evaporate and the American opportunity to contribute to a more stable world order would disappear.

At the same time, if the Black Power revolution accelerates and the United States experiences three, four, or five more Detroits this summer, the internal fabric of this country could be rent beyond repair. Furthermore, the evidence is mounting that the Black Power revolution is in part fueled by advice and resources supplied by America's principal antagonists. For example, Carl Rowan, the well-known Negro journalist, reported that the Chinese Communist government gave RAM (Revolutionary Action Movement)

(Continued on page 57)



—Wide World Photos

Black Power advocates may set off more riots requiring troops like these in Detroit during last summer's unrest.



CAT III at Sea



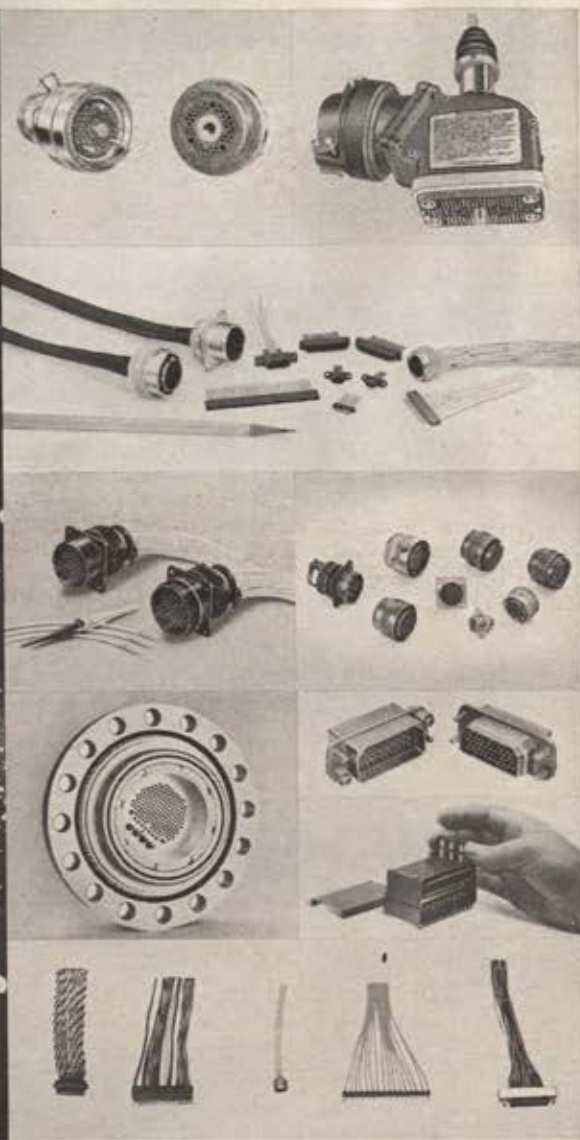
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Bombing Red River dike system is one proposal for ending war in Vietnam. This would flood river valley, shown above, cutting off major North Vietnam rice supply. Here, bombs from USAF F-105s are cutting a railroad and highway.

\$1 million for disruptive work in the Philadelphia area.

The next set of priorities should be US relations with its NATO allies and development of policies to prevent another conflict in the Middle East. NATO and the Middle East are integrally related. If the United States could not support Israel in a future conflict, either by policy choice or because of the erosion of the strategic superiority or the lack of adequate conventional forces, the Soviet Union would gain a dominant position in the Middle East. Such a disaster would probably drive the last nail into NATO's coffin. Conversely, if NATO continues to disintegrate, the ability of the United States to support Western interests in the Middle East, under any conditions, would be sharply reduced.

The war in Vietnam should weigh most lightly on this priority scale of America's problems. Nevertheless, it is important because our commitment has made it important. It represents an American response to a challenge made by North Vietnam—one that is supported by both the Soviet Union and Communist China. It is difficult, however, to imagine a more strategically unrewarding locale for indirect strategic confrontation between the United States and the Soviet Union. Even if the United States "wins" and achieves a negotiated settlement that would not be recognized as a defeat, we will not have done much more than stabilize the *status quo* of Southeast Asia. This is, of course, important, but it is perhaps less important than stabilizing the *status quo* in the Middle East and maintaining the integrity of our position in Western Europe. Likewise, the cost-exchange ratio of our endeavor in Vietnam

compared to that of the Soviet Union is immensely unfavorable, *i.e.*, 30 to 1 in favor of the Soviets. To put it differently, as Vietnam forces the US to spend some \$30 billion dollars annually on conventional warfare, it becomes easier for the Soviet Union to improve the relative status of its strategic forces.

The continuation of "measured response" in Vietnam will get us nowhere. As long as General Giap retains the initiative, the prospect of "victory" is still far in the future. The United States, which enjoys immense technical superiority, now bears the principal brunt of the battle. Under present procedures, the cost of liquidating a single Viet Cong has reached astronomical figures. The war has become, for all intents and purposes, an American war, rather than a war in which we support an Asian ally in his efforts to defend himself against outside interference.

No American could wish anything better than the fastest termination of this conflict. Yet suppose the present US high-commitment strategy does not succeed prior to the 1968 elections?

Our choice is an offensive that will bring an early victory, or withdrawal. Two proposals merit serious consideration. One is to strike the Red River dike system, which cradles North Vietnam's rice supply. "Attack or even the threat of attack on these water systems could measure the war's duration in months instead of years, since it would simultaneously limit internal distribution of the now vital food imports from Red China and the Soviet Union."^{*}

Another alternative is to invade the North, cutting North Vietnam's narrow waist at Vinh. This would block access through the mountains into Laos. This would require a coordinated land-sea-air campaign but would create a battlefield of our own choosing which could force the war to a quick conclusion. In view of the present confusion in China and the current weakness of the People's Liberation Army, the entry of Chinese Communists into the conflict appears most unlikely.

No matter when the conflict ends, an American presence of some size would have to remain in Vietnam. Early ending of the conflict, however, would permit bringing back 300,000 US servicemen; the retention of many of them in operational units would permit the general-purpose reserve to be reactivated with very little additional cost.

Our problems with NATO fortunately do not involve considerable resources, but they do require a reorientation of our policy. Presently, the main thrust of US global policy can be characterized as the pursuit of a *détente* with the Soviet Union, above all other considerations. Our frantic efforts to obtain a nuclear antiproliferation treaty in Europe reflect this policy. Let us henceforth change US policy to a willingness to *search* for a *détente* with the Soviet Union and to be responsive to genuine Soviet initiatives that might lead to a *détente*. This policy change would permit us to place the integrity of the NATO Alliance

(Continued on following page)

^{*}Norborne T. M. Robinson, III, *Washington Report*, February 19, 1968.



Soviet influence in the Middle East is growing fast, although it received a setback as a result of the dazzling success of Israel over the Russian-equipped and -trained Arabs last June. At left, Egyptians flying Russian MIGs attack an Israeli force. Few of the Arab aircraft survived after the Israeli surprise air attack that destroyed most equipment on the ground.

—Wide World Photos

ahead of our unilateral efforts to deal with the Soviet Union. Likewise, a more precise US awareness of Soviet ambitions in the Middle East may be all that is required to keep the lid on the pot in that seething region. At the same time, the planned British withdrawal from east of Suez, accompanied by the Soviet buildup of naval power in the Mediterranean, may require increased US commitments in the Middle East.

The early termination of the war in Vietnam would free funds needed to meet other pressing problems, particularly the maintenance of strategic superiority and the Black Power revolution.

The Black Power revolution, no matter how serious it may be, relates primarily to a relatively small group of the militants who cannot be appeased by any allocation of funds that is now "possible." Consequently, priorities would have to be established between incentives for Negro participation, such as improved housing and education, and disincentives such as deterring those members of the Negro community who have become alienated from the social order and seek to overthrow rather than renovate it. The effective use of police powers is imperative, not simply increases in welfare budgets, if further "Detroit" are to be avoided next summer and the following five to ten summers.

The zeal, ambition, and motives of the revolutionaries are such that sensible, well-managed improvement programs will not satisfy them. Without vigorous law enforcement (and this is chiefly a political matter, not a fiscal one) it's not even technically feasible to pour enough into the ghettos to head off riots and revolts. Yet the urgent problems of the Negro ghettos—housing, health, jobs, education, and training (which Black Power militants exploit)—require far larger-scale funds and investments from both the public and private sectors. Even though eliminating the ghettos is a long-range job, which will take a minimum of five to ten years to make substantial progress, we need to address this problem now with far greater resources. Only then can the Black Power revolution be derailed.

Concerning external challenges elsewhere than in Asia, the root question is whether the priority maintenance of strategic superiority, preserving the NATO Alliance, and safeguarding the Middle East are largely,

though not exclusively, matters of policy choice. Our response to these issues may reflect decision-making assumptions about Soviet intentions, not options dictated primarily by availability of funds. Many Americans are beginning to wonder why we build bridges to Moscow when Soviet SAMs are killing US airmen in Vietnam.

It was difficult to discern any meaningful set of priorities in the President's 1968 State of the Union message. Vietnam received top billing—and some increase in funds. The war on crime and the war on poverty were scored as the major domestic problems—and a modest increase in funds was pledged to deal with these issues. The NATO alliance was not even mentioned. The nations of the Middle East were told that they had "the opportunity—and the responsibility—to find the terms of living together in stable peace and dignity." The massive Soviet intervention in the Middle East, calculated to prevent this development, was patently ignored. Instead, various détente measures, particularly the nuclear antiproliferation treaty, were stressed. Unlike last year, there was no reference to Soviet developments in strategic weapons. Although progress has been made in improving our relations with the Soviet Union, "we must," nevertheless, "maintain a military force capable of deterring any threat to our nation's security, whatever the mode of aggression."

Although the President conceded that "our country is challenged, at home and abroad," the means chosen to meet these challenges do not appear to be proportionate to their intrinsic severity.

Two choices must be made before the United States can support a more valid set of priorities. One is to change our fallacious assumptions about the ambitions of our principal adversary in the global confrontation—the Soviet Union—and to introduce an austerity program at home. The other is to replace "measured response" in Vietnam with initiatives designed to bring the war to an early conclusion. Time is of the essence, for unless this country can soon establish those sound priorities for action which will best ensure domestic tranquillity and provide for the common defense, it may already be far on the way to "Debate Road."—END



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Reacting against the inflexibility of the "massive-retaliation" strategy of the Eisenhower-Dulles era, important military thinkers became advocates of limited-war concepts which have been put into practice during the Kennedy and Johnson Administrations. But there seem to have been some drastic miscalculations in applying this strategy to Vietnam and, as a result, we have reached a point where a general pullback seems our only unsatisfactory alternative . . .

Vietnam: Limited-War Strategy at a Dead End?

By Mark E. Swenson

It may well be that a limited conflict on the Korean scale will never happen again.

—David Rees, *Korea: The Limited War*

IN VIETNAM, there is now little question but that the United States has become locked in an unfortunate and ironic war—a conflict that is getting larger in scope with mounting casualties. It is unfortunate and tragic because of the human, material, and spiritual cost. It is ironic because our involvement has been brought about and enlarged by advocates of a strategy that was allegedly devised to foster a successful conclusion to just such a war as Vietnam. Paradoxically, this strategy has led the United States—the most powerful nation in world history—into a strategic dead end, a sinkhole without bottom.

The shadow of Korea lies over our Vietnam policy, for the festering legacy of the Korean War has never been reconciled in the American mind. The Korean limited war demonstrated how difficult it is for Western democratic governments to apply limited force as an instrument of foreign policy. Here was a modern American war that was not fought as a crusade, and the American public reacted with hostility. As a Western nation heavily influenced by the Judeo-Christian ethic, the Enlightenment, and Liberalism, American public opinion historically has supported only those conflicts fought in the so-called "absolutist tradition" for a clear and overpowering military victory.

The important thing to remember is that the Korean War never resolved the historic dilemma of the American presidency—that of reconciling foreign policy with

public opinion. Of course, one of the marked differences between Korea and Vietnam was that in Korea we were at least supporting a government of some strength and cohesion with a "father" figure of historical importance in Syngman Rhee. And we were not unilaterally involved. We had the blessing of the United Nations and a broader base of allied support.

The roots of the US strategy for Vietnam took hold in the reaction to the Eisenhower-Dulles defense policy of the 1950s. Revolted by "massive retaliation," important military men like Generals Maxwell Taylor and James Gavin and an entire coterie of civilian defense intellectuals became firm advocates of limited-war concepts. The accession to political power of the Kennedy Administration formalized this shift and in fact institutionalized the power of the limited-war school. As Bernard Brodie has observed, "Both the new President and his Secretary of Defense were enamored of the idea." Thus, national strategy shifted to flexible response; General Maxwell Taylor was brought out of "retirement"; General Gavin came back on the active scene; books supporting the limited-war philosophy and downgrading the political efficacy of strategic nuclear power appeared in droves; and the defense intellectuals began to run the Pentagon.

The result of this drastic reorientation has been a disaster for our strategy in Vietnam. It now seems that most of the scenarios on limited, conventional war played out in US think tanks during the past decade have proved to be as inappropriate and irrelevant to our predicament in Vietnam as are the scenarios now being tilted over relating to all kinds of unlikely inter-

national situations in the year 2000. The seers were proved wrong on all counts that mattered: As it turned out, we were not backing a strong government with a hold on its people; the enemy, and not we, retained freedom of movement and the ability to escalate or de-escalate; and we have no conception or understanding of the enemy's operational code with its strong emphasis on the political continuum. In Vietnam, the "B" of reality does not seem to follow the "A" of the scenario.

To say that we were better prepared militarily for Vietnam than for Korea is surely not saying much. Psychologically, it can be argued that we were even more ill-prepared for Vietnam than for Korea. At least in Korea the stark thrust of the aggression was clear-cut, thereby giving hope that the war would be backed strongly by the American public. Here again, little theoretical thought was given to the possibility that the US public might not support a prolonged limited war. How much plausibility was given to the idea that a substantial portion of the American public would not only refuse to support the war, but would in fact vociferously oppose it?

The fact is that the US is not geared—has not been prepared despite all the theorizing about conventional war—militarily or psychologically to fight this war. We have been taken in by the miasma of the necessity to fight a conventional war. And, in many respects, of course, Vietnam is anything but a conventional war. We have been lashed down by the fear of having possibly to confront China and perhaps Russia, and by the pervasive influence of the limited-war school.

Having misread South Vietnam's ability to help itself, we compounded the error by applying the unsound strategy of gradualism, *i.e.*, flexible response. We stretched ourselves thin and attempted to interdict and harass the enemy from north to south and at the same time to pacify the countryside with only a modicum of the troops we really needed. In the meantime, General Giap has retained the rhythm of his classic strategy—hitting here, feinting there, and all the time building up, all the time realizing the twin allied vulnerability in the cities and in the isolated outposts. At the same time, gradualism infected the air war as we hit one target today, another tomorrow, without really conducting a sustained air offensive against the enemy's transportation, communications, and government controls.

Inhibited almost fatally by geography from the start—another critical point often forgotten in scenarios—we have not hit the enemy's one big port which supplies him with tens of thousands of tons of heavy, modern equipment. And we have seen him unload materiel at ports in Cambodia, truck it over a highway built with American funds, infiltrate it to South Vietnam, and then use it against us while we are powerless to do anything about it. Indeed, in late February, the US spotted enemy truck convoys moving materiel right up to Cambodia's border with South Vietnam! There is hardly a historical parallel for the Cambodian hypocrisy.

Too, our attempt to fathom the enemy has, as expected, run afoul of our penchant to read everything as if all is based on the Western experience and tra-

ditions of reason, common sense, and basic morality. No greater mistake could be made. For the enemy does not see war and peace as two mutually exclusive states of affairs. To him, war and peace are relative terms and the continuum is recognized with struggle as an accepted state of politics. The Communists believe in the supremacy of political considerations combined with rare skill in applying force to advance their long-term objectives. It is a vast mistake to think that a committed, determined enemy will quit a human and material war of graduated attrition when he is not being hurt badly in his own backyard. This is liberal, Western thinking, as foreign to Eastern Marxist theories as theirs is to ours. Thus, we have turned to counting

(Continued on following page)



—Wide World Photos

In our effort to fight the war in Vietnam under rigid rules of "flexible response," we have spread ourselves too thin, as at Khe Sanh where our troops are pinned down, and can often be resupplied only by cargo drops, as above.

bodies as if the loss of life is felt precisely the same in Hanoi as in Hartford.

Where does this leave us? At this late hour, there is no neat, clear-cut solution. The fact remains that some problems are *not* soluble, but can only be ameliorated. Today, the list of nations that have been long divided is lengthy indeed. Surely, now wisdom springs from recognition that our present strategy is at a dead end. Thus, the present alternatives are these:

- A sustained military offensive to get us off dead center and take the play away from the enemy. We are not talking about a token increase in troops or more of the same discredited strategy which has, for example, left Khe Sanh exposed, a place where we have little to gain and everything to lose—especially politically and psychologically. We are talking about a heavy, sustained blow at the North, including pulverizing attacks on Haiphong, the Red River dam network, transportation, communications, and government controls coordinated with a ground offensive by troops in numbers that we do not now possess in Vietnam.

- A move back to defensible positions in line with the limited number of line, combat troops we now have in Vietnam. We would then see if the South Vietnamese could shore themselves up, for they will have to stand or fall on their own capabilities. Should the South Vietnamese government collapse and the fabric of society in the South come completely unraveled (always a possibility), then an eventual American withdrawal cannot be discounted.

The fact is that complete withdrawal now is impractical and even indefensible because of our already heavy commitment. Because of our unwillingness to take the offensive with a heavy blow and because we are unwilling to pour in the requisite number of troops

to do the job (possibly a million men), the logical alternative now would seem to be a general pulling back, thus consolidating ourselves to see if the South Vietnamese can take up any of the burden and assert themselves in any way at all, as far as nation-building is concerned.

US ensnarement in Vietnam is surely one of the most striking misapplications of strategy in American military history. We have become bogged down in a backwater by a strategy as futile and inappropriate as it is staggeringly costly. The annual bill in Vietnam is substantially larger than the cost of the entire Korean War, and, if the conflict continues much longer, the loss of American life will surely be greater in Vietnam than it was in Korea. And the fact of the matter is that *the American public will not long support a prolonged stalemate in Vietnam*. The longer the war drags on, with increasingly greater US casualties, the more intense will become the drumfire of protest at home.

How many wars in history have been won in an environment fantastically favorable to the enemy? By adapting to the enemy's strategy? By being stretched far too thin in places remote from one's power? By leashing and restricting one's strong suit? By a thousand compromises in strategy, weapons, numbers of men, and organization? By a nation divided and in turmoil at home? Thus structured—or fragmented—will the US support this war indefinitely?

To ask these questions is to answer them.—END

Mark E. Swenson is the nom de plume of a longtime student of military affairs who is currently employed in the Department of Defense. His earlier article for this magazine, "The Vietnamese War—A Case of Misjudged Staying Power," appeared in the December '67 issue of AF/SD.



—Wide World Photos

We are under siege at Khe Sanh, with little to gain and everything to lose. Exposed, the outpost can be supplied only by air, a hazardous business with the enemy's artillery zeroed in on the one runway. Here a C-123 burns, finished off by mortars.

Space Life Support Systems



Advanced Fighter Designs



F-4 Tail Assemblies



747 Wing Control Surfaces



SST Body Structures



F-105 Systems



Safety Car Designs



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How the World's Largest Aircraft Revolutionizes Strategy and Technology



The C-5 Galaxy, theme of AFA's 1968 National Convention, dramatically re-vamps and expands the nation's strategic mobility. In the words of the President, the behemoth opens "a new era in America's power." At the same time, the C-5 launches a new phase of advanced aeronautical technology, over a range that extends from sophisticated aerodynamics to the first real quantum advance in jet-engine technology. In terms of both aeronautical technology and military strategy, the C-5 appears destined to serve in a profound and revolutionary role.

By Edgar E. Ulsamer

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

THE revolution in strategic mobility, crisis management, and nonnuclear deterrence made possible by the United States Air Force's big new transport forms the central theme and highlight of the Air Force Association's 1968 Convention in Atlanta. The aircraft is the 364-ton C-5 Galaxy, being built by the Lockheed-Georgia Co. First flight is scheduled for June 1968.

Speaking at the C-5 rollout ceremony in Marietta, Ga., on March 2, 1968, President Johnson declared that this aircraft opens "a new era in America's power" and represents a "long leap forward in the effective military might" of the United States. The President added:

"The exciting adventure which produced this plane began just a few years ago.

"America was then developing its capacity for flexible response—to meet any danger that threatened it, in whatever measure was appropriate. One critical element was missing. We could not move a fighting force quickly over long distances.

"Now, with this plane, that crucial need is met.

"The C-5 Galaxy can only be described in extraordinary terms:

"It is the biggest aircraft in the world. Its cargo floor alone is longer than the first flight made by the Wright brothers.

"Its jet engine is twice as powerful as any now in existence.

"It can do three times the work of the biggest cargo plane we now have—cutting operating costs almost in half.

"It can span the Pacific, from California to Japan, in a single jump.

"But most important of all: For the first time, our fighting men will be able to travel with their equipment to any spot on the globe where we might be forced to stand—rapidly and more efficiently than ever. Today it would take eighty-eight cargo planes to move an infantry brigade from Hawaii to Vietnam. Their heaviest equipment would have to go by water.

"That entire operation could be handled by twenty of these new aircraft."

Gen. James Ferguson, Commander of the Air Force Systems Command, which guided the C-5's development, called its impact on strategic airlift "revolutionary" and said its operating costs are "competitive with ships."

Gen. Howell M. Estes, Jr., Commander of the Military Airlift Command, said, "The combination of the C-141 and the C-5 will provide the US with a strategic deployment capability second to none in the world."

In a cargo compartment large enough to house six



—Wide World Photos

An elated President Johnson officiated at the rollout ceremony, hailing the C-5 as a "long leap forward" in US power.

Greyhound buses or 100 Volkswagens, the C-5 can accommodate ninety-nine percent of all Army divisional equipment, including bulky mobile bridges and tanks. Its fuel load alone weighs more than the C-141, largest military transport currently in the USAF inventory. It is also substantially larger than the world's largest operational transport, the Soviet AN-22.

The C-5's impact on US military strategy is profound. For the first time military planners will be able to move large numbers of troops and their vehicles, artillery, armor, and other equipment and supplies to almost any point in the world within hours—combat-ready and without depending on prepositioned supplies. Men and machines arrive together, the so-called "unit integrity" that has long been a military dream.

The C-5 came into being in the incredibly short time of twenty-nine months, from contract award to rollout, and exactly on schedule. And, according to Lockheed-Georgia Co. President T. R. May, it will "meet or beat" all the stringent and steep performance guarantees, which include:

- Transporting a 100,000-pound payload 5,800 nautical miles at a cruise speed of 440 knots (506 mph) with a takeoff distance of 8,000 feet.
- Transporting a 220,000-pound payload 3,050 miles, also at a cruise speed of 440 knots.

- Transporting a 265,000-pound payload 2,700 nautical miles under emergency operating conditions (G loading of 2.25 instead of 2.5) with a takeoff roll of 9,100 feet.

- On a resupply mission, carry a 100,000-pound payload 2,500 nautical miles, land at a runway length of 4,000 feet, unload and return to originating point without refueling, while maintaining a cruise speed of 440 knots on both legs.

- Maximum speed of 540 miles per hour, and a ferry range of more than 7,000 nautical miles.

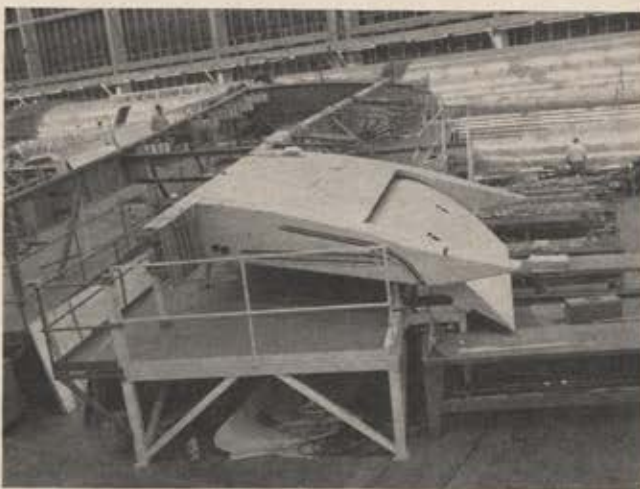
The Military Airlift Command will operate the C-5. Altus AFB, Okla., will serve as MAC's initial C-5 training center.

A New Airlift Dimension

With a mixed force of C-141s and C-5s, MAC will be able to meet all airlift requirements currently envisioned by the Department of Defense, including the transport of large combat forces to Europe, the Far East, or to both areas at once. A wide variety of combat forces can be carried in the C-5, which accommodates between seventy-five and eighty-three troops on an upper deck without interfering with the basic cargo area. With doors front and aft, double or triple rows of vehicles can be driven on and off over full-width ramps. Unloading takes fifteen minutes or less. Loading, refueling, and other standard turnaround services require less than an hour.

On resupply missions, the C-5 can fly direct from the US to forward-area airfields. Where port facilities are lacking or inadequate, MAC will use air transportable docks for unloading. Used in conjunction with Light Intratheater Transport (LIT, currently in USAF design formulation) or by carrying a disassembled cargo helicopter aboard, the C-5 can deliver equipment and supplies direct from the US to the foxholes. In addition, the C-5 can airdrop four 50,000-pound units on one pass. A number of advanced methods are currently under study to accelerate cargo handling at the destination.

(Continued on following page)



Among the myriad of evolutionary technology advances triggered by the C-5 is the highlift system using flexible seals in conjunction with Fowler trailing edge flaps.



First prerollout "outing" of C-5 took place when aircraft number one left main manufacturing building for empennage-mating hangar—a specially designed structure at Lockheed-Georgia plant where C-5 fuselage was mated with 65-foot-tall tail.

In spite of its great weight and size, the C-5's twenty-eight-wheel landing gear has a "footprint" no greater than the C-130 or a loaded Army jeep. It can land and take off up to 130 times on primitive support airfields, with or without matting, before the strip has to be repaired. Actually, the strip needs to be no firmer than the average lawn.

Aircrew staging and support functions, such as fueling, supply, and maintenance, will be done at rear recovery bases to reduce congestion and ground time in exposed forward areas. The C-5's ability to deliver substantial loads to forward points without refueling will reduce aircraft and crew vulnerability and provide more flexible response to changing combat situations.

At the moment, there is no plan to operate the C-5 as a personnel carrier except in emergencies, but it is possible to carry about 350 fully equipped troops without changing the interior. It would also be possible to carry as many as 700 troops in a triple-deck arrangement. No such requirement or plan exists, however, at this time.

A crew of six will operate the Galaxy, working in shifts with a relief crew on long flights.

Options for 200 Galaxies

The first Air Force order is for fifty-eight aircraft to cost about \$1.9 billion, \$1.4 billion going to Lockheed and \$500 million to General Electric for the advanced technology powerplant, the TF39. USAF holds options for 200 aircraft. Lockheed-Georgia President May expects that as many as 275 military C-5s will be built, which would drop the unit price to about \$16 million. More than 2,000 subcontractors and suppliers are involved to the tune of more than \$420 million on the first fifty-eight copies.

Advanced Technology Aircraft

Because of the unprecedented reliability and maintainability guarantees built into the C-5 contract, the Air Force/industry team was understandably cautious

in introducing new, untried technologies into the design. But in many instances they had no choice. As one Air Force planner puts it: "We certainly were not frivolous in injecting new technologies, but the quantum jump in size and capability taken with the C-5 concept automatically forced us into quantum jumps in systems and manufacturing sophistication, running the gamut from chemical milling to new materials."

H. L. Poore, Lockheed vice president in charge of the C-5 program, described some of the manufacturing problems for AF/SD:

"We had to combine the dimensions and brute strength of a shipyard with the precision of a laser beam. Our tooling and assembly jigs look like shipways. Forward and mid-fuselage sections are too large and heavy for overhead cranes. We fitted them with tooling wheels and rolled them over floors smoothed with epoxy. The vertical fin support is so high above



Stringent and exhaustive TF39-engine test procedures are said to assure high reliability even under extreme climatic conditions. Static and flight testing are under way.



Through-loading capability of the C-5 speeds up the aircraft's ground time and reduces its vulnerability in forward areas, since offloading takes no more than fifteen minutes.

the factory floor that we equip workmen with safety ropes like mountain climbers, in case they lose their footing."

The Engine

The C-5's pacing element, in terms of state-of-the-art advances, is its engine—General Electric's TF39 fanjet. The result of basic Air Force engine research, it is the first of a new family of advanced technology engines.

The TF39 is twice as powerful as any transport jet engine in service today. It delivers up to 41,100 pounds of thrust (about 8,000 pounds in cruise), yet weighs a little more than 7,000 pounds. Extracting 41,100 pounds of thrust from a 7,000-pound turbofan is comparable to building a 300-horsepower automobile engine weighing only fifty pounds. The TF39 is sixteen feet long and eight feet in diameter. General Electric spokesmen state that takeoff thrust can be increased to "more than 50,000 pounds very easily and quickly" if necessary, by running the engine at higher temperatures.

A number of fundamental features set the TF39 apart from current transport engines. Its bypass ratio is

eight to one, compared to a maximum of two to one in current designs. This means that the amount of air which goes through the fan but passes around the core engine to exit through the fan nozzle is eight times the volume of air that is channeled through the engine. A high bypass ratio increases the thrust of the engine on takeoff, enabling a relatively small and light engine to lift a heavy aircraft quickly. Since the high bypass ratio design employs what is in effect a shrouded propeller, its efficiency falls off with speed. As a result, thrust output drops off as the speed increases. The TF39 engine compensates in part by running much hotter—by about 700 degrees Fahrenheit—in terms of turbine-inlet temperatures than contemporary designs. As a result, its specific fuel consumption, the amount of thrust extracted from a given fuel unit, is about twenty-five percent higher than in present-day engines. Its thrust-to-weight ratio, of course, is also considerably improved.

Another unique feature of the TF39 is its stage-and-a-half front fan. To get a high bypass ratio the fan must move an inordinately large volume of air. Ordinarily this would call for a very large fan, and consequently, a large nacelle. This has an adverse effect on airframe drag. By using, in effect, two fans, with the small one in front, it becomes possible to reduce the fan diameter by seven percent over a single-stage design with equal airflow capability, according to General Electric's C-5 Program Director D. C. Berkey. In addition, the half-stage fan helps even out the divergent pressures which rise at the hub of the engine, on one hand, and at the outer tip of the large single-stage fan, on the other. This pressure equalization provides a definite plus in terms of over-all engine efficiency. The stage-and-a-half front fan is constructed primarily of titanium to save weight and to protect against corrosion.

A "fringe benefit" of the high bypass ratio and the double fan is the ready availability of air which can be used to cool the turbine blades. Of the enormous
(Continued on following page)



C-5 pilots and navigators are furnished a battery of novel navigation aids. Lear Siegler furnishes the two Precision Aircraft Reference Systems, components of which are above.



B. F. Goodrich and Lockheed achieved breakthrough in C-5's brakes by using beryllium, which cuts weight by thirty-five percent, yet is more durable than conventional material.

quantities of air that the TF39 gulps—up to 1,549 pounds per second on takeoff, equal to pumping out all the air in a large home in less than a second—a portion is diverted to a radically new cooling system. This cooling air insulates internal components from the intense temperature (2,300 degrees F. plus) reached at the inlet.

In torture tests, walnut-size pieces of ice were fired at 600 mph into the air intake to demonstrate the engine's ability to ingest foreign objects much larger than encountered under normal flight conditions. The engine also has been repeatedly started successfully after being "soaked" in temperatures of sixty-five degrees below zero.

The TF39's high-pressure turbine, which drives the core compressor, has two stages, both air cooled. Thermal stresses are kept well within allowable limits.

Also adding to long turbine life is the use of new materials.

The TF39's six-stage, low-pressure turbine drives the fan through a shaft concentric with the core engine. The low-pressure turbine's inlet temperature is below 1,400° F., and no air cooling is needed. The low temperature, low-tip speed, and shrouded blade tips promise low stresses with inherent long life and reliability.

The TF39 is designed to meet all applicable FAA requirements for commercial operations. Its useful operational life is 15,000 hours for hot parts and 30,000 hours for cold parts.

Aerodynamic Advances

A new order of aerodynamic efficiency had to be created for the C-5. This was accomplished through innovations in the airfoil shape, in the wing geometry, the wing-body fillet and landing gear fairing, the nacelle configuration, and a high lift system. The C-5's "peaky" airfoil, in itself, is credited with significantly increasing speed and efficiency.

The term "peaky" derives from the fact that the airfoil is so designed that pressure "peaks" in the first ten percent of the wing chord where there is less tendency to create shock which would disturb the airflow. As a result, the optimum cruise speed is increased by 0.015 Mach over conventional high-speed airfoil designs.

The "swept-tips" design of the C-5 wing also helps by suppressing compressibility and wing vortex drag. Highly refined contouring of the wing-body fillet and main landing gear fairing cuts the interference drag of the aft fuselage. Innovations in location and slant of the nacelles give a favorable interference effect and reduce cruise drag by about five percent. The C-5's cruise lift/drag ratio, the most critical factor in aerodynamic efficiency, is 18.6, higher than that of any comparable transport design. (The C-141's L/D, for example, is 17.1.)

The high lift system on the C-5 achieves a higher lift coefficient at climb speed than any existing swept-wing jet airplane. According to Lockheed, this is the
(Continued on page 75)



First ship of the C-5 line is shown in Lockheed's huge Flight Test Center in Marietta just prior to rollout on March 2, 1968.



FROM AN ORIGINAL PAINTING FOR CHANDLER EVANS BY KEITH FERRIS

**MAIN
FUEL
PUMPS**
by
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The Air Force's General Dynamics F-111A is now operational with the "Harvest Reaper" unit at Nellis AFB. With its variable-sweep wings it has excellent range, load, flight control, landing characteristics and can fly two and a half times the speed of sound. It is powered by two Pratt & Whitney Aircraft TF30-P3 afterburning jet engines—equipped with main fuel pumps engineered and precision-produced by Chandler Evans.

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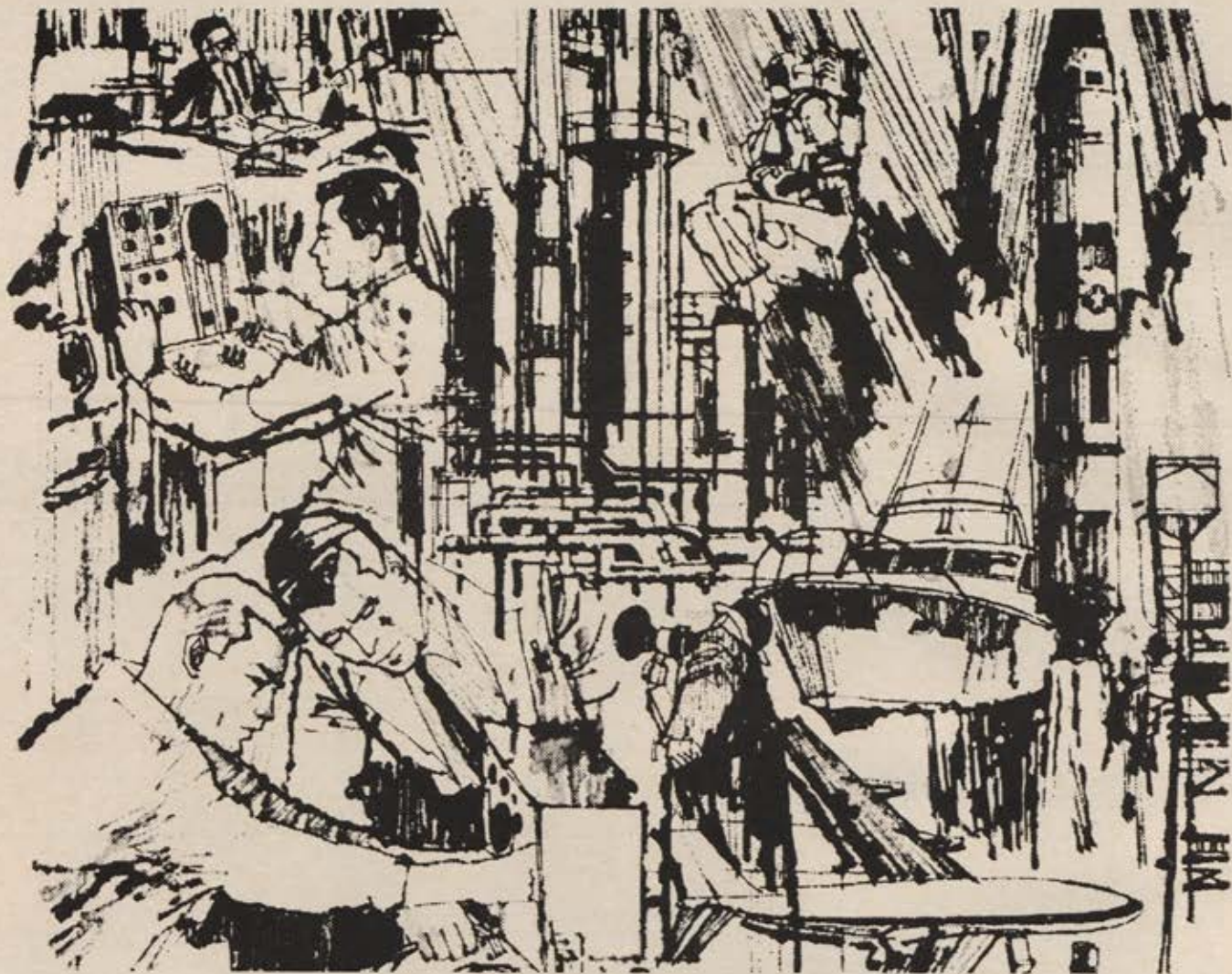


A-7A Corsair II, powered by TF30-P-6

PUNCH by A-7A **POWER** by TF30

Pratt & Whitney Aircraft

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result of using a tailored leading-edge slat in conjunction with Fowler-type trailing edge flaps and newly developed flexible seals. As a result, climbout with one engine dead can be achieved easily.

The stiff requirements set for the C-5's flying qualities led to a number of technological advances which permit the aircraft to be operated at speeds as low as, or lower than existing jet transports. It will handle easier, safer, and with more agility than modern jetliners half its size.

C-5 Program Manager Poore explained the problem: "With a 246-foot length, 223-foot wingspan, and normal maximum weight of 728,000 pounds, the Galaxy has extremely large inertias. Even so, it will take off and land at speeds as low as, and in many cases lower than, current jets.

"That combination—high inertias and low speeds—increased the problem of providing good flying characteristics by an order of magnitude.

"Our engineers solved the problem with an integrated design of control surfaces, hydraulic power systems, and three-axis stability augmentation. Each control axis has three hydraulic power sources. Each control surface has double actuators. The pilot will be able to control and land the C-5 even after complete failure of any two hydraulic systems. Ailerons coordinated with lateral control spoilers, plus an augmentation system with a wheel-quicken feature, will give the Galaxy the fastest roll response of any jet transport in service."

There are eighteen primary and forty-one secondary control surfaces on the aircraft (the C-5's rudder is larger than the total wing surface of the average fighter plane). Integrated yaw, pitch, and roll stability augmentation systems have been used in a different form in supersonic fighter aircraft, but the C-5 is the first subsonic aircraft to employ one.

Most airplanes stall and lose their ability to fly at very high angles of attack, i.e., an extreme nose-up attitude. A computerized system, called a stallimeter, will keep the C-5 out of such deep stalls.

The stallimeter computer constantly monitors angle of attack, Mach number (airspeed), flap and slat position, and yaw-rate data. If the computer foresees a potential deep stall, it warns the pilot by shaking the control column. If the pilot doesn't heed the warning, the computer immediately signals a hydraulic actuator to move the control column forward—and thereby nosing down the airplane and averting the stall.

The C-5's augmented controls will also allow it to meet a very demanding maneuver requirement during minimum visibility instrument landings. A C-5 pilot, for example, will be able to line up with the runway on final approach even if he breaks out as much as 200 feet to one side of the correct glide path and as low as 200 feet above the ground.

The autopilot system includes an "altitude capture" feature which automatically levels out the aircraft at any programmed altitude after ascending or descending. The navigation system, working in tandem with the autopilot system, permits automatic terrain following (300 to 1,500 feet altitude) and radar approaches to a landing site without using ground guidance signals. When an instrument landing system is available,

the C-5's automatic landing system includes control to touchdown and automatic rollout.

The autopilot will also perform an automatic go-around on command by the pilot. Other features include automatic terrain avoidance and station keeping for precise formation flying. The system can scan and track up to fifty-nine aircraft flying in formation and display their position on a radar indicator.

The inertial doppler navigation system, employing a new floating-ball inertial platform, together with
(Continued on page 77)

The C-5 at a Glance

WEIGHTS

Flight design gross weight—2.5g	728,000 lb.
Flight design gross weight—2.25g	764,500 lb.
Basic mission weight	712,000 lb.
Maximum landing weight (9.0 fps sink rate)	635,850 lb.
Operating weight	323,904 lb.

CARGO COMPARTMENT

Length excluding ramps	121.1 ft.
Length including ramps	144.6 ft.
Height	13.5 ft.
Width	19.0 ft.
Total volume including ramps	34,734 cu. ft.
Palletized volume including ramps (36 463L pallets)	19,020 cu. ft.
Forward loading opening	height 13.5 ft.—width 19.0 ft.
Aft loading opening (ramp lowered)	height 12.9 ft.—width 19.0 ft.
Aft straight-in loading	height 9.5 ft.—width 19.0 ft.

PERSONNEL CAPACITY

Crew	6
Alternate crew	6
Courier seating	8
Troops—upper troop compartment	75

FUEL SYSTEM

Capacity (JP-4)	49,000 US gallons (318,500 lb.)
Single point refueling rate	2,400 US gallons/min. (15,600 lb./min.)
Jettison rate	1,460 US gallons/min. (9,490 lb./min.)

PERFORMANCE

High-speed cruise	470 knots
Long-range cruise speed	440 knots
Aerial delivery drop speed	130-150 knots
Rate of climb at sea level, standard day at basic mission* weight	2,100 ft./min.
Takeoff distance over 50 feet at basic mission* weight (sea level, tropical day)	7,500 ft.
Landing distance over 50 feet with 100,000-lb. payload midpoint of 2,500 nm radius mission (sea level, tropical day, wet runway)	4,000 ft.
Design payload—2.5g	220,000 lb.
Design payload—2.25g	265,000 lb.
Range with 220,000-lb. payload	3,050 nm
Range with 112,600-lb. payload (maximum 2.5g takeoff weight)	5,500 nm
Ferry range	7,275 nm

*Basic mission: 100,000-lb. payload, 5,500 nm

Roll of Honor—Major Subcontractors for the C-5

In terms of weight, more than fifty-four percent of the C-5 is being manufactured by subcontractors. More than 2,000 firms in forty-one states, Canada, England, Germany, and Scotland participate in the program.

Listed below are the major C-5 subcontractors as announced by Lockheed:

Subcontractor	Location	Component
AiResearch Manufacturing Co. Garrett Corp.	Los Angeles, Calif.	Environmental Control Systems, Ram Air Turbine, Leading Edge Actuation
AiResearch Manufacturing Div. Garrett Corp.	Phoenix, Ariz.	Auxiliary Power Unit, Main Engine Starter, Air Turbine Motor
Arrowhead Div. of Federal-Mogul Co.	Los Alamitos, Calif.	Environmental System Ducting
Avco Corp., Electronics Div.	Cincinnati, Ohio	Long-range Radio (HF/SSB Radio)
Avco Corp. Aerospace Structures Div.	Nashville, Tenn.	Inner and Outer Wing, Wing Center Section
Bendix Corp., Aerospace Div.	South Bend, Ind.	Main and Nose Landing Gear
Bendix Corp. Navigation & Controls Div.	Teterboro, N. J.	Engine Tape Instruments, Vertical Scale Flight Instruments, Flight Director Computer, Peripheral Command Indicator, Attitude and Director Indicator
Bertea Products Co.	Irvine, Calif.	Primary Flight Controls Actuation System
Brooks & Perkins	Detroit, Mich.	Cargo Rollers and Conveyors
Brunswick Corp.	Marion, Va.	Nose Radome
Cadillac Gage Co.	Costa Mesa, Calif.	Flight and Ground Spoiler Actuation System
Canadair Ltd.	Montreal, Canada	Aft Cargo Doors, Wing Leading Edges, Wing Tips, Ailerons, Main Landing Gear Fairings and Doors
Collins Radio Co.	Cedar Rapids, Iowa	UHF and ADF Systems
Convair Div., General Dynamics	San Diego, Calif.	Empennage
Electro Development Corp.	Seattle, Wash.	Integral Weight and Balance System
Elliott Brothers Ltd.	Rochester, Kent, England	Central Air Data Computer, Energy Management Computer, Crosswind Castering Control System
General Electric Co.	Evendale, Ohio	Engine Thrust Reversers
B. F. Goodrich Co. Aerospace Defense Products Div.	Troy, Ohio	Wheel and Brake Assemblies and Tires
H. M. Hobson Ltd.	Wolverhampton, Stratfordshire, England	Artificial Feel Actuator
Hoffman Electronics Corp.	El Monte, Calif.	TACAN
Honeywell, Inc.	Minneapolis, Minn.	Automatic Flight Controls
Hydro-Aire Div. Crane Co.	Burbank, Calif.	Antiskid System, Hydraulic Boost Pumps
Interstate Electronics Corp.	Anaheim, Calif.	MADAR Oscilloscope, MADAR Printout Unit
Kaman Aircraft Corp.	Bloomfield, Conn.	Wing Flaps and Spoilers
Walter Kidde & Co.	Belleville, N. J.	Nose Landing Gear Actuation System
Lear-Siegler, Inc.	Grand Rapids, Mich.	Attitude and Heading Reference Units
Litton Industries, AMECOM Div.	Silver Spring, Md.	Radar Altimeter
Menasco Manufacturing Co.	Burbank, Calif.	Main Landing Gear Bogey
Norden Div., United Aircraft Corp.	Norwalk, Conn.	Multimode Radar
Northrop Nortronics	Palos Verdes, Calif.	Inertial-Doppler Navigation System
Rohr Corp.	Chula Vista, Calif.	Engine Nacelles and Pylons
Steel Products Engineering Co.	Springfield, Ohio	Wing Flaps Actuation System
Sundstrand Corp.	Rockford, Ill.	Constant Speed Drives
Teleflex Corp.	North Wales, Pa.	Cargo Restraint Rails
Western Gear	Lynwood, Calif.	Horizontal Stabilizer Actuation System

multimode radar, furnishes accuracies and reliabilities greater than any existing system. An airdrop mission, for example, can be programmed with an accuracy of close to 100 yards. En-route navigation with a maximum error of one mile per hour of flight can be maintained for five hours without position updating.

Ground Handling

The C-5 has a built-in weight and balance system. Multiple sensors located in the main and nose gear assemblies measure aircraft weight and center of gravity within one percent. Gross weight, center of gravity, and differential weight are displayed on a control panel in the main cargo compartment.

The C-5 is the first aircraft to use solid disc beryllium brakes, designed jointly by B. F. Goodrich and Lockheed. Use of beryllium reduces weight by about 1,500 pounds and increases durability substantially.

A new crosswind landing system does away with the need to make control changes on touchdown through an electronically synchronized turning of the main gears and the nose gear. The pilot can deflate tires in flight to meet particular soft field conditions. Once on the ground he can reinflate to normal pressures. To pick up cargo, the C-5 can "kneel," i.e., lower its fuselage by telescoping the landing gear.

The C-5's maintainability is a firm, contractual, measurable guarantee which must be demonstrated by performance. In order to meet the stringent maintainability guarantee in the contract, maintainability had to be designed into the C-5 from the beginning and through the development cycle.

The key to easy maintenance, according to Lockheed engineers, is a unique malfunction detection, analysis, and recording (MADAR) system, which continually monitors more than 600 test points (expandable to 1,300).

MADAR automatically checks more than half the aircraft's critical line replacement units (LRUs) once every second. A malfunctioning subsystem's number lights up on the flight engineer's panel. A wave pattern from the affected subsystem shows up on a screen. The flight engineer then compares it with a number of "standard" malfunction patterns flashed on a second screen from a memory bank until he makes a diagnosis. He then can check his tech order data and radio ahead for a replacement. Meanwhile, MADAR continues to monitor all other test points automatically.

Comprehensive Test Program

Underlying the performance and reliability of the C-5 is what Brig. Gen. Guy M. Townsend, Director of the C-5 System Program Office, Air Force Systems Command, terms "the most comprehensive test and flight-test program in history." Ground testing by the manufacturer will involve 120,000 simulated flight-hours and 48,000 landings, the equivalent of four times the normal life cycle of the aircraft.

A propulsion system test stand will check the installed XTF39 and later production General Electric engines, thrust-reverser performance, and evaluate

nacelle and pylon structure during the 150-hour endurance tests. It will also test effects on the engine of hydraulic, pneumatic, electrical, and throttle control system parts contained in the pylon and nacelle.

The Air Force has assigned an eight-plane fleet to the C-5 flight-test program that begins in June and continues through mid-1970.

Four different Air Force commands will send more than 600 men to Lockheed-Georgia Co. for C-5 training over a seven-month period, beginning September 11. Divided into fifty-six separate classes, they will study twenty-two flight crew and maintenance subjects.

More than an acre and a half of aluminum honeycomb is designed into the C-5 in the form of cargo flooring, cargo doors, wing leading and trailing edges, flaps, engine nacelles and pylons, and fuselage panels.

New chemical milling techniques make it possible to fabricate in one piece large components such as fuselage frames, making them lighter, stronger, and more durable. A special chemical milling building located near the aircraft's assembly site can handle fifty-foot parts in a continuous process.

The C-5's unique capabilities and features obviously suggest potential applications in areas other than logistic transport. General Townsend told AIR FORCE/SPACE DIGEST that, while the Department of Defense has not stated specific corollary mission requirements, the use of the C-5 as an airborne command post appears promising (see page 96). Speaking at the rollout ceremony in March, Congressman L. Mendel Rivers, Chairman of the House Armed Services Committee, pointed out that the size and mission of the C-5 now make it possible and advisable to consider nuclear propulsion systems for aircraft (see AF/SD, August '67).

In spite of the quantum jump in size and payload represented by the C-5, the Air Force and Lockheed are already studying the need for and potential of an even larger aircraft, the LGX. General Ferguson says the C-5 "is far from being the end of the line in aircraft development." He predicts that "still better, even bigger airplanes are entirely possible. Technological advances in materials, propulsion, and flight dynamics, leading to new generations of aerospace vehicles, are now being pursued in the laboratories and research centers of the Air Force and industry. These promise to have as great an impact on aviation of the future as the C-5 promises to have on airpower of today."—END

The C-5—Special Reports

The C-5 Galaxy has brought on radical changes in technology, component design, strategy, and procurement procedures. Lockheed and the Air Force have singled out ten specific areas of C-5 technology and impact which are the subject of special briefings at AFA's 1968 Convention. Summaries of these briefings appear on the following pages to furnish our readers a unique, in-depth coverage of the C-5 and its broad meaning to US aerospace power.

—THE EDITORS

AFSC—THE C-5'S PRINCIPAL MENTOR



Guiding the evolution of the C-5, from concept formulation and systems definition to actual acquisition, is the task of the Air Force Systems Command. Through the Aeronautical Systems Division's C-5 Program Office, AFSC instituted management procedures as novel as the aircraft itself, centering on the Total Package Procurement Concept (TPPC). AFSC is confident that the final goal—bringing the C-5 into operational readiness for turnover to the using forces—will be realized on schedule. Here's the AFSC report as told by Brig. Gen. Guy M. Townsend, USAF, Director, C-5 System Program Office, ASD, AFSC.

THE requirement for a large and efficient military transport aircraft was the subject of numerous exhaustive studies conducted in the early 1960s. The impending obsolescence of the C-124 and C-133 aircraft was recognized. The upcoming C-141 would provide a major advancement in military airlift, but, like all military systems, the existing state of the art and the realities of the scheduled need-date imposed limitations on it, particularly in the areas of operating from second-class airfields, ability to handle outsized items of cargo, and the frequency of "cubing-out" or reaching the volume limit of the cargo compartment with low-density cargo before running into structural and performance limitations due to cargo weight.

Let's look at the part AFSC has played and will continue to play in the program.

The management manuals divide a program into phases and prescribe major participation by Systems Command in three of them—conceptual, system definition, and acquisition. These terms do not by themselves indicate the nature or magnitude of the effort involved, so I will break them into tasks and cite examples, with particular emphasis on those which were new or unusual at the time they were performed in the C-5A program.

The purpose of the conceptual phase is to determine that achievement of the program objectives established by Headquarters US Air Force is feasible. The uninited tend to think of this function only in terms of technical approach, but consideration must also be given to developing the operational, maintenance, and logistics concepts; cost analysis and procurement policy; and, most important, the integration of all the foregoing into a cohesive system program. Of these tasks, Systems Command has primary responsibility for proving technical achievability and cost-effectiveness, definitizing procurement policy, and combining these with inputs from the using command and the Air Force Logistics Command to demonstrate the feasibility of the complete system.

In 1963, Project Forecast was conducted under the personal guidance of Gen. Bernard A. Schriever, then

Commander of AFSC, to examine candidate aerospace systems which might meet the military requirements predicted for the 1970-1980 time period; and then to assess the current state of the art, identifying those areas having a high probability of payoff to enable a meaningful focus of R&D efforts and resources in support of the potential systems. This group concluded that developments and analyses should be pursued in the areas of high-bypass-ratio turbofan engines, lightweight structures, and improvement of aerodynamic efficiency in support of what was then designated the CX-HLS—cargo airplane/heavy logistic system.

A management cadre was established in the Aeronautical Systems Division to coordinate this conceptual effort. Under its auspices, and with the considerable support of the various subsystem engineering directorates and laboratories at Wright-Patterson AFB, specific R&D tasks were carried out in late 1963 and throughout 1964.

The degree of potential improvement in engine performance was exciting but unproved, so funded "demonstrator" engine programs were conducted in the fabrication and test of actual prototype hardware, which in turn proved that the component efficiencies, thrust, and fuel consumption required for the CX-HLS were achievable at practical fan speeds, bypass ratios, and operating temperatures.

Other examples of technical feasibility efforts performed or managed by AFSC elements included an investigation of the stability and control characteristics of massive airplanes utilizing a variable-stability B-26 test-bed. Tests were conducted in conjunction with US Army civil engineers to investigate the flotation characteristics of support-area airfield soils and to develop corresponding criteria for landing-gear design. Extra-wide tires and expandable tires were investigated as means of improving ground flotation.

Available data on laminar-flow control and other means of improving aircraft range were reviewed, as were the development status of beryllium, titanium, and boron fiber composites as lightweight structural materials. A committee was established to study the

avionics area and determine what the status in that field was in terms of accuracy, reliability, producibility, and miniaturization for weight and power reduction. ASD's cost-effectiveness analyses considered the results of all these, in conjunction with the projected ten-year operation and maintenance costs for a variety of airplane sizes, utilization rates, cruise speeds, and load combinations. They concluded that a CX-HLS was cost-effective; and further, the bigger the airplane the more cost-effective it would be, up to the practical limits imposed by existing facilities which could not be upgraded economically.

Meanwhile, the procurement people in Systems Command were busy developing the specific implementation of the total package procurement concept (TPPC) formulated by the Hon. Robert H. Charles, Assistant Secretary of the Air Force for Installations and Logistics. Stated simply, this concept was based on the now-accepted premise that the Air Force would realize the lowest realistic over-all cost by considering at the outset every possible aspect of the system, through the operational phase, and obtaining through competition a fixed-price or fixed-price-incentive contract for all those purchased elements which could be defined sufficiently to provide confidence in pricing.

This conceptual effort culminated ultimately in two sets of documents: one a compilation of study and test efforts which led to Department of Defense and Headquarters USAF concurrence that the CX-HLS was both feasible and cost-effective; the other a two-part request for a proposal (RFP) containing more than 2,000 pages. One RFP covered the engine; the other covered the air vehicle and the integration of all the purchased elements of the system.

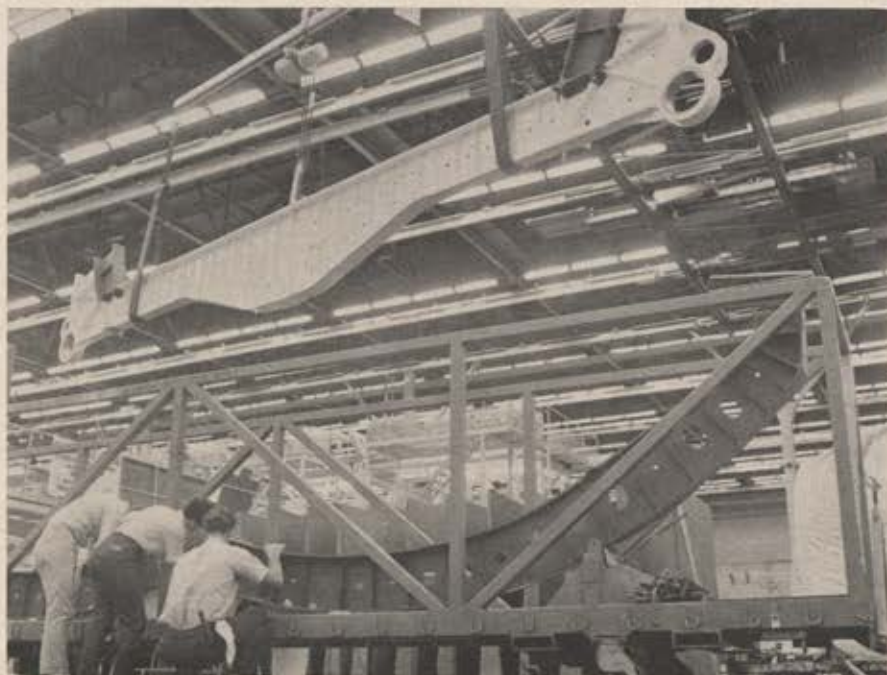
For all practical purposes, the definition phase began with the release of the RFP at the end of 1964. Shortly thereafter the C-5A designation was established, and the C-5A System Program Office, or SPO, was officially created and assigned the responsibility of managing the system development and acquisition efforts.

The engine RFP specified a powerplant of not less than 40,000 pounds thrust at sea level. The air vehicle RFP called for an airplane having a minimum fixed floor area of 2,300 square feet; a cruise speed of at least 440 knots true airspeed; and the capability to land, taxi, unload, and take off from unpaved support-area airfields having a California bearing ratio (CBR) of nine to one, roughly equivalent to the outfield in Yankee Stadium. Both RFPs required the bidders to quote on the basis of a buy of fifty-eight airplanes with a firm-price option for fifty-seven more, and a pricing formula for an additional eighty-five. The scope of the proposals was to include development and production of aircraft and engines, test support services and equipment, base-level support equipment, maintenance trainers, flight crew trainers, mission flight simulators, initial spares, handbooks for operation and maintenance, and training of Air Force instructors. In addition, the contractors' efforts were to include development of the system analysis data necessary for later separate procurement of depot-level support equipment and follow-on spares, and also data for determination of new or revised operational and maintenance facility requirements, manning and training within the Air Force, and similar interface with the purchased portion of the program.

During early 1965 the SPO, with the aid of other commands, engaged in answering bidders' questions and conducting in-process reviews of their proposal preparations. On April 20, the technical proposals were received, followed one week later by the cost proposals.

In all, there were eight basic proposals to evaluate: one from each of the two engine bidders (General Electric and Pratt & Whitney), and two from each airframe contractor (Boeing, Douglas, and Lockheed) because of the differences in engine design and programming. In addition, there were numerous alternative approaches to the basic proposals.

In all, an estimated thirty-five tons of proposals and
(Continued on following page)



Some of the largest forgings and extrusions ever required for aeronautical applications make up the C-5 Galaxy. The Air Force Systems Command, which guides the C-5 program, was concerned with creating a design that would not "cube out," that is, be limited by the volume of the cargo, regardless of its density, rather than by the structural and performance limitations of the aircraft. The design that ultimately evolved is considered capable of furnishing optimum cube space.

backup data were delivered to Wright-Patterson AFB within a week. The herculean task of evaluating this vast amount of data fell to an *ad hoc* group chaired by Maj. Gen. C. H. Terhune, Jr., then Commander of ASD. His group included all of the members of the C-5A SPO, plus specialists from the ASD staff, engineering directorates, and laboratories; representatives from other Systems Command elements including the Flight Test Center, Arnold Engineering Development Center, and Air Proving Ground Center; the Military Airlift Command and Air Force Logistics Command; the Army Corps of Engineers; and non-DoD agencies such as NASA and FAA.

At its height, the evaluation group numbered in excess of 400 persons, and in just five months evaluated the volumes of data submitted and negotiated firm signed contracts with all five bidders for all the program combinations and alternatives. We are justifiably proud of this accomplishment.

The definition phase ended in September 1965 with the selection of General Electric and the Lockheed-Georgia Co. as the engine and system contractors, respectively. Release of the already negotiated contracts to the selected sources initiated the acquisition phase.

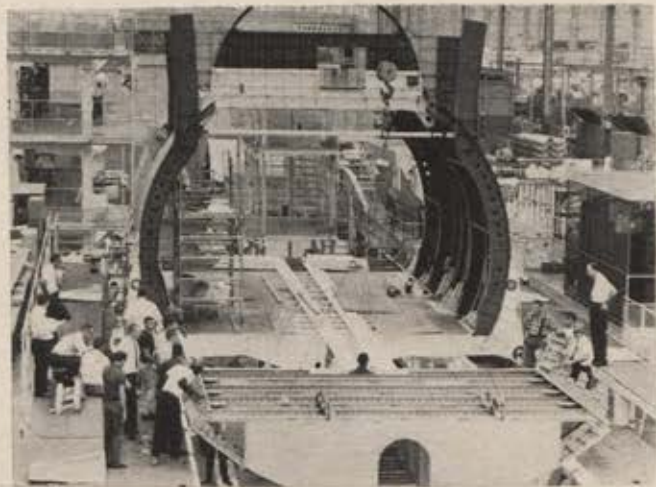
Since that time, the Systems Command's role in the program has followed three principal channels:

- The routine administration of the basic program.
- Meeting those commitments which are not the contractors' responsibilities.
- Definitizing and negotiating new work requirements which have arisen since the original contracts were released.

Administration of the basic program involves tracking the progress of the contractors and all other agencies involved to coordinate interfacing activities; to readjust the programmed funds to fit the need; and to report problems, status, and outlook to higher headquarters for integration into over-all defense planning and programs. Because of the awesome responsibility assumed by the contractors under the total-package/fixed-price concept, we must perform this administration function in a manner which will neither constrain the contractors' efforts to perform, nor relieve them of any responsibility for system performance. This routine administration also includes progressively delineating those areas which are covered only broadly in the contracts, such as qualification testing and ground-equipment definition within the broad terms and criteria which are in the contract.

A contract is a bilateral agreement, and ours calls for the Air Force to perform actions and provide services and supplies on a schedule compatible with the contractors'. A great deal of Systems Command effort is currently directed toward these functions. For instance, we located and secured a CBR-9 area on which support-area airfield operations can be evaluated and performance measured, and furnished a test cell and services at Arnold Engineering Development Center for determination of engine and engine/nacelle performance at high altitudes. These are typical of a dozen or more major interfacing functions which the SPO and other AFSC elements are involved in at the present time, and there are scores of lesser ones.

New work accounts for a portion of our effort. For



C-5's cargo floor section and main frame forgings topped by upper lobe (where up to 83 troops can be housed) are shown here on the assembly line of Lockheed-Georgia Co.

example, shortly after release of the initial contract, a directive was issued requiring all inertial navigation equipment to be evaluated by the Holloman Air Development Center. This necessitated establishing a test program in conjunction with Holloman and contracting with Lockheed to provide air vehicle equipment and technical services in support of the Holloman test mission.

More recently, we contracted with Lockheed to conduct producibility, structural, and flight testing of a boron fiber composite leading-edge slat segment for the C-5A. This development is not a necessity to the C-5A program, but does serve the Air Force's material development program by expanding the boron filament technology in terms of part size and complexity as well as natural and induced environments. In addition, depot-level support equipment, as it is identified, is being covered by contract changes.

In general, system changes, and particularly design changes, are the bane of achieving program goals. Changes consume funds, delay schedules, degrade operational effectiveness, and complicate logistic support. I am happy to say that substantive changes to the C-5 system have been held to an absolute minimum. This is a tribute to the total package procurement concept, and to all those personnel and organizations involved in it, both contractor and government.

The Systems Command will continue to perform these functions in the C-5 program until the system has been qualified through flight and ground tests, the system capability has been determined in all areas, and production of air vehicles has been completed. Portions of these activities may extend to 1973 and beyond.

In summary then, the role of the Systems Command in the C-5 program includes managing for the Air Force of (a) the efforts necessary to define the system; (b) develop, qualify, and produce the end items which comprise the system; and (c) bring it to a state of operational readiness for turnover to MAC and AFLC. This has been a very challenging and satisfying role, because it provides a very necessary aeronautical system under a procurement concept which is novel, stimulating, and, in our opinion, beneficial.

—END

GROOMING THE GIANT FOR FLIGHT TEST



Lockheed-Georgia Co., the C-5 prime contractor, is confident that the aircraft will meet the numerous and unprecedentedly stringent guarantees concerning its performance, reliability, and maintainability as stipulated by the contract. As the mammoth transport is being readied for first flight in June of this year, ground testing is being accelerated to assure that it will live up to the expectations of the Air Force. In the following, Lockheed Vice President and C-5 Program Manager H. Lee Poore discusses the problems and challenges of building the world's largest aircraft.

ONE OF our major milestones, rollout of the first C-5 airplane, is only one month behind us. Today, that airplane is being readied for its first flight in June. Our manufacturing pipeline is filling up with succeeding airplanes. How did we get here? First, let's look at what we are trying to accomplish, then we will quickly review some of the key milestones in the program, look at our progress to date, and retrace some of the steps which brought us to where we are today.

The Air Force, General Electric, and Lockheed all shouldered an awesome responsibility when we undertook to design, develop, and build the world's largest airplane. An airplane which is, in fact, so large that it dwarfs the DC-8 and 707 and our own C-141 Star-Lifter. Its maximum gross weight is over twice that of the C-141—its payload is about three times as great, and its cube is nearly five times as large.

The challenge, however, was more than that of just building a large airplane—the challenge was to build an efficient airlift system that could carry large and heavy payloads over long distances with modest operating and maintenance costs. Yet, this airlifter would have to stand up to wartime use into semiprepared runways where ground equipment and maintenance facilities would be scarce or nonexistent.

Our contract with the Air Force contains guarantees for such items as reliability, schedule, maintenance man-hours per flight-hour, and performance. Performance guarantees include payload/range points, mission profiles, and takeoff and landing performance. We are quite pleased at our progress in meeting or bettering those guarantees, and feel that the airplane is going to do all we said it would do.

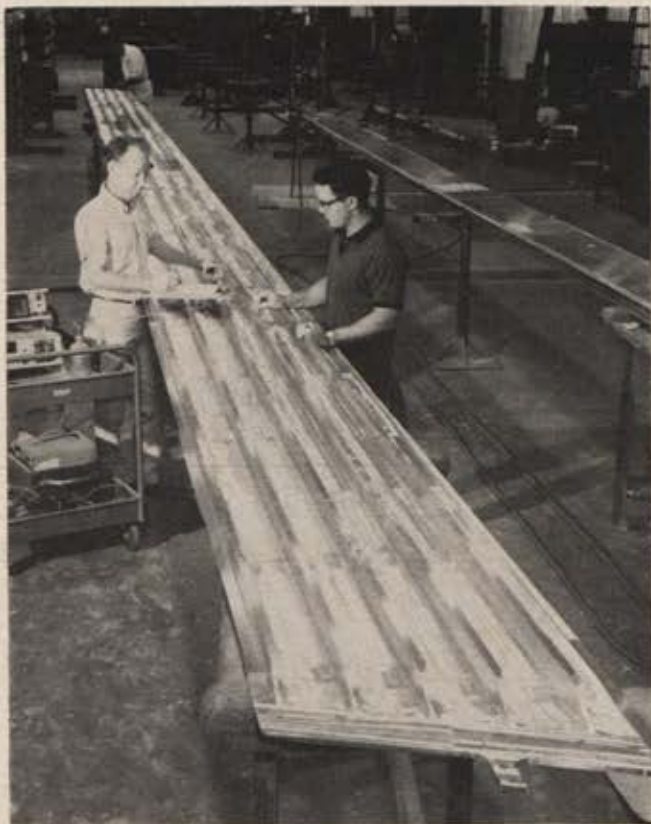
The contract was awarded in October 1965 after a lengthy contract-definition phase which provided the framework for rapid progress into the comprehensive design and manufacturing activities. We faced the usual problems of weight control, drag refinement, and design trade offs for optimum performance. As these challenges were being met, design was progress-

ing, subcontracts were being placed, and tooling was being made. Fabrication of parts began in August of 1966. The first airplane was assembled during 1967 and early 1968, and rolled out in February for the official ceremony on March 2.

First flight is our next major milestone. From June 1968 through June 1969, the first eight aircraft will be
(Continued on following page)



Gen. Howell M. Estes, Jr. (second from right), Commander of the Military Airlift Command, is shown here with USAF and Lockheed officials during one of his frequent inspection visits in Marietta, Ga., to monitor progress of the C-5.



Immense sixty-foot "planks" of special aluminum alloy, used to form outer wing section of the C-5, are manufactured by Aveco Corporation's Aerostructures Division.

delivered to the flight-test program and undergo extensive flight and operational testing. The first delivery to the Military Airlift Command will be in June 1969, and the first squadron will be operational by the end of that year. The fifty-eight airplanes on our initial contract will be delivered by January 1971—at which time planned production run "B" deliveries begin.

The design of the airplane was continually optimized, almost up to final engineering release. Consequently, we have made many improvements over the design which won the contract two and a half years ago. The nose is now more sharply pointed. The wing fillet size was increased, and the fillet streamlining was improved to further reduce aerodynamic drag. A change in the landing-gear design, which I'll explain in a moment, permitted us to smooth, lengthen, and narrow the landing-gear pod fairings. The final configuration of the aft fuselage and empennage has gentler lines and is more streamlined—the vertical tail is larger and the taper ratio is higher than that of the previous design.

As a result of these design changes, we are now confident that we will achieve or better our cruise drag target of 250 counts. After close inspection of recent wind-tunnel test data, we believe the count to be probably around 245 or 246.

During design refinement, the main landing gear bogie width was decreased from 144 inches to 85½ inches. This reduced the wheel pod size, saved weight, and increased bogie stability, while still maintaining the required high flotation capability. Just recently,

we refined the gear design even further with substantial savings in both weight and cost while maintaining essentially the same dimensions and features of this gear design. The major changes consisted of (1) elimination of the pinned joint where the trail beams join the cross beam and (2) redesign of the aft axles. Pressure-welded elbows replace the large pinned joints and the aft axles are now substantially smaller. These changes do not seem particularly impressive, until you realize that because there are four of these huge bogies on each airplane—we are talking about a weight saving of 1,382 pounds per aircraft, plus a substantial cost saving and easier maintainability.

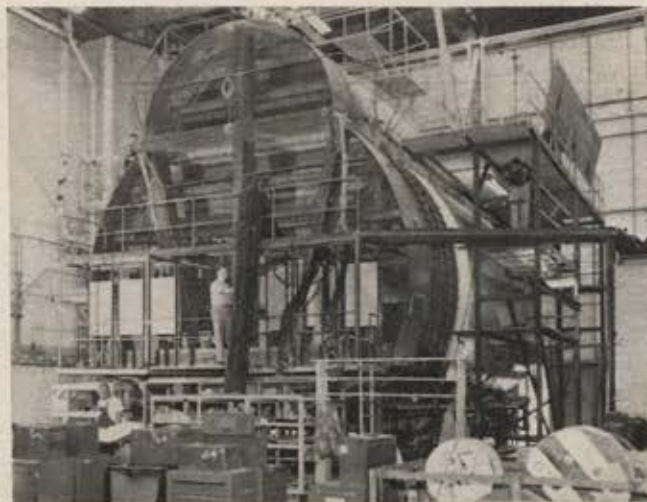
We are currently engaged in three primary areas of development evaluation and demonstration testing. These are structural testing, subsystems testing, and flight testing. The testing we have planned for this airplane represents the most extensive program ever accomplished by Lockheed and, I believe, by any other manufacturer.

Any review of our test activity should begin with a description of our new engineering test center, which is the largest cantilevered roof structure in the world. Its dimensions are 630 feet by 480 feet. It will house the static test article, the fatigue test article, and two flight test aircraft.

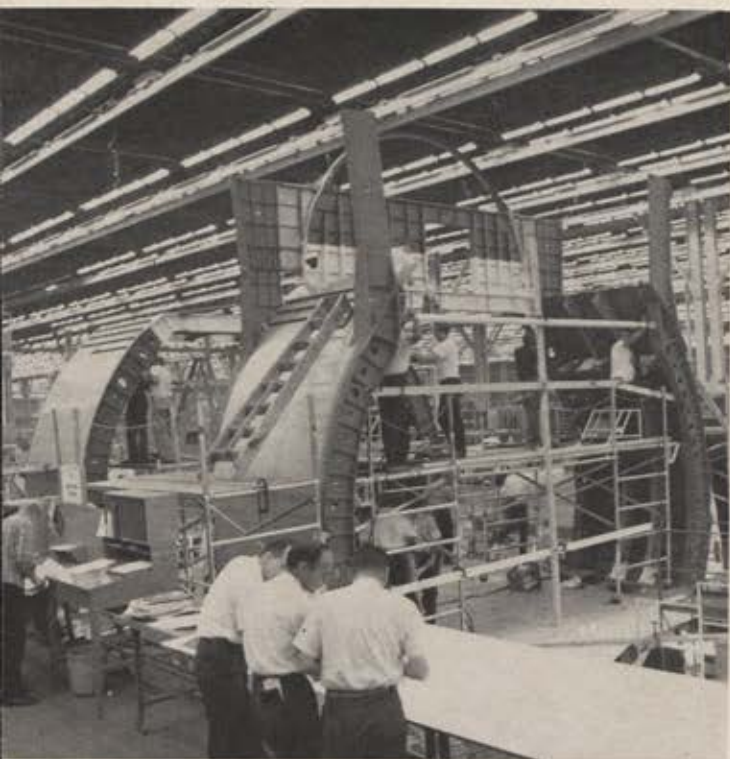
On the avionics simulator, acceptance tests for the multimode radar, the inertial navigation system, the interim radar altimeters, the attitude heading reference units, and the doppler radar have been completed.

These simulator tests are being followed up with airborne tests in a C-141 flying test-bed. Guidance system components have all been test flown. This program also includes testing of the inertial navigation and prototype MADAR systems.

One of the more significant structural component tests, a BL 120 joint, upper surface wing panel, was subjected to several compression loading sequences during the second week of February. It was finally loaded in compression until failure at 836,000 pounds. The test proved the analytical stress methods, and identified areas requiring minor configuration changes.



Giant test rig, set up at Lockheed plant, probes fuselage strength of the C-5. Future tests scheduled for C-5 include load distribution, pressurization, and loading operations.

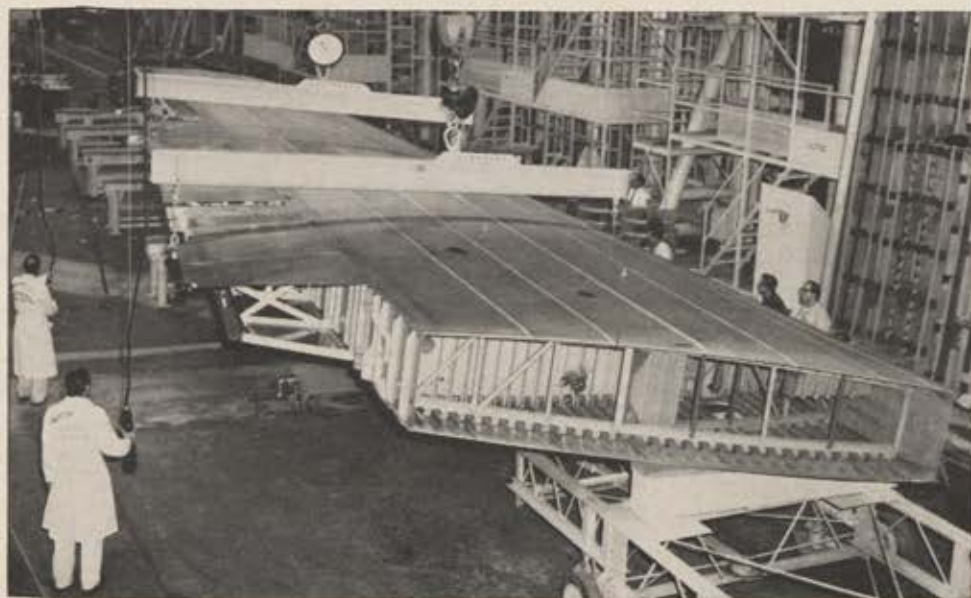


Fuselage frame assembly delineates the tremendous size of the C-5 Galaxy. A special building had to be constructed to mate the towering empennage with the fuselage.

A total of five airplanes will be used in the Category I flight-test program—Category I is the Lockheed-conducted portion of the test program while Category II is conducted by the military.

Some of the tests are combined Category I and II.

- The first airplane will be used to evaluate flight characteristics and the flight control system.
- The second airplane will be used for propulsion system and performance evaluation.
- Number three is programmed for structural integrity testing. Support area landing tests will be accomplished at Harpers Lake, Calif., in late 1969.



Depicted here is the Galaxy's huge outer wing section, as it moves from final assembly toward final test, to be shipped by rail from Avco Corporation's Aerostructures Division to the Lockheed-Georgia Co. in Marietta, Ga. Basic problem in designing the C-5 was combining the precision of aeronautics with the size of shipbuilding.

- The fourth airplane will be used for avionics testing.

- The fifth will conduct aerial delivery system testing at Fort Bragg, N. C., in 1969 and 1970.

Category II tests are the prime responsibility of the Air Force. Three additional airplanes are scheduled for Category II. Aircraft number 6 is a "Lead-the-Force" airplane and is scheduled to fly 2,700 hours during the first year. The seventh and eighth airplanes will be used for service suitability and extreme climatic testing. Reliability and maintainability testing will be done by the Air Force on aircraft numbers 4, 5, and 7. A total of 1,080 hours of testing is planned by mid-1970 to verify Lockheed's reliability and maintainability guarantees.

Our main production area looks somewhat like a shipyard, with much of the work being done on multi-level work stands and docks twenty to thirty feet above the floor. The forward, mid, and aft sections of the fuselage are assembled in separate jigs. They are then transported to the body-mate jig where they are floated together on air pads for precise location, then mated. Body mate of ship number 1 began on August 14, 1967, when the mid fuselage assembly was moved into position. On November 6, the completed fuselage moved from the body-mate jig to the wing dock. On December 7, ship number 1, with wings attached, was moved further down the line to line position 3. During the night of February 19, we moved airplane number 1 to the empennage-mate building for attachment of the sixty-five-foot-tall T-tail.

The special building was constructed to install the empennage, which towers six stories above the ground. Following empennage mate, the airplane was moved to our new flight-test hangar on February 24, where the official rollout ceremony took place on March 2. From here we go to the first flight in June, at which time we really get our teeth into the extensive flight-test program—and then on to production deliveries on what is proving to be the most exciting and challenging program we've ever tackled at Lockheed.—END

The TF39—Quantum Jump in Engine Technology



Underlying the C-5 concept is a radically advanced propulsion technology. It utilizes the combined, synergistic effects of high bypass ratio and sharply increased turbine inlet temperatures. Built by General Electric's Aircraft Engine Group, the TF39 extracts more energy from a specific amount of fuel than any existing aircraft engine. Shorter than many existing designs and not much heavier, it produces more than twice the thrust of any contemporary transport engine.

FOUR mighty fanjet engines—generating enough power to light a city of 50,000—will provide all 164,000 pounds of "muscle" needed to propel the 350-ton US Air Force/Lockheed C-5 jet transport.

Built by General Electric, the four TF39 turbofans are the free world's most powerful military jet engines. Each TF39 will deliver up to 41,100 pounds of thrust—yet will weigh in at just over 7,000 pounds. The TF39 measures sixteen feet from intake to exhaust and is eight feet in diameter at its widest point.

The engine's basic components include a large front fan, an advanced gas generator (*i.e.*, core engine), and a low-pressure fan turbine.

The TF39 has a dual rotor and variable stators. Its

stage-and-a-half front fan is driven by a six-stage, low-stress, low-temperature turbine through a shaft concentric with the core engine. The fan supercharges the gas generator, which consists of a variable-stator, sixteen-stage axial-flow compressor, an annular combustor, and a two-stage, air-cooled turbine. The core engine has a 16.8:1 pressure ratio, and the fan a pressure ratio of 1.55:1. Over-all pressure ratio at cruise is about 25:1.

The first seven stator stages (inlet guide vanes, plus six stators) of the core engine compressor are variable. The fan and core engine both discharge into fixed plug-type nozzles, with the core engine's cowling forming the plug nozzle for the fan.

Flight-test program of the General Electric TF39 engine started in the spring of 1967 with installation of the 41,100 pounds of thrust powerplant on a B-52, in place of two standard engines. Inherent growth potential of the eight-to-one bypass ratio design is said to be above the 50,000 pounds of thrust mark. Operating temperature is above 2,300 degrees.





TF39's most distinguishing characteristic is the huge stage-and-a-half front fan, which measures more than eight feet in diameter and provides high bypass ratio.

The TF39 has a bypass ratio of 8:1. Up to this time, the highest bypass ratio of any turbofan in operation anywhere in the world was less than 2:1. Bypass ratio is the ratio of the portion of the total fan flow that exits through the fan nozzle compared to the part of air that flows into the core engine. In the TF39, eight-ninths of this air, which has been compressed to about 150 percent of its original pressure, is discharged through the fan nozzle. The other one-ninth part of air flows into the core engine. Hence a bypass ratio of 8:1.

The one-ninth share of air that goes through the core is further raised to pressures twenty-five times the original air pressure as it moves through the com-

pressor. Then burned in the combustor to temperatures over 2,300 degrees Fahrenheit, this one-ninth part of air drives a two-stage and a six-stage turbine, which in turn drive the core engine compressor and the huge fan.

A half-stage fan in front of the full-span second stage is used to help make the pressure rise near the hub of the engine more nearly match the pressure rise at the outer tip. This allows the highest possible tip-to-hub ratio and smallest fan diameter for the required thrust. A smaller fan diameter also reduces aircraft drag. Without the half stage, the single stage fan would be seven percent larger in diameter.

A key to the TF39's low fuel consumption advantage is running the engine hot. Air entering the high-pressure turbine is in the 2,300 degree F. range, which compares to a range of 1,600 to 1,700 degrees in current operational jet engines. However, the turbine blades never feel this tremendous heat due to a unique air-cooling system developed by GE that keeps the turbine blade surfaces well below this 2,300 degree environment. This cooling technique is used in the first two turbine stages. The dropoff in gas temperature in these two stages is so great that air-cooling is not required in the following six turbine stages of the low-pressure fan turbine.

Reliability is a hallmark of the TF39. Initially, it will be scheduled for an automatic overhaul every 1,000 flight-hours—which will be about once every 500,000 miles, or twenty times around the world. After TF39 engines have logged about 2,000,000 miles, the interval will be extended to 5,000 hours—once every 2,500,000 miles, or, approximately 100 round-the-world flights!

TF39 dependability is the result of more than three years of extensive development testing at GE's Aircraft Engine Group plant in Cincinnati, Ohio. When it enters service, the TF39 will rank as one of the world's most tested jet engines. At the time of the C-5's maiden flight this June, GE's TF39 program will have logged approximately 150 flight-test hours and more than 7,000 factory-test hours.—END

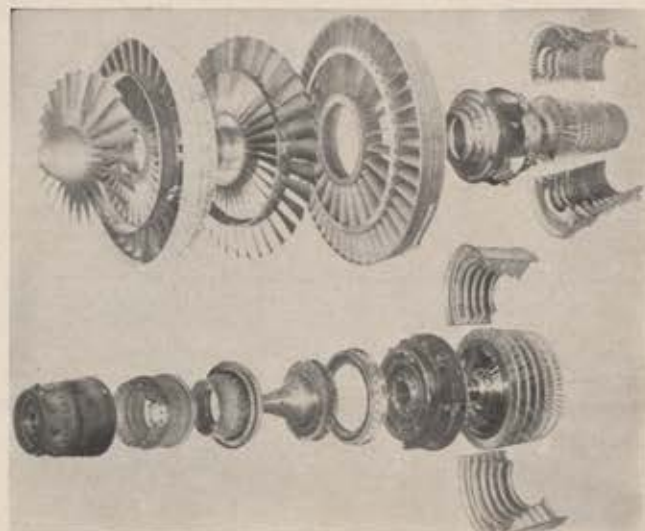
AT A GLANCE—THE GENERAL ELECTRIC TF39 TURBOFANS FOR THE C-5

Physical Characteristics

Weight (Spec.)	7,026 lb.
Over-all Length	15.7 ft.
Maximum Diameter	8.3 ft.
No. of Stages	
Front fan	1½
Main compressor	16
High-pressure turbine (air cooled)	2
Low-pressure turbine	6
Combustor	Annular
Fuel Control	Hydro mechanical

Performance

Maximum takeoff thrust (flat rated at 89.5° F.)	41,000 lb.
Maximum altitude and Mach No.	50,000 ft. Mach 1.0
Airflow at takeoff	1,549 lb./sec.
Bypass ratio	8:1 class
Over-all cruise pressure ratio	25:1 class
Turbine inlet temperature	2,300° F. class
Thrust-to-weight ratio	5.85:1
Specific fuel consumption	Classified



Exploded view of TF39 shows, from top left, first fan stage and stator plus second stage and stator, frame and compressor rotor and stators. Lower row shows compressor frame, combustor, nozzle, turbine rotor, and stators.

The C-5's Unique 'TIPS' System



The C-5's huge size precipitated new and special requirements in the design and integration of such areas as the environmental control, air turbine motor, and tire-inflation systems, all of which had to be designed for capacities substantially above existing hardware and with an eye toward maximum reliability and minimum weight. Garrett/AiResearch, operating with the so-called Total Integrated Pneumatic System (TIPS), is furnishing the C-5 with an advanced and thoroughly integrated environmental and pressurization system, which also performs such tasks as powering the C-5's special kneeling mechanism.

BECAUSE of its extraordinary size, capacity, and mission, the USAF C-5A required significant advances in equipment, design, and system-integration techniques to achieve success. Particularly important are improvements in component performance-to-weight ratios, reliability, and maintainability.

One might wonder if really significant improvements in performance-to-weight ratios can be achieved in this modern age when aircraft already in production are the product of intense design and price competition. The data in the table below demonstrates that such improvements are not only possible but have been achieved in the C-5A.

	707	C-141	C-5A
ECS Weight (lbs.)*	771.3	576	709
Airflow (lbs./min.)	250	200	500
Airflow/ECS Wt. (lbs./m/lb.)	.32	.35	.70

Design goals of reduced weight, improved performance, and increased reliability and maintainability were achieved by careful design of individual components of the various pneumatic subsystems.

TIPS Concept

The principal contribution of Garrett/AiResearch to the C-5A is the Total Integrated Pneumatic System (TIPS). The TIPS concept was initiated during the contract-definition phase (CDP) of the C-5 and was a vital part of the program through the development and will continue through qualification and operational use of the airplane. Garrett, as a subcontractor to the Lockheed-Georgia Co., has not only the responsibility for supplying the components for the pneumatic system but also that of system integration. (The number of components in ECS and BACS alone totals 123.)

Because of its role as system integrator, Garrett had the freedom to adjust design requirements among the many related pneumatic system components in order

to optimize the total system performance and weight. This component specification refinement has continued right through the development phase of the program with a minimum of redundant engineering at both Garrett and Lockheed.

Of course, Garrett does not install the equipment in the aircraft and so the role of system integrator is actually not complete. However, because of a working relationship with Lockheed developed over many years, it has been possible to minimize the number of problems which otherwise might have arisen.

Results of TIPS Concept

The Total Integrated Pneumatic System includes:

- Environmental Control System (ECS).
- Bleed Air Control System (BACS).
- Auxiliary Power Unit (APU).
- Air Turbine Motor (ATM).
- Air Turbine Starter (ATS).
- Tire Inflation System (TIS).
- Kneeling System Actuators.
- System Integration Hardware.

Environmental Control System

The Environmental Control System (ECS) consists of an air-cycle refrigeration subsystem, a compartment temperature-control subsystem, a cargo-floor heating subsystem, and a cabin-pressure control subsystem.

In flight, the ECS will automatically maintain an eighty-degree Fahrenheit temperature and an 8,000-foot altitude in the airplane on a hot day with a fresh air supply of twelve cfm per person. The upper forward deck is controllable to 70° F. on a hot day with twenty cfm per person.

Cold-day heating capabilities permit 70° F. minimum in the troop and cargo compartments and 80° F. minimum in the flight- and relief-crew compartments. The floor is heated to prevent freezing and to maintain an average floor temperature of 50° F. on a cold day.

During ground operation, using the APU-supplied air, the same temperature levels are maintained ex-

*The ECS (Environmental Control System) weights include the turbocompressor for the 707, the bleed air precooler for the C-141, and the bleed air control subsystem hardware necessary for the C-5/ECS to operate.

cept that only heating (no cooling) of the cargo compartment is required.

The air-cycle refrigeration subsystem consists of two bootstrap cycle packages. Each package uses a lightweight, highly efficient turbine compressor which operates normally at 50,000 rpm, a turbine-driven cooling fan, aluminum primary and secondary heat exchangers, a water separator, and ram-air exit modulating flap. Also included are a turbine-bypass valve and controls, a fan-modulating valve, and the controls necessary to program the fan speed, exit flap position, and turbine-bypass position for optimum system performance.

A unique feature resulting from the TIPS concept is the capability of controlling four compartment temperatures using the airflow from only two refrigeration packages and, at the same time, minimizing ram-air drag by modulation of cooling airflow. This is accomplished by use of a turbine-bypass control which discriminates between the various compartment demands for cold air and modulates the system to obtain the lowest required temperature at the water-separator discharge. Individual compartment temperature controls then add hot air as required to the flow to those compartments requiring higher temperatures.

The cabin-pressure system is completely automatic, but also provides for manual operation as well as emergency depressurization. The system utilizes an electronic control which transduces cabin pressure and cabin pressure rate of change into power signals to an electrically actuated cabin air outflow valve.

Bleed Air Control System

The Bleed Air Control System (BACS) mixes air from the last-stage bleed of the General Electric TF39 engine with air from the midstage bleed manifold to

control the supply pressure to the pneumatic system to thirty psig minimum as long as the last-stage air temperature is below 60° F. Additionally, temperature augmentation is provided when nacelle antiicing is required.

Auxiliary Power Units

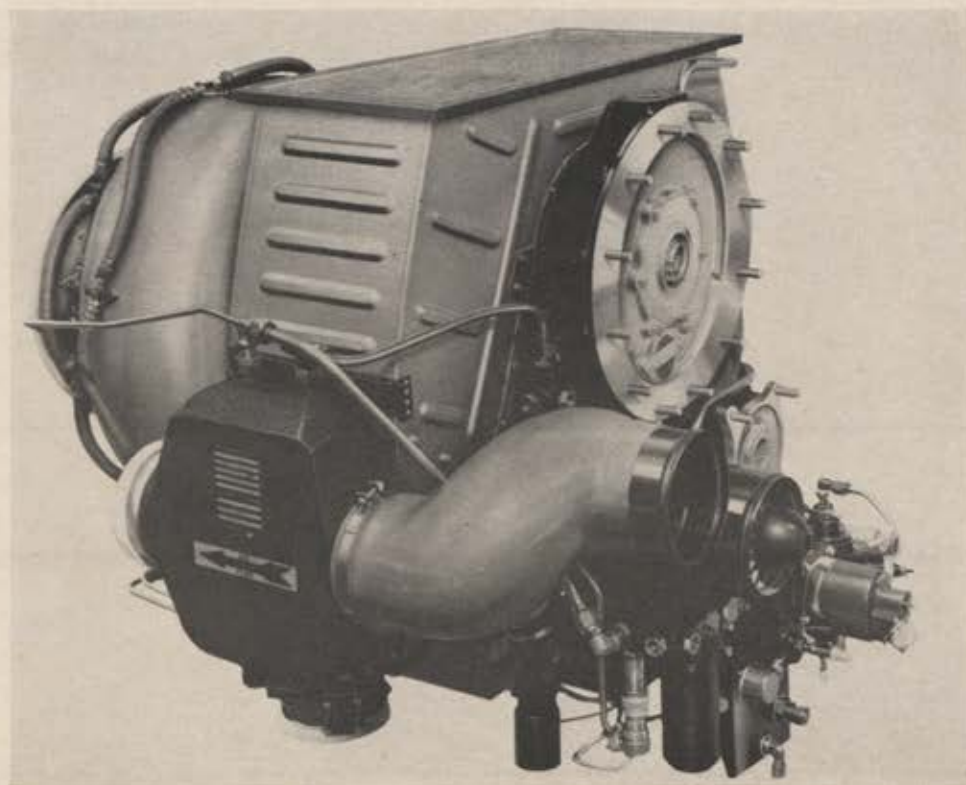
Two Garrett/AiResearch model GTCP 165-1 Auxiliary Power Units (APU) are used; one on each side of the airplane in the landing-gear pods. Either APU may be used to supply air to the engine starter (ATS) and essential ground services. The APUs are also used on the ground to supply electrical power, drive the Tire Inflation System (TIS); power two air-turbine motors (ATM), which drive hydraulic pumps; supply air to the main landing gear air motor drives (kneeling system); air conditioning; and floor heating. The APUs may be operated in flight for emergency starter assist.

Kneeling System Actuators

A recent addition to the Total Integrated Pneumatic System, the kneeling system actuators are pneumatically driven with air-turbine motors. The associated control valves are also part of TIPS.

System Integration Hardware

Certain hardware became necessary to properly integrate the pneumatic system. This includes various shut-off valves and controls. Especially noteworthy is a pressure-regulating or priority valve which became necessary when the ATM was added to the system. The valve operates automatically to maintain pressure to the ATM at the expense of the ECS. The specifications for this valve are extremely rigid.—END



Garrett/AiResearch provides the C-5 Galaxy with the unique Total Integrated Pneumatic System (TIPS), which is comprised of the Environmental Control System and a number of other subsystems such as tire inflation. Shown here is one of the Garrett/AiResearch Auxiliary Power Units.

The Galaxy Aims High in Navigation and Guidance



In addition to sheer size and payload, the C-5 will be able to do things no cargo aircraft has ever been able to. Furnishing a large share of these unique capabilities is the C-5's pioneering inertial-doppler navigation system, built by the Nortronics Division of Northrop Corp. In addition to higher accuracies than available in contemporary systems, the combined inertial-navigation and doppler technology will feature many self-testing features as well as a modular design to facilitate replacement of defective components.

NAVIGATION in the world's largest airplane, the US Air Force C-5 jet cargo transport, will be accomplished by an inertial-doppler navigation system produced by the Nortronics Division of Northrop Corp. in Hawthorne, Calif.

Developed and built under contract to the Lockheed-Georgia Co., builder of the C-5 Galaxy, Northrop's navigation equipment is the heart of the mammoth aircraft's guidance system. The self-contained system will be able to navigate accurately and correctly establish aircraft position under all weather conditions at any time, completely independent of ground-based aids.

The Northrop system is the first of its type—combining both doppler and inertial navigation techniques for optimum accuracy and backup capability—to be used in a cargo airplane. Inertial accuracy of the sys-

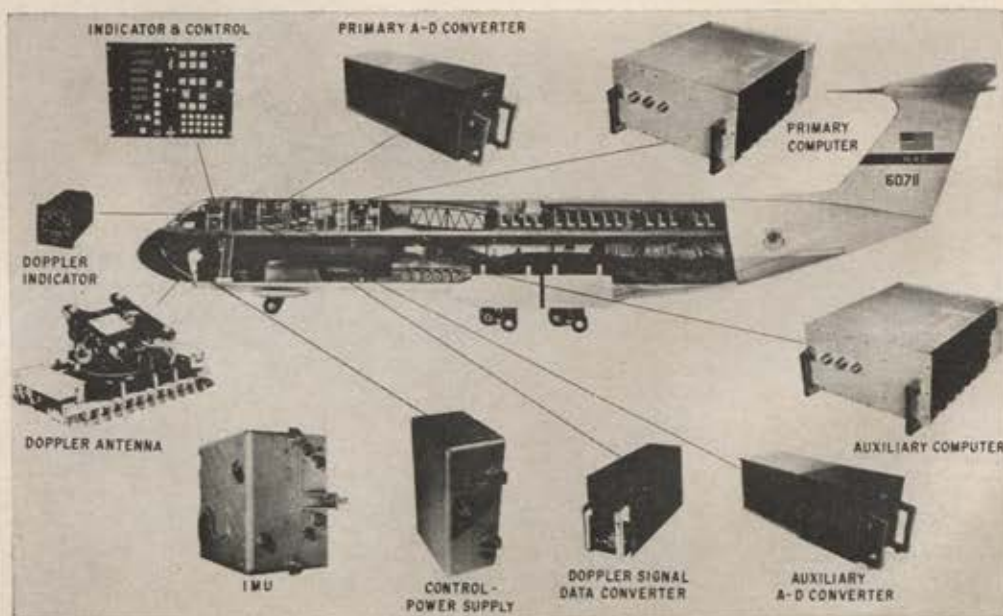
tem will be better than one nautical mile per hour, and can be further improved during flight with a feature known as "checkpoint incorporation."

The major functional groups of the navigation system are:

- An inertial measurement unit, consisting of a floated inertial platform with thermal conditioner and associated electronics;
- A doppler radar, including antenna, electronics, and indicators;
- A computational system, consisting of a primary and an auxiliary digital computer with input/output functions;
- Navigation display and control panels.

The doppler and the inertial portions of the system will each have a reliability of at least 1,000 hours mean time between failures (MTBF). The use of automatic,

First of its type, the C-5's elaborate navigation system employs both doppler and inertial navigation techniques to provide highest possible accuracies as well as backup capability. Nortronics Division of Northrop Corporation is the manufacturer.



built-in fault isolation procedures will enable rapid and simple maintenance of system components. The maintenance philosophy of the system emphasizes plug-in replaceable modules at the flight-line level.

Without the use of preflight ground equipment, the inertial-doppler system needs only twenty-five minutes to warm up and completely align itself for maximum performance in temperatures that can range from sixty-five degrees below zero to 160 degrees above.

For maximum navigational dependability, the inertial-doppler equipment can function in any of four navigation modes. In order of descending accuracy capability, these are: doppler-damped inertial; free inertial; doppler dead reckoning; and air-data dead reckoning.

In the event of malfunction within any part of the system, the "next best" mode available is automatically (or manually, if desired) selected to complete the mission effectively. This is possible through the use of a "self-diagnosis" test feature which takes into consideration the performance of the inertial-doppler equipment and prevailing conditions. The mode under which the equipment is operating at any time will be displayed on the navigator's control and display panels.

A second, distinct self-test feature of the system will be its ability during a mission to positively isolate doppler-inertial equipment faults to a replaceable modular unit to facilitate subsequent ground maintenance. Northrop Nortronics is also building, under separate contract to Lockheed-Georgia, the digital computers for the equipment that performs a similar function for all other C-5 systems—the malfunction analysis detection and recording (MADAR) system.

The inertial-doppler navigation system, in conjunction with precision radar equipment also on board, will vertically and horizontally guide the airplane automatically through the flight control system, or via displays to the pilot, to a point in space which is within the aircraft's safe landing minimums under adverse weather conditions. At this point the aircraft will be aligned to within a few feet of the center line of any selected runway.

For airdrop operations, the inertial-doppler system, in conjunction with other C-5 avionics, will perform a terminal navigation procedure to determine the Computed Air Release Point, or CARP. This will make it possible, under all weather conditions, to drop men and equipment accurately into a predetermined target area without dependence on ground-based navigation signals.

The navigation computer determines the air release point and generates steering signals to guide the aircraft over that point. After the drop, the navigation system will continue to guide the aircraft along the desired approach course until a new destination is selected.

The system's inertial measurement unit uses a unique floated inertial platform (FLIP) concept developed by Northrop Nortronics. The platform is an inertially stabilized sphere that is buoyant within a larger support sphere on a thin layer of fluid. The fluid gap provides complete and unrestricted freedom of rotation of the vehicle about the inner sphere.

The inertial measurement unit and all associated

electronics are packaged in a single housing about the size of a standard typewriter. The housing contains the floated inertial platform, platform electronics, and attitude readout servo assemblies. The platform electronics subassemblies consist of microelectronic modules, integrated circuits, and discrete components, mounted on circuit matrix boards.

The Precision Products Department of Northrop Nortronics, Norwood, Mass., manufactures the miniature, precision, gas-bearing inertial platform gyroscopes. These provide the basic reference for sensing every move made by the aircraft which would result in departure from the prefixed course.

Doppler radar for the C-5 navigation system is supplied by the GPL Division of General Precision, Inc., Pleasantville, N. Y. Computer memories are made by Electronic Memories, Inc., Hawthorne, Calif.

Kearfott Division of General Precision, Inc., Little Falls, N. J., is the subcontractor for platform accelerometers.

Electronic Memories, Inc., Hawthorne, Calif., is the subcontractor for the core memories for the navigation and MADAR computers.—END

The C-5's inertial platform employs a new floating principle, rather than mechanical support, for greater accuracies in measuring pitch, roll, and azimuth data.



Advanced microelectronic circuitry design and sophisticated packaging techniques enable Northrop Nortronics to provide the C-5's computers with exceptional capabilities.

The C-5's Advanced Multimode Radar System



Housed in a radome larger than the average backyard swimming pool is the C-5's multimode radar equipment, designed and built by the Norden Division of United Aircraft Corp. Uniquely versatile and precise, this system furnishes the Galaxy with such diverse capabilities as long-range ground mapping, terrain following and avoidance, global navigation, weather contour mapping, and station keeping. In addition, this sophisticated system will enable the C-5 to perform airdrops with unprecedented accuracy and to perform landings at night or in adverse weather, without ground aids.

THE multimode radar equipment for the Air Force C-5A Galaxy was developed by the Norden Division of United Aircraft Corp., Norwalk, Conn. It is a vital part of the C-5A guidance system, which is designed to achieve accurate global navigation and landings, day or night, in adverse weather, without any help from ground equipment.

The guidance system will permit approaches to support-area landing strips under weather conditions of 500-foot ceiling and one-mile visibility, following a 300-mile, low-level penetration of a hostile area. For airdrop missions, the C-5A's avionics system is capable of positioning the C-5A to drop supplies within a 100-meter circular probability.

First delivery of a multimode radar system was made by Norden to Lockheed-Georgia Co. in September 1967. The radar currently is being flight-tested aboard an Air Force C-141.

The C-5A radar equipment provides more capabilities than any other operating airborne radar equipment. Ground mapping, precision fix taking, weather mapping, terrain following, terrain avoidance, beacon, contour mapping, and radar approach to landing—all

these are included in the modes of operation. The equipment consists of two essentially independent radars, operating on K_a band and X band to perform multiple functions. Primary and backup functions are assigned to each radar, but all of the functions may be performed by either radar. Radar outputs may be shown simultaneously on three indicators, for pilot, copilot, and navigator.

Primary functions of the K_a-band radar are high-resolution, short-range ground mapping and radar approach for aircraft landings. Primary functions of the X-band radar are terrain following, terrain avoidance, and long-range ground mapping (250-nautical-mile range), ground contour mapping, weather contour mapping, and beacon operation. Each function can be independently controlled from any of the three operator positions. In case of failure of one radar during low-altitude penetration, the remaining radar can be used to provide simultaneous terrain following and ground mapping. Normally the X-band radar is controlled by the pilot or copilot, and the K_a band by the navigator. When ground aids are available, each radar

(Continued on page 93)

The C-5 Galaxy's immense radome, larger than a normal backyard swimming pool, houses unique navigation and guidance systems. Aircraft has precise global navigation capability and can land, day or night, in adverse weather without ground aids, through use of multimode radar.



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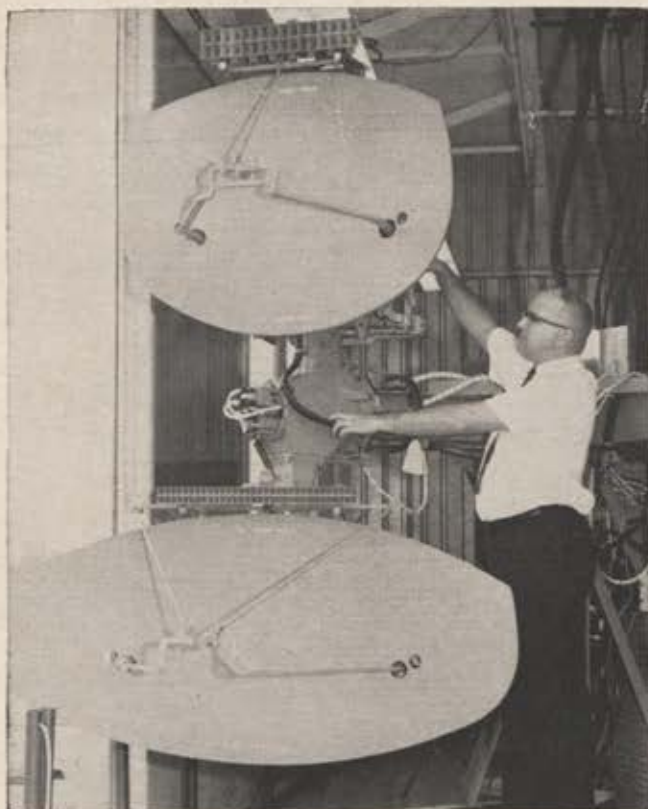
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RADIO ENGINEERING LABORATORIES DIVISION

Dynamics Corporation of America
Long Island City, New York, 11101





C-5's advanced-technology multimode radar system is produced by the Norden Division of United Aircraft Corp. The system employs two radars for full backup in all modes.

can interrogate and receive returns from beacons in its respective band.

The terrain following/terrain avoidance display shows three types of information. At the top of the display are two terrain ridge lines with a zero degree elevation reference line. One ridge line shows the terrain elevation angle versus azimuth angle ahead of the aircraft out to five to ten miles, depending on the range selected by the pilot. The other ridge line is for a range of 2.5 or five miles. The remainder of the scope shows a ± 45 degrees azimuth-scan contour map

with a five- or ten-mile range and, in the center of the display, steering information.

A centered PPI display can be selected for all search modes of operation. The pilots usually have a ± 90 degree scan about ground track, and the navigator additionally can select a north up display. The navigator has an aircraft heading mark when he uses a north up display.

The navigator can select a sector scan from ± 15 degrees to ± 60 degrees wide about a manual scan center. The pilots can select a ± 45 degrees depressed center scan. The navigator can also select a ± 15 degree to ± 60 degree sector scan centered about the azimuth cursor. The azimuth cursor can be controlled automatically by the guidance subsystem digital computer or by the navigator's cursor control.

For precision fix taking or a radar approach to landing, the navigator can select an expanded B display, which produces a ground map presentation that is centered about the range and bearing cursor. This display can be used for targets up to fifty miles in range.

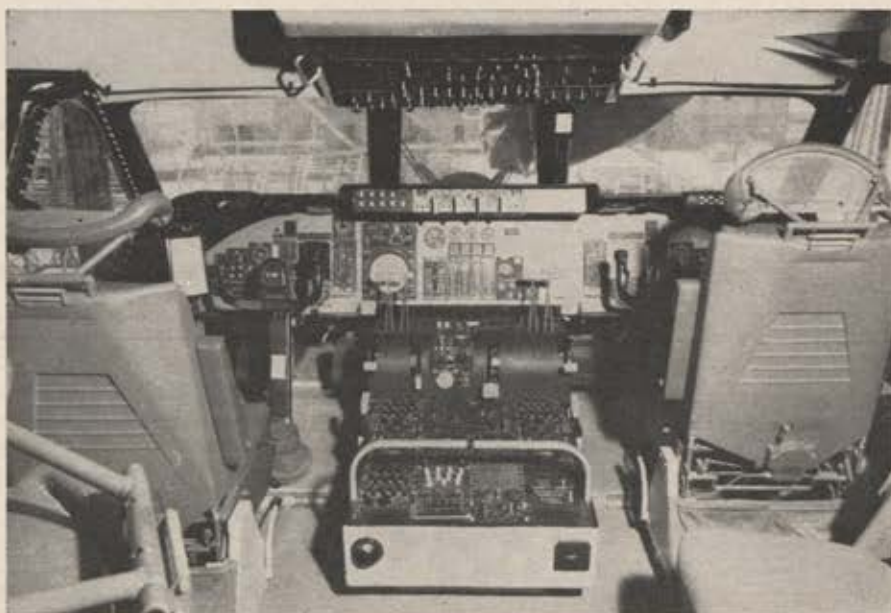
The station-keeping display is a 360-degree PPI. The video is obtained from a forward 180-degree scanning station-keeping system in the nose of the aircraft and from a rear 180-degree scanning system in the tail. The range displayed varies from 1.5 miles to twenty miles with 1/3-, one-, or five-mile range marks depending upon the range selected.

The equipment consists of two double-curved reflectors and two phase interferometer arrays mounted on a common-roll assembly. The phase interferometer technique, pioneered by Norden in its search and terrain clearance radar systems for the Navy's A-6A Intruder aircraft, is employed because of its extremely fast data-acquisition rate, wide elevation coverage, ability to perform ground mapping, and effectiveness at shallow grazing angles.

The C-5A multimode radar is the largest forward-looking airborne system ever built. It is housed, together with an inertial measurement unit, doppler radar, and the forward C-band station-keeping radar, in the nose radome, which measures nineteen feet wide, seventeen feet high, and ten feet long.—END

Despite its gigantic size, the C-5 Galaxy will have flight characteristics similar to and, in many instances, better than much smaller contemporary transport aircraft.

Novel and highly sophisticated avionics will make the pilot's job easier and compensate for high inertias inherent in C-5's great size. Multimode radar system, designed and manufactured by Norden, includes a number of capabilities that represent firsts for transport aircraft.



C-5 Opens New Era In Strategic Airlift



For the moment at least, the Military Airlift Command is the only using command for the C-5 Galaxy, and the one that set the giant airlifter's performance requirements. The C-5, for the first time, will enable MAC to provide the full strategic airlift vital to the flexible response policy of the nation. This capability will permit full unit integrity and will extend from the continental United States and rear-area points to forward airstrips within combat zones.

THE C-5 represents the fruition of a requirement that was identified as far back as October 1961 by the Military Airlift Command (MAC). MAC realized the need for a new aircraft to replace its C-133 force, and the need for an aircraft to support the Army's new mobility concepts. MAC outlined some range, payload, and performance parameters which, since that time, have been reevaluated and redefined many times by all agencies of the Department of Defense. In 1964, the C-5 requirements were finalized. Together they represented a major portion of the capability to provide the strategic airlift needed for the flexible response strategy of our national policy.

The primary mission of MAC is deployment of strategic forces in support of the national interest of the United States. During each of the four months just past, MAC has been involved in strategic deployment operations. The C-5, if it had been available, could have completed these deployments faster and would have provided a greater selection of operational options. For example, in November and December, MAC provided 391 missions for "Operation Eagle Thrust," the airlift of the 101st Airborne Division to South Vietnam. Missions would have been reduced to 115 using the C-5. In the deployment of US forces to Southeast Asia during January and February, the number of missions required would have been reduced by seventy percent. These are impressive statistics and illustrate the tremendous capability the C-5 will provide.

The C-5, in conjunction with the C-141, will provide a massive airlift capability to meet multiple war-time and/or contingency requirements. The high-flotation characteristics built into the aircraft and its short-field takeoff and landing ability will enable the C-5 to operate into short (4,000-foot), semiprepared airstrips. It will be used to deploy combat forces directly from the continental United States and rear-area marshaling

points into objective areas, using airdrop or landing techniques at semiprepared airstrips as far forward as the situation requires and aircraft performance permits.

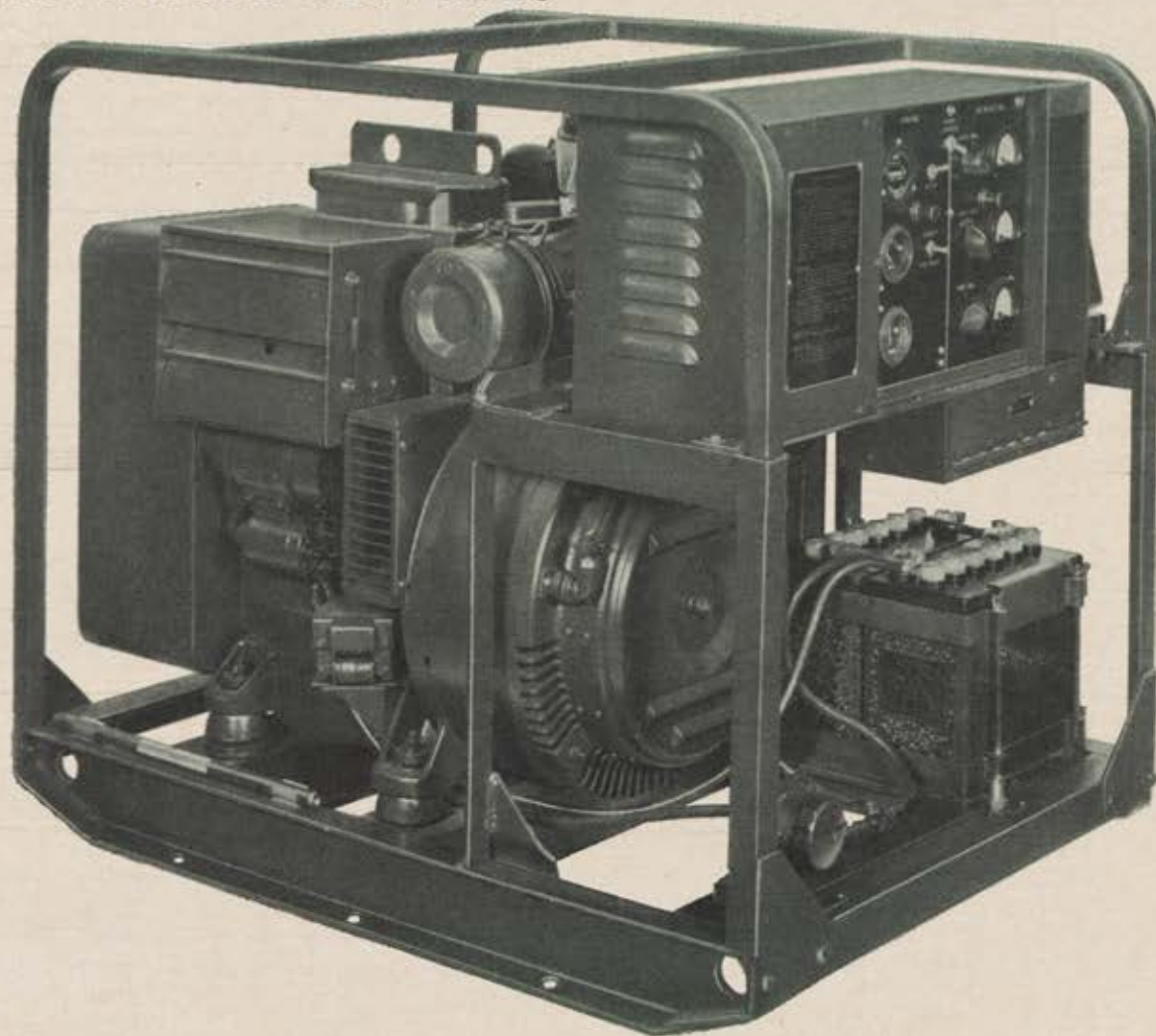
The very large cube and lifting capacity of the C-5, coupled with the ability to transport up to eighty-three troops in the upper deck, will permit us to deploy a wide variety of combat forces and still maintain unit integrity, which has not always been entirely possible up to now. Ninety-nine percent of all Army divisional equipment can be accommodated in the C-5 without major disassembly. Bulky items, such as a seventy-four-ton mobile scissors bridge, can be handled by the world's largest airlifter.

Each C-5 will be able to drop four 50,000-pound unit loads, a total of 200,000 pounds, in one pass over a drop zone. This airdrop capability is extremely flexible because of the navigational package on the C-5. The C-5's multimode radar and navigational computer system provides for terrain-avoidance and terrain-following flight paths. In addition, the radar has the capability to monitor thirty-six aircraft in formation. These capabilities allow for airdrops in weather and at night, with the guidance subsystems positioning the aircraft at the computed air release point for a drop within 100 meters of the desired drop zone. The capability of dropping 100 tons of Army equipment within 100 meters of the drop zone by one aircraft is a quantum jump forward in airdrop capability.

After initial deployment of the contingency forces, the next job for the strategic airlift forces is to resupply the deployed forces. In the resupply role, the C-5 will deliver supplies and equipment from the continental United States and rear-area logistics bases into multiple forward-area airfields as close as required to the forces being supported. In those forward-area airfields with little or no port facilities, air-transportable

(Continued on page 96)

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C-5's ability to carry a 265,000-pound payload, including outsized, bulky items, is portrayed by mockup showing the nineteen-foot-wide cargo compartment. Double row of six trucks and trailers can be accommodated with space for center and side aisles.

docks will be used to offload C-5 cargo. These docks can be set up in a minimum of time and each handle three C-5 cargo loads at one time.

Containerization and unitization of cargo, final configuration of which will depend on user requirements, will provide us with the methods for the more rapid movement of cargo which this massive airlift system demands. The design of the landing gear will allow a minimum of 130 landings and takeoffs at forward-area airfields. Such an airfield is constructed on ground which has a minimum soil stabilization sufficient to support an Army vehicle.

A recovery base concept will be used for both deployment and resupply operations into forward areas. The use of recovery bases takes advantage of the extended range capabilities of the C-5 and reduces facility and support requirements in the forward areas. Under this concept, the C-5 will arrive at the forward-area airfields with sufficient fuel to return to rear-area support airfields after offloading.

Aircrew staging, refueling, supply, and maintenance support will be consolidated at rear-area recovery bases. Support requirements in the forward area will be limited to those which are to make safety-of-flight emergency repairs on the aircraft, and those required to receive and disperse the forces, supplies, and equipment delivered. Ground times and congestion at the offload bases are substantially reduced, and vulnerability of the aircraft and crews is minimized. The use of recovery- and rear-area support bases also provides greater flexibility to respond to changing combat needs and moving fronts.

Another concept for the resupply mission will be the operation of the C-5 in conjunction with surface transportation. As an example, the C-5 may be employed in tandem with surface lines of communications, such as logistics ships. The C-5 and the ships under this concept would commence deployment of combat forces, supplies, and equipment at the outset of the contingency. The C-5 would operate between the continental United States and/or rear-area marshaling points and the theater of operations until the logistics ships begin to arrive in the theater. At that time, a portion, or, if required, all of the C-5 aircraft will commence operations between the surface offload area and the objective area. When very large forces and/or quantities of supplies and equipment are involved, the C-5 operating in tandem with surface lines of com-

munications provides very high productivity and the ability to inject large quantities into the forward areas in minimum time.

The sole peacetime mission of MAC is to prepare for the wartime mission. There are various airlift operations undertaken to prepare for this mission—which includes joint airborne training, exercises, and special and logistics lift. The by-product of some of this training is productive airlift capability for movement of Department of Defense peacetime requirements. The C-5 will, within its capabilities, provide airlift for all air-eligible DoD cargo, equipment, and supplies from established, multidirectional aerial ports in the continental United States to aerial ports in the overseas areas; between aerial ports in the overseas areas; and from overseas aerial ports to continental United States aerial ports.

The flow of cargo between this network of strategically located bases will be on an established frequency determined by the Joint Chiefs of Staff or Department of Defense user requirements. To obtain maximum effectiveness and economy from the C-5, the eighty-three troop/courier seats built into the upper deck will be used to airlift couriers, drivers, and troops.

The C-5 will also be used on special assignment missions to provide the capability to airlift items which are outsized by dimensions and/or weight to present transport aircraft. The extended range of the C-5 and the wider range of airfields into which it can operate will permit airlift delivery of supplies and equipment into areas and airfields which have heretofore been denied the strategic airlift force. The C-5 will be employed in providing such special airlift throughout the world, as required.

In summary, the C-5, in conjunction with the C-141, will provide the long-sought airlift capability required for true strategic mobility. This force will provide the airlift capability for massive deployment and support of combat and support forces anywhere in the world under almost any condition. In nonemergency conditions, the C-5 will be used in training our own airlift forces and the combat and support forces we support to ensure instant and effective responsiveness to our wartime missions. We in the Military Airlift Command are proud to be associated with this revolutionary development in air transportation. We are certain that the C-5 will provide the air logistics capability that is programmed in the 1970s.—END

The C-5—Capable of Many Different Missions



Inherent in the C-5's great size, range, and payload capability is the potential for missions other than heavy logistic transport. Lockheed, in conjunction with other defense planning authorities, has studied a number of corollary missions for the C-5, which run the gamut from nuclear-powered missile launcher to mine-layer. Here Lockheed-Georgia Company Vice President F. A. Cleveland outlines some specific corollary missions for the C-5.

WHEN we started working on the basic C-5, we also began planning corollary applications to take advantage of the airplane's unique design and performance. The C-5's capabilities will permit significant improvement and concept expansion in current missions. It will also allow the performance of jobs that heretofore have been considered marginal for aircraft.

The C-5 has built-in features that make it well suited for other mission applications. Of particular importance are its large and flexible internal volume, high payload capacity, and long range and endurance.

A list of more than 100 potential new missions has been developed, and most have been investigated in depth. We have selected seven of these to discuss in more detail.

- **Airborne Command Post**—One of the most obvious potential corollary applications for the C-5 is as an Airborne Command Post. An Airborne Command Post must provide survivable command and control capability, either immediately following an attack on the United States or friendly countries or when such an attack is believed to be imminent. A large aircraft, having long endurance at altitudes above 28,000 feet,

is required. Our studies show that the C-5 is well suited for this mission. Its tremendous size easily permits a variety of three-deck arrangements. The basic C-5 can be configured to meet Airborne Command Post requirements by removing the ramps and nose actuation features, all cargo-handling equipment basic to the airlifter, adding a third deck and appropriate antennas, avionics, and electrical power equipment. Figure 1 illustrates one arrangement under study.

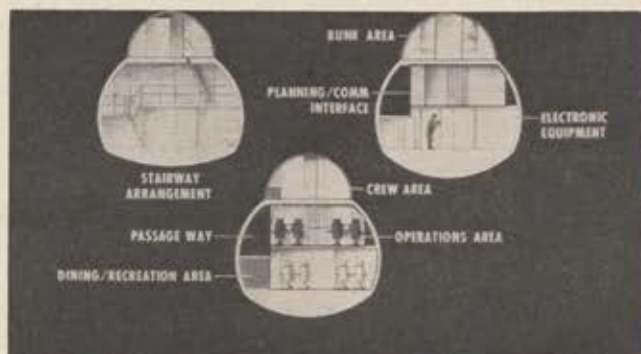
The cross-sectional layout might look like the accompanying illustration. On the left are the stairways—at the forward and aft ends of the command and control area—which permit ready access to the three decks. The center view shows the operations, dining, and recreation areas. The passageway on the left runs the full length of the command and control area and permits traffic without interference with operational activity. Separate doorways from this passageway are provided to the operations and planning areas. On the right are two rows of electronic equipment on the lower deck, the planning area on the second deck, and bunks on the upper deck.

- **Armed Command Post**—The Airborne Command

(Continued on following page)



C-5's potential for use as an Airborne Command Post is most promising corollary mission currently under study. In-board profile layout shown here features three decks.



Cross-sectional layout of Airborne Command Post shows operations, dining, and recreation areas of C-5, which would provide survivable command and control capabilities.

C-5 is shown here adapted for corollary mission as radar early-warning aircraft. A number of other missions for the C-5 Galaxy are being examined by government and industry, including that of a tanker, missile launcher, and even bomber. Payload of any would, of course, exceed substantially that of contemporary, comparable aircraft. Lastly, C-5's magnitude permits active consideration of nuclear power.



Post function could be combined with a defensive missile capability. In this mission, the aircraft would loiter offshore loaded with defensive missiles and electronic warning and detection systems, making it an armed early-warning station capable of directing its self-contained air-to-air missiles, and ground-based interceptors, against enemy targets. The C-5's size and inherent endurance make this dual mission possible. Missiles would be carried in the lower area of the main compartment and launched through missile ejection bays in the aft end of the airplane. The number of interceptor missiles that could be carried far exceeds the quantity that can be carried by existing aircraft.

• **Minimum Modification Tanker**—The C-5 also looks good as a tanker. Through relatively minor modifications, it could be converted to a tanker that would possess two very important operational advantages: greater off-load capability and the ability to operate from support-area airfields. To convert the basic C-5 to a min-mod tanker, a palletized boom control station is mounted on the aft ramp, and the aft fuselage doors are replaced by fairings.

The fuel off-load characteristics of the minimum modification tanker are impressive. At 1,000-nautical-mile radius, present tankers can offload 137,000 pounds of fuel—the C-5, 332,000 pounds. However, this doesn't represent the complete tanker potential of the airplane. Our engineers are looking at other configurations that will have even better performance characteristics.

• **Medusa Concept**—In addition to the defensive missile concept discussed earlier, we have looked at several concepts for launching ballistic missiles, including a design launching missiles from vertical fuselage tubes. This represents the first time that a substantial number of large missiles could be carried internally in an aircraft and launched vertically. The missile is a Polaris type, conceived by Martin during a study conducted for USAF. Missiles could be launched either in flight or when the airplane is on the ground.

• **Low-Altitude Cruise Missile Launcher**—The C-5 could also serve as a platform for launching low-altitude cruise missiles. The missile is released from an overhead rail system through the aft aerial delivery opening of the airplane. Its motor ignites after it reaches a point safely below the C-5.

• **Minelayer**—In addition to its Air Force missions, the C-5 offers potential for numerous Navy tasks. For example, one C-5 could, on a single mission, deliver more than 400 500-pound mines, 200 1,000-pounders, or 100 of the 2,000-pound class. This is quite an improvement over our present minelaying capability of about fourteen mines per aircraft, or fifty mines on a surface ship or submarine.

• **Nuclear Airplane**—One of the obstacles to development of a nuclear-powered airplane has been the lack of an airframe large enough to accommodate the propulsion system, thus requiring costly airplane development concurrently with the reactor and associated equipment development. However, with the introduction of the C-5, this obstacle is removed. We are investigating several approaches to nuclear propulsion. In one concept, chemical fuel would be used for take-off and landing. This requires a dual-purpose engine having a heat exchanger in line with the combustion chambers to permit operation in either chemical or nuclear mode. A unit-shielded reactor would be located in the center of the airplane. Since a nuclear-powered C-5 would have virtually unlimited range, it would represent as great an improvement over the C-5 as the C-5 does over previous cargo aircraft.

These are just a few of the jobs which the C-5 can do in addition to its basic mission. We think its more significant characteristics, i.e., large volume, high payload, and long range and endurance, make it ideal for the airborne command post, missile launcher, minelayer, and nuclear missions just described; but we also feel that it can excel in just about any application—the list may be limited only by our imagination.—END

HOW AFLC DESIGNED INTRINSIC EASE OF MAINTENANCE INTO C-5



From the inception of the C-5 program, Air Force Logistics Command planners and specialists instilled advanced and comprehensive ease-of-maintenance features into the design. These include MADAR (an on-board automatic malfunction detection and recording system), the first of its kind, which represents a substantial advance in both aircraft maintainability and reliability. As for the C-5's importance to the Air Force logistics mission, the following AFLC report terms the aircraft a giant step forward.

LOGISTICS support of the C-5A Galaxy will be centered at Air Force Logistics Command's San Antonio Air Materiel Area (SAAMA—Kelly AFB, Tex.), which has been designated system support management AMA for the aircraft and item manager for its TF39 engine.

Although SAAMA will be the prime logistics support AMA, other AFLC facilities will also be involved since they manage items common to all aircraft. For example, many of the aircraft instrument items will be managed by Oklahoma City Air Materiel Area, since they are common to other aircraft and OCAMA has item manager responsibility for this supply class. Other AFLC depots will similarly be involved with the C-5.

However, the focal point of C-5A logistics support will be SAAMA.

It is estimated that 130,000 items will be stocked in the AFLC system in support of the C-5A. These items will be ordered by the using command—Military Air-lift Command—as necessary to maintain the C-5A at operating bases. Many of the parts, however, relate to depot-level maintenance and will be used internally within AFLC. This 130,000-item inventory will not be centralized at SAAMA, though many of the items will be stocked there. Each AMA will have its share of the inventory, depending upon the items they manage.

From a logistics standpoint the C-5A will not offer any significant unique supply or maintenance problems to AFLC. Despite its huge size, approximately sixty percent of the spare parts and forty-five percent of the ground-support equipment required for the C-5A are already in common use for other aircraft in the Air Force inventory. Even where there are new design requirements such as are evident in the jet engine, the landing gear, or the airborne electronics equipment, the Air Force has contractually placed a great deal of emphasis on simplicity in design and maintenance tasks, and a high level of system reliability.

In addition, the maintenance practices for the C-5A will be essentially the same as for other Air Force jet transport aircraft, such as the C-141. At the same time, Air Force maintenance capabilities should be enhanced by the C-5A on-board automatic malfunction and detection system (MADAR), the first of its kind. Thus, AFLC will be in a position to make immediate and maximum use of its existing supply and maintenance management systems in supporting the C-5A, and anticipates that long-term logistics support will be greatly enhanced by the stringent system maintainability and reliability performance requirements.

2,600 People Involved

At the peak of the C-5A program it is expected that some 2,600 AFLC personnel will be involved in direct support of the aircraft. This represents about two percent of the command's civilian work force.

(Continued on following page)



Colossal in size and cargo capability, the C-5 creates an entirely new concept in logistics and strategic mobility.



A number of on-board digital computers furnish the C-5 the exacting and unique capabilities required by USAF. Northrop Nortronics is manufacturer of the C-5's computers.

SAAMA has been preparing for assumption of C-5A logistics support since the mission was assigned there in October 1965. A system support management organization was set up in the Directorate of Materiel Management at that time and the nucleus of the organization that will eventually have full responsibility for keeping the giant transport at a high rate of operational readiness was formed.

Subsequently, a resident provisioning team from SAAMA was established at the Lockheed facility at Marietta, Ga. This team's responsibilities are to ensure that spares are procured in economic quantities and in a timely manner.

SAAMA also has at Lockheed a materiel improvement team, which will review and process engineering changes that are necessary during production.

AFLC Planned Ahead

Even before the mission was assigned to SAAMA, however, AFLC was heavily involved in planning for C-5A support. When the aircraft was still in the conceptual stage, and continuing during the evaluation and contractor selection, logistics experts from AFLC worked with other responsible Air Force organizations, providing the logistics expertise to ensure that the system being planned has supportability, maintainability, and reliability.

From conception onward, AFLC specialists have served as principal logistics advisers on the C-5A, accomplishing the preliminary logistics planning concurrent with the planning for research, development, and testing of the aircraft. This has been accomplished initially through an AFLC Plans Office and later more directly by a SAAMA logistics detachment assigned to the C-5A System Program Office (SPO) at Aeronautical Systems Division, Wright-Patterson AFB, Ohio.

This SAAMA detachment has been deeply involved in every aspect of the program. They have participated in all the detailed logistics planning, spelling out in detail how the weapon system will be supported during both its testing and operational life. They have participated in the updating and rewriting of specifications, developing new criteria and requirements for contractor change proposals, preparing data for updating budgets and programming data, and assisting in the technical evaluation of the various components of the system to ensure the operational supportability, maintainability, and reliability.

All of the AFLC and SAAMA effort is directed toward one goal—providing a high level of logistics support to the nation's newest weapon system once it is delivered to the operational command.

Revolutionary Logistics Impact

The effect which the C-5A will have on logistics—and particularly transportation—will be far-reaching. It has been predicted that this aircraft will create a transportation milestone of sufficient impact to completely reorient and modernize military logistics concepts.

The C-5A will carry a 112,600-pound payload 5,500 nautical miles, or 220,000 pounds 3,050 nautical miles without refueling. It will land on strips of less than 4,200 feet at sea level on a tropical day.

This giant aircraft—245 feet long, sixty-five feet high, and with a wingspan of 223 feet—contains 2,300 square feet of floor space and more than 34,000 cubic feet.

A Vital Tool for Logisticians

In supporting ever-lengthening supply lines, the C-5A will provide the military logistician with a vital new tool.

The C-5A will be five times as productive as the C-141, which is a highly productive aircraft itself, and twenty times as productive as the C-124.

Direct operating costs will be about four cents per ton-mile, compared with seven and a half cents under current accounting procedures for the C-141, and twelve cents for piston-engine transports.

The primary requirement, of course, is the massive movement of military equipment, much of which is oversize for airlift by the present fleet, and passenger accommodations for the troops who would operate and use it.

Great advancements in military logistics have historically, and of necessity, been preceded by giant forward steps in transportation.

The C-5A is one of these steps.—END



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C-5 Points the Way To Even More Advanced Aeronautical Technologies

The C-5 is opening new vistas and, in that sense, will serve as a catalyst for an upsurge in such vital areas as aerodynamics, propulsion efficiency, and new structural materials. By pushing the state of the art in terms of available technology, it accelerates advances on a broad front for future transport designs. In the following article, Lockheed-Georgia's Chief Advanced Design Engineer, R. B. Ormsby, illuminates some of the promising future transport technologies that suggest themselves on the basis of the C-5 experience.

IN THIS discussion of future aircraft technology as applied to transport aircraft, I shall examine three areas: aerodynamics, propulsion, and structures. While there will be important advances in aircraft subsystems such as electronics, hydraulics, electrical, etc., the basic configuration of future aircraft will depend primarily on the technology areas selected for discussion. Improvements in the subsystem areas will permit vastly increased operational capabilities through improved reliability, reduced maintenance, and all-weather capability.

First, some important advances in the aerodynamics area.

Lockheed progress in advanced airfoil technology is shown in the accompanying illustration (*see Figure 1*). Wind-tunnel tests have established the relationship of two-dimensional lift coefficient and drag divergence Mach numbers as shown for three levels of technology. By drag divergence Mach number, I mean the highest Mach which can be used for long-range cruise flight. The curve labeled "Six Series" is typical of the characteristics of the NACA airfoils in the 1950s. Incorpora-

C-5 introduced completely new concepts into aeronautical technology in such fields as aerodynamics, propulsion, and structures. Rather than scaling up existing designs, the giant transport called for innovative techniques and completely new technologies which give rise to a wave of further advances that promise to revolutionize both commercial and military aviation.



LOCKHEED PROGRESS

AIRFOIL TECHNOLOGY

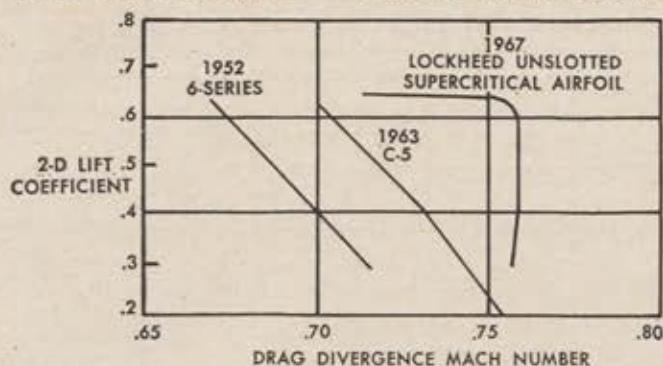


Figure One.

THREE-DIMENSIONAL WING CHARACTERISTICS

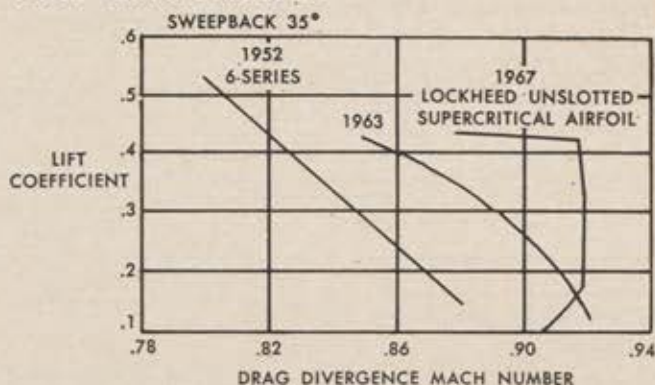


Figure Two.

tion of the "peakiness concept," or high leading edge suction, during the early C-5 development program produced the C-5 technology curve.

Subsequent effort has been directed toward a supercritical airfoil concept, and this work has produced the test results shown on the curve at the right. For a given lift coefficient, the drag divergence Mach number has been increased substantially. These data are, of course, for a constant wing thickness and for zero sweep. Note that these drag divergence Mach numbers are for the two-dimensional case and are substantially increased for the swept-wing case, as shown in the second illustration (Figure 2).

Here the drag divergence characteristics of the two-dimensional airfoil data shown in Figure 1 have been applied to a thirty-five-degree swept wing of constant thickness. It can be seen that the unslotted supercritical airfoil is capable of going to Mach .92 before the drag divergence is reached. We have similar efforts to extend this work into the supersonic case.

It's also worth noting that these results were first achieved in 1967 and are already in hand from a basic technology point of view. For this reason we are quite safe in predicting successful application to airplanes to be operational in the 1975-1980 time period since adequate time is available for the necessary further detailed refinement necessary before applying this approach to an actual airplane.

In leaving this area of aerodynamic improvements, I might note we have made similar advances in analytic techniques to reduce drag of the fuselage, and wing fuselage intersections.

I'll turn now to the development of engine technology.

We foresee improvements in engine technology development both in specific thrust and in specific fuel consumption (see Figure 3). The column labeled

SFC IMPROVEMENTS

	CURRENT	1975 MAX	Δ SFC/SFC	
			0.9M TF	2.0M TJ
CYCLE	2100°F PR 25	2500°F PR 40	1.4%	2.4%
INLET (SUPERSONIC)	92% P_T	94% P_T	—	0.9%
COMPR/FAN EFF	87%	89%	0.4%	1.2%
TURBINE EFF	90%	92%	0.4%	1.5%
COMBUST EFF	98%	99%	1.0%	1.0%
NOZZLE VEL COEFF	98.5%	99.5%	2.7%	2.1%
			5.9%	9.1%

Figure Three.

"Current" assumes values of 2,100 degrees Fahrenheit for turbine-inlet temperatures, and twenty-five for an over-all pressure ratio. These are representative of current technologies. The current component efficiencies for inlets, compressors/fans, turbines, combustion sections, and nozzle velocity coefficients are as shown. The next column labeled "1975" shows the maximum improvements that may be expected in these areas for engines having turbine-inlet temperatures of 2,500 de-

(Continued on page 104)



degrees Fahrenheit and pressure ratios of about forty, which we feel are representative for that state of the art.

The right two columns labeled "Mach .9 Turbofan" and "Mach 2 Turbojet" show percentage reductions in specific fuel consumptions for the 1975 engines as compared to current values. We anticipate improvement of about six percent in subsonic turbofan engine SFCs and a little over nine percent for the Mach 2 turbojet.

STRUCTURAL MATERIAL WEIGHT COMPARISON

COMPONENT	ALUMINUM	BORON COMPOSITE	TITANIUM	BERYLLIUM
WING	1.0	0.5	0.8	—
VERTICAL FIN	1.0	0.6	0.9	0.6
STABILIZER	1.0	0.6	0.9	0.6
RUDDER ELEVATOR AILERON	1.0	0.6	1.0	0.5
FUSELAGE	1.0	0.7	0.9	—
NACELLES PYLONS	1.0	0.7	0.8	—

Figure Four.

Figure 4 outlines the developments which may be expected in the field of aircraft structures and materials.

Advances being made in new structural materials will permit new design concepts to be developed which were not feasible in the past because of inadequate strength and stiffness. The estimated effect on component weight for an advanced transport airframe is shown on this chart for aluminum, boron, titanium, and beryllium. The reference in this case is aluminum structure. Boron composites offer attractive weight reductions in all of the structural components listed. Weight reductions resulting from the use of titanium are less spectacular than those resulting from the use of boron composite, but in some cases may be more realistically achievable when costs are considered. Weight savings for beryllium, in the right column, are shown only for those portions of the airframe which appear amenable to the use of beryllium.

Combining the improvements in aerodynamics, propulsion, and structures as discussed, we can develop aircraft which result in the data shown in Figure 5. For

GROSS WEIGHT OF ADVANCED TECHNOLOGY TRANSPORTS

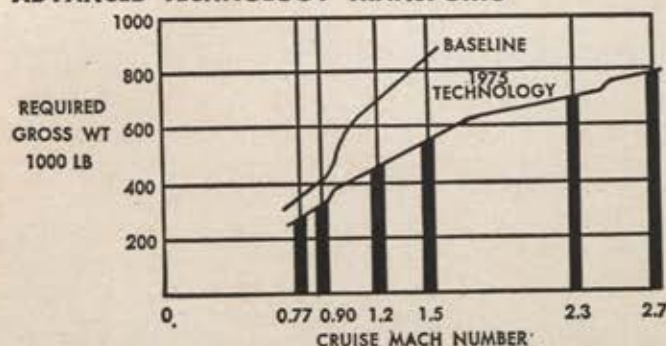


Figure Five.

this analysis we assume a design payload of 100,000 pounds and a design range of 4,000 nautical miles. The heavy vertical bars at Mach .77, .9, 1.2, 1.5, 2.3, and 2.7 represent specific design point studies.

We have performed other studies of size variation of aircraft, and it would appear that the general relationships shown here also extend to larger aircraft having payloads in excess of 300,000 pounds and gross weights of over 1,000,000 pounds. All of these improvements are quite dramatic when expressed in terms of critical Mach numbers, engine performance parameters, and weight fractions, as I have done in the discussion to this point.

For military missions, where slight performance advantages may mean the difference between success or failure, many if not all of these improved technologies will be used extensively in aircraft operational in the 1975-1980 time period. For commercial operations, however, it is necessary that these improved technologies reduce operating costs before the designer will incorporate them on a large scale in a successful commercial design. We have performed an analysis to determine benefits of advanced technology for the commercial market in the 1975-1980 period.

DIRECT OPERATING COST

LG500-114M & LGX-160

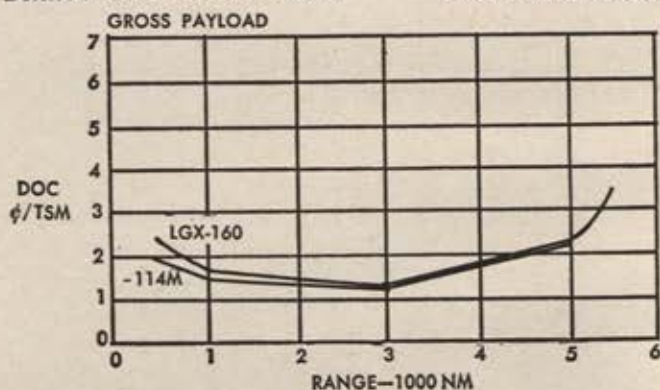


Figure Six.

Figure 6 shows direct operating cost in cents per ton-statute mile calculated by the ATA formula as a function of range for two aircraft; the first is the LGX-160, an advanced technology airplane, and the other is the L500-114M, a greatly modified and extensively changed commercial adaptation of the C-5 military transport.

As you can see, the direct operating cost of the two aircraft are quite close together, and for ranges of 2,000 to 4,000 nautical miles the direct operating costs are almost identical. For this reason, and because the L500 can be available in the early 1970s, we are quite heavily engaged in defining an L500 airplane for the commercial cargo market.

In summary, we are quite optimistic that the proposed L500 long-range cargo transport will offer the airlines a new level of capability to meet the rapidly expanding market for containerized air cargo. It can carry fifty percent greater payloads on transatlantic routes than competitive aircraft, will operate at thirty percent lower cost per ton-mile, and has sixty-five percent greater earnings potential.—END

THE SPACE AGE IN PERSPECTIVE

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DIGEST

VOLUME 11, NUMBER 4 • APRIL 1968

Tactics and Technology for Limited War: Systems Command's Role

By Gen. James Ferguson, USAF 109

Air Force Systems Command is working hard to put technology to work in solving military problems in Southeast Asia through a direct line from the origin of a need in Southeast Asia to the source of R&D authority in the Pentagon, while continuing to look to future requirements.

What Makes Technology Run?

By Martin Góland 116

There are many factors involved in developing technology and predicting, once developed, the good or evil, or both, it does for society. There is no single approach that can take all of these factors into account in every case, and therefore no easy formula to guide and direct its use.

Selling the Space Program on its Merits

By Rep. Joseph E. Karth 122

Although we succeeded in catching and holding the public's interest in the manned space program for a time, we somehow have missed informing the man in the street, in terms he can understand, of the earthly benefits he can expect from the investment in the space program.

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Weather has no respect for national boundaries. Perhaps that's why international cooperation in forecasting has for a long time been a constant in an area fraught with inconsistency.

Cooperation is important, but it's not the only answer to more accurate and longer range forecasting. Computer technology is a key factor.

This is fortunate for the United States, because no other nation is further advanced in this area.

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Geophysical Fluid Dynamics Laboratory use them to simulate the earth's atmosphere by means of theoretical models.

Their goal is to develop a satisfactory model comprised of elements which closely approximate those of the real atmosphere.

By changing just one variable in this mathematical model—sea surface temperature, snow cover, atmospheric pollutants, for instance—scientists can in effect experiment with the atmosphere and determine how that one alteration influences the entire model.

These simulations are so complex, the elements so numerous that a 24-hour forecast for the northern hemisphere can take 10 hours of computing.

Despite this scientists are optimistic. In fact, current results indicate that reliable 14-day forecasts are a distinct future possibility. Also, the observational network must be expanded to the whole of the earth.

It will take some time, therefore, before two week forecasts become standard. Scientists estimate five to ten years.

But if it weren't for computers, it might take forever.

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Univac is saving a lot of people a lot of time.

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No one can stop the rain, but we can help you be ready for it.



Through a direct line from the origin of a need in Southeast Asia operational situation to the source of research and development action authority in the Pentagon, Air Force Systems Command is working hard to put technology to work in solving military problems in Vietnam . . .

Tactics and Technology for Limited War: Systems Command's Role

BY GEN. JAMES FERGUSON, USAF

Commander, Air Force Systems Command

RESearch and development is charged today with the responsibility of being in two places at once—at the frontier of future opportunities and on the doorstep of present problems.

The challenge of supplying the needs of our operational forces, whether those needs are ten minutes or ten years away, is resulting in a new order of responsiveness on the part of the Air Force Systems Command. The contributions of research and development to US needs in Vietnam represent an "unlimited war" on limited war, a concentrated effort within the Air Force to influence tactics by the use of technology.

Historically, nations have entered into successive wars with the weapons and concepts that had been successful in the last war. If the conflict lasts any length of time, innovations in techniques or technologies will occur, and these tend to persist until other wars bring about

other changes. However, the circumstances of recent years in the course of the cold, hot, and technological wars going on among nations suggest that the time interval for innovation and technological inventiveness is growing increasingly shorter. In fact, the day may be near when "leftover" weapons and on-the-shelf technologies will be inadequate, insufficient, or ineffective as a means of winning a war or discouraging an aggressor from starting one.

This eventuality brings into sharper focus the preventive mission of defense research and development, which in the past decade or so has been eminently successful in satisfying national policy requirements for weapons and systems of a strategic nature. These same channels of policy, budget, and technology decision-making have been somewhat less successful in assuring US tactical superiority under limited-war conditions. In this respect, our collective foresight has not been as perceptive as it might have been.

Accordingly, those of us charged with research and development responsibilities must ask ourselves two related questions:

- Is R&D delivering the goods today, in terms of today's needs and in support of the current emphasis on tactical capabilities?
- Are we simultaneously addressing our talents and technologies to the needs of the future?

Recognizing that world conditions and national policies can change overnight but that weapons cannot, we must be continually aware of changing conditions, long-range prospects, and the possibility that unless development lead times are respected we could again be found wanting at some point downstream. The test is to determine how ably we are looking for new and better ways to do familiar things, seeking new technologies to overcome old problems. At the same time, are we trying



*Gen. James Ferguson,
Commander, Air Force
Systems Command.*

to look ahead to the kinds of difficulties that might plague us in any future use of military forces in the defense of freedom, ours or other people's?

Because Vietnam is a "different" kind of war, there is no reason to believe it will be unique. Unwilling to challenge the strategic power of the United States, the Communists have resorted to aggression at the lower conflict levels, where massive power cannot be used without restraint. To overcome US vulnerability to this tactic, we have moved to strengthen our general-purpose forces, improve our technology, and enrich our R&D resourcefulness. In short, Air Force responsiveness to the situation in Southeast Asia is intended to discourage subsequent "wars of national liberation" as well as assist in resolving the present one.

Spanning the Spectrum of Threat

To avoid exploitation at the hands of the Communists or anyone else, the US show of strength clearly must span the spectrum of threat. Toward that objective, the Air Force Systems Command mission today has three prime facets:

- First, we are seeking ways to serve the diverse needs of the operational forces in Southeast Asia better and more quickly.
- Second, beyond that immediate goal, we are searching the horizons of technology for those capabilities which will deter tactical threats as effectively as our long-range missile and bomber forces have deterred strategic threats.
- Third, we are energizing all the technologies and resources at our command to assure the continued adequacy of our strategic forcefulness.

In every case our intention is to deter, discourage, or dissuade aggression, and in each facet of this three-part mission the meaning of deterrence is the same—assurance to the enemy that he cannot succeed.

We have come to understand that in a limited war the aggressor has the advantage of picking the time and place of confrontation. In the past, the choice of tactics and weapons from among those available to us had not always been broad enough to offset that advantage. The research and development community today has the opportunity to introduce new weapons and technologies either not available to the enemy or unsettling to his "style" of warfare. Ideally, these should be innovations that can overcome an enemy's advantage decisively and at costs that are not prohibitive.

Despite the superiority of free world forces opposing the Communists in Vietnam, the environmental conditions favor the enemy. These conditions include "guerilla-absorbent" terrain and the advantages of familiar ground. In addition, the enemy forces are trained to live off the land, to function at night and in adverse weather, and to pose as noncombatants. They are exceedingly adept at hiding, tunneling, and merging with the landscape.

The novelty, to say nothing of the difficulty, of trying to fight a war without front lines and in the absence of a readily distinguishable enemy has been reported many times but is still not fully appreciated in terms of the burden it places on the defender. The enemy's ability to blend with his surroundings and to use geography to



A weapon of major importance in the effort to produce a high level of sustained firepower in order to hold off guerillas during surprise attacks is the six-barrel, 6,000-round-per-minute Minigun used on many aircraft in Vietnam.

maximum advantage represents the most difficult obstacle to our success in Vietnam. The ability to hit small, mobile targets with pinpoint accuracy remains one of our most urgent needs.

The mazes of trails, roads, and waterways, together with the seemingly endless resources of manpower for the repair and resupply missions, make interdiction of supply lines a difficult and constant job. Roads and bridges are quickly repaired or circumvented. So vehicles and supply lines must be hit directly, accurately, and repeatedly.

The real turn in the tide, not only in Vietnam but in discouraging similar situations, may well come when US technologies overcome the enemy's natural advantages with respect to terrain, tactics, and manpower. In the Systems Command, we are committed to the earliest possible realization of this objective. Technological progress already has contributed substantially to the improvement of US capabilities in Vietnam. The opportunities for further advances are getting prompt and emphatic attention in current research and development efforts.

Fast Technical Assistance

The Systems Command's key contribution to success in Vietnam is fast technical assistance, or, as Secretary of the Air Force Harold Brown has put it, "a capacity to make swift innovations tailored to the immediate circumstances." All the resources of the Command have

been made available to the Southeast Asia support requirement. An Assistant for Southeast Asia on the Headquarters staff serves as the central coordinator for the Command's multiple limited-war activities.

These activities begin with an on-the-scene assessment of combat-area problems. Our Systems Command liaison office in Saigon, located with Hq. Seventh Air Force, maintains close contact with all Southeast Asia operational units.

Through a Southeast Asia Operational Requirement (SEAOR) procedure, the Seventh Air Force can address a requirement to the Systems Command. Upon receipt, the stated need generates an immediate search for a technical solution. This response first takes the form of a best preliminary estimate (BPE), expressed concurrently with Tactical Air Command's determination of the best operational tactical solution.

SEAORs serve to bring a required operational capability to the surface for immediate exposure and prompt consideration. The intent of the SEAOR is to elicit swift response, both technically and procedurally. Problems demanding broad, long-term action may "graduate" from the SEAOR category once it has been determined that a quick-fix solution is not possible or attainable. The need for an airborne command post, for example, was originally identified through the SEAOR procedure, which led to the procurement of the C-130E aircraft equipped for the control of airborne and ground operations in battle areas. Another SEAOR stated the need for a long-range weather radar, and AFSC satisfied the requirement by procuring and developing suitable equipment that was commercially available.

The direct line that we have established from the origin of the need in a Southeast Asia operational situation to the source of the research and development action authority in the Pentagon can, if necessary, be traveled by telephone or radio. Along with this fast-reaction approval channel, we have set up a funding source to assure rapid evaluation of new hardware and techniques for limited-war needs. This source has provided the funds necessary to buy, test, and try readily available equipment with promising potential. Although it allows only for funding of test quantities, the availability of this funding source shortens the time span through the development and operational testing to the point where a procurement decision is practical.

In seeking ways to continually improve the timing and the quality of the Command's responsiveness, we have concentrated on making our technical assistance efforts personal, prompt, and professional. One of the ways it has become personal is through the direct contact our Saigon liaison people have with the forces in the field. Recognizing that those who are directing the operations or engaging in combat actions are the best qualified sources of operational requirements, we insist that our people talk with forward air controllers, strike pilots, and other aircrewmembers at every opportunity.

Requirements and Problems

Among other things, we have found from these and other experiences that "requirement" and "problem" are not necessarily the same thing. A requirement generally is a definite and definable need, while a problem may

lack specific identity. On occasion, the cure for a problem may be available but unknown, or the problem may exist but remain unidentified. There may be technologies on the shelf which could lead to new or more effective ways of doing a particular job but the application of which has not been discovered or realized. This situation represents a solution looking for a problem.

To avoid the possibility of needed solutions going begging, we have attempted to improve and expand communications between the Air Force's using commands and its technology teams. We have taken a number of steps to provide research and development personnel greater "visibility" in actual combat situations. These steps include short-term tours and orientation visits of research and development officers and civilians to the combat zone, for on-the-spot exposure to problems which they may be able to solve or alleviate.

Another effort in this direction aims at recouping as many combat-experienced R&D officers as we can, following completion of their SEA tours. At the moment, among the most precious resources we have in the Command are the science and engineering officers lately returned from Vietnam and assigned to active limited-war research and technology projects. Many of them may return to the combat area, but in their R&D status.

As rapidly as possible we expose new ideas and new technologies to the operational environment, through our liaison office in Vietnam. We have found that it is as useful to have R&D-qualified officers assigned to key positions in the combat theater as it is to have combat veterans selectively assigned to R&D programs here in the States.

Mating technology to operational needs involves considerable "imagineering" as well as engineering. At the Air Proving Ground Center, Eglin AFB, Fla., a simulated Southeast Asia jungle environment—complete with sampans—provides a realistic setting for the testing of ideas and equipment potentially useful to US forces.

Last June we established the Directorate of Technical Applications for Southeast Asia. This is an intentionally small, mission-minded task force located at Eglin as a part of the Air Proving Ground Center organization. Our purpose in forming this group is to bring operationally oriented and technically qualified people into direct contact with those battle-zone problems amenable to quick-fix solutions.

Today and Tomorrow

Throughout the Systems Command, as well as in other elements of the Air Force, other innovations in procedures and in the development of technologies and their applications are being encouraged and emphasized with a view toward improvements in combat effectiveness today and deterrent effectiveness tomorrow.

The primary problems we encounter are the classic ones of offense and defense, but they are greatly complicated by the natural restraints and the political and military constraints applicable to the Vietnam situation. Technology probably can never overcome all these limitations, but we are confident that novel approaches, new ideas, and capabilities structured on technological advances can provide added thrust to our offense and greater strength to our defense.

Another development designed to solve the particular problems of counterinsurgency warfare is the low-altitude parachute extraction system (LAPES). This system can make pinpoint delivery in areas under fire or where the drop zone is too narrow for normal paratroops. With LAPES, platform-mounted loads are pulled from the rear of aircraft at an altitude of about five feet.



The offensive power of the free world forces in Southeast Asia has been impaired by a limited ability to locate and identify the enemy, to curtail his mobility and his freedom to function at night and in bad weather, and to discriminate with enough precision to assure accurate strikes against proven military targets.

We are further handicapped by having to risk aircraft and other costly equipment in attacks on relatively low-value targets, such as truck convoys, bridges, river traffic, and the like. Such interdiction actions, of course, are necessary to cut down the flow of supplies and to reduce the infiltration from the north. Technological advances enabling us to carry out such strikes more effectually, while minimizing the risk to our own people and equipment, would contribute substantially to the value of our offensive power.

Defensively, we need better base security, with devices for detecting enemy intrusion, to safeguard our forces against surprise attack. Some of the answers to these problems are already realities; others are coming.

Sensor technology is being advanced rapidly under the impetus of the Vietnam conflict. Night traditionally has favored the enemy, and bad weather conditions long have afforded him cover and security against air attack. These advantages soon will be denied to the enemy through systems which will make our "eyesight" almost as good at night or in poor weather as it is under favorable daylight conditions. The Shedlight program is a comprehensive technical effort to eliminate darkness as the enemy's asset. The program involves the advancement of surveillance, detection, illumination, and attack technologies.

In addition, detection devices sensitive to heat, odors, and even colors are under development. We are looking for ways to find tunnels, weapons, and concentrations of enemy troops. High on our list of priorities are better ambush detection equipment, fully effective base-intrusion detection devices, and foolproof booby-trap alarms.

Through the provision of better electronic and communications equipment, munitions, and lifesaving, rescue, and evacuation techniques, field elements already have witnessed the effects which up-to-date tactics and technologies can make on battlefield situations. Compared to Korea, for example, there are more and bigger

helicopters, superior communications, faster response capabilities, and a much better record of personnel rescue. Most important, the death rate among battle casualties is significantly lower because of the improved medical and air evacuation facilities.

Rescue and survival are more nearly the rule than the exception, and ground-to-air rescue devices have been developed which make it possible to pick up downed airmen from any type of terrain. A new crash-position indicator, also developed by the Systems Command, has been successfully tested and is in use, simplifying search and rescue procedures and speeding responsiveness. These are examples of relatively fast answers to combat problems.

To help control the air war over Vietnam, the Command has created flying command posts by converting C-130E aircraft into airborne battlefield command and control centers. They serve effectively as radio relay points, coordinating weather, intelligence, air rescue, attack, and air traffic control.

Increasing Combat Effectiveness

Space systems also contribute to the effectiveness of US combat capabilities. Thirteen days after the last three satellites in the Initial Defense Communication Satellite Program were orbited last July, that system was declared operational in the Pacific, handling up to 1,000 messages a week over the Hawaii to Saigon link. Other Defense Communications Agency terminals are in operation in the Philippines and at Nha Trang, South Vietnam.

In the same time period, tests were begun on the early components of a tactical communications satellite system. Using an all-transistorized ultrahigh-frequency repeater satellite, the LES-5, the Army, Navy, and Air Force conducted test transmissions that linked aircraft, ships at sea, and submarines. The high-power satellite, together with the small, lightweight, highly mobile terminal (which can be jeep-mounted or back-packed, for that matter), makes the tactical system under development ideally suited to combat situations.

Other direct support items of limited-war value which have flowed from Systems Command research and de-

velopment efforts include expandable shelters, new adjustable litters for air evacuation, a cold-water-cooled flying suit for pilots flying low-altitude missions, and techniques for low-level parachute supply deliveries. Four types of steerable parachutes, including one capable of lowering a 2,500-pound load, have been tested. Development work and field tests have been completed on radar sets small enough and compact enough to be back-pack-carried into remote sites where they can be quickly assembled and put into use. Portable air traffic control equipment, mobile weather stations, and rapid preparation of remote landing sites have also contributed to the flexibility of US forces.

As another indication of the extent to which Systems Command resources have been marshaled in support of limited-war forces, the eight Air Force Laboratories under my Director of Laboratories have been searching their specialized and highly advanced inventory of technologies for applications useful in the Southeast Asia conflict. Laser technologies, among other things, have been particularly promising, especially for illumination and communication purposes.

Research and development attention has also focused on flight control techniques designed to minimize the exposure of low-flying aircraft to radar detection. Other sophisticated equipment, like terrain-following radar and electronic countermeasures, are critically important to the penetration capability of attack aircraft and to their survival in the hostile environment of enemy planes, antiaircraft fire, and surface-to-air missiles.

As a safety measure, an explosion-proofing polyurethane foam material has been developed and qualified for use in aircraft fuel tanks. The foam virtually assures that an explosion will not occur as a result of the fuel tank's being punctured by an incendiary projectile.

New and improved types of munitions, including better air-to-air and air-to-ground missiles, also have been developed as part of the research and technology approach to limited-war effectiveness. Bombs designed to penetrate jungle foliage before detonating, bombs to assure low-flying attack aircraft ample escape time, and various area denial devices are among the special types developed for use in Southeast Asia.

Research and development work of a more traditional nature is exemplified in the design and acquisition of aircraft tailored to the conditions of counterinsurgency, limited war, and the needs of our general-purpose forces.

In the Concept Formulation Package stage are several aircraft systems, including the F-X tactical fighter for future assured air superiority and the A-X specialized close-air-support aircraft. The Concept Formulation Package is our basic means for advocating new systems and is the foundation for justifying the resources necessary to their development.

More immediate to the needs of Southeast Asia are a number of aircraft being acquired or modified to serve the various missions of close air support, interdiction, forward air controller, and psychological warfare. Among these are the A-37, A-7D, O-2A, O-2B, and OV-10.

The Air Force's R&D assault on limited-war problems and obstacles ranges from armaments to aircraft and from laboratory ideas to field equipment. Since Systems Command technicians joined with tacticians to

produce technical answers to tactical problems, a variety of items to meet a variety of needs have been developed and put to use in the combat zone.

Challenges to Be Met

In short, we are trying very hard in the Systems Command not to overlook any area of opportunity that will improve our advantage in Southeast Asia. Yet there are still many problems to be solved, many challenges to be met.

Our operational forces find that their aircraft can still be shot down. Over all, there is a great need to improve our capability to detect the enemy, distinguish friend from foe, and strike small targets more precisely and—perhaps—more economically.

Despite all our advances in detection techniques, we can still benefit a great deal from any new-found means for obtaining real-time reconnaissance of ground targets that move, radiate heat, or reflect or consume power.

The Air Force's success in technological war is having a pronounced effect on the current "hot" war. Without the advances of a scientific or technical nature that have been developed and applied to the Vietnam situation, our losses there would surely be much greater and our effectiveness much less.

Air Force resources for research and development are pledged to the continuing support of Southeast Asia needs and requirements. Those same resources of talent and technology are pledged equally to the deterrence of subsequent wars and to a readiness to fight and win them should they occur. This preparation goes on in full awareness that future wars may entail different sets of circumstances, may be waged under very different conditions, and may require wholly new technologies.

"One should be very careful," Secretary Brown has warned, "in remembering that [Vietnam] is not the only kind of war, and if we proceed to organize and procure equipment and train people only for this kind of war, we can very easily get a bad surprise if we find ourselves in a war where, unlike the one in South Vietnam, the enemy has rather advanced weaponry and can operate advanced surface-to-air equipment, missiles, artillery, and aircraft themselves."

This possibility alone is good reason to pursue the whole spectrum of research and development programs designed to maintain and extend US technological superiority. Our goal is to be prepared for the future and to cause our capability for preparedness to impact on the present. We seek to make tactics and technology the winning combination in a balanced force structure geared to any degree of controlled response required by national policy.—END



General Ferguson assumed command of AFSC in 1966 after serving previously as Deputy Chief of Staff, Research and Development, Hq. USAF. He has held a number of important research and development posts in the Air Force, and served in Europe during World War II as well as in the Pacific. As AFSC Commander, he is also Director of the Air Force Manned Orbiting Laboratory (MOL) program. The above article is excerpted from the AIR UNIVERSITY REVIEW issue of November-December 1967 and appears in AIR FORCE/SPACE DIGEST with permission.

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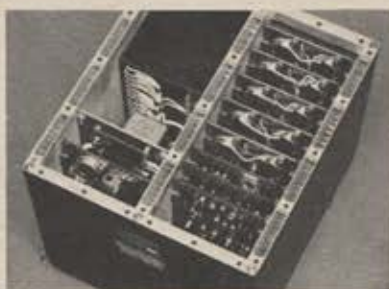
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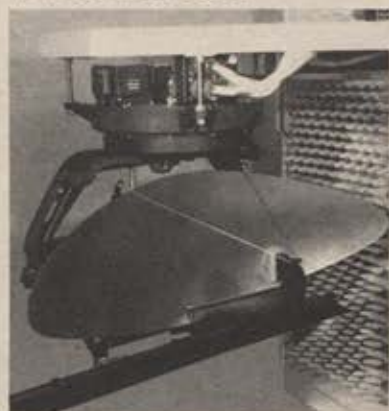


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"The good side of technology is that it elevates man, frees him from misery and pain, expands his experience, and prolongs his life. The other side of the coin is also evident, in our lack of control of technological forces, and as the problems of a mechanized, affluent society close in on us."

What Makes Technology Run?

BY MARTIN GOLAND

BARBARA Ward [of the *London Economist*] in her excellent writings advances the thought: "In a sense magic is primitive man's technology. We use technology to get us what we want." May I introduce these remarks by paraphrasing her words—technology is modern man's magic. He thinks he can use it to get everything he wants.

As is characteristic of magic, however, there are both good and bad varieties. The good side of technology is that it elevates man, frees him from misery and pain, expands his experience, and prolongs his life. The other side of the coin is also evident, in our lack of control of technological forces and as the problems of a mechanized, affluent society close in on us.

It is paradoxical that technology should involve difficulties. If we can create life in a test tube and travel to outer space, why can't this same creative energy be used to shape a proper future, at least insofar as material things are concerned? In principle, the knowledge we need can be produced by the sciences—physical, social, and economic. Our factories can pour forth the needed material wealth. And the latest breed of technologists, the superplanners—whose systems analyses are sensitive to every input and its effect on the end result—can tell us how to best deploy our resources.

This utopian world, however, is far from being with us. In actuality, we are continually surprised at the un-

expected consequences of our technological efforts. Science and engineering aid offered to emerging nations often does no good. Birth-control techniques regulate the wrong populations. A tax increase is proposed, and even the experts are unable to agree on what the effects on our economy will be six months later. Pockets of poverty across our nation are deepened, rather than alleviated, as our technology grows stronger.

These unexpected turns are, of course, a consequence of the complexity of the technological process. As the thesis for these remarks, I should like to review the underlying factors for technological advance, and use this as background for comments on some of the current public issues in the area of technology.

The Climate for Advance

Let us begin by listing the combination of ingredients needed to create technological advance. At the risk of belaboring the obvious, the following appear to be necessary:

- First, the technical knowledge which makes new technology possible;
- Second, a social climate which is receptive to a more material way of life;
- Third, a political and governmental structure which encourages new technology;
- Fourth, the availability of the necessary labor and management skills, coupled with an entrepreneurial attitude;
- Fifth, the availability of venture capital; and
- Sixth, effective distribution and marketing.

Of the six items, the second seems to me to be of the greatest over-all importance.

It is worth noting that science and engineering, which are normally thought to be the backbone of technology, actually represent only one-sixth of the process. If any of the other five elements are absent, or unduly weak, the technological engine will not run.

The message being conveyed is simple. Technological advance is essentially a matter of cultural development,



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a balanced mixture of ideas and ideologies which favor a more material way of life. Technology responds to markets, and markets reflect the tastes and desires of the people.

To those who would plan for technological progress in a piecemeal fashion—beware. In the city of Parás, in Mexico, there is a most advanced housing development built for the workers of a large textile mill. Among its other conveniences is the availability of automatic washing machines to each household. The machines, however, are unused; clothing is washed by the women, as in centuries gone by, down by the neighboring stream. One cannot, after all, exchange gossip and pass the morning socially when gathered around an automatic washer.

As an illustration, consider the "brain-drain" phenomenon which is of so much concern to certain of our friends abroad. The missing link in these countries, stated in oversimplified fashion, is a failure of technological management. Management builds the bridge between the technician and the practical exploitation of his skills. If the technician is neither appreciated nor properly supported, he will leave when better opportunities arise. In the modern jargon, the "brain drain" and the "technology gap" are close kin, and both have their sources in the boardroom rather than the research laboratory or engineering office.

Domestic Issues

Our own country is, of course, preeminent in the world today as an example of technological development. Yet, imbedded in our affluence are problems. Segments of the population, geographic regions of the country, and certain industrial groups have difficulty in participating in the quickening technological tempo which surrounds them. Once matters of private concern, the underlying causes of these problems are now accepted as public responsibilities as well. In appraising the merits of governmental plans and programs, it is well to keep in mind how they relate to the list of factors mentioned earlier as contributing to over-all technological progress.

In the case of lagging industries, a variety of government efforts are being directed toward improved dissemination of technical information. Examples are the state technical services program and the NASA technology utilization program. While these efforts are broadly directed toward obtaining maximum value, for the benefit of all industry, from the vast storehouse of technical knowledge accumulated through government-sponsored research and development, the principal concerns are with encouraging new activity in slower moving industrial areas, and with upgrading the quality of small business.

The worth of these programs in transferring technical knowledge across industrial boundaries is, of course, significant. Nevertheless, when conducting periodic reviews of their effectiveness, it must be recognized that their range of activity compared with the over-all problem is limited. A bald tabulation of readily documentable items of technical data transferred, versus directly traceable new industrial activity, is bound to be disappointing.

In most industries where the criticism is legitimately

directed, the primary causes for a lack of industrial development are for other than technical reasons. An alert and knowledgeable management, the ready availability of venture capital, and a clear indication of market potential are factors of greater importance. In fact, if these ingredients are present, the search for new technical knowledge and its exploitation follows as a matter of course.

To realize the fundamental objectives of the State Technical Services Act, as a case in point, I have the feeling that its thrust should be directed as much toward the education of management and the financial community as toward the establishment of data banks for scientists and engineers. A literal reading of the Act does not support this broader viewpoint.

For analogous reasons, I am also much in favor of the effort by government agencies to achieve a more uniform geographic distribution of their research and development activities; in effect, taking deliberate steps to ensure that all regions of the country are creatively involved in new science and new engineering. The gains here are not merely the limited ones of helping all our universities to upgrade their science and engineering capabilities, and to spread the contract wealth. Of greater importance is the indirect benefit, the influence of a technology orientation of the perspectives and attitudes of the community at large.

In essence, the point is that in today's mobile age, with consultants crowding the airlines, technical knowledge can be imported into a region with little difficulty. What cannot be imported is the culture of technology. This must grow from within the community itself. The challenge and excitement of research and development activities, made more real through local involvement, are splendid levers to cause the process of technological advance to begin.

Emerging Nations

There [has been] considerable discussion of how to induce technological growth within the poorer countries of the world, the so-called emerging nations who are striving to elevate their standards of living. While no serious student would presume to reduce so complex a question to black-and-white issues, it is proper to say that two opposing philosophies [are] evident. There are those who contend that the poorer nations, already faced by desperate problems of want, have no recourse but to propel themselves almost overnight into modern technological states. The opposing view is that only a slower, more evolutionary plan is possible of achievement, using borrowed technology in its simpler forms at the start, and emphasizing population orientation and training rather than early productivity goals. According to this second viewpoint, ignoring the evolutionary mechanism of technological development will result in a wasteful and unsuccessful allocation of the limited resources available to spark progress. . . .

I am very much on the side of the evolutionists. The growth of technology within a society must pass through successive levels of increasing sophistication; the learning process can be accelerated, perhaps compressed to the span of several decades, but it cannot be omitted.

As a case in point, consider . . . Mexico. Here, by means of a partnership between private enterprise and

government political support, a national plan for industrialization is moving forward steadily and successfully. In its early stages, the plan reflected Mexico's almost complete dependence on foreign skills and materiel. To achieve domestic production strength in selected industrial areas, the procedure is to use protective tariffs and import regulations to gradually force the conversion from foreign to local production.

Mexican industry is favored only when the various ingredients needed for a sound transition appear to be present. The lack of trained labor meant that the early growth of productive capability was restricted to simpler industrial operations. Only recently was it made economically mandatory to assemble cars for the Mexican market in Mexican factories. By comparison, it is recognized that a more advanced technological climate is required to support an electronics industry, and so the development of local capabilities in electronics are not yet being stressed.

The approach throughout is pragmatic and evolutionary. For the bulk of its science and engineering, which are expensive in terms of both skills and supporting laboratories, Mexican industry continues to look abroad—to this country, Europe, and Japan. The majority of Mexican industrialists will express the view that "Mexico cannot yet afford its own research and development; this must come later." On the other hand, these same industrialists will emphasize their responsibilities to train and educate not only their employees, but the families of their employees as well.

The same down-to-earth attitude is reflected in the attitudes of Mexican youths graduating from science and engineering schools. Few look forward to a career in research; most see their futures in the factories and sales offices of Mexican industry. The "brain drain" is also not a Mexican problem. Opportunities and challenges at home are sufficient to cause even those educated abroad to be anxious to return.

The Mexican experience serves as a model, it seems to me, for other developing countries. Overambitious goals, and quick solutions, are discarded in favor of a broad, sociopolitical view of how technological forces mature. Mexico does not boast of nuclear research stations, or advanced centers of scientific excellence. It can point to solid and balanced progress in the development of its financial resources, the training of its people, and in the gradual ascendancy of its industrial capabilities to first-rank performers.

Planning for the Future

Having outlined the variety of factors which enter into technological growth, it would be satisfying to be able to conclude this discussion with a neatly worked out formula for industrial progress. Unfortunately, our equations are not yet powerful enough to lead us soundly into the future.

I would, in fact, like to use this opportunity to comment on an aspect of the current environment for decision-making. My remarks are directed toward the methods of "systems engineering," techniques so ably pioneered and developed by the Department of Defense and NASA for the management of complex engineering projects. My concern is with the fact that the systems approach is now being touted as the means for solving

larger social problems, an area in which its utility is open to serious question.

Let me emphasize that I have no objection to fads in terminology, and so long as the term "systems analysis" is used as a synonym for a broadly based, intelligent look at the future, no harm is done. When the formalized, quantitative approach becomes prominent, however, we must be certain that the results are more worthwhile than misleading.

[There is a] formula for the potential value of complex computer programs: $GI=GO$, which in English reads as "garbage-in equals garbage-out." When systems procedures are used to balance the relative importance of various hard-to-define, socially based inputs, much the same nonsense will prevail at the output.

The great argument in favor of the systems approach is that it forces a logical consistency, according to rules established for the game, in traversing a complicated network of interrelating factors. It is equally effective, however, by virtue of its very complexity, in disguising the fallacy of false input data. The point was made some years ago [in 1962] by Dr. Philip J. Davis, writing in the *American Scientist*:

"A curious neutralism emanates whenever mathematics comes into contact with the world of men. The mathematician approaches calmly many things that are emotion-laden. The difference between monopoly and duopoly may be the basis of an antitrust suit lasting a decade. To a mathematical economist, it may be 'merely' an additional term in a set of equations."

Carrying the negative argument further, in a systems analysis of the water resources of the nation, what value suitable for logical manipulation can be assigned to a "wild river"? The pathogenic effects of mild degrees of air pollution are elusive and largely unknown; other than on the grounds of emotion and judgment, how much value should be assigned to extreme air purity at the expense of industrial development? Amidst the complexities of urban planning, with its crisscrossing of politics, economics, social factors, and traditions, can a systems approach do other than elegantly confirm a decision already arrived at by other means?

Another disturbing characteristic of the systems approach is its tendency to converge toward a solution which, while workable, is unnecessarily complex and costly for the purpose at hand. This is largely a consequence of the emphasis on logical procedure, at the expense of the shortcuts which come from intuition. In problems where cost is secondary to an assured solution, such as in military areas, this drawback is not fatal. In civilian matters, however, excessive cost and undue sophistication usually restrict the proposed solution to the realm of the theoretical.

Because of the great emphasis currently being placed on "the system" in government planning circles, I feel compelled to offer these words of warning. Nor is my concern reduced by the standard slogan of the systems analyst to the effect that he does not reach definite conclusions, he merely clarifies the nature of the problems. For a study to be worth doing in the first place, there must be a reasonable degree of confidence that its findings will be realistic and meaningful. Thus far, systems analysis has demonstrated no real capabilities in areas where social values are important. I am inclined to think it will not do so in the foreseeable future.—END

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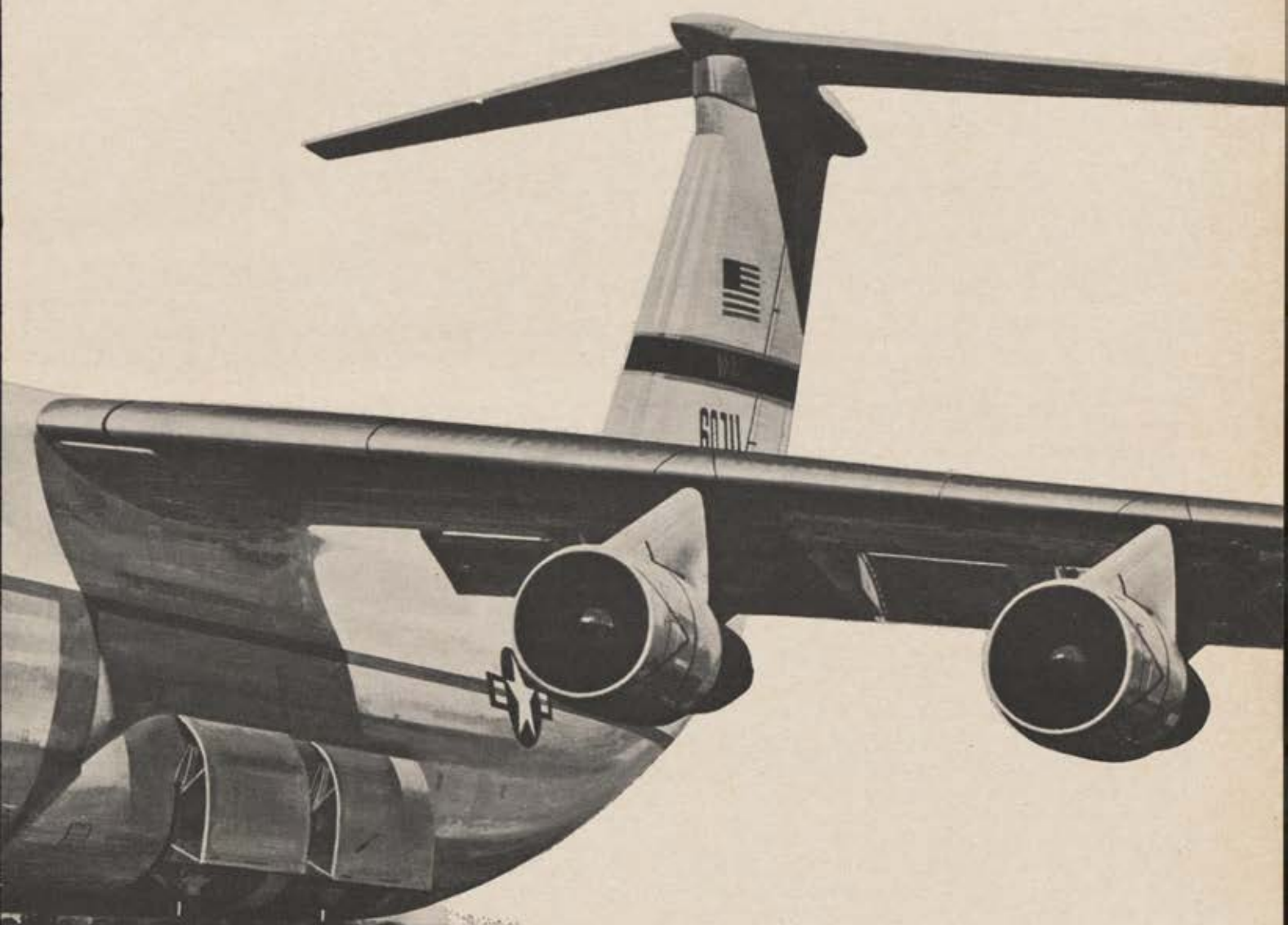




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Amid all the hoopla attending our space achievements, we have somehow neglected to inform the man in the street—in terms that he would understand—about the earthly benefits he could expect from his investment in the space program. Yet it should be clear that the future health of the program hinges on the potential harvest of benefits . . .

Selling the Space Program on Its Merits

BY REP. JOSEPH E. KARTH

I HAVE not lost faith in our space program—definitely not! But I can't go along with all the policy statements that are made, appearing to be a total partisan, and still feel I'm being honest. So I have to call the shots as I see them, and the way I see things from the public's viewpoint, 1967 was the year "the bloom came off the rose."

The space program got off the ground ten years ago on a surge of apprehension and sensationalism. [In 1967] it became very clear that public acceptance or rejection will be a key factor in shaping the US objectives in space for the years ahead. Perhaps it is a mistake of our times for some to insist that Congress must not get involved in policy-making in the area of science and technology—and the space program.

Many years ago, Congress not only put forth legislative proposals, but also had the responsibility to accept or reject what had been proposed by the Executive Branch of the government. And in many instances Congress made policy—in a minor way at times and major at others. In so doing it exercised its own judgment.

In more recent times, the majority of proposals have originated in the Executive Branch, and some have mistakenly assumed that this trend means Congress ought to be just an "acceptor" or "rejector." I say "Not so!" Congress has a big part of the public policy-making job—and this applies to science as well as to education, to taxes, and to all the other issues with which Congress deals.

Time for Appraisal

Obviously Congress is not made up of engineers and scientists, but such experts could be engaged as advisers, as in the administrative branch of government. Decisions as to meaningful programs, and the structure

and size of agencies to implement such programs, can and must be reached with more objectivity. Having ushered in the second decade of space exploration, both NASA and the aerospace industry should now review their "ledgers" to make the best use of their achievements to date, as well as learn from the mistakes and false starts of the past.

We have left behind us a most eventful year. [Nineteen sixty-seven] started with the tragic fire of the Apollo capsule, progressed to the successful scanning of the moon's landscape with the Lunar Orbiter, the soft landings of the Surveyors, the exploration of Venus by the US Mariner and Russian Venus-4 spacecraft, and was concluded with the maiden flight of the Saturn-5. But if 1967 is to be remembered for these events, it can be identified also as the year in which public interest and congressional support for the space program reached its lowest ebb. This was reflected in the deep budget cuts by the Congress.

Lack of Deep Conviction

There is probably a multitude of reasons to which we could ascribe this apparent disenchantment, but essentially it amounts to a lack of deep conviction over our national objectives in space and their worth vis-à-vis other needs competing today for big expenditures. I think that the way in which the National Aeronautics and Space Administration and the news media in general continued originally to present space exploration to the public—as a sensational experiment—was a wrong approach to courting public interest. As time and events have shown, interest drummed up by sensationalism is very volatile.

We are presently faced with the task of interpreting the space effort in terms of its more direct and practical benefits. For instance, for the relatively small invest-



Representative Joseph E. Karth, a Democrat of Minnesota, maintains that "somehow we neglected to tell the celebrated man in the street—in terms he would understand—what earthly benefits he could expect from his investment in . . . space."

ment that we have made in communication satellites, we have gained a great deal of knowledge to help us fulfill our communication needs of the 1970s and the '80s. The same can be said about weather satellites, the forerunners of tomorrow's robot meteorological stations in space that will help us forecast weather on a global basis, weeks in advance. Not far behind these also comes the development of navigation satellites which will make sea and air travel safer than ever before.

Earth Resources Satellites

We have other areas of great practical benefits to be derived for all mankind which should come from the projected use of Earth Resources Satellites. Vice President Humphrey has expressed great personal interest in the Earth Resources Program. But I have seen relatively little publicity or imaginative interpretation, in general news media, of the far-reaching significance of such satellites.

Before the development of satellites man could study only in a very fragmentary way some of his most pressing of earth resources and environmental problems. Through the use of space robots we can now acquire a total view of such problems as forestation, crop deterioration, erosion and flooding, and the changes in polar masses and coastal outlines. All of these conditions have a direct bearing on man's future on this planet and may be studied more thoroughly from space than from the earth's surface. Cost-effectiveness will be the consideration in determining whether single-purpose

and relatively simple satellites should be used for such tasks or multipurpose complex machines.

Emphasize the Practical

I feel it is time for private industry to take a good look at the entire space program and make recommendations for practical applications with commercial possibilities. Considering the total progress our nation has made in space exploration in ten years, the industry, NASA, and the military have made fabulous contributions toward the preeminence of the US in space. But I hardly believe that we have done so well that we could not do better—particularly in deriving practical applications from our space capabilities.

Now I'm not advocating that we discontinue "non-payoff research" in space or eliminate our manned exploration efforts. All I'm saying is, let's continue some basic research with an eye to the future, but not to the extent of overlooking what is already at hand in technology and capabilities that can be turned into practical uses. For example, as far as complex astronomical satellites are concerned, I'm not fully convinced about their cost-effectiveness relative to other requirements at this time.

Sell the Public; Not Each Other

We needed to emphasize the manned aspects of space exploration, when we started, to establish a basis of public interest. But it seems we never changed our tune,



Congressman Karth thinks it would be a mistake not to couple a Saturn-5 vehicle, above, with a Voyager spacecraft.

even after we engaged the public's interest. Somehow we neglected to tell the celebrated man in the street—in terms he would understand—what earthly benefits he could expect from his investment in the space effort.

Contrary to some opinions, the American in the street is a reasonably well-informed fellow. In general he may not have a great orientation toward things scientific, but he is curious, likes to ask questions, and is accustomed to measuring scientific progress mostly in terms of an improved standard of living. If science were to be left strictly to the scientists, engineering only to engineers, and politics exclusively to the politicians, then these specialists would communicate mostly within their own groups and in the end lose sight of the public interest.

Voyager Makes Sense

I don't want to give the impression that I am against manned exploration; I think the Apollo program has a good pace. But I don't like to see the manned aspects dominate the scene totally in the post-Apollo activities, nor to extend to the planets prematurely. I have no doubts that before this century is over, man will set foot on the near planets; but at least for the next decade or two he has considerable homework to do on and around this planet. It seems more reasonable to me to first find out more about the other planets by means of automated robots.

And in this latter respect, I will be disappointed if it

turns out that we don't couple the great capabilities of the Saturn-5 vehicle with those of a Voyager spacecraft. Our failure to do so would assure the Soviets even a greater lead in interplanetary exploration than they are beginning to demonstrate. However, be they the merits of the Voyager concept or the potential benefits of Earth Resources Satellites, the public and Congress must be honestly convinced of their values if space efforts are to be supported.

Needed: Imaginative Marketeers

We may possibly need a new type of salesmanship in the aerospace industry. That is, the type of effort directed to sell the practical capabilities of the industry to the public (not the industry itself)—in addition to selling the customers in the government. A shortcoming of industry has been to keep advancing proposal after proposal for contracts, but without enough attention to some practical applications for existing technology, or management know-how. Surely we must have enough heat-resistant pots and pans and transistor radios by now to look for other derivatives from space research. . . . Perhaps what we need in the aerospace industry is a new breed of imaginative marketing engineers who can view each quantum advance in technology with an eye to consumer applications. The larger organizations may be in a better position to train such specialists, by virtue of available resources and also the breadth and variety of their fields of endeavor.

Expectations at Your Doorstep

As a nation we have now reached the point where the most imaginative brainpower resources we have are engaged in government-financed research and development—in the defense establishment, the Atomic Energy Commission, and NASA. But much of the R&D funds and effort pumped into classified Defense Department and AEC work cannot yield readily usable benefits for the public, and this brings the public's hopeful expectations to the doorstep of NASA and the aerospace industry. "If we have learned to develop fantastically complex spacecraft and vehicles, and to manage this type of effort from here to the moon," say some of my colleagues and constituents, "then why in the world can't we use this knowledge to solve some of our more immediate problems down here?"

I submit that all those in positions to suggest "how" and "how soon" might do well to make themselves heard. In fact, if this is not done, those who are so willing to explain "why we can't" and "why we shouldn't" can be expected to swing the public even further from support of the space program.—END



Congressman Karth, Democrat of Minnesota, is the second-ranking majority member of the House Committee on Science and Astronautics, Chairman of its Subcommittee on Space Sciences and Applications, and a member of its Subcommittee on NASA oversight. The above article is adapted from an interview with Congressman Karth which appeared in Aerospace Management, a publication of the General Electric Co.'s Missile and Space Division, and appears here with permission.

We keep an eye on the ear

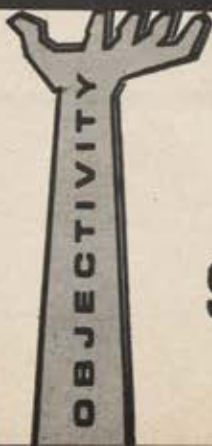
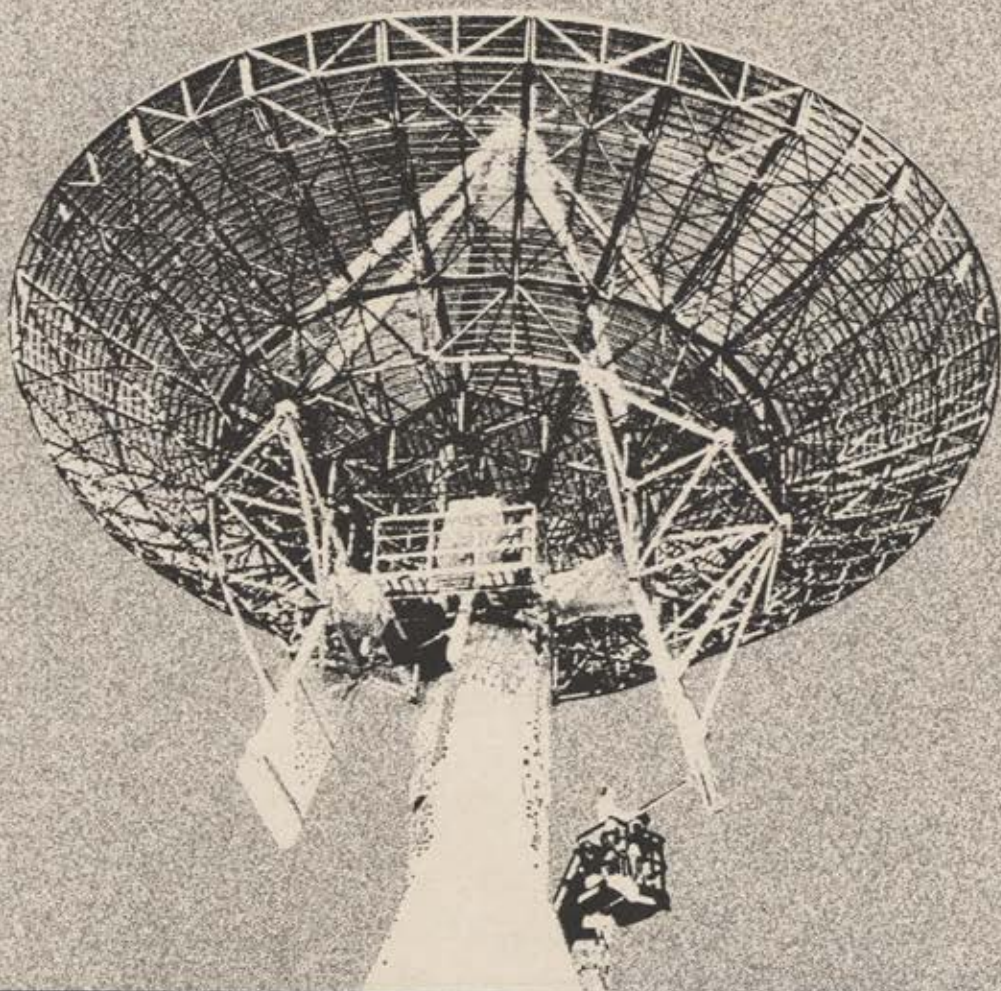
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Profit is becoming a dirty word when used by some congressmen in reference to the defense industry, despite the fact that the government chose to use private industry as its defense supplier, recognizing that profits are good and necessary to our free-enterprise system. But profits on defense contracts are falling and the companies are consequently turning to commercial business to satisfy their stockholders, who are naturally looking for a reasonable return for their investment . . .

AIR FORCE

APRIL, 1968

Declining Defense Profits— Government Economy, or a National Security Risk?

By Claude Witze

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D. C.
IT IS not widely known, but the Department of Defense and the Armed Services Procurement Regulations both recognize profit as something that is good, not evil. It is, in fact, reasonable to argue that profit is essential to national security, as ASPR does when it says at one point: "... low average profit rates on defense contracts over-all are detrimental to the public interest."

The regulations (Paragraph 3-808) are even more specific:

"... Effective national defense in a free-enterprise economy requires that the best industrial capabilities be attracted to defense contracts.

"These capabilities will be driven away from the defense market if defense contracts are characterized by low profit opportunities.

"Consequently, negotiations aimed merely at reducing prices by reducing profits, with no realization of the function of profit, cannot be condoned. . . ."

In the face of these rules and the stated intention of Robert S. McNamara, the former Defense Secretary, "to improve the use of the profit motive as a stimulus for effective and economical contract performance," there is today increasing concern among contractors over the sliding margin of profit on defense business.

This country decided, many years ago, to depend on its private industrial capability to provide its arsenal. Here in 1968, there is nothing to be gained by rehash-

ing the reasons why we went in this direction, which were sound at the time and remain sound even as the cold war boils up and we look ahead to a continuing demand for weaponry.

Despite the fact that the customer himself recognizes the requirement for a reasonable profit, and has many tools to ensure that the profit remains reasonable, there is genuine apprehension in industry today. There are cries, current on Capitol Hill and in some segments of the press, of "war profiteering." At the same time, sober compilations of financial statistics portray a contrary picture.

At a recent Washington meeting of the Electronic Industries Association, a Wall Street expert defined the dilemma. Robert V. Higdon, an official of the Chase Manhattan Bank, remarked that for twenty years he has watched the efforts to devise a really efficient system to provide arms for our soldiers, sailors, and airmen.

Yet, Mr. Higdon said, "as new people move into the arena, much of this is forgotten and the problems are rediscovered. Too frequently we argue from conventional models of our world that are remote from reality.

"For instance, we hold our country up as a model of free enterprise and capitalism, yet it seems that many of our citizens regard profit as an unnecessary social cost. This view is reflected by their representatives in government who often appear to us to become

(Continued on following page)

Congressman Henry B. Gonzalez, of Texas, charges we now face "war profiteering" to the extent that it approaches sabotage. He wants a tougher, permanent Renegotiation Board to control "gouging" of the government.



more involved in limiting profit than in seeking efficiency."

No names were mentioned, but here in Washington the voices are loud and easily identified. The charter of the Renegotiation Board will expire on June 30, and Representative Wilbur Mills (D.-Ark.), Chairman of the House Ways and Means Committee, has introduced the customary legislation to extend it for two more years.

There are other men in Congress who want the board made permanent and armed with more elaborate powers. One of the most persistent and extreme is Rep. Henry B. Gonzales (D.-Tex.). He has made a long series of speeches in the House denouncing the "war profiteers" and has appeared as a witness before a Senate subcommittee on economy in government.

Mr. Gonzales has offered no credentials for his own expertise other than the fact that he never heard of the Renegotiation Board until a year and a half ago. Renegotiation has been a fact of life for defense industry since the original act was passed in 1942, as every contractor is aware. The present board dates to 1951.

Here is a sample Gonzalez evaluation:

"The profiteers who intentionally gouge the government for excessive profits during a time of war are also guilty of consciously withdrawing efficiency from our industrial capacity. These private businessmen profiteers are in reality guilty of sabotage. Our history has been one of rampant war profiteering, and I am convinced that even the limited annual reports of the Renegotiation Board reveal that profiteering is going on now, is increasing, and will continue to increase unless something more realistic is done to stop it."

Asked for an opinion on this blanket indictment, Thomas D. Morris, Assistant Secretary of Defense for Installations and Logistics, said, "I know of absolutely no evidence to support these statements."

Mr. Morris made no effort, in his appearance before

the Senate subcommittee, to deny there have been procurement mistakes. He pointed out that the Pentagon is involved in 15,000,000 procurement transactions each year and argued that if the system were ninety-nine percent perfect there would still be 150,000 errors. He knows of no data that will bear out the Gonzalez generalization, including the reports of the Renegotiation Board. In Fiscal 1967 the Board made eighteen determinations of excessive profits.

The House of Representatives, at this writing, is about to hold hearings on the proposed extension of the Board's life. The expectation is that the more reasonable Mills bill (H. R. 14802) will be adopted after a brief examination of the issue.

Secretary Morris has the mission of administering the Defense Department's purchasing effort and presumably is trying to conform with the ASPR viewpoint on profit as well as Secretary McNamara's professed concern that the industry cannot stay healthy on profits that run in the neighborhood of three percent on sales. Incidentally, the few persons who profess to have heard Secretary McNamara express this kind of apprehension, hasten to add that he was querulous more than he was compassionate. If you are not making three percent, he wanted to know, why not? Is the fault with the contracting officers or your own bad management?

To back him in any discussion on Capitol Hill, with the General Accounting Office, or with the Renegotiation Board itself, Mr. Morris now has the support of a new study on profits made by the Logistics Management Institute (LMI). This is a survey of sixty-five companies started by LMI in 1966. The participating firms volunteered to be subjects of the examination.

Twenty-three of the firms are classified as high-volume, with annual defense sales of more than \$200 million. Twenty-five are low-volume companies with annual defense sales ranging from \$1 million to \$25



Thomas D. Morris is Assistant Secretary of Defense for Installations and Logistics. He says he can find no evidence to support charges made freely in Congress by Mr. Gonzalez.

million. Seventeen are in between, with defense sales from \$25 million to \$200 million.

Financial information was obtained from these firms for the years from 1958 through 1966. In each case, the company was included because it is doing more than ten percent of its total business with the Defense Department, and in each case this amounts to more than \$1 million in sales annually.

A major feature of the LMI study is a comparison of the profits made on defense contracts with the profit made on commercial sales. For this purpose, LMI used the average profit as a percent of capital investment, after deduction of federal income taxes. The low-volume company data was considered a hindrance in this case and was not used. The conclusions, then, were reached on the basis of findings for the high- and medium-volume companies—those with defense sales of more than \$25 million a year.

Here are the highlights of what LMI learned:

- Profit on defense contracts has dropped sharply since 1958. Profit on commercial work has increased.
- Between 1958 and 1966 defense profits as a percentage of the Total Capital Investment (TCI) ranged from a high of 10.2 percent in 1958 to a low of 6.3 percent in 1964 and stood at 6.9 percent in 1966.
- The comparable figures for commercial business by the same firms in the same period ranged from a low of 4.7 percent in 1961 to a high of 11.6 percent in 1965 and stood at 10.8 percent in 1966.
- Again in the same period, defense TCI turnover, which is the ratio of sales to TCI, declined from 3.8 in 1958 to 2.9 in 1966. The commercial TCI turnover ranged from 2.0 in 1958 to 2.2 in 1966.
- The defense business ratio of profit to sales declined from 2.7 percent in 1958 to 2.4 percent in 1966. The commercial business of the firms showed increases from 3.4 percent in 1958 to 5.0 percent in 1966.
- The decline in defense profits was caused primarily by the decline in turnover and to a lesser degree by a decline in profits on sales. However, the fact that commercial turnover and profits on sales increased steadily in the same period has resulted in a widening of the gap between defense profits and commercial profits on TCI.
- The nondefense portion of defense industry business has been expanding at a slightly faster rate than commercial business in general. The defense portion of defense industry business, therefore, has been declining as a percentage of their over-all business.
- Most defense contractors plan to increase their commercial business as a percentage of the total. They will concentrate their growth efforts on nondefense business. Here are their reasons for this decision:
 1. Commercial business is growing more rapidly than defense business and will continue to do so.
 2. Financial risk has shifted significantly from the government to contractors in the defense business.
 3. There is a greater profit potential in commercial business.
 4. Commercial business is *less* competitive and has more production stability than defense business.

Of course, it must be added that not all of the contractors covered in the LMI survey agree with all of these conclusions in every detail. For example, there are some who believe there is less financial risk in doing business with the government, emphasizing that this is particularly true in research and development work. In one sense, R&D is subsidized by the Pentagon as a customer, but never by the commercial buyer.

There also are some contractors who, upon cross-examination, are of the opinion that defense profits should be lower than commercial profits. This is a point that was not missed by Mr. Higdon, the Wall Street observer and expert on the availability of investment capital. He expressed some distrust—or, at least, perplexity—about people who can't agree on what a fair profit is. And, possibly more perplexing, he finds "noneconomic factors" influencing the criteria by which fair profit is determined.

Mr. Higdon cited the LMI discovery that some contractors feel defense profit should be lower than commercial profit while "the reasons advanced are not based on economic considerations."

"All contractors," he continued, "emphasized the need to ensure that the profit motive is understood by government employees, yet we know that the profit motive is not the only factor inducing corporations to undertake defense business; in fact, in many cases, it may not be even the dominant motive."

"We apparently believe that industry should suffer the consequences of poor estimating, but that the taxpayer should not bear the cost of poor estimating on the part of government officials."

The LMI report itself was not blind to the vital problem of investment capital and the kind of facts that Mr. Higdon has to monitor in the interest of his profit-seeking clients. These clients, of course, are the people who must provide the capital for all industry—defense and commercial—the stockholders.

LMI found that the companies most attractive to the stockholders are "the mixed, often conglomerate, type organizations. Such companies will have options on where to supply their resources beyond those available to companies performing primarily for defense."

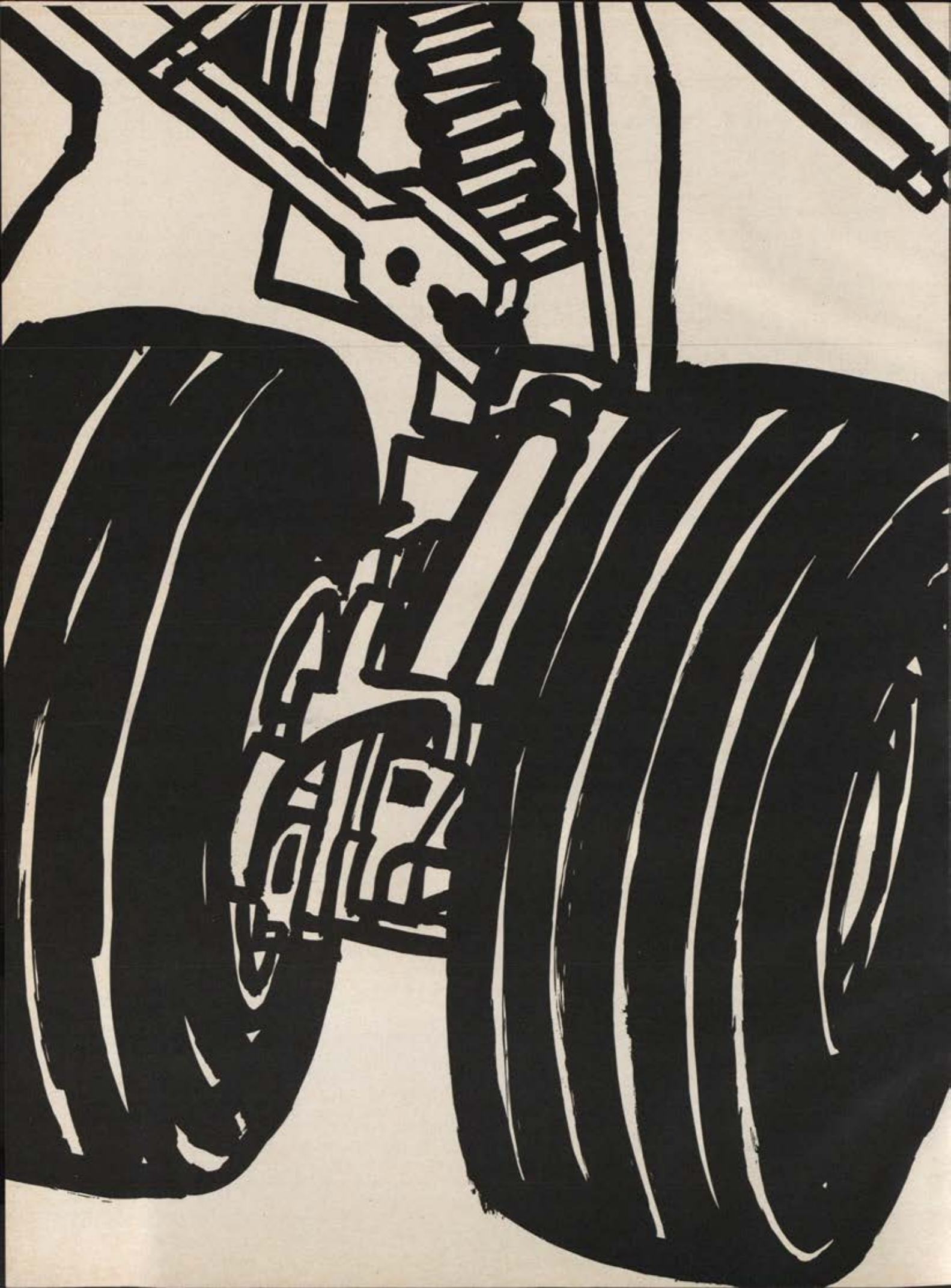
"Such companies' profits are also less affected by DoD procurement policies and less vulnerable to the shifts in volume and character of defense hardware acquisition."

"As stated in the ASPR, if profit opportunities are not adequate, the best industrial capabilities will be driven away from the defense market."

The people who are going to invest money in industry take a close look at earning records. The LMI analysts selected a sample of companies and grouped them in these categories:

1. **Defense.** Defense sales average more than seventy percent of total sales.
2. **Mixed.** Nondefense sales average thirty percent to ninety percent.
3. **Commercial.** Defense sales are less than ten percent of the total.

(Continued on page 135)



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Two words bother us in this concept. One is the word "system"; the other is the word "responsibility."

The trouble with the word "system" is that the marketing people are taking it away from the engineers. Engineers use this word to define and call attention to an area of component interaction with a single function. Unfortunately, marketing people are beginning to use the same term as a selling device. They'd like to sell as many of their products as possible for use on your airplane.

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And when it comes to skid control, we have something that nobody else has: the practical experience from millions of landings with over 13,000 operating aircraft. Since 1948. From the B-47 to the DC-9. From the Jetstar to the C5A and the 747. With every commercial U.S. built jet transport now in service.

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4. **Dow Jones Industrials.** Thirty large firms, representing a cross-section of American industry.

The accompanying chart shows the capital market performance of the four groups from the beginning of 1959 to the end of 1966. LMI assumes an investment of \$1,000 in each group, spread evenly over the companies, as of January 1, 1959. Stock splits and stock dividends are taken into account, and it is assumed that all cash dividends are reinvested in the business.

Here are the results, by category:

1. A \$1,000 investment in **Defense** jumped to \$1,228 by the end of the first year, fell as low as \$759 at the end of 1964, and at the end of 1966, after eight years of working for the investor, was worth only \$1,098.

2. A \$1,000 investment in **Mixed** had its good and bad years but ended up, also at the end of 1966, worth \$3,295.

3. A \$1,000 investment in **Commercial** hit a high of \$2,286 at the end of 1965, fell to \$1,987 a year later.

4. A \$1,000 investment in the **Dow Jones Industrials** fluctuated less but also hit a high in 1965, closed at \$1,752 at the end of 1966.

As any investor can see, the **Mixed** industrial firm, where the nondefense sales average thirty percent to ninety percent, offers the best bet. There is no other explanation needed for many of the current explosions in what most sophisticated observers considered the steady and technically superior defense industry.

Not long ago a national news magazine enjoyed an editorial holiday with Ling-Temco-Vought, Inc. The company's annual report says that sales in 1966 were twenty-seven percent commercial and seventy-three percent government. The commercial business sales

contributed fifty percent of the year's total profits.

An important feature of the news about LTV is that it purchased Wilson & Co., Inc., a step that places an accepted defense and aerospace contractor into the position of selling "meat balls, golf balls, and goof balls." Says the LTV 1966 report:

"We see Wilson as an excellent diversification move for LTV. We believe the company is one of the best in the meat- and food-processing industry, where it ranks as third largest. Its wholly owned sporting-goods subsidiary is the largest company of its type in the world. Additionally, the company has important interests in the pharmaceutical-industrial chemicals industry."

In late February of this year, LTV reported on 1967. It said the total volume of government business has increased. LTV now is in tenth place on the list of major defense contractors. This also is true:

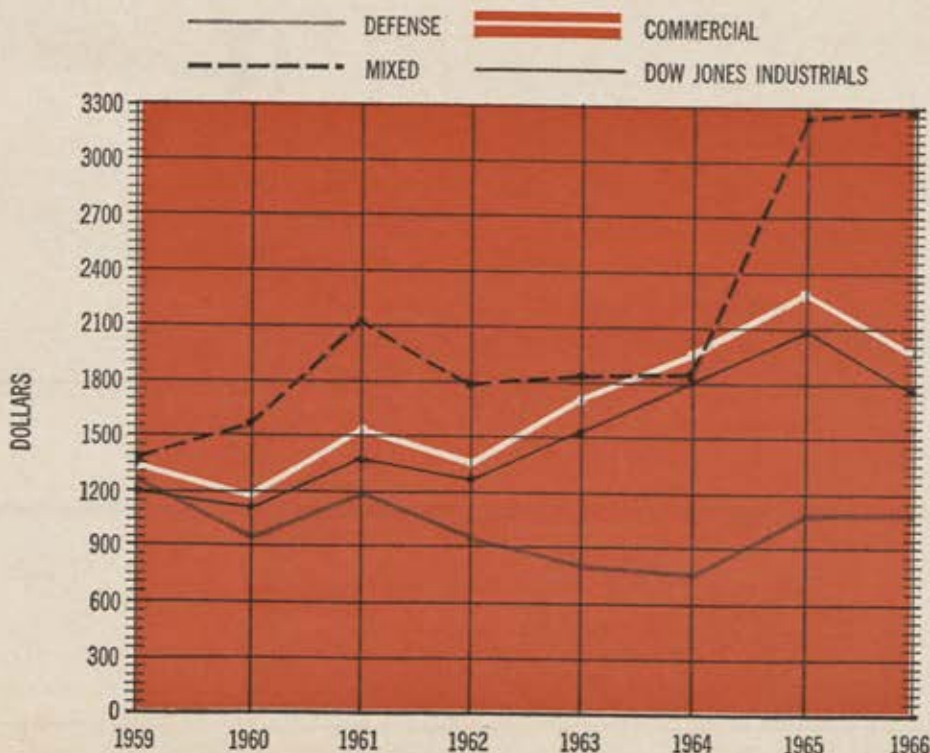
"The ratio of government to commercial business was *inversed* from seventy-three percent to approximately twenty-seven to seventy-three percent."

Only a day or two before LTV made this announcement, the financial pages of the New York Times revealed that Armour & Co., an ancient food packer known to every man who ever ate a ham, is "concentrating on the market development of aerospace industries."

Let it be made clear at this point that LTV builds the A-7 light attack aircraft in all configurations for the Navy and Air Force, the Lance missile for the Army, and numerous other defense products. Investors, as well as military aviation buffs, will be fascinated by the contest with Armour & Co., as that firm seeks

(Continued on following page)

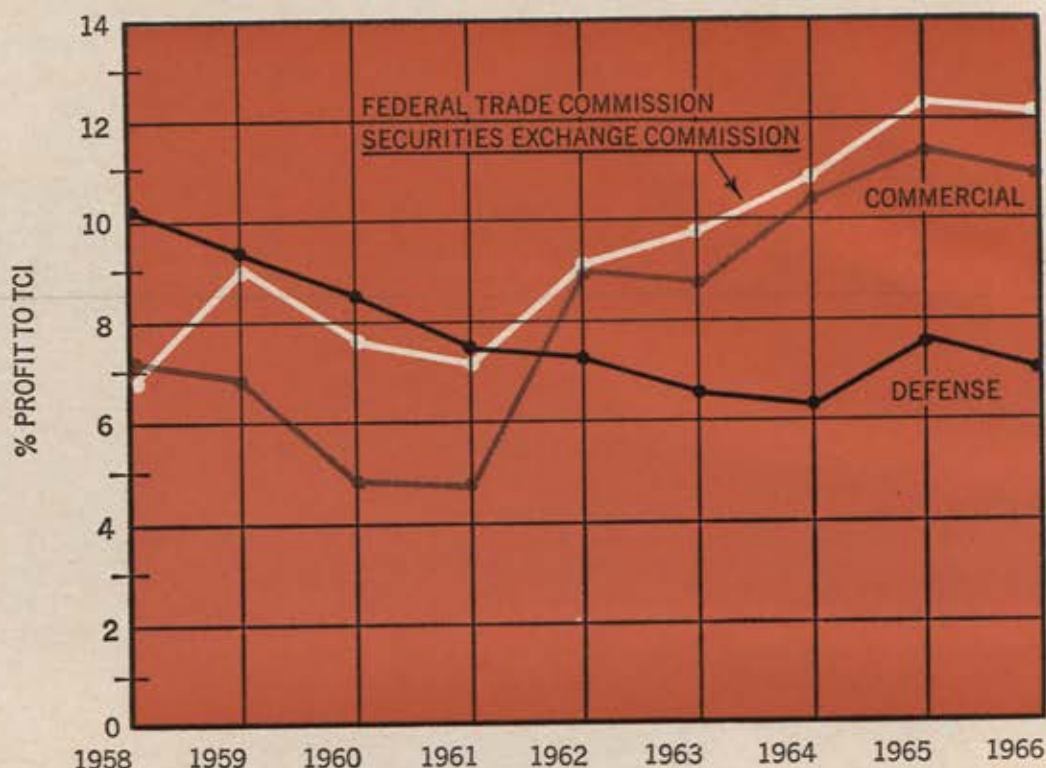
CAPITAL MARKET ANALYSIS



Suppose that on January 1, 1959, you had \$1,000 to invest. This chart shows that the equity you had at the end of 1966, after eight years with your money at work, would depend on the type of industry you selected at the outset. If your group is heavily engaged in defense business, you have made only \$98. If it is mixed, probably a "conglomerate," averaging thirty percent to ninety percent nondefense sales, you can sell out with a profit of \$2,295. Predominantly commercial firms and the Dow Jones Industrials fall in between.

PERCENT PROFIT TO TOTAL CAPITAL INVESTMENT HIGH AND MEDIUM VOLUME COMPANIES—AFTER TAX

Another LMI chart, on the relation of profit to capital investment, shows that since 1958 the trend of profits on defense business has been downward and the profit on commercial business upward. The FTC-SEC line represents a selection of durable goods manufacturers used by those federal agencies to study profit trends.



a foothold in some part of the aerospace spectrum. Without laboring the point, there are other examples that must be cited.

- The Boeing Co. reports 1967 earnings up ten percent with record sales of \$2.9 billion. The firm's total backlog has increased but its backlog of government orders has declined. In 1967, Boeing delivered 277 commercial jet airplanes.

- United Aircraft Corp. sales and earnings reached new highs in 1967. For the fourth successive year, UAC's commercial sales rose to a new peak, now providing thirty-nine percent of total sales, as against thirty-six percent for 1966. The UAC backlog of \$3.3 billion is about evenly divided between government and commercial business.

- North American Aviation, Inc., has merged with Rockwell-Standard Corp., and the new North American Rockwell Corp. has held its first annual meeting. W. F. Rockwell, Jr., Chairman of the Board, says they are going to expand. Where? Primarily in the commercial market. Mr. Rockwell claims the new conglomerate is the leader in space, automotive supplies, textile machinery, and mill supplies. They also have a top position in business aircraft, aerospace electronics, oceanography, life sciences, and atomic energy.

- McDonnell Aircraft Corp. and Douglas Aircraft Co. have merged. Clearly, this is a new giant, reporting a backlog of \$4.2 billion, of which sixty-one percent is commercial and thirty-nine percent government orders. It is a new, and life-saving, mix.

- Sperry Rand's President, J. Frank Forster, says that profits from his UNIVAC computer operations are "well on the way to becoming the leading contributor

to [our] earnings." And, he proudly added, "although US government military business now represents less than twenty-nine percent of Sperry Rand's total sales volume, down from forty-nine percent five years ago, the Sperry group will measurably help corporate earnings because of the increasing demand for autopilots and other cockpit instrumentation for commercial aircraft." The areas of Sperry Rand operations that have been most profitable in recent years are Vickers hydraulics, New Holland farm equipment, and Remington electric shavers. Mr. Forster did not specify the weight of Defense Department purchases in the area of hydraulics, tractors, and razors.

Both the LMI study of defense profits and the trend in corporate structure are matters that demand close scrutiny, in the interest of national defense if nothing else. LMI's President, Barry Shillito, already claims some credit, particularly for an announcement in early February that the Defense Department will increase normal progress payments from seventy percent of total incurred costs to eighty percent under fixed-price types of contracts having a long lead time. For small business concerns, the rate was increased from seventy-five percent to eighty-five percent.

Mr. Shillito also feels the report has called attention to inequities in the application of Weighted Guidelines, the supposed yardstick by which the Defense Department seeks to establish profit margins.

The report calls attention to the fact that the Pentagon's effort to cut down on Cost Plus Fixed Fee contracts in favor of Firm Fixed Price contracts has not been encouraging to the industry. The profit/sales

(Continued on page 140)

AIR FORCE-THIOKOL

Progress in Propulsion



From Minuteman at-the-ready in silos underground, to the Falcon missile on aircraft above, Thiokol supports the U.S. Air Force, providing a wide range of propulsion and military accessories to strengthen our armed forces.

Thiokol is there with far-reaching developments in big solid boosters. It is there with air-augmented pro-

pulsion for increased rocket flexibility; with off-the-shelf solid motors for space research; with pyrotechnic and ordnance devices to complement field activity.

Behind Thiokol's performance for the Air Force lies a total capability—research, design, development, production—which can move your propulsion projects forward faster.

Progress in
propulsion...

part of the
Widening World of



Thiokol
CHEMICAL CORPORATION
Bristol, Pennsylvania



ECI's 12 channel MicroMux* — small enough to fit in an attache case

*A look ahead
in communications
with ECI*

Military communications capacity will quadruple

ECI's new μ M-1 MicroMux* will quadruple present-day military communications capacity per cubic foot of equipment space.

Before 1963, a 48-channel airborne multiplex set required 80 cubic feet of space... providing 0.6 channels per cubic foot. Then, ECI introduced a miniaturized all solid-state multiplexer and increased capacity to 3 channels per cubic foot... a 500% improvement.

Today, ECI's newly developed μ M-1 MicroMux* is available for tomorrow's military communications systems. It will handle 12 channels in a cubic foot, quadrupling present-day capacity. Microelectronics plus universal channel modems, twin-channel switchover and unique modular construction make it possible.

The μ M-1 MicroMux* is designed to DCA performance standards and is equally well suited to manpack, fixed ground, airborne, or surface ship applications.

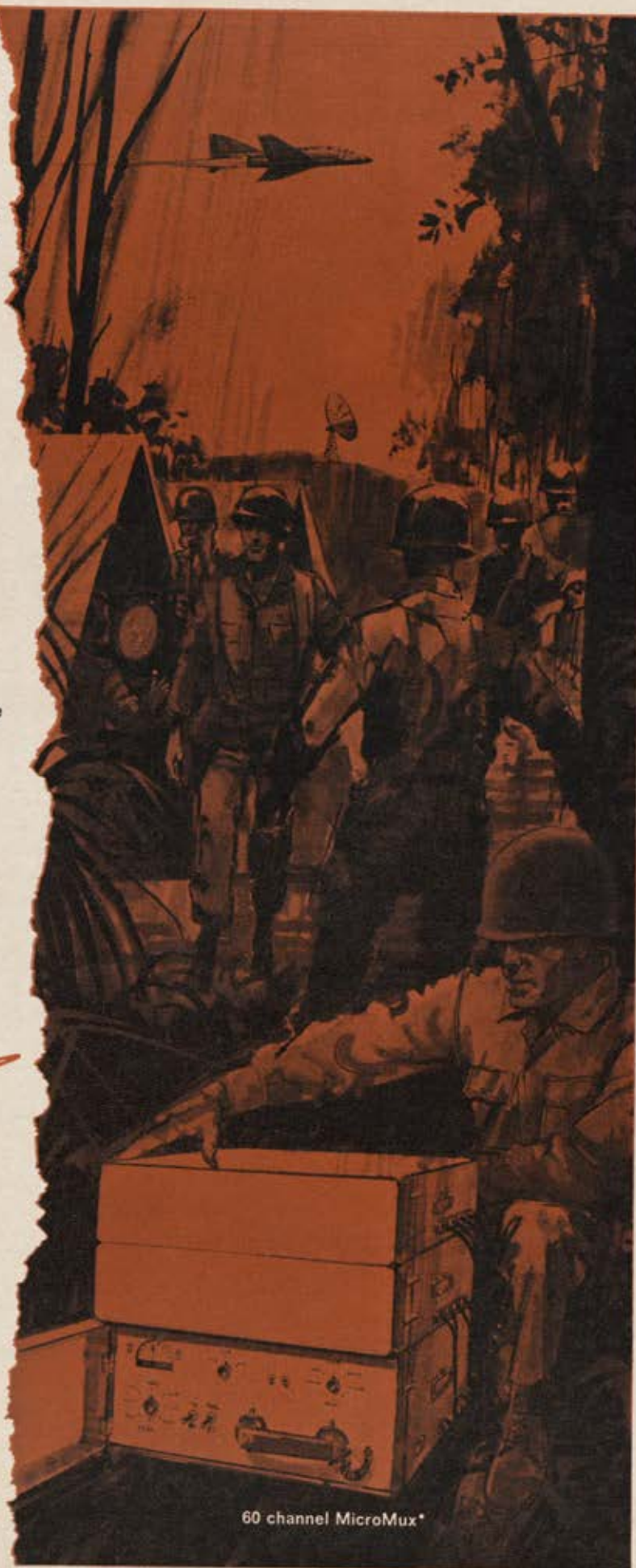
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To investigate career opportunities in communications, call or write Mr. Chuck Kelly, Professional Placement Office, Electronic Communications Inc., P.O. Box 12248 St. Petersburg, Florida 33733. Telephone (813) 347-1121. (Equal opportunity employer, M & F.)

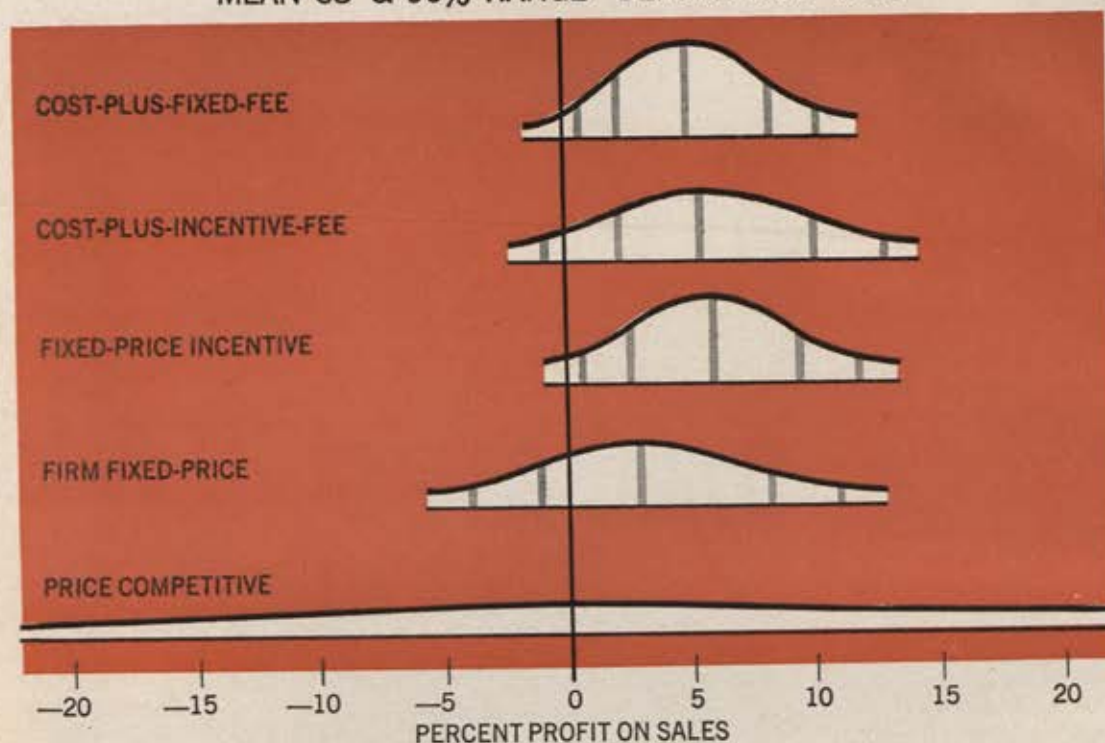
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60 channel MicroMux*

DISTRIBUTIONS OF THE PROFIT TO SALES RATIO BY TYPE OF CONTRACT SALES

HIGH AND MEDIUM VOLUME COMPANIES
MEAN 68 & 90% RANGE BEFORE TAX—1966



Basic message in this LMI chart is that higher risk involved in Price Competitive contracting ensures low median profit—near zero. Low ratio on FFP and Price Competitive deals result from substantial losses on small number of large contracts.

ratio of FFP contracts has been lower since 1961 than the same ratio on all other contract types. At the same time, the ratio on CPFF contracts has risen slightly, a change that LMI traces to the restriction of this type of contract to highly technical efforts. When Firm Fixed Price and Price Competitive contracts are involved, the ratios "are strongly affected by substantial losses on a small number of large contracts," the report says.

Mr. Shillito points to the fact that LMI found thirty-six contracts of the FFP type in 1966 on which industry suffered losses of \$103 million. The blame is not fixed, but it is clear that both the Pentagon and the industry should profit from the experience. The Defense Department must concern itself with the possible injudicious use of FFP. Corporations, large and small, must find some way to resist the winks and wiggles of pretty contracts on a highly competitive sidewalk.

Lawrence E. Hartwig, Chairman of the Renegotiation Board, has said that the safeguarding of incentive lies at the heart of the renegotiation process, and it is a statement that has not been challenged, even by Congressman Gonzales. Mr. Hartwig also pointed out that Congress itself has refrained from establishing a rigid definition of "reasonable" or "excessive" profit. This is true in the law, if not in the looser language tossed around on the floor of the House of Representatives.

In view of the trends in profit uncovered by LMI and the trend of the industry toward the conglomerate

operation, it is not unreasonable to raise some probing questions about the future.

In the first place, there is a good deal of talk these days about adopting the know-how and technologies and management capabilities of the aerospace industry to our current nonmilitary problems. Gen. B. A. Schriever, possibly the one man who made the ICBM possible, is now applying his talents to our urban and social problems, accompanied by some of his former suppliers who are looking for new challenges. The effort sounds promising, but the prospective contractors will not be encouraged if profit is denied while they face charges of "poverty profiteering."

Then, as the conglomerates grow, there is the possibility they can follow the pattern set currently by the automobile makers. It has not been widely publicized, but the three major car manufacturers recently refused to bid on a government purchase of 3,177 automobiles. The reason they gave is that they will not sell cars if they have to tell the customer how much it costs to build them.

This is not to suggest for one moment that defense contractors can go on strike or would even consider it. There is no evidence they would shun their responsibility.

But it is equally evident that our defense industry is not an arsenal and its existence does not depend entirely on government funding.

Private investment in defense is indispensable. The rewards must be commensurate with the magnitude of the task.—END

An Aerospace
Capabilities
Report on
Beech Aircraft
Corporation

BEECH
TOTAL
INVOLVEMENT
IN
SPACE



From first ICBM to interplanetary flight...

As a pioneer in the storage, transfer and control of cryogenic fluids, Beech has contributed from the start in the development of launch vehicles for ICBM and spacecraft systems. Beech R & D, manufacturing and testing capabilities have met the challenge of LOX/Liquid Hydrogen propellant systems, ground service equipment and related components and hardware.

Beech participation has contributed to the success of such launch vehicles as Atlas, Centaur, Titan and Saturn and in the manned spacecraft Lunar Module, Gemini and Apollo. The company's role in these programs has ranged from engineering development and environmental testing of system components to complete systems management responsibility.

Today, while actively engaged in several areas for Project Apollo...on the ground and for the launch vehicle as well as in the spacecraft...Beech is involved in conceptual developments for programs such as the Apollo Applications, refueling in orbit and manned inter-planetary missions of more than a year's duration.



From giant heat exchanger for Apollo...



To intricate control electronics for cryogenic gas systems



...To high energy fuel chemistry, Beech is totally involved in aerospace-related activities.

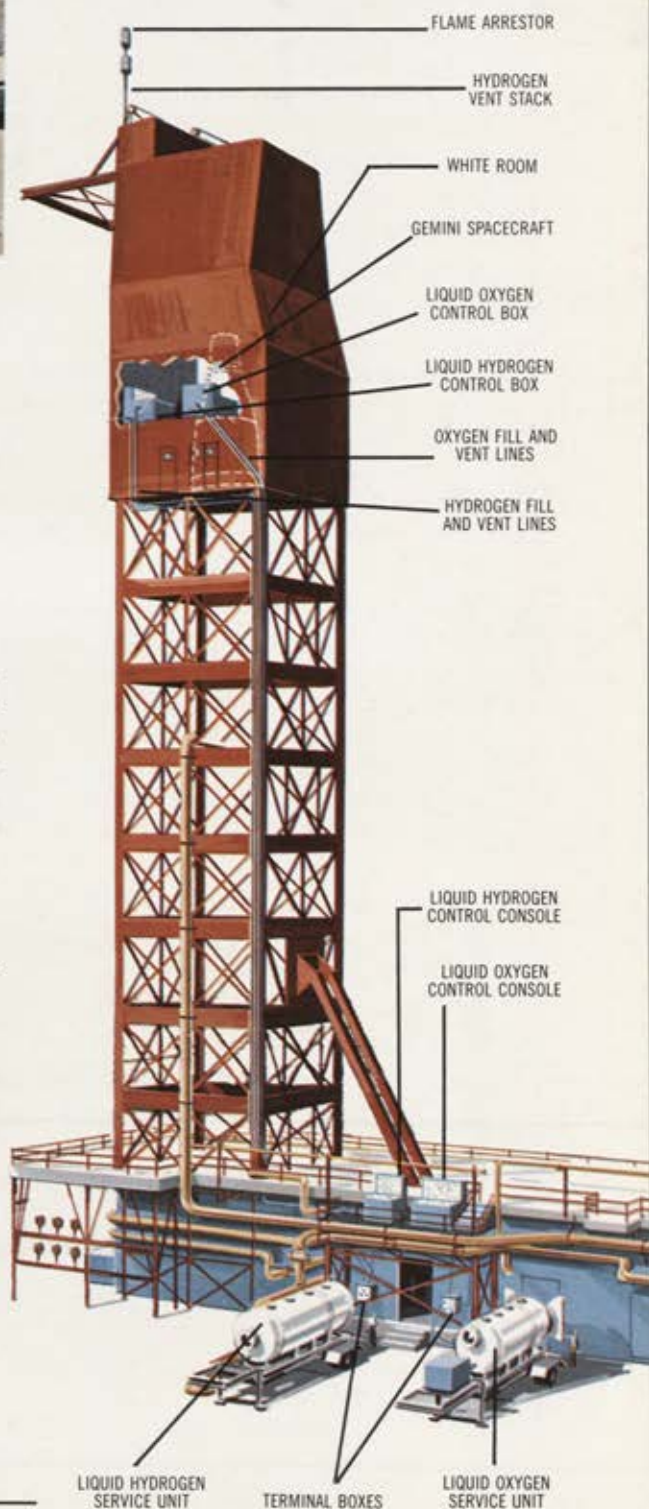


These highly intricate and precise control systems regulate the flow of liquid hydrogen and liquid oxygen to the Gemini environmental control and fuel cell storage tanks. The control consoles (center) regulate the transfer of the fluids from ground level to the White Room, high in the erector tower. The control boxes (outside) are located in the launch complex White Room and regulate the actual filling of the cryogenic storage tanks to exact capacity.

Where Beech ground support was vital to Gemini mission success

Complete systems responsibility for delivery of liquid oxygen and liquid hydrogen for the Gemini Reactant Supply and Environmental Control Storage Systems was assigned to Beech, under contract with McDonnell Aircraft Corporation. The completed Gemini program, with a perfect 12 out of 12 successful missions, indicates how well Beech and all the other aerospace manufacturers on the Gemini team accomplished their individual assignments.

The various components of the Beech Ground Support Equipment System for Gemini demonstrate the scope and range of Beech capabilities in research and development, from concept to qualification to production. The service unit dewars, the terminal boxes, the control consoles, the vacuum insulated flexible and hardline transfer lines and the control boxes are all as precisely built as laboratory instruments. And each has the rugged reliability that has always been associated with Beech.



Life support and electrical systems for Project Apollo will depend on Beech

Beech responsibility aboard the Apollo Service Module includes the design, construction and testing of cryogenic gas storage subsystems. These consist of two hydrogen tanks and two oxygen tanks, plus all related components and controls to provide breathing oxygen to the environmental control system and provide oxygen and hydrogen for fuel cells that supply electrical energy for the Apollo Command Module.

Systems requirements that are vitally important to sustained space flight include maximum storage capacity, maximum storage time through minimum "heat leak" loss and minimum system weight. A Beech "breakthrough" in flight-weight thermal protection systems applied to the cryogenic gas storage subsystems of the Apollo spacecraft is a significant improvement over original project specifications, reducing heat leak by one-half and reducing insulation weight by 75%.

These systems for the Apollo, Block II, Service Module are among the largest and most sophisticated ever designed for environment and electrical power generation in manned space flight. They have met the highest, most severe performance standards ever established for "man-rated" space-borne storage systems. Fully qualified, they are now in a production line status at Beech.



Beech also developed and built the Beech Maintenance Equipment needed to test and functionally certify Beech-built airborne systems after installation in the Apollo spacecraft.



Models of the Apollo spacecraft Service Module, Command Module and Lunar Module form the background for a cutaway display of the Beech cryogenic gas storage system on display at the NASA Manned Spacecraft Center, Houston.



This cutaway view of the Apollo Service Module shows approximate positioning of four Beech cryogenic gas storage systems (two for liquid oxygen and two for liquid hydrogen). These will carry oxygen and hydrogen supplies for life support and electrical energy generation for a 14 day mission.

A radiant heating reflector system inside the 20-foot vacuum bell of this thermodynamics test facility can be programmed for various heating modes during desired cryogenic fluid storage or flow conditions. Data measurement and data reduction systems are an integral part of this facility.



Every system and component designed and fabricated by Beech for Project Apollo have met tests on the ground that are more demanding than they will face in the vacuum of outer space.



The largest of its type, this A-249 electrodynamic exciter subjects Beech aerospace equipment to severe vibration tests to demonstrate integrity and reliability of design.

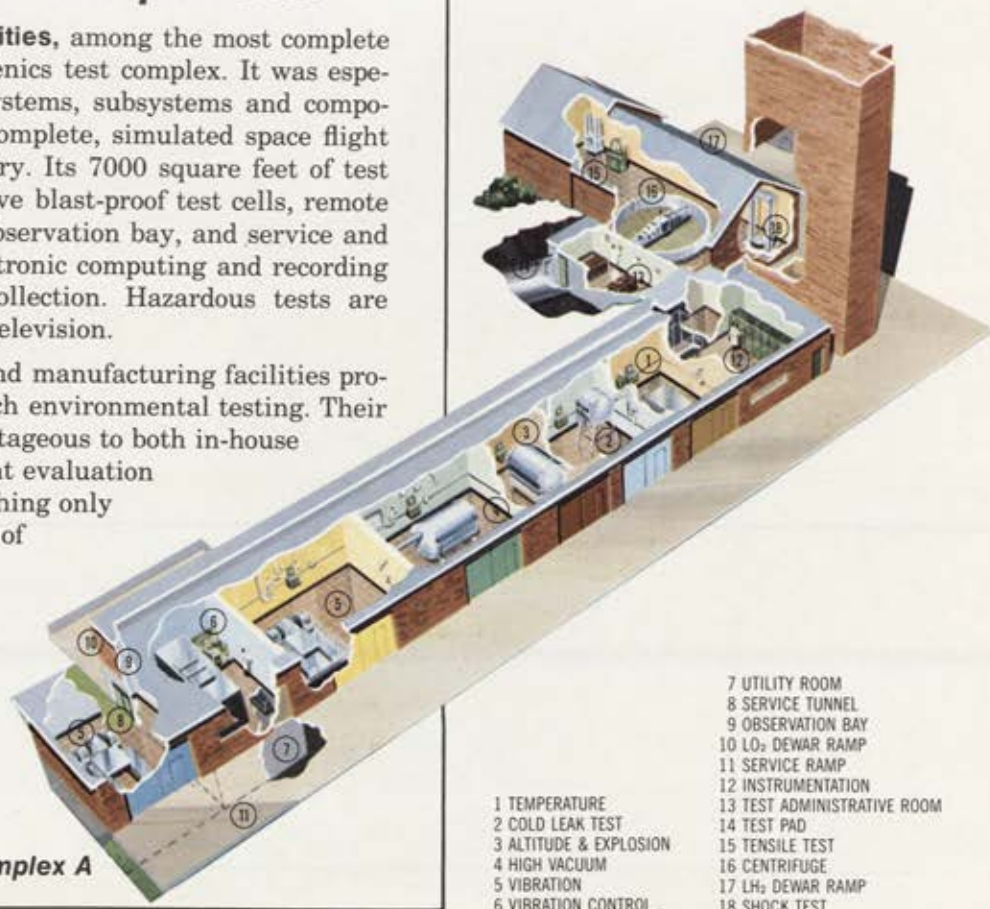
Where Beech tests vital space systems and components

Beech environmental test facilities, among the most complete in existence, include this cryogenics test complex. It was especially constructed for testing systems, subsystems and components through all phases of a complete, simulated space flight sequence, from launch to re-entry. Its 7000 square feet of test area include such features as five blast-proof test cells, remote instrumentation and controls, observation bay, and service and escape tunnels. High speed electronic computing and recording provides fast, accurate data collection. Hazardous tests are observed through closed circuit television.

The **Beech engineering staff** and manufacturing facilities provide exceptional back-up to Beech environmental testing. Their close association has been advantageous to both in-house and contract aerospace equipment evaluation programs...for components weighing only ounces, to a simulated operation of the Douglas third stage portion of the Saturn V launch vehicle.

Beech is involved in the Saturn V

Assigned to study the logistics of the entire Project Apollo propellant loading system at Merritt Island, Beech was involved with the launch vehicle as well as the spacecraft. Assignments included the study, design, development, fabrication and testing of the liquid nitrogen and liquid hydrogen vaporizers and all associated control components at the Merritt Island complex. It also involves testing of some vital cryogenic hardware that only Beech has the test capabilities to perform.



Beech cryogenics test complex A

- 1 TEMPERATURE
- 2 COLD LEAK TEST
- 3 ALTITUDE & EXPLOSION
- 4 HIGH VACUUM
- 5 VIBRATION
- 6 VIBRATION CONTROL

- 7 UTILITY ROOM
- 8 SERVICE TUNNEL
- 9 OBSERVATION BAY
- 10 LO₂ DEWAR RAMP
- 11 SERVICE RAMP
- 12 INSTRUMENTATION
- 13 TEST ADMINISTRATIVE ROOM
- 14 TEST PAD
- 15 TENSILE TEST
- 16 CENTRIFUGE
- 17 LH₂ DEWAR RAMP
- 18 SHOCK TEST

**Beech is ready now
for the long duration
Post-Apollo missions**

Three years before Sputnik I heralded the world's entry into the space-age, Beech began its pioneering work in the then little-known field of aerospace cryogenics. This pioneering created opportunities for development of unusual capabilities in many areas associated with aerospace applications. Today, Beech has exceptional knowledge, experience and plant facilities for assuming a wide range of responsibilities...up to and including complete systems management.

Beech has created a revolution in flight weight thermal protection. Proven by use in the liquid hydrogen tanks now being supplied for the Apollo, Block II Service Module...and in the liquid helium dewar that will service the Lunar Module before launch, this space- and weight-saving Beech system is capable of wide application.

Over and above the excellent thermal performance and low weight of the Beech thermal protection system, other advantages that have been demonstrated are: *production repeatability*, with components prefabricated and tested before installation; *easy vacuum acquisition* provided by the small amount of material in the vacuum annulus; and *moderate cost* stemming from ease of assembly and simplicity. Practically all systems now foreseen will be constructed with a vacuum annulus less than 1 3/4 inches thick!

Cryogen tank systems now under development and test by Beech engineers will be capable of storage and delivery of oxygen, hydrogen and nitrogen for periods of a year and more. In addition, development of measurement, controls and instrumentation for these systems has gone beyond existing state-of-the-art to keep pace with the extended mission capabilities established.

A recently completed 6-year funded study of bladder expulsion of liquid hydrogen for zero gravity applications has added to the already extensive Beech experience. Positive expulsion for cryogenic fluids will be a necessary part of orbital refueling procedures of the future.

The challenge of meeting the Beech responsibility on the Lunar Module led to cryogenics research and development that has materially advanced the "state-of-the-art".



The newest Beech lightweight cryogen storage design (see sketch) is capable of storing fluids for a period of 180 days or more. Minor modification will provide storage for one year or longer. New concepts under development will extend performance capabilities even further.



Final assembly of space-borne tanks is accomplished in a clean room to avoid any contamination. The air supplied to the clean rooms at Beech is 3,000 times cleaner than mile-high mountain air, and even then it is re-filtered just to be sure.



Liquid helium for use in the Lunar Module will be transported and stored in the dewar being fabricated here. The golden, elongated globe is the inner pressure vessel for relatively low pressure containment of the minus 452° F fluid. A new Beech thermal protection system is primarily responsible for the reduction of empty dewar weight-to-helium capacity ratio in this dewar from the usual 5.8 to 1.0 to a startling 1.9 to 1.0 ratio. Size and weight limitations imposed by this assignment could not have been met by insulation methods normally used.



Apollo, Block II Hydrogen tanks were the first application of a new Beech thermal protection system. Apollo performance specifications for 14 day missions were easily met and, with minor modifications, this thermal protection system can exceed Apollo mission performance requirements by a factor of seven.

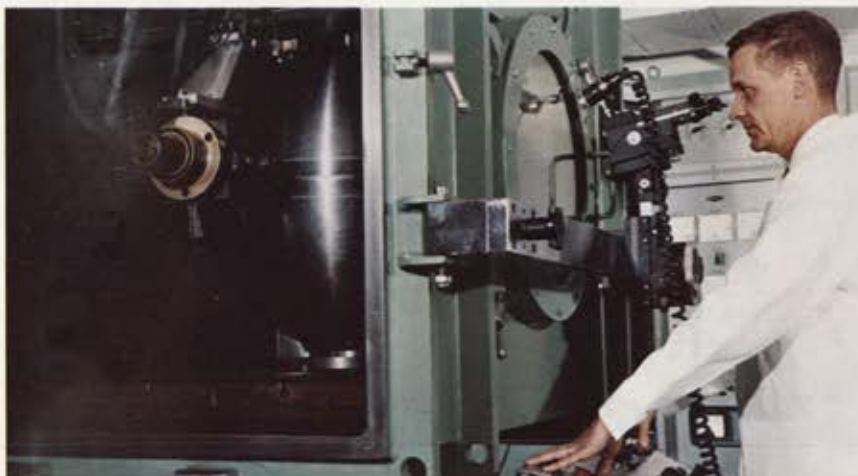


This Beech-developed liquid helium Conditioning Unit receives helium at ambient temperature and high pressure and conditions it, through a combination of heat exchangers, to the super-critical state. The super-critical helium is then supplied for final filling of the Lunar Module spacecraft helium tank at 9.7° R and at pressures of 2.5 to 35 KG/cm² (the dewar provides helium for cool-down and initial fill). Beech Ground Support Equipment for the Lunar Module offers, for the first time, direct reading on a digital display of temperatures in the 8°-20° R range with 1/2° accuracy, and digital display of helium mass flow rate measurement.

With over 1600 square feet of computer operating and office space, plus lease agreements for extensive additional facilities, Beech makes full use of the growing science and its technology.



A six-year Beech R & D program proved the capability of polymeric bladders for positive expulsion of liquid hydrogen for zero gravity applications.



Production welding of .012" titanium was pioneered and perfected at Beech, where a high degree of proficiency has also been developed for welding inconel 718, aluminum and 300 series stainless steels for cryogenic equipment.



Metallurgical knowledge was advanced by Beech metallurgists' application of "high strength-to-weight ratio" metals to low temperature applications, resulting in benefits for future space applications.



One of several significant technical breakthroughs in connection with subsystem development is a small electric motor that will operate in temperatures as low as minus 425° F and at pressures as high as 1000 psi.



A vacuum leak detection system was especially designed by Beech to provide accurate measurement of helium or hydrogen gas leakage or permeation. Permeation levels as low as 1×10^{-6} std cc per sec have been measured.

The pioneering spirit lives on at Beech

Contributions by Beech are as diverse as the requirements of space flight. The Beech breakthroughs in flight weight thermal protection and in subsystem development...state-of-the-art advances in metallurgy, measurement, welding, positive expulsion and many other areas are all a result of the same creative pioneering spirit.

This is the reason why Beech has been selected for so many vital aerospace assignments, ranging from environmental testing of small components to complete systems management...by government agencies and all major primes.

For full information about how you may take advantage of Beech experience in systems management and proven capabilities in designing, developing, manufacturing and testing components for aviation and aerospace projects, write, wire or phone Contract Administration, or Aerospace Marketing, Beech Aircraft Corporation, Wichita, Kansas 67201, U.S.A.

For meeting
tomorrow's standards...

**Look to Beech
Capabilities!**

Beech Aerospace Division
Wichita, Kansas • Boulder, Colorado

Although at first glance Philip Klass's explanation of unidentified flying objects, in his new book, *UFOs—Identified*, may seem prosaic to those who are anticipating the supreme adventure of communicating with beings from another world, most readers of this soundly based and strongly argued book will have to postpone their daydreams and, accepting Mr. Klass's "plasma theory," conclude that many UFOs really are . . .

GREAT BALLS OF FIRE!

By J. S. Butz, Jr.

TECHNICAL EDITOR, AIR FORCE/SPACE DIGEST



THERE are many who will not want to believe that "flying saucers" really are "balls of ionized fire," a sort of atmospheric phenomenon as natural as rain-fall but rare as a waterspout.

First of all, it's too easy. If this is so, why haven't scientists known about it for years and scotched the stories that have mushroomed into the modern legend of the UFO?

To believe the "balls of fire" theory, you also must discount or at least reevaluate the numerous reports of veteran airline and military pilots, and other competent trained observers who have seen UFOs and sometimes flown close formation with them for many minutes.

Strictly from the technical viewpoint, few people in the United States are prepared by formal education, or otherwise, to accept the concept of natural plasma—the fourth state of matter, in which a few ounces of ionized (electrified) air can be kept glowing and restrained for significant periods inside a "bottle" formed by the earth's magnetic field. How can these plasmas grow to diameters of more than 100 feet and, on occasion, maneuver with what appears to be "intelligence"?

A final objection, though one which most of us probably won't admit, arises from a hope the glowing air theory is wrong because it tends to eliminate the possibility of this generation's participating in the greatest of all adventures—an encounter with beings from another world.

In spite of these objections, most readers of the book, *UFOs—Identified*,* probably will give up their daydreams and accept the plasma theory as the most plausible solution to the great flying saucer mystery.

The author, Philip J. Klass, has collected a mass of data and generated a strong argument to support it. His conclusion, in effect, is that there has been no hoax in the majority of the thousands of UFO sightings. He believes the observers did see something, a plasma,

(Continued on following page)

**UFOs—Identified*, by Philip J. Klass, Random House, N. Y., 290 pp., \$6.95.

GREAT BALLS OF FIRE!

and their consistent misinterpretation constitutes one of the most significant cases of mistaken identity on scientific record.

Mr. Klass's explanation for the lateness in appreciating this phenomenon is that the sensationalism surrounding UFOs has kept serious scientists at a distance. He doesn't claim to have originated the idea that UFOs are a form of *Kugelblitz* (ball lightning) or an electrified plasma of air. But he does make two important contributions.

One is an exhaustive reporting job, which is sufficiently detailed and restrained to appeal to scientists. No previous publication comes close to making as strong a case for the plasma theory. It is likely that at the very least Mr. Klass's book will provide the spark to ignite extensive and badly needed scientific investigation of the subject.

At the same time, the book has great appeal for the layman. Mr. Klass relates his experiences as a detective story—his initial reluctance to consider UFO sightings seriously, the first suspicions that plasma was involved, the occurrences that prompted his decision to make a detailed investigation of many sightings, and some of the bizarre adventures that befall one entering the UFO "community" for the first time.

Virtually anyone interested in UFOs can understand the book, and those who do will run the risk of becoming converts to the plasma theory.

Phil Klass has some unique qualifications for writing this book, which I can attest to personally, as we worked together four years on the staff of *Aviation Week & Space Technology*, where he is now Senior Avionics

Editor. He is an electrical engineer and had ten years' experience on advanced projects at General Electric before turning to technical reporting, and he is knowledgeable about plasmas.

But much more important is his prodigious capacity for reporting and writing. In his fifteen years with *Aviation Week* he has poured out a volume of stories that probably won't ever be equaled in the technical reporting field. His record is of the Babe Ruth variety; few people will come close. To top it off, Mr. Klass has a high batting average for accuracy. He is seldom wrong.

The combination is formidable, and it is apparent in his book, *UFOs—Identified*. If Phil is wrong on this one, he's picked a lulu.

But the chances of his thesis being incorrect seem small. He reports a survey conducted by Dr. J. Rand McNally, Jr., of the Atomic Energy Commission's Oak Ridge Laboratories. Nearly 16,000 persons were interviewed, and only 513, or 3.2 percent, reported ever having seen ball lightning.

Mr. Klass discusses talks with a number of other scientists who have studied *Kugelblitz*. Some of this work has related to possible defenses against missiles. So far this aspect has proved fruitless, but it has produced several experts in the field. One of them, Dr. Martin A. Uman of the Westinghouse Research Laboratories, believes that ball lightning is a family of phenomena, one of which can be triggered by the corona-type of electrical discharge that glows around high-voltage power lines.

Dr. Uman's corona theory fits right in with Mr.



Ball lightning, or *Kugelblitz*, is shown at left in this time-exposure photograph taken by Dr. B. T. Matthias in 1961 at Los Alamos, N. M. Ball lightning usually is reported during or after a thunderstorm. However, according to Mr. Klass, other forms of natural plasma have been triggered on clear days, at high and low altitude, by power line corona and electrical discharges from aircraft.



A photograph of a glowing, saucer-shaped UFO (right) with a "vertical tail" extending from its lower portion was taken by James Lucci of Beaver Falls, Pa., as he was making time-exposure of the moon (left). This saucer came from the direction of high tension lines. Only the saucer-shaped portion was visible to Lucci and his companions, suggesting that the "tail" was radiating infrared energy outside of the visible light portion of the spectrum.

—Photo by James Lucci

Klass's own conclusions. Mr. Klass's investigations began when he read the book *Incident at Exeter*, in which John G. Fuller reported exhaustively on widely publicized UFO sightings near Exeter, N. H. Mr. Fuller suggested, among other things, that most of the sightings had taken place near power lines because the "objects" were seeking the power. Mr. Klass explains the sightings in the area on the basis of a combination of salt air from the sea, the dry dusty atmosphere that summer, possibly extra-high voltage excursions

in the power system, and other conditions that tend to create plasma discharges.

As Mr. Klass records, he believes that virtually all UFO sightings at low altitude are either out-and-out hoaxes or can be explained by the corona-discharge theory.

High-altitude UFOs are another matter, and Mr. Klass suggests they are triggered by aircraft when atmospheric conditions are right. This could occur when an aircraft accumulates a relatively high electrical charge and a discharge occurs at the wingtip and "ignites" water vapor, ice crystals, or pollution products in the wingtip vortex.

World War II "foo-fighter" reports of glowing fireballs shooting past aircraft or flying "formation" for many minutes, and more recent UFO reports of large saucer- and cigar-shaped objects, are similarly credited by Mr. Klass to this type of phenomena.

Scientific interest has been aroused, and Mr. Klass reports on conversations with many physicists who are beginning to look at UFOs as a matter for serious investigation. Many men are equipped for serious study, as Kugelblitz and plasma are being created experimentally in many laboratories. However, a rigorous answer to the question is going to take a unique expertise in plasma and atmospheric physics, and to date no one has suggested an easy method of experimentally proving the theory.

One current need is for more detailed descriptions of foo fighter and UFO sightings at high altitude. Anyone who has had such experiences is invited to get

(Continued on following page)

What USAF Is Doing About UFOs

An independent investigation of UFO sightings is under way at the University of Colorado. The Air Force is sponsoring the study, but has given Dr. Edward U. Condon, the project leader and former director of the National Bureau of Standards, a completely free hand in seeking a valid explanation of UFO phenomena.

The Colorado study was initiated about two years ago after complaints from UFO enthusiasts about the USAF's "withholding" of flying saucer information had reached the thunderous stage. A report from the Colorado group is due next fall. It will be reviewed by a special group from the National Academy of Sciences.

The Air Force also is continuing to record and investigate UFO sightings through a small office at Wright-Patterson AFB, Ohio.

A plasma in the process of shorting out a high-frequency radio antenna for the USAF/Martin Titan III launch vehicle is shown at right. Most antenna designs have failed this type of vacuum chamber test of broadcasting characteristics in a near-space environment. Mr. Klass cites such antenna shorts as another mechanism for creating plasma UFOs in the atmosphere, and in space near the earth.



in touch with Mr. Philip Klass through this magazine.

Mr. Klass also is experiencing the saddest aspects of "UFO fever." Men who have "flown" on saucers, around the earth, and "to other worlds" are attracting cults of believers. Some are booked solid on speaking tours, appear regularly on TV, and are followed about by newspaper reporters. Some are taking in substantial sums from their followers.

One young woman recently called Mr. Klass from Florida to ask his opinion on a move her in-laws were about to make. They were being encouraged by a saucer "flyer" to donate their home and savings to an institute of "cosmic" research and to come to California to live on a ranch which is "visited" by the saucer men.

The young woman, incidentally, alienated her in-laws by recommending against the move. She is now accused of wanting their money herself.

\$10,000 OFFER

Philip Klass, author of UFOs—Identified, has not yet had any takers for his offer to pay \$10,000 to anyone who signs an agreement with him. Mr. Klass will pay the \$10,000 when an authentic extraterrestrial visitor appears on live television or presents his credentials to the United Nations, or if a crashed spacecraft is found which clearly exhibits construction techniques from another world. There's one catch—the other party to the agreement must agree to pay Mr. Klass \$250 a year until any of the above specified events occur.

"UFO fever" also has bitten large numbers of reputable men and women. The most conservative of their organizations is NICAP (National Investigation Committee for Aerial Phenomenon) with about 12,000 members. This group earnestly believes the UFO question has not been studied adequately by the government and has undertaken to do it itself. NICAP has sent its investigators all over the United States and prepared detailed reports on thousands of sightings. It has attracted many thousands of man-hours of volunteer time from enthusiasts and maintains a small full-time staff. Most people familiar with its activities, Mr. Klass included, report they are not out to make a buck on the UFO craze.

NICAP officials, however, do not put much stock in Mr. Klass's plasma theory. One says, "He is trying to explain one unknown with another unknown."

Among the rank-and-file UFO believers, however, there is a strong resistance to Mr. Klass's idea because it seems to rule out the possibility of extraterrestrial life, at least in terms of current visits to this small planet. But this must be recognized as a narrow view.

Certainly it doesn't do justice to UFO enthusiasts of two decades ago. They would have looked at many options for an advanced world sending out space travelers. Solid "earth-style" vehicles piloted by what has become the stereotype "little green men" are only one possibility. Who is to say that advanced civilizations cannot—or do not—travel in plasma form? After all, it is now well known that the universe itself is ninety-nine percent plasma, and an earth-type assemblage of atoms is an occurrence of relative rarity.

Mr. Klass may have started far more than even he bargained for.—END

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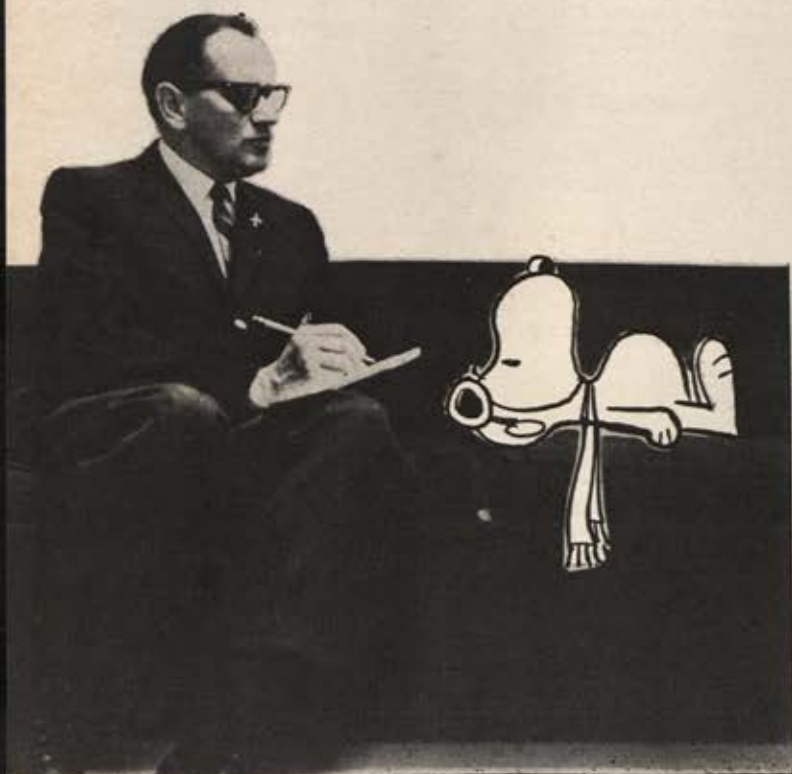
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CURSE YOU, RED BARON!

Over the years, Ed Mack Miller, veteran Air Force, Air National Guard, and airline (United) pilot, has interviewed most of the important personalities in aviation while producing three books and some 122 published articles and stories. Included in the aviation greats he has interviewed have been such illustrious pilots as the late Cols. James Jabara and Ross Greening, Paul Mantz, William Wellman, Gen. Curtis LeMay, Ernest K. Gann, Maj. Alexander P. de Seversky, Capt. Eddie Rickenbacker, and many others. But feeling that his coverage of aviation would always be incomplete until he cornered that nonpareil of World War I's Western Front—Snoopy—Miller courageously posted himself on the scent of the "Lone Beagle." Here's the result. "It wasn't for the money," Miller says modestly. "Actually, I did it for Peanuts."

An Interview



By Ed Mack Miller

Snoopy's replies by Charles M. Schulz
Beagle artwork by Charles M. Schulz
Photographs by James Gilbert

Q: In World War I, many of the great pilots of the Lafayette Escadrille came from Ivy League colleges and were wealthy scions of leading families. But others came up the hard way. Raoul Lufbery had been a mechanic. Others, like William Wellman, had been drivers in the Norton-Harjes ambulance corps. How did you get started?

A: *Hard work and lots of imagination.*

Q: As a handsome young pilot, did you have any trouble making contact (*coupez*) with beautiful French mademoiselles?

A: *They loved me in Pont-à-Mousson!*

Q: How many dogfights have you been in? More than they used to have on an average day at the Daisy Hill Puppy Farm?

A: *I don't believe in dogfighting. You get dog hair all over you.*

Q: Were you considered an eager beagle? Or an eagle beaver?

A: *I think I'll leave.*

Q: Is a Nieuport better than any old port (in a storm)?

A: *I can see you're not taking me seriously.*

with SNOOPY



Q: Did you really invent the phrase "Ready, willing, and beagle," and the phrase "Trust in Allah, but tether your camel," and the words "tailspin" and "dogfight"?

A: *Probably.*

Q: What's more desirable from your point of view—the Purple Heart or Red Heart?

A: *I hate these sarcastic questions.*

Q: Was the Sopwith Camel really a dog? What did it think of you? What model did you fly? Wasn't this model rather squarish—built kind of like a small house? What was its coefficient of lift? (L over D?) Would you walk a mile for one?

A: *Please repeat the question.*

Q: Do you have any bones to pick with the experts on your record?

A: *They refuse to verify my kills. They have no imagination!*

Q: What do you think of Oberleutnant Schulz as a Boswell?

A: *That Schulz never did know what was going on!*

Q: Is it true that you once flipped over a French poodle . . . pardon, flipped over when you landed in a French puddle?

A: *Oh, what a girl! Just thinking of her brings tears to my eyes!*

Q: In your day, fighter pilots used to put their thumb to the sun to spot an enemy. Did you have any particular problems this way?

A: *I can't stand these insulting questions.*

Q: Were the Boche gauche? Was a Kraut a lout, or could a Hun be fun? Did you get a thrill out of a vrille?

A: *I can't stand it!*

Q: Do you expect to become snoopersonic in the '70s?

A: *Curse you, Red Baron!*



Japanese Balloon Bombs in World War II

During the last ten months of World War II, the Japanese launched thousands of bomb-carrying balloons from their home islands. The balloons were calculated to cross the Pacific and, by means of an ingenious timing and release mechanism, drop their lethal loads on the US mainland. A number did just that. The new secret weapon caused great official concern in this country but was largely kept from the public. Though only six people are known to have been killed by this weapon, its potential destructiveness was immense. The Japanese balloon bombs were, in fact . . .

The World's First Intercontinental Missiles

By Maj. Robert C. Mikes, USAF

JIMMY Doolittle planned his April 1942 bombing raid on the Japanese home islands to "cause confusion and impede production." He knew the bomb loads of his sixteen carrier-based B-25 Mitchell bombers could not do enough real damage to have much effect on the war. But he had high hopes that the appearance of American planes over the Japanese homeland only four months after Pearl Harbor would be such a psychological blow that the enemy might change his strategy to the benefit of the Allies.

Doolittle's bold raid did indeed change the course of the war by encouraging the Japanese to engage the Americans at Midway, where they lost disastrously. Ironically the Doolittle mission also sparked the invention of the world's first intercontinental missiles, an invention that could have changed the course of the war back in favor of the Japanese. In a desperate attempt to find a means of reprisal, the Japanese undertook history's first balloon-bomb campaign. Their plan was simple: launch balloons with incendiary and antipersonnel bombs attached, let the prevailing winds carry them across the Pacific to drop on American cities, forests, and farm lands.

It took over two years to design the balloons, the bombs, and an automatic dropping mechanism. Japanese scientists, spurred by the fury of the militarists and the need for a return gesture that would regain them the "face" they felt they had lost, worked day and night to solve the technical problems. Finally, on November 1, 1944, the first of more than 9,000 bomb-bearing balloons was released.

Four days later, this balloon's canopy was fished from the water near San Pedro, Calif., minus its load

of bombs. Before the project ended, almost 1,000 of the death-dealing balloons reached the North American continent. However, only 285 were found, stretching over a wide area from the island of Attu in the Aleutians, eastward as far as Michigan and as far south as Mexico. Six people—a minister's wife and five children—lost their lives when they dragged one of the bombs from the woods while on a picnic near Lakeview, Ore. Fortunately, no other lives were lost, so far as is known, and no extensive damage was done, although the potential for destruction and fires was tremendous. More important, if the extent of this remote kind of bombing had become known throughout the country, the shock to American morale might have been worse than any material damage that could have been inflicted.

The balloon bombs were one of the two main secret weapons with which the Japanese Army had hoped to counteract the tide of war then going against them. The other was a scheme for bombarding American coastal cities with rockets fired from submarines. This latter idea never got off the drawing board.

Historians have tried to make light of this seemingly pathetic last-ditch effort to retaliate against the United States by using man's oldest air vehicle. It was, however, a significant development in the concept of war and presaged the development of today's intercontinental ballistic missiles, which can be launched from land or undersea. Had the Japanese balloon weapons been further exploited by using germ or gas bombs, the results might well have been of serious consequence to the American people.

The Japanese balloon-bomb idea was originated in 1933 by Lt. Gen. Tada Reikichi who then headed the

Japanese Army Scientific Research Institute, which investigated and developed new war weapons. At this time, several revolutionary weapons were under consideration. One, called the "I-Go Weapon," was a small wire-controlled manless tank that could attack enemy pillboxes and wire entanglements. Another was the "Ro-Go Weapon," a project to develop a rocket propellant. Still another was a "death-ray" weapon that was supposed to be able to kill at close range with an electrical charge.

But it was the "Fu-Go Weapon," or balloon bomb, that showed the most promise. The idea was based on small constant-altitude balloons capable of carrying explosives. The wind was to carry the balloons over enemy positions, where the bomb load would be released by a time fuze. It was expected that the results would equal or exceed the range and accuracy of the Big Berthas, the heavy guns used by the Germans against Paris in World War I. As it turned out, the range was far exceeded but accuracy was something else.

Since great numbers of the balloons would be needed, one of the technical problems to be solved was to design an inexpensive gas-proof balloon bag able to be mass-produced. After much experimentation, the Japanese found they could obtain good results from tissue made from the fibers of the *kozo* bush and *konnyaku-nori*, an adhesive made from potatoes. As the technical problems were being resolved successfully, research was conducted with low-altitude balloons to enable them to drop propaganda leaflets over enemy positions. Balloons large enough to carry foot soldiers behind enemy lines were considered and were under development at the beginning of World War II.

This balloon project showed such promise that it was expanded to include larger types capable of being launched from submarines at night from a range of 800 miles. Plans were nearing completion, and some submarines were modified for this mission when the Guadalcanal campaign in the summer of 1942 forced the project to be discontinued. But as the noose of



A captured Japanese balloon, inflated under test conditions, shows scallop to which shroud lines were attached.

Allied might began to draw around Japan's ill-gotten empire, the necessity for the Japanese to find some way to carry the fight to enemy shores became more urgent. The development of longer-range balloons launched from Japanese soil seemed the best answer.

The main concern in the research for the "Fu-Go Weapon" was developing a means of keeping the balloon at a constant altitude for the fifty to seventy hours it would take to cover 6,000 miles of ocean. If the balloons were launched in the daytime, continuous sun radiation in cloudless skies at high altitudes would cause the gas temperature to rise and the balloons would expand to the bursting point. At night, the reverse would be true, and the balloons would lose altitude as they lost buoyancy.

The solution to this problem was the installation of a gas-discharge valve and an ingenious system for automatically dropping ballast. The balloons were made of five layers of the tissue paper cemented together to form a sphere about thirty-three feet in diameter and inflated with hydrogen to a capacity of 19,000 cubic feet. When filled, the balloons had a lifting capacity of 1,000 pounds at sea level or about 300 pounds at 30,000 feet. The balloon envelope was encircled by a scalloped cloth band to which numerous shroud lines were attached. Below the balloon, these shroud lines were tied together in two large knots, and from them hung the bombs and the ballast-release mechanism.

The release mechanism consisted of a cast aluminum wheel from which bags of sand were hung. By means of an aneroid and a small battery, the fuzes attached to two of the sandbags were ignited, releasing this weight whenever the balloon reached a preset minimum altitude. The balloon then rose, was carried along by the wind currents, and sank again to the minimum altitude as the gas slowly escaped or became cooler.

(Continued on following page)



For the past seventeen years the author, Major Mikesh, has directed his outside interests into the field of Japanese aviation history. He has produced several notable studies in this area, and his seven years of military assignment in Japan helped his research. The accompanying story was sparked by a Japanese friend who had helped build these balloon bombs. Major Mikesh's aviation interests started with model building as a boy. Some of his

scale models are in the National Air Museum in Washington, D. C. An active member of the American Aviation Historical Society, Major Mikesh has prepared material on presidential aircraft for the Society's publication. Now assigned to a tactical air support squadron in Vietnam, where his tour will be over this summer, Major Mikesh has many years of military flying experience. He flew a combat tour in Douglas B-26s during the Korean War and later served in the first USAF units to receive the B-57 bomber.

THE WORLD'S FIRST INTERCONTINENTAL MISSILES

Then two more sandbags were dropped and the process repeated. When all the sandbags had been used, the balloon would discharge its load of bombs and theoretically destroy itself by means of a small demolition charge.

In the winter of 1943, the Japanese made preliminary tests to determine what operational problems they might encounter. Radio-carrying balloons were tracked to see the courses they would follow since there was little data on wind velocities above 45,000 feet. The scientists knew that the west-to-east wind currents increased in October, reaching their maximum from November to March. Wind speeds of 120 to 185 mph were known to exist over the Asian continent in the winter; in the summer months they would decline to as low as fifty to sixty mph.

While experimentation was going on during the early part of 1944, personnel were being trained, launch sites prepared, and equipment manufactured. Three major launch areas along the eastern coast of Honshu—Nakoso in Fukushima Prefecture; Otsu in Ibaraki Prefecture; and Ichinomiya in Chiba Prefecture—were selected. In addition, three radio direction-finding stations were established to track one radio-carrying balloon each day.

In the meantime, manufacturing facilities for the balloon envelopes were set up in seven different locations around Tokyo. Much of the work of gluing the thin sheets of tissue and later versions made of silk was done by school children. The other components were made by several manufacturers and shipped to the launch sites. None of those who made the parts was aware at the time what they were making. During the summer of 1944, more than 200 experimental and training launches were made, but none of these balloons apparently ever reached the American continent.

The first official operational launch with bombs in-

tended for destructive purposes was launched to celebrate the birthday of Emperor Meiji—November 1, 1944. It was this balloon that was recovered from the sea off California on November 4.

Japanese General Sueyoshi Kusaba, in charge of the project, eagerly followed the launchings. He estimated he had five months to prove the effectiveness of his new weapons. With an allocation of 10,000 balloons, he knew it wouldn't be an easy matter to launch so many successfully in that time. Launchings could take place only on cloudless days, with relatively no surface wind. Balloons ascending through rain, snow, or clouds would accumulate moisture that would freeze and add weight—so much weight that the balloons could not reach their intended operating altitude. In the five-month period, only about fifty days would be available for the operation. The maximum number of balloons that could be launched in any one day was about 200.

The launchings picked up speed as the crews at the various launch sites gained efficiency. Meanwhile, Japanese intelligence officials were directed to keep a sharp lookout for any information from the United States press and radio that would prove that the balloons were arriving over North America.

The second balloon known to US authorities was the discovery of a paper balloon near Kalispell, Mont., on December 11, 1944. Eight days later a bomb crater was discovered near Thermopolis, Wyo. On December 31, a balloon and some mysterious apparatus were found near Estacada, Ore.

US military authorities were puzzled. When the balloon at Kalispell was discovered, it was at first thought to have been launched from a Japanese Relocation Center or a German POW camp in the US. The bomb crater at Thermopolis contained fragments from a Japanese-made bomb. When, during the first two weeks of



Three US servicemen hold a captured Japanese balloon bomb to show the complicated release mechanism. On the right side of the cast aluminum wheel hangs one of the sandbags which were to be dropped at preset altitudes. When all the sandbags were dropped, the balloon would discharge its load of bombs and then destroy itself with a small demolition charge.



Above is a photo of a Japanese balloon taken by a pursuing P-63 in March 1945 near Reno. Aircraft and ground observers kept a watch for the balloons and had orders to report all sightings. Some were shot down by fighters.

January 1945, four more balloons were recovered in Oregon, California, and Saskatchewan, US Intelligence officers concluded that the balloons were actually a new offensive Japanese weapon with frightening possibilities.

The extent of the impact of this new threat was not lost to the War Department agencies responsible for the air defense of the United States. Fighter units of the Fourth Air Force were put on alert status, to watch for and shoot down the deadly gas bags over the water or in open country. US Navy ships patrolled the Pacific sea-lanes with orders to report any balloons sighted. The FBI, forest rangers, and national, state, and local officials were asked to report any and all balloons found—but to do so without alarming the public.

War Department experts, working with the apparatus and the bomb fragments recovered from the first few balloons, were able to figure out the principles of the weapon, and they made drawings that later proved remarkably accurate. Sand from the ballast bags was examined, and Intelligence reported that it came from one of five locations on the east coast of Japan. Word was flashed to B-29 photo reconnaissance units in the Pacific to take pictures of these five places. Shortly afterward, one of the launch sites was pinpointed for later destruction.

To their credit, Air Defense officials did not panic when the facts about the balloon bomb and more "incidents" were recorded. The Army Air Forces established "Project Sunset" to deal with the new menace. Ten

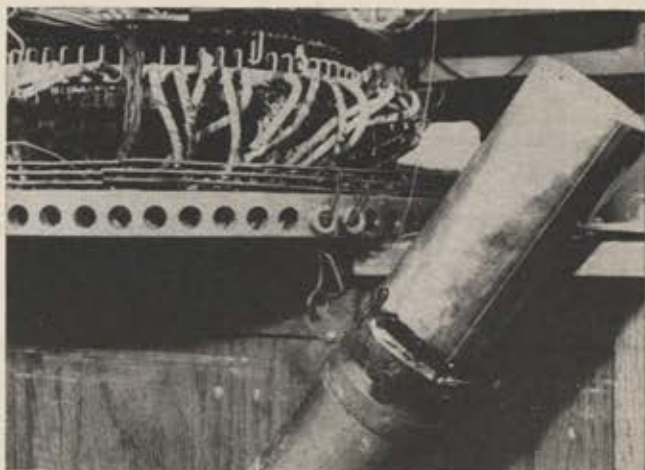
radar units along the coast of Washington state were put on a twenty-four-hour duty status. P-38 and P-63 fighter planes were kept on alert at Paine Field, Quillayote Naval Air Station, and Shelton Naval Air Station. A weather unit provided up-to-the-minute information on the probable courses of incoming balloons. Arrangements were made with the Canadian government for the rapid interchange of information.

Balloon sighting sharply increased in January and February 1945, and fighter planes shot down two of the weapons. The greatest danger didn't appear to be from the thirty-two-pound antipersonnel bombs the balloons carried but from the incendiaries, which posed a serious threat to the West Coast forest regions during the dry months. One incendiary could ignite hundreds of square miles of valuable timber. As a result, Army paratroop units were alerted to cooperate with Forest Service and civilian fire-fighting agencies.

When the possibility that the enemy might launch germ-carrying balloons was advanced, Army officials immediately advised the Department of Agriculture. Without fanfare, word was spread to health and agricultural officers, veterinarians, 4-H Clubs, and agricultural colleges to be on the lookout for the first sign of any strange disease in livestock or crops. Stocks of decontamination chemicals and sprays were quietly shipped to strategic points in the Western states.

In view of the widespread dispersion of the balloons, as they were reported from the Arctic Circle to the Mexican border, the most difficult task was thought to be one of preventing any news of their arrival from getting back to the Japanese. It was obvious that the Japanese would be eager to know of the effect of the bombs so they could evaluate and improve their techniques. The discovery of the bomb fragments near Thermopolis, Wyo., was freely reported in the press and was the only one of the many balloon incidents reported to War Department officials that appeared in the nation's newspapers.

(Continued on following page)



Incendiary bombs, such as the small ten-pounder attached to the ballast-dropping device above, posed the greatest danger because of forest fires. Units were alerted to cooperate with the Forest Service to help save valuable timber.



In addition to its load of incendiaries, each balloon carried a single thirty-two-pound antipersonnel bomb like the one shown above. It was one of these bombs that killed six picnickers in woods near Lakeview, Ore.

On January 4, 1945, the Office of Censorship asked newspaper editors and radio broadcasters to give no publicity whatsoever to balloon incidents. This voluntary censorship was adhered to from coast to coast, a remarkable self-restraint in a free-press-conscious country. Three months later, in a "strictly confidential" note to editors and broadcasters, the Office of Censorship stated:

Cooperation from the press and radio under this request has been excellent despite the fact that Japanese free balloons are reaching the United States, Canada, and Mexico in increasing numbers. . . . There is no question that your refusal to publish or broadcast information about these balloons has baffled the [Japanese], annoyed and hindered them, and has been an important contribution to security.

The voluntary censorship, ironically, made it difficult to warn the people of the danger of the bombs. The risk seemed justified as the weeks went by and no casualties were reported. However, on May 5, 1945, the five children and a woman were killed near Lakeview, Ore., by a bomb which exploded as they dragged it from the woods.

This tragic accident caused the War and Navy De-

partments to abandon their campaign of silence. In a joint communiqué describing the nature of the balloon bombs, the nation was warned not to tamper with any such object which they might find. It was then conceded "that the saving of even one American life through precautionary measures would more than offset any military gain accruing to the enemy from the mere knowledge that some of his balloons actually have arrived on this side of the Pacific."

The one incident that had made the papers in the United States was indeed known in Japan. A Chinese newspaper had picked up the report from American sources and repeated it in late December 1944. This demonstrated to the Japanese high command for the moment that the concept was sound and allowed General Kusaba to continue his project. However, to their chagrin, no further comments on the balloons came in, although US, Russian, and Chinese reports were continually screened.

Although the winds continued favorable, balloon launches were abruptly discontinued at the end of March 1945. General Kusaba was summoned before his superiors in Tokyo and asked to justify why his wasteful program should be permitted to go on. "You have wasted thousands of yen on this stupid project," he was told. "You have had 10,000 balloons built but 1,000 of them would not work. Of the 9,000 that you managed to get into the air, only one ever got to the American continent. Twice that many even returned to Japan endangering our citizens!"

Kusaba was certain that his balloons were reaching North America and tried to prove his theories by producing detailed data from the radio-bearing balloons he launched each day. However, the Japanese General Staff could not be dissuaded from their belief that Kusaba's balloon weapon was the most expensive and ineffective weapon ever used. Their clinching argument was based on an appraisal of the personality of Americans as seen through Japanese eyes.

"We know your calculations to be wrong, no matter what you say," Kusaba's superiors declared. "We have received no evidence from the American press that your balloons have arrived. The Americans could never keep a secret that long!"

While the bold experiment with the balloon bomb is now history and militarily was a complete failure, the danger still exists. Hundreds of these bombs were never found and may still be detonated with the slightest contact. On January 1, 1955, the Department of Defense released the word that such a bomb, "still highly explosive and dangerous even after exposure . . . for nearly a decade," had been found in Alaska.

It has now been more than two decades since the last death balloon left Japan, but the menace still lurks in American and Canadian forests. Demolition experts warn that the slightest movement of these bombs can set them off. Hunters, hikers, and fishermen are especially warned to report to the nearest military installation without delay the location of any bombs found. It would be the supreme irony if any more American lives were lost to the "Fu-Go" revenge bombs, relics of a war the world wants to forget.—END

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News and Comment about Air Force People...

By Jackson V. Rambeau

AFA DIRECTOR OF
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MSgt. Ray Young, enlisted aide to the Vice President on Air Force Two, is given the reenlistment oath in flight by Vice President Humphrey on his VC-140 JetStar. In rear is Lt. Col. Speight Drummond, Aircraft Commander.

Catching Up with the Cost of Living

More than 500,000 military retirees are now assured of a 3.9 percent increase in their retirement benefits during the month of April. A much smaller number will get increases averaging two percent.

Nearly 900,000 Civil Service retirees and survivors are expected to get a comparable increase during May, depending on the cost of living in February. Both increases are automatic and are tied to the rise of living costs as computed by the Bureau of Labor Statistics. Under the law, annuities must be adjusted any time living costs rise by three percent and remain above that figure for at least ninety days. The base month from which living costs were measured was September 1966 for military personnel and a month later for Civil Service retirees.

Military and Civil Service systems differ, however, as to amounts and eligibility, and many civilians believe the military has a better system. Under the military system a retiree must have been on the retirement rolls as of last October 1, the date of the last military pay raise, to get the full 3.9 percent. Those who retired after that date, or will retire before the next pay raise due in July, will get an average of two percent. The exact amount will depend on the increase of living costs since their retirement.

Under the Civil Service system an employee is eligible for the full amount if he is on the retirement rolls on the effective date of the adjustment. He can retire on April 30 and get the full increase effective May 1, but he won't get

anything if he retires on the day after it goes into effect.

This is the third general adjustment in retired pay under this new system.

Per Diem—Military and Civil Service

The Air Force Association in one of its convention resolutions last year urged Congress to increase per diem rates for both military and Civil Service personnel to a more realistic rate above the standard \$16 limit. The Administration supported an increase up to \$25 a day for Civil Service employees.

At the request of Bob Smart, AFA President, Congressman Charles E. Bennett (D.-Fla.), member of the House Armed Services Committee, introduced a bill which would equalize per diem for Civil Service and military personnel. Recently, the House Government Operations Committee approved a bill which will increase Civil Service per diem to \$20 a day. Hearings will be held shortly in the House Armed Services Committee on a bill to increase military per diem to \$20 a day. Passage this year for both bills in the House and the Senate appears to be likely.



Mrs. Elizabeth J. Robinson and her son Bill, a cadet captain at the US Military Academy at West Point, hold the Purple Heart and Silver Star medals presented to the Robinson family in recognition of combat missions flown by Lt. Col. Lewis M. Robinson in Vietnam. Colonel Robinson was killed there June 4, 1967, when his A-1E Skyraider was hit by ground fire and exploded on impact. Bill, who is scheduled to graduate from West Point in June, was flown to Colorado where the medals were presented by Lt. Gen. Arthur C. Agan, Commander, Aerospace Defense Command, at ADC Headquarters. The family, including Mary Lou, 23, Scott, 14, Brad, 11, Gary, 6, lives in Colorado Springs.

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F-102s of the 144th Fighter Group, California ANG, perform a flyover during award ceremonies at which the unit was presented with the Air Force Outstanding Unit Award for achieving and maintaining a high outstanding operational readiness status as indicated by two ADC evaluations from August 1965 to May 1967. The unit is on twenty-four-hour ADC alert. Maj. Gen. James C. Jensen, Vice Commander, ADC, presented the award to Col. Milton R. Graham, Group Commander.

The Airman Promotion Puzzle—Part II

As we reported last month, the Subcommittee of the House Armed Services Committee which has held executive hearings on the problems of enlisted promotions was about to put out its report and copies of the hearings. Together, we're told, they will amount to about a thousand printed pages. The least we can say is that this subject has had a pretty thorough airing. As we went to press we were told by the Committee that the report should be made public by April 1.

A preview of the report indicates the Committee, at this time, will not recommend that any promotion specifics be written into law. A recurring theme, however, throughout the report is that unless the problem can be solved administratively the Congress will move rapidly to put criteria and rules regarding promotion into law. The Committee indicated a continuing concern that the Air Force still resists establishing a weighted criteria system which would give every individual a clear picture of where he stands in regard to promotion.

A special letter on this subject has been recently transmitted to the Air Force from the Committee. The report will strongly urge the Air Force to establish a skill-testing system similar to the Navy's. We agree with the Committee that the Navy testing system certainly deserves a real evaluation by the Air Force. Navy enlisted men almost unanimously endorsed the testing program, and the least that can be said about it is that it tells a man once a year where he stands. We hope that merely mentioning the fact that the Navy has a workable system does not kill the idea completely.

Again, we repeat that to a considerable extent the Committee hearings, even before they're published, have been a success as far as enlisted people in the Air Force are concerned. The great increase in enlisted promotions announced last month by the Air Force, and the promise heard during the Committee hearings that the Air Force

would be allowed by OSD to go to its desired seventy-two percent of top six grades by 1970, are positive results.

Reserve Reorganization—The Hard Way

It has been pretty apparent all along that many in the Air Force didn't want a Reserve Bureau. But after the Reserve Bill of Rights became law on January 1 the Air Force had to do something. What apparently is going to be done, however, will still fall short of the efficient setup of the Air Division of the National Guard Bureau. The law pretty clearly envisioned a similar office. The plan under consideration will also cost more money and more people than the Air National Guard system.

(Continued on following page)



Lt. Col. Dafford "Jump" Myers, who was rescued in Vietnam by Medal of Honor winner Maj. Bernard F. Fisher, receives a Commendation Medal from Col. William E. Bethea, 4410th CCTW Commander, during his retirement ceremonies.



Sgt. Len Marrow, Tactical Air Command's only practicing blacksmith, and possibly the only one in USAF, plies his trade at his shop in back of his home near Myrtle Beach AFB, S. C., shoeing horses and doing other metal work.

As we understand the proposed reorganization plan, the newly confirmed Chief of Air Force Reserve, Maj. Gen. Tom E. Marchbanks, Jr., will head up an office in the Pentagon and Washington area of 113 people. It will be charged with all Reserve staff functions except operations. To perform in this latter area a Reserve Headquarters will be maintained at Robins AFB, Ga., in Continental Air Command facilities, with the Command presumably phased out. This headquarters will also be commanded by a Reserve major general. The five Reserve Regions will be consolidated into three Reserve Air Forces. Pentagon manpower sources indicate that, due to this fracturing of the management structure, manpower requirements will be double that required to manage the considerably bigger Air National Guard.

On the other side of the coin, however, even if this organization is approved as proposed, it will be a major victory for the Air Force Reserve and General Marchbanks. Considering the opposition he faced, we can only congratulate him on a most effective selling job. And maybe, after all, the reorganization will have to be evolutionary rather than revolutionary. We are sure more changes will be made in the future, and we believe the program is in good hands.

We just find it difficult to understand why the problem has to be solved the hard way.

Here Come the "Plucking" Boards

The Air Reserve Forces have exceeded their statutory grade authorizations for majors and lieutenant colonels

almost since the day of enactment of the Reserve Officers Personnel Act (ROPA). There are now some 5,100 overages in these grades. At the urging of the Senate Armed Services Committee, the Air Force has approved the establishment of a career retirement program for certain non-extended active-duty officers with twenty or more years of satisfactory service. The legal authority for this act was provided in Public Law 90-168 (H. R. 2).

The Boards will select 3,000 lieutenant colonels and 1,500 majors for removal from an active Reserve status during FY '68 and a similar number in FY '69. Officers will be screened who have completed at least twenty years of satisfactory service for Reserve retirement purposes and, as specified by law, are not to be assigned to a unit that would be recalled. They will be given the option of applying for voluntary retirement in lieu of Selection Board action.

Hopefully, screening actions will be implemented in a manner which will enhance their acceptance among Reservists and maintain the posture of the Air Force Reserve. We think a lot of people will welcome a way to get out of a program which has been constantly in turmoil and beset with the seemingly never-ending requirement to search for suitable assignments.

The requirement for Selection Board action will be considered on an annual basis to assure that the Air Reserve Forces remain within their statutory grade limitations. All of this is the price for maintaining a viable unit vacancy promotion program.

The FY '68 Boards are now set to meet in early June.

Delaying Tactics

A detailed questionnaire on participation of National Guard Technicians in state retirement systems is the next step in a renewed effort to obtain federally sponsored retirement benefits for the Guard's 40,000 full-timers.

The questionnaire was prepared by the Senate Armed Services Committee and has been distributed to the Governors of all states. From answers provided by the Governors to this lengthy list of questions the Senate group hopes to obtain a wide range of information on the many complexities of the long-debated retirement proposals.



Maj. Paul A. Whelan returned briefly from his tour in Vietnam, where he is serving as a C-7A Caribou pilot, to receive his doctorate in history from St. Louis University. His wife and eleven children, above, were on hand for the graduation. He earned his Ph.D. under the AFIT program.

We hope the Senate Committee is not using this as a delaying tactic. Time is running out.

Awards

The Air Force has named for this year's USAF Personnel Manager of the Year awards: Lt. Col. George M. Karl, Jr., Hq. USAFE, Ramstein Air Base, Germany, Outstanding Senior Personnel Manager; Capt. Jerry C. Schaff, Hq. PACAF, Da Nang Air Base, Vietnam, Outstanding Junior Personnel Manager; and SMSgt. Stanley W. Edwards, Hq. PACAF, Cam Ranh Bay Air Base, Vietnam, Outstanding USAF Personnel Technician of the Year.

The trio will each receive an engraved plaque to be presented during ceremonies within their respective commands. Sergeant Edwards will also be honored by the Air Force Association.

Short Repartee

A short time after the *Pueblo* incident and the Greenland crash of the B-52 bomber, the following near confrontation took place in a Pentagon men's room: An Air Force colonel and a Navy captain were standing side by side, washing their hands. Without looking up, the Air Force colonel said, "I hope you get your boat back." The captain, without looking up, dryly replied, "I hope you get your bombs back." They both dried their hands and left the room without ever really looking at one another.

Parting Shots

The Royal Air Force in England will observe its fiftieth anniversary on April 1. The RAF was founded as a separate service in Britain toward the end of World War I when the significance of airpower was first recognized.

The location of the Hubbell Military Compensation Study Group legislative package is still a mystery. Time is running out in Congress for this subject to receive consideration this year. A check with both the Senate and House Armed Services Committees indicates little chance of action during this politically charged session. Our mail on the Hubbell recommendations, as they have been reported in the press, had been universally opposed to the plan. We think it is unfortunate that OSD does not see fit to take the wraps off the entire plan, including the pay tables. We have felt that the plan would receive a considerable amount of approval if it were fully understood.

Dental care legislation for dependents of active-duty personnel now looks like it has a fair chance this session, at least in the House. As we went to press, Congressman Rivers had introduced his long-awaited bill on this subject. But OSD is still not supporting the legislation and its future in the Senate does not appear promising.

At press time, reports of further Reserve recalls were being considered and deployment plans for some of the already recalled units were in their final stages. Air Reserve Forces personnel strength now stands at 501,000 in the Air Force Reserve and 86,000 in the Air National Guard.

Senior Staff Changes

Dr. George A. Contos, from the Institute of Defense Analyses, to Asst for Special Studies, Operations Analysis Office, Hq. USAF . . . B/G Henry B. Kucheman, Jr., from Vice Cmdr., ASD, AFSC, Wright-Patterson AFB, Ohio, to Deputy Director of Development, Hq. USAF . . . B/G James B. Nuttall, from



Gen. Thomas P. Gerrity died of a heart attack at his quarters at Wright-Patterson AFB, Ohio, on February 24. The Commander of Air Force Logistics Command was buried in Arlington National Cemetery after services at Bolling AFB.

Chief, Aeromedical Services, USAFE, to Surgeon, SAC, Offutt AFB, Neb., replacing L/G Kenneth B. Pletcher.

PROMOTIONS: To Major General: William W. Berg, George E. Brown, Archie M. Burke, Roland A. Campbell, Gilbert L. Curtis, Courtney L. Faught, Edward B. Giller, Lee V. Gossick, James F. Hackler, Jr., Archie A. Hoffman, Gerald W. Johnson, Joseph J. Kruzel, Henry B. Kucheman, Jr., Lee M. Lightner, Winton W. Marshall, John L. Martin, Jr., Sherman F. Martin, Edward A. McGough, Burl W. McLaughlin, John M. McNabb, Lester F. Miller, Frederick E. Morris, Jr., John E. Morrison, Jr., John R. Murphy, Edward M. Nichols, Jr., Edmund F. O'Connor, Jammie M. Philpott, Daniel E. Riley, Louis T. Seith, Richard F. Shaefer, Pete C. Sianis, Ralph G. Taylor, Jr.

To Brigadier General: James A. Bailey, John W. Baska, Harry C. Bayne, Cleo M. Bishop, Jonas L. Blank, Richard C. Bulgin, Chester J. Butcher, Robert L. Cardenas, David L. Carter, Theodore S. Coberly, George P. Cole, Richard N. Cordell, Maurice A. Cristadoro, Rexford H. Dettre, Jr., Abraham J. Dreiseszun, Harvey W. Eddy, Alan C. Edmunds, Edmund B. Edwards, Alfred L. Esposito, John French, John C. Giraudo.

Also: Louis G. Griffin, Robert E. Hails, James A. Hill, Richard M. Hoban, Robert J. Holbury, Arthur W. Holderness, Ralph T. Holland, Spencer S. Hunn, Clare T. Ireland, Jr., Harold R. Johnson, Jimmy J. Jumper, Thomas B. Kennedy, William G. King, Jr., Jonah Lebell, Edwin L. Little, Robert W. Maloy, George H. McKee, George W. McLaughlin, Sanford K. Moats, John O. Moench.

Also: Warner E. Newby, James B. Nuttall, Robin Olds, Lee M. Paschall, Maurice R. Reilly, Roger K. Rhodarmer, Donald H. Ross, Alton D. Slay, James G. Silliman, Charles H. Snider, Robert V. Spencer, Eugene A. Stalzer, Henry J. Stehling, Donald E. Stout, Alex W. Talmant, Fred W. Vetter, Jr., Edwin S. Wittbrodt.

RETIREMENTS: B/G Clarence J. Galligan.—END

the big systems by Collins



Australian earth station serves vast area



Australia's new computer-controlled earth station near Moree permits satellite communication with any country from the U. S. to Thailand — or from Alaska to New Zealand.

Procured by the Australian Overseas Telecommunications Commission, the earth station can accommodate 600 telephone calls and one television channel simultaneously, with a capacity for later expansion. The facility employs a 90-foot-diameter antenna with shaped reflector. Design of the pedestal permits pointing of the antenna at satellites in approximately equatorial orbits.

Collins provided transmitting and receiving equipment, the antenna, the building, all associated control and monitoring systems, installation, and testing. The facility is the first fixed ground station designed and built by one manufacturer for satellite communications.

COMMUNICATION/COMPUTATION/CONTROL



Letter from Los Angeles

American Airlines has broken the ice in the airbus competition by announcing an order for twenty-five McDonnell Douglas DC-10s, after an extended period of competition between McDonnell Douglas and Lockheed. But Lockheed has cut the price on the 1011 to stay in contention and McDonnell Douglas has followed suit . . .

THE AIRBUS RACE: STILL NECK AND NECK

By Irving Stone

WEST COAST EDITOR, AIR FORCE/SPACE DIGEST

The trijet airbus, accommodating about 250 to 345 passengers and spanning ranges from about 300 miles to non-stop transcontinental runs, will enter airline service late in 1971—about one year after the Boeing 747 jumbojet with its 360-plus passenger capability begins operation.

American Airlines, first carrier-customer for the airbus, bought twenty-five of the McDonnell Douglas DC-10s and took a firm option for twenty-five more. Although the McDonnell Douglas obligation to build the DC-10 hinged on receipt of sufficient orders for the aircraft—probably at least seventy-five—it seemed almost certain these orders could be obtained by McDonnell Douglas, or by its competitor, Lockheed-California Co., if the latter were successful in selling its L-1011-385 airbus design.

The airbus likely had a price tag of \$16-\$16.5 million. Estimates were that total value of the airbus program could run as high as \$16 billion. Both McDonnell Douglas and Lockheed designs evolved as very similar in configuration and performance, probably as a result of intense negotiations between them and the airlines, which were in a very favorable bargaining position because of McDon-

nell Douglas' desire to capture the airbus market and Lockheed's determination to reenter the transport business. Aircraft performance, price, delivery schedules, guarantees, and, finally, rapport between the individual airlines and the aircraft manufacturer were expected to be decisive factors in the airbus selection.

McDonnell Douglas perhaps was in a favorable position to eliminate Lockheed from the competition, because of the initial impetus given the McDonnell Douglas effort by the American Airlines order. But after this setback, Lockheed cut its price to about \$15 million to sharpen the competition, and McDonnell Douglas probably followed suit to remain in contention.

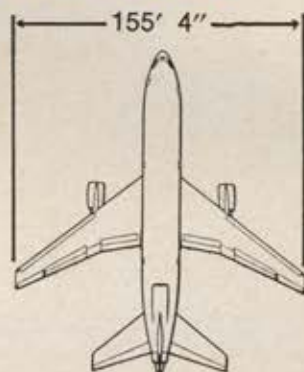
Airlines that were expected to follow American Airlines' purchase included Eastern Air Lines, ordering perhaps twenty-five aircraft initially; Delta Air Lines with perhaps eight for its first go-around; with later orders expected from United Air Lines, Trans World Airlines, and National.

Competition for the airbus engine was between General Electric with its CF6/36-2 fanjet rated at 37,000 pounds sea-level static thrust, and Rolls-Royce with its RB211-17

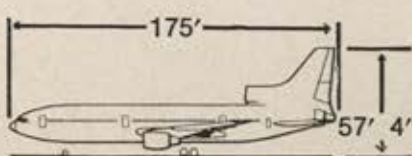
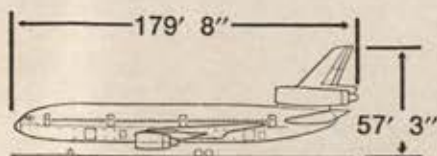
THE AIRBUS—TWO PROPOSALS



McDONNELL DOUGLAS DC-10



THE LOCKHEED L1011-385



Side-by-side comparison of Lockheed-California Company's 1011 (right) and McDonnell Douglas Corporation's DC-10 brings out the size similarity which resulted from the airline industry's standardization requirement. Both designs are trijets capable of operation from the so-called close-in airports such as New York City's La Guardia and Chicago's Midway, which impose restrictions on length, wingspan, and weight.

fanjet, also rated at 37,000 pounds of thrust. Price of the aircraft with the Rolls engines appeared to be about \$250,000 to \$300,000 less than if fitted with the General Electric engines. Main reason for the difference would be in the cost of podding to accommodate the engines.

The basic DC-10 configuration finally offered to the airlines has been proposed with several arrangements:

- 250 passengers, with twenty percent in the first-class section with six-abreast seating at thirty-eight-inch pitch (distance between rows longitudinally), and eighty percent in the coach section with eight-abreast seating at thirty-six-inch pitch.

- 262 passengers, with nineteen percent in first-class with six-abreast at thirty-eight-inch pitch, and eighty-one percent in a "tourist" section, eight-abreast at thirty-four-inch pitch.

- 278 passengers, with eighteen percent in first-class with six-abreast at thirty-eight-inch pitch, and eighty-two percent in an "economy" section, nine-abreast at thirty-four-inch pitch.

- 273 passengers in an "all-coach" arrangement, eight-abreast at thirty-six-inch pitch.

- 290 passengers in an "all-tourist" arrangement, eight-abreast at thirty-four-inch pitch.

- 312 passengers in an "all-economy" version, nine-abreast at thirty-four-inch pitch.

It's likely that these arrangements or variations will be considered by other airlines initially and in follow-on orders.

Lockheed had been proposing similar arrangements of 250 passengers in a 20/80 mix between first class (six-abreast, thirty-eight-inch pitch) and cabin (eight-abreast, thirty-six-inch pitch); 264 passengers in a 15/85 mix (eight-abreast, thirty-four-inch pitch in cabin); and 275 (eight-abreast at thirty-six-inch pitch); 328 (nine-abreast, thirty-four-inch pitch); and 345 (nine-abreast, thirty-two-inch pitch) passengers in all-coach or all-economy sections.

Both aircraft have been designed to operate from smaller airports, such as La Guardia, for flights between New York and Washington, D. C., or Chicago. Both aircraft feature lower (belly) galleys with elevators to lift food to the passenger deck. Cockpits of each aircraft would accommodate pilot, first officer, second officer, and seats for two observers.

Dimensional similarity of the DC-10 and L-1011 designs is striking. DC-10 length is 179 feet, eight inches; fuselage diameter is 237 inches; wingspan 155 feet, four inches. Wing area is 3,550 square feet, wing sweep thirty-



Two McDonnell Douglas DC-10 advanced-technology tri-jets, capable of accommodating 252 passengers in a mixed configuration of first-class/economy-class seating, are depicted here alongside a BAC-111 short-range jet.

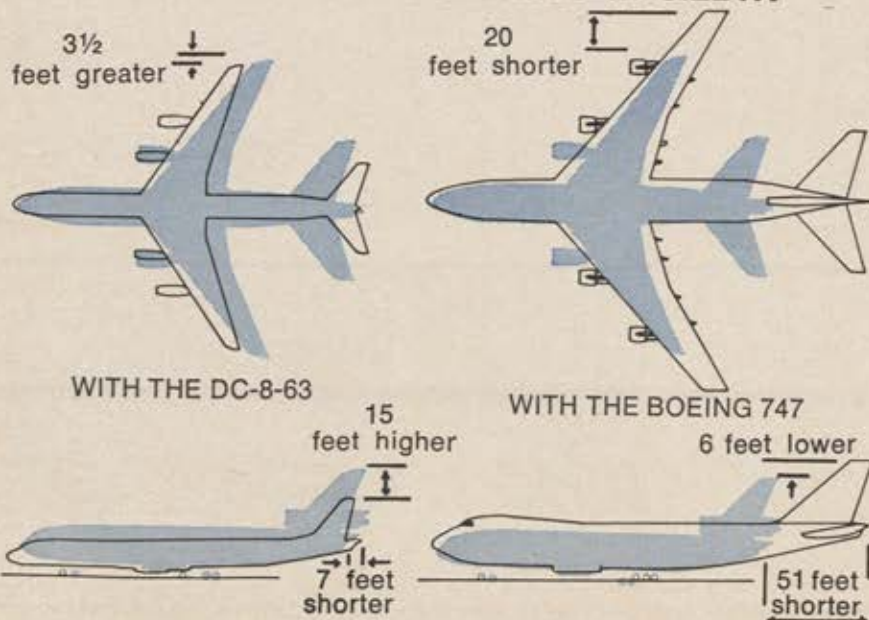
five degrees. Tail height above ground is fifty-seven feet, three inches. Maximum gross takeoff weight is pegged at 386,500 pounds.

By comparison, the L-1011 length is 175 feet, fuselage diameter 235 inches, wingspan is the same—155 feet, four inches. Wing area is 3,456 square feet, wing sweep also is thirty-five degrees. Tail height fifty-seven feet, four inches. Maximum gross takeoff weight is pegged at 382,500 pounds.

Takeoff field length for both aircraft for a transcontinental run would be equivalent, approximately 9,700 feet at sea level on a ninety-degree F. day. For Mach 0.85 cruise (about 561 miles per hour) block times for both aircraft would be approximately the same for such routes as New York (La Guardia) to Chicago (perhaps an hour

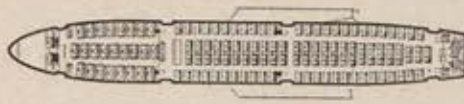
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HOW THE DC-10 COMPARES IN SIZE...

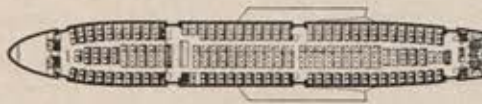


Superimposed outlines of the DC-10 (shaded) and the DC-8-63, largest commercial airliner currently in operation, shown on the left, and the DC-10 (shaded) superimposed on a Boeing 747 jumbojet, reveals interesting size details of the Douglas airbus. The DC-10's fuselage is almost twice as wide as the contemporary jetliner, to permit roomier and more comfortable cabin arrangement. Compared with the Boeing 747 jumbojet, the airbus shows off its substantially shorter wingspan and shorter length.

TWO PROPOSED DC-10 INTERIOR ARRANGEMENTS



250 passengers in mix of First Class and Coach, seating 6-8 abreast.



312 passengers in All Economy (DC-9 seats), seating 9 abreast.

Seating arrangements of the DC-10 can be varied greatly to tailor capacity and seat layout to divergent market requirements. Two variations in an all-economy class arrangement and first and coach class mix are shown here.

and forty-five minutes) and New York's Kennedy Airport to San Francisco (perhaps slightly less than five and a half hours—only about five minutes more than Boeing 747 time).

Tacnavsat Competition

Proposals for a critical Air Force program were submitted on March 4 for a nine-month study of a tactical navigation satellite system that would permit a quick precision-position fix for high-speed tactical aircraft in combat missions. The system, however, would have triservice application, would furnish position fixes for ships and ground forces. The Air Force is aiming to include funds for development of the satellite in the Fiscal 1970 budget.

An indication of the interest in the program is evidenced by the strong teams formed for the competition—TRW, Teledyne, and Texas Instruments; Lockheed, International Business Machines, and ITT Federal Laboratories; Grumman, Philco, and General Dynamics/Electronics; General Electric, Litton, and Motorola; Hughes, Magnavox, and General Precision; Radio Corporation of America and North American Rockwell's Autonetics Division; Westinghouse, Fairchild Hiller, Raytheon, and Honeywell; Boeing; and McDonnell Douglas.

The study will be sponsored by Air Force's Space and Missile Systems Organization (SAMSO), will involve 25,000 man-hours of effort, and probably will result in selection of two contractors for parallel analyses, each funded for approximately \$500,000.

Self-Eject for Future ICBMs

The promising investigation for controlled, safe ejection of a solid-propellant ballistic missile from its silo has been cut back by SAMSO for lack of funds to support an extensive research and development program involving theoretical analysis and subscale testing. This indicates that firming of any configuration for an advanced ICBM is still far down the road.

Known as self-eject, the technique is seen particularly applicable for initial boost of large-diameter advanced ICBMs with greater payload capabilities. The concept involves use of a special propellant end-grain in the missile,

designed to afford a near-constant pressure in the silo and an initially slow, progressively increasing acceleration. At a distance of perhaps fifty to seventy-five feet above the silo, the missile's special end-grain would have been burned, and its main propellant grain then would be burning to provide the full design-acceleration.

This controlled liftout aims to eliminate hazards associated with the high gas pressure, heat, and noise levels encountered in conventional "hot launches," which might prove destructive for the missile or its precision equipment. Another benefit seen is the ability to use a smaller-diameter silo than that required for conventional hot launches—a distinct cost advantage in configuring a silo for a high hardness level.

Three companies—Aerojet-General, Lockheed Propulsion Co., and Thiokol Chemical Co.—are involved in the competitive self-eject evaluation. Original funding, about \$700,000 for each contractor, has been slashed about two-thirds, eliminating field tests that were programmed to complement the theoretical and laboratory analysis. Three methods of end-grain treatment for the self-eject technique being investigated include use of:

- A special slow-burning coating on the initial grain to provide a specific rate of burning different from that of the regular grain.
- Vertical inhibitor strips covering a substantial portion of the propellant, to expose a predetermined area during initial burning.
- An ablative coating on part of the propellant surface to retard initial burning.

These methods, involving a degree of similarity, are aimed to have the launch start with a constraint and, when the missile is clear of the silo, have the main grain burning fully for production of normal boost thrust.

Under the curtailed program, which is scheduled to end this spring, propellant combinations will be evaluated in laboratory-size motors and in computer runs.

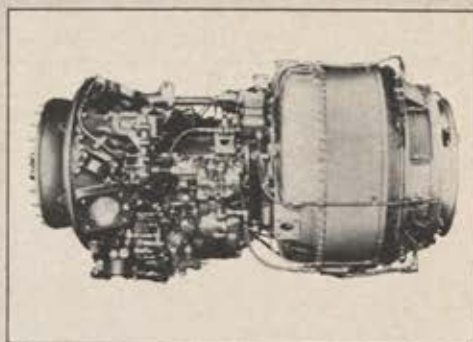
Decks Evaluated for Silos

Anticipating the deployment of Minuteman III and advanced ICBMs in silos sufficiently hard to withstand detonation of a Soviet missile with a high targeting accuracy—perhaps a low circular error probability of a half nautical mile—the Air Force is pushing the evaluation of various silo-closure concepts with respect to survivability, radiation-resistance, debris-removal capability, maintainability, and cost.

(Continued on page 177)



Air travelers of the future will demand sharply improved levels of comfort and spaciousness. American Airlines' DC-10 interior shown here by artist in exaggerated width, shows economy-class seating almost as wide as present first class.



This much sand could kill a normal 1400 horsepower engine.

Twice as much would hardly even make our Avco Lycoming T53 gas turbine breathe hard.

It's that tough.

On purpose. Because aircraft powered by it take off in clouds of dust and sand every day. We admit that sand and dust aren't the healthiest things for a turbine engine, but for the T53—no sweat.

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Or bullets. Eight out of ten choppers flying the unfriendly skies of Vietnam are Avco-powered. We've seen them make

it back to base with holes shot right through their engines.

Rugged performance like this didn't come overnight. Five million hours of grueling service helped. And most of these were in actual combat.

But ruggedness is only one of our engines' virtues. Compact power is another—as much as one horsepower for every three ounces of engine weight.

So how come with an engine this great we don't blazon a huge picture of it right across this whole page? Because we know it's no thing of beauty—not to look at anyway.

But open the throttle and you'll see the T53 in a different light. That's the beauty of it.

Avco Lycoming Division, Stratford, Conn.





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First flight of the Martin Marietta/USAF X-24A lifting body, shown at left, is expected late this year. The flight testing will be a joint research effort to be conducted by AFSC's Aeronautical Systems Division and NASA's Flight Research Center, Edwards AFB, Calif.

Survivability and radiation-resistance requirements will dictate investigation of the strength of material and construction schemes far beyond the capability of existing ICBM silos.

Because a silo-closure system is critical to retaliation capability, the evaluation is expected to include testing of a number of static and operational subscale models. These tests should indicate the preferred concept, which then would be evaluated with a full-scale closure design. Testing should be completed by next fall.

While depth of silos anticipated for advanced ICBMs are certain to be substantially greater than for current Minuteman silos, it shouldn't be necessary to create a full-depth hole to provide an environment with realistic silo rigidity to evaluate the full-scale closure design.

Optics for XB-70 Touchdowns

A new research task for the Mach 3 XB-70 will include landing trials with an optical system to provide the pilot with visual reference for three-degree slope touchdowns, to approximate the path used by commercial airliners. Prior use of the optical system with the XB-70 has been limited to "touch-and-go" exercises. Previously, the XB-70 has been following a one-degree slope in landing, with the chase aircraft calling out heights to the supersonic aircraft.

The Air Force/North American Rockwell-designed XB-70, operated under cognizance of National Aeronautics and Space Administration's Flight Research Center, Edwards AFB, Calif., has been funded to continue subsonic and supersonic flight trials through 1968.

X-24A Nears Flight Tests

USAF's X-24A manned lifting body, built by the Martin Marietta Co., will be flight tested in a joint research effort to be conducted by Air Force Systems Command's Aeronautical Systems Division, Wright-Patterson AFB, Ohio, and National Aeronautics and Space Administration's Flight Research Center, Edwards AFB, Calif.

The first flight of the X-24A, expected late this year, will be a powerless glide, attaining a speed of about 450 mph after launch from a B-52. Top speed in powered flight will be about Mach 2 (approximately 1,300 mph).

The X-24A is the vehicle for the piloted low-speed test follow-on to the PRIME (precision recovery including maneuvering entry) program previously conducted by USAF's Space and Missile Systems Organization (SAMSO), in which three unmanned lifting entry bodies were launched by Atlas boosters from Vandenberg AFB, Calif., downrange over the Pacific Ocean. All of the PRIME vehicles were

heavily instrumented, and all returned valuable entry data. The first vehicle, launched in December 1966, was not recovered. The second vehicle, which was launched in March 1967, also not recovered, was used for some cross-range maneuvering. The third vehicle, launched in April 1967, was recovered after demonstrating cross-range maneuvering.

In a preparatory step, the X-24A was tested late in February and early in March in NASA's Ames Research Center's full-scale (forty by eighty feet) wind tunnel to verify aerodynamic predictions for the vehicle that were obtained in small-scale model tests.

In its flight-test program, the X-24A would not be subjected to speeds developing sufficient heat to require coating the vehicle with an ablative sheath. Nevertheless, in the full-scale tunnel tests, the X-24A was tested with and without an ablative coating. Tests with the coating—a mixture of finely grained sand and paste—served to measure the increased drag that would be caused by the remaining charred portion of an ablative coating required for thermal protection of a lifting body during an entry from space. The ablative mixture was washed off for the remainder of the Ames full-scale tunnel tests.

USAF has borne the cost of design and development of the X-24A and will furnish the bulk of the funding and operational support for the flight tests. NASA will have operational management of the flight tests.—END



—Wide World Photos

American Airlines' President George A. Spater (left) and McDonnell Douglas Corporation Chairman James S. McDonnell (right) announced American Airlines selection of the DC-10 airbus at press conference in New York February 19.

Freedoms Foundation Winners

At the Freedoms Foundation's nineteenth annual National and School Awards Program February 22 at Valley Forge, Pa., three USAF officers were among the top ten winners in the "Letters from Armed Forces Personnel" category. Col. Daniel "Chappie" James, Jr., a veteran of seventy-eight combat missions over North Vietnam, was among those who wrote on this year's theme . . .

'Freedom—My Heritage, My Responsibility'

FOR A letter he wrote (*next page*) while serving at Ubon Air Base, Thailand, as Vice Commander of the famed "Wolfpack" 8th Tactical Fighter Wing, Col. Daniel "Chappie" James, Jr., received an award from the Freedoms Foundation of Valley Forge, Pa., on February 22.

Colonel James, now Vice Commander, 33d Tactical Fighter Wing, Eglin AFB, Fla., was the Wolfpack's vice commander under Col. (now Brig. Gen.) Robin Olds and flew seventy-eight F-4C Phantom missions over North Vietnam. He led a flight in the "Bolo" MIG sweep on January 2, 1966, during which seven Communist aircraft were destroyed—the highest total kill for a single unit on any day of the war.

Two other Air Force officers, Capt. John D. Williams, Jr., action officer with the Secretary of the Air Force's Office of Information, and Col. Harold D. Shoemaker, Staff Chaplain, Seventeenth Air Force, USAFE, were among the top ten freedom award winners. For writing on this year's topic "Freedom—My Heritage, My Responsibility," the three men each received a George Washington Honor Medal and \$100.

Commissioned in 1943 after attending Tuskegee Institute, Tuskegee, Ala., Colonel James flew P-47s during World War II and then F-51s and F-80s during the Korean War, ending that war with 101 combat missions.

Upon his return from Southeast Asia last December,

Colonel James Speaks to AFA

Col. "Chappie" James recently expanded on his views concerning patriotism at a meeting of AFA's Fort Worth, Tex., Chapter, receiving, after his inspiring address, a standing ovation from the audience of more than 400.

Speaking at the Carswell AFB Officers' Club, he said, "I couldn't live long enough to pay this country back what I owe it.

"If anyone wants to challenge America, they've got me to run over first.

"I'd go back to Vietnam if they'd let me, and it wouldn't take me but about fifteen minutes to pack.

"I've fought in three wars and three more wouldn't be too many more to defend this country."

Colonel James' speech received extensive press coverage, including an editorial in the Fort Worth *Star-Telegram*, which said, ". . . [Colonel James] showed us that unabashed patriotism is still in style."



Congratulating AF award winners is Foundation President Kenneth D. Wells, center, who presented medals and cash awards to, left to right, Col. Daniel James, Jr., Col. Harold D. Shoemaker, and Capt. John D. Williams, Jr. At right is Howard H. Callaway, Foundation trustees chairman.

Colonel James was personally debriefed by President Johnson.

Captain Williams, who was commissioned through the AFROTC in 1955, has also served in Southeast Asia. His award-winning letter, addressed to a captured US pilot in Hanoi, said, "No doubt the Hanoi Communists tell you every day about all that's going wrong in the United States. . . . That's why I'm writing—to try to set the record straight.

"I think that all these Americans . . . the solid citizens, the hippies, the dissenters—realize in one way or another that you and our other men there are paying a high price for their right to be weird or different or whatever they want to be. Most, I'm sure, are grateful. . . .

"No one has forgotten."

In a letter addressed to his son, Colonel Shoemaker wrote, "We need to count our national blessings and give thanks for our freedom . . . not in a mood of boastfulness but in the spirit of simple truth.

"We must be aware that the mere existence of a free and robust America is a source of reassurance to millions of people living under the shadow of external aggression and internal nihilism. We do neither ourselves nor the world any good by cringing under the unjustified attacks of carping critics. . . .

"So, Denny, let's agree to speak up for America every chance we get."

—L. W. Z.



Col. Daniel "Chappie" James, now the Vice Commander of the 33d Tactical Fighter Wing, Eglin AFB, Fla., flew seventy-eight missions in the F-4 Phantom over North Vietnam.

1967 FREEDOMS FOUNDATION AWARD WINNER

By Col. Daniel "Chappie" James, Jr.

The following letter by Colonel James was written while he was serving with the 8th Tactical Fighter Wing in Southeast Asia. It was among the top ten Freedoms Foundation George Washington Honor Medal winners.—THE EDITORS

The strength of the United States of America lies in its unity. It lies in free men blessed and ordained with the rights of freedom working to provide, build, enjoy, and grow. Those who would subvert us, or any free people, try to disrupt this unity by breaking the small parts from the whole, driving in wedges of fear and discontent.

I am a Negro and, therefore, I am subject to their constant harangue. They say, "You, James, are a member of a minority; you are a black man." They say, "You should be disgusted with this American society, this so-called democracy." They say, "You can only progress so far in any field that you choose before somebody puts his foot on your neck for no other reason than you are black." They say, "You are a second-class citizen."

My heritage of freedom provides my reply. To them I say, I am a citizen of the United States of America. I am not a second-class citizen, and no man here is unless he thinks like one, reasons like one, or performs like one. This is my country and I believe in her—and I believe in her flag—and I'll defend her—and I'll fight for her and serve her. If she has any ills I'll stand by her and hold her hand, until in God's given time, through her wisdom and her consideration for the wel-

fare for the entire nation, things are made right again.

Today's world situation requires strong men to stand up and be counted, no matter what their personal grievances are. Our greatest weapon is one we have always possessed, our heritage of freedom, our unity as a nation. We must stop finding so many ways to hate each other because of race, creed, religion, political party, or social strata. We must stop using personal grievances as an excuse to break the laws of the land. We must not join with any lawless mobs, no matter what the provocation, in disregard for law and order. A thief is a thief, I don't care what he gives for his reason for stealing. A mob is a mob, I don't care what the provocation is.

We can't afford it in this great country of ours. It is our responsibility to preserve our freedom and our unity. Great thinking men must help unite those with whom they come in contact through hard work and participation. Our contributions to the total effort can be a by-product of what we achieve through excellence in our chosen field. In our daily lives we must become a strong link in the chain of unity and freedom that has always been the strength of the United States of America.

I am an American. My heritage is bound by the tenets of freedom inherent in that simple statement. My responsibility is to allow my children to join a community of free people everywhere who have the right to say, "I am what I am because I have the freedom to say it."

AFA on Main Street

On the occasion of AFA's Twenty-second Anniversary National Convention in Atlanta, Ga., it is fitting that recognition is given to some of the many outstanding events that AFA units have contributed, making possible another outstanding Air Force Association year. . . .

AFA: Putting Action in Airpower

THIS month, AFA members and leaders, and military, government, and aerospace industry leaders from throughout the nation gather in Atlanta, Ga., for AFA's Twenty-second Anniversary National Convention.

As AFA again shows its face to the world as a great national organization, it is fitting that we review some of the unit activities that contributed so effectively to the stature and success of the Air Force Association in 1967.

- The Utah State AFA Organization's consistent and effective programming has included a wide variety of outstanding programs. The success of its Annual Aerospace Symposium and Education Seminar has now become almost a legend. But its Air Force Anniversary observance of the past several years is probably the most notable of all its programs.

The State's Air Force Anniversary program in 1967 was planned to include the entire community and consisted of many events, each hosted by one or more of the state's AFA chapters.

Programmed events included two circus performances; an Air Force family day at a local recreation area; horse racing; an Air Force Anniversary Ball; a Dining-In for the OOAMA Commander and his staff, aerospace industry executives in Utah, civic leaders, Hill AFB civilian executives, and AFA leaders; an AFA Logistics Award Banquet; and a Dining-In to recognize the AFROTC and the Cadets from the local colleges and universities.

The success of this unit is due in large part to the dynamic leadership and team effort of all the individuals and units within the state.

- The Mt. Clemens, Mich., Chapter, one of the Association's most effective Chapters in telling the Air Force and the aerospace story to its community, sponsored its first aerospace education seminar in 1967.

This highly successful program reached more than 200 educators and featured AFA Board Chairman Jess Larson as the banquet speaker, and AIR FORCE/SPACE DIGEST Senior Editor William Leavitt as the keynote speaker.



At the Ute Chapter's Logistics '70 Workshop, a model of a Lockheed C-141 StarLifter attracts the attention of, seated from left, David Whitesides, Utah State AFA Past President; National President Robert W. Smart; Rocky Mountain Regional Vice President Nathan Mazer; and, standing, Utah State President Nolan Manfull; Colorado State Secretary Parks Deming; and Utah State Vice President Jack Price.



At a chapter organization meeting at Wurtsmith AFB, Mich., Col. Joseph J. Young, left, Vice Commander, 379th Bomb Wing, discusses the program with participants Marjorie O. Hunt, Mt. Clemens Chapter President, and Lt. Col. James S. Wall, Chief of the Air University Aerospace Presentations Team. The Team has made numerous presentations under sponsorship of various AFA organizations.

The Chapter also has a continuing program of furnishing aerospace books and periodicals to the local library.

- One of the outstanding events of the year was the reception sponsored by the Santa Monica, Calif., Chapter to celebrate the fiftieth wedding anniversary of AFA's first President and his wife, Gen. and Mrs. Jimmy Doolittle.

- The Wright Memorial Chapter of Dayton, Ohio, maintains a full calendar of consistently successful and effective programs.

One of its most outstanding programs of the past year was a formal dinner-dance observing the Twentieth Anniversary of the Air Force.

More than 400 attended this program at which the late Gen. Thomas Gerrity was the guest of honor and principal speaker.

Another of its extremely effective programs was a Small Business Seminar, to which potential Air Force retirees were invited to be briefed on the proper procedures for establishing a small business.

- More than 600 members of the civilian and military communities at Griffiss AFB, N. Y., attended an anniversary dinner in observance of the twenty-fifth anniversary of the establishment of the base.

Cosponsored by AFA's Colin P. Kelly Chapter and the Rome and Utica Chambers of Commerce, the affair featured an address by Gen. John P. McConnell, USAF Chief of Staff.

Other distinguished guests included Lt. Gen. Leighton I. Davis, National Range Division Commander; Lt. Gen. David Wade, Eighth Air Force (SAC) Commander; Lt. Gen. Lewis I. Mundell, AFLC Vice Commander; and Maj. Gen. James C. Jensen, First Air Force (ADC) Commander.

The success or failure of any unit is dependent on the degree of effectiveness of its leadership and the individuals within the unit. Many of these leaders and individual workers have been mentioned in this article and in the accompanying photos. There are, however, many others who have contributed much effort and time to making the Air Force Association the leading aerospace power spokesman in the nation.

—DON STEELE



Wright Memorial, Ohio, Chapter President Robert Hunter, left, and Ohio State President George Gardner, right, present the Chapter's Certificate of Appreciation to Joseph Taylor for the Small Business Administration's Columbus Regional Office for its part in conducting the Chapter-sponsored workshop conducted for US Air Force retirees on the subject of "Starting a New Business."



At the 1967 Texas State AFA Convention, Alamo Chapter President Ben Griffith, left, receives the State's Man of the Year award from Texas President Sam E. Keith, Jr.



Early in 1967, Jess Larson, then AFA National President, was the principal speaker at the Charter Night Program of AFA's first "Mothers' Chapter" in Pittsburgh, Pa. Here, Mr. Larson presents Charter to Mrs. Ethel M. Kickler, the Mothers' Chapter founder and first President.

A VERY SPECIAL OFFER

to all readers of *AIR FORCE / SPACE DIGEST*

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CHAPTER OF THE MONTH

Florida West Coast Chapter, cited for

consistent and effective programming which has focused widespread community attention on the Air Force Association mission.

Gen. Bruce K. Holloway, USAF Vice Chief of Staff, recently addressed AFA's Florida West Coast Chapter at the MacDill AFB Officers' Club.

More than 300 Tampa Bay-area AFA members and guests attended the formal reception and banquet to hear General Holloway present a major address on "Close Air Support: A New Look at an Old Mission."

Chapter President Joseph M. Martin served as Master of Ceremonies and, prior to General Holloway's address, presented a Chapter Citation to Tampa Mayor Dick A. Greco, Jr., for his "strong interest in and support of the United States Air Force, the US Strike Command, and MacDill Air Force Base."

Special recognition was given to Gen. Paul D. Adams, USA (Ret.), founder and first Commander in Chief of the US Strike Command (USSTRICOM), for his long-time membership in AFA and his strong interest in the USAF and aerospace power.

Mrs. Holloway accompanied the General to Florida and was presented a "lifetime membership" in the MacDill Officers Wives Club by Mrs. Lucille Giglio, Club President.

Distinguished guests included Lt. Gen. Fred M. Dean, Deputy Commander in Chief, USSTRICOM; Maj. Gen. L. H. Richmond, Director of Plans, J-5, USSTRICOM; Brig. Gen. A. M. Hendry, Jr., Commander, 836th

Air Division; Brig. Gen. H. E. Kreidler, Deputy Director of Operations, J-3, USSTRICOM; retired General officers E. J. McMullen, Edward H. White, A. T. Wilson, T. C. Rives, J. R. Beam, and H. J. Reis Elbara; John F. Loosbrock, AFA's Deputy Executive Director; Florida State AFA President Lester Curl; and George I. Barrett, Assistant to the Mayor of Tampa.

Also, a group of Air Force combat pilot veterans of Vietnam, now stationed at MacDill, who flew more than 100 missions over North and South Vietnam during their combat tours, were guests of the Chapter.

Brig. Gen. Robin Olds, famed Vietnam MIG-killer and now Commandant of Cadets at the US Air Force Academy, was the guest of honor and speaker at the Altus, Okla., Chapter's Third Annual Air Force Appreciation Banquet recently held in the Altus AFB Officers' Open Mess.

General Olds concluded his speech to the more than 250 AFA members and guests with the question, "What respect does the world have for a guy who fights for a tie? Let's fight to win."

During the program, Chapter President Stansell Whiteside presented the Chapter's "Robert S. Kerr Memorial Award" to General Olds.

Brig. Gen. Howard Moore, USAF

(Ret.), a former Commander of the 816th Air Division at Altus AFB, served as Toastmaster.

Special guests included Col. Joseph J. Young, Commander, 11th Strategic Aerospace Wing; Col. Van Haggard, Commander, Altus AFB; Col. Charles Hill, Commander, 4th Mobile Communications Group; Col. Roy Patterson, Commander, 816th Medical Group; and Oklahoma State AFA President and Vice President, Lawrence Leffler and Bill Jones, respectively.

Maj. Gen. James B. Knapp, Chief of Staff, Strategic Air Command, was the keynote speaker at the Twelfth Annual Billy Mitchell Memorial Award Dinner in Milwaukee, Wis.

Sponsored by AFA's Billy Mitchell Chapter, the Dinner was attended by more than 300 civic, industrial, and AFA leaders and members.

The Chapter's Billy Mitchell Memorial Award is given annually to a Wisconsin native, resident or former resident, for outstanding contributions to aerospace activities. The award for 1967 was presented at the dinner to Maj. Gen. Woodrow P. Swancutt, Vice Commander, Second Air Force, Barksdale AFB, La.

Chapter President Norman Ross made the welcoming remarks and Leonard Dereszynski, a past Wisconsin AFA Wing Commander, served as Master of Ceremonies and General Chairman. State Senator Taylor Benson, Chairman of the Chapter's Awards Committee, presented the awards and Algie A. Hendrix, Vice President, General Dynamics Corp., introduced the speaker.

AFA Executive Director James H. Straubel, recipient of the Billy Mitchell Memorial Award in 1960, was a special guest.

More than 500 leading business, civic, and military leaders attended a recent meeting of AFA's Alamo, Tex., Chapter that featured Gen. Gabriel P. Disosway, Commander, Tactical Air Command, as the guest speaker.

Following the address, General Disosway was presented mementos of his trip to San Antonio, including honorary assignments as Mayor of La



At the Florida West Coast Chapter's recent formal reception and banquet, Gen. and Mrs. Bruce K. Holloway, left, guests of honor, greet Lt. Gen. Fred M. Dean, right, as Mrs. Joseph Martin, center, greets Mrs. Dean. Chapter President Joseph Martin is barely visible in the background.

Altus, Okla., Chapter President Stansell Whiteside, right, presents the Chapter's "Altus AFB Airman of the Year" plaque to CMSgt. Sterling L. Schlangstein of the 11th Strategic Aerospace Wing.



Villita and Ambassador for San Antonio's HemisFair.

Distinguished guests included San Antonio Mayor W. W. McAllister; Lt. Gen. Sam Maddux, Jr., Commander, Air Training Command; Maj. Gen. Frank E. Rouse, Commander, San Antonio Air Materiel Area; Maj. Gen. George B. Greene, Jr., Commander, Lackland Military Training Center (ATC); Maj. Gen. Louis E. Coira, Commander, USAF Security Service; AFA's Southwest Regional Vice President J. J. Walden, Jr.; David Straus, President, San Antonio Chamber of Commerce; newly elected Chapter President B. L. Cockrell; and immediate Past Chapter President Ben Griffith.

The following day, the Chapter, the Reserve Officers Association, and the San Antonio Chamber of Commerce cosponsored a special luncheon honoring Brig. Gen. Tom E. Marchbanks, chief of the newly established Office of Air Force Reserve.

Among the more than 450 who attended the luncheon were San Antonio Mayor McAllister; C. L. Sledge, Chairman, Armed Forces Committee, San Antonio Chamber of Commerce, who served as Master of Ceremonies; and Maj. Gen. Frank E. Rouse, Commander, San Antonio Air Materiel Area.

• • •

The Minnesota State AFA's Annual Convention held recently in Minneapolis featured AFA's Executive Director James H. Straubel as the principal speaker.

More than 150 attended the banquet in the Fort Snelling Officers' Club to honor the Silver Wings airman of World War I, and Walter Bullock, recipient of the State Organization's Meritorious Citation for 1967. Mr. Bullock was honored for "his continued service to Minnesota aviation."

State President Vic Vacanti served as General Chairman of the affair.



Maj. Gen. William D. Greenfield, left center, Commander, Central NORAD Region/Tenth Air Force (ADC), and Mrs. Greenfield recently hosted a dinner at the Richards-Gebaur AFB Officers' Club for members and their wives of AFA's Mohawk Chapter of Greater Kansas City, Mo. Shown with General Greenfield are, from left, Chapter Treasurer Charles H. Church, Jr., Chapter Vice President Rodney G. Horton, and the President of the Chapter, R. Neal Luzier.

MAURICE "MO" LIEN JOINS AFA STAFF

On March 18, Maurice L. Lien joined the AFA Headquarters Staff as Assistant Director of the Field Organization Department.

"Mo" Lien, as he is better known to his many friends throughout the Air Force, is a native of Wisconsin. He attended public schools in a suburb of Chicago, Ill.

Mo became a Flying Cadet upon graduation from high school and, after receiving his wings in December 1944, he served in a variety of assignments including pilot training instructor, administrative and personnel officer, and, for the last twelve years of his Air Force career, as a Public Information Officer.

He attended the University of Maryland's extension school in Germany, graduated from Boston University's short course in Communications and Public Relations, and completed many Air Force-sponsored courses in Administration, Management, and Planning.

At the time of his retirement from the Air Force in August 1967 as a lieutenant colonel, Mo was Chief of Internal information in the Community Relations Division of the Air Force Systems Command Headquarters at Andrews AFB, Md.

Mo and his wife Jo have a son and a daughter. The family resides in Oxon Hill, Md.



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AFA NEWS

CONTINUED



Representative James McClure (R-Idaho), center, was the guest speaker for a recent Boise Valley Chapter meeting. Shown with Congressman McClure, who spoke on US involvement in Southeast Asia, are Chapter President Don Riley, left, and Brig. Gen. James M. Trail, Assistant Adjutant General for Air, Idaho National Guard and an AFA National Director.

Executive Director John O. Gray; Jackson Rambeau, Director of Military Relations; A. H. Duda, Program Director; Michael Nisos, Managing Director of the Aerospace Education Foundation; and Organization Director Don Steele.

The Denver, Colo., Chapter recently sponsored a luncheon at the Lowry AFB Officers' Open Mess to welcome Col. and Mrs. James C. Gross. Colonel Gross is the new Commander of the Air Force Finance Center in Denver.

Distinguished guests included Gen. Robert M. Lee, USAF (Ret.), President of AFA's Colorado State Organization; Maj. Gen. Joe C. Moffit, Adjutant General of Colorado; and Maj. Gen. D. O. Monteith, Commander of Lowry Technical Training Center.

During the program, Chapter President Roy Haug presented General Monteith with the book *Stampede to Timberline*, and a painting of Colorado.

CROSS COUNTRY . . . Congratulations to newly confirmed Air Force Reserve Brigadier Generals John O. Gray, AFA's Assistant Executive Di-

rector, and Farmer Smith, founder of AFA's Tarheel Chapter in Raleigh, N. C. . . . The San Bernardino, Calif., Chapter kicked off the new year with a highly successful golf tournament. Forty-four two-man teams participated in the tournament and more than 130 attended the reception and buffet dinner at which prizes and trophies were presented to winners in the tournament. Low gross honors went to Sergeants Ed Ceriani and Bill Brenton of Norton AFB . . . The AFA Mothers' Chapter in Pittsburgh, Pa., recently celebrated its first anniversary. New officers, installed at the anniversary meeting, are: President Fran Sigmund, Vice President Mary Coyne, Recording Secretary Gail Chasey, Corresponding Secretary Eileen Stevenson, and Treasurer Elizabeth Murphy.

Coming events: California AFA Mid-Year Meeting, May 4, Monterey . . . Ute Chapter Logistics Conference, May 13-14, Ogden, Utah . . . Hoyt S. Vandenberg Chapter ROTC Awards Banquet, May 17, Detroit, Mich. . . . Texas State AFA Convention, June 14-16, Del Rio, Tex.

—DON STEELE

Pepper Rodger, left, new University of Kansas coach and former Academy assistant coach, was at the Colorado Springs Air Power Council banquet honoring the AF Academy football team. With him are Academy Coach Ben Martin, Joseph Roetzel of the Council, and Gen. Raymond J. Reeves, CinC, NORAD.



This Is AFA

The Air Force Association is an independent, nonprofit airpower organization with no personal, political, or commercial axes to grind; established January 26, 1946; incorporated February 4, 1946.

Membership

Active Members: US citizens who support the aims and objectives of the Air Force Association, and who are not on active duty with any branch of the United States armed forces—\$7 per year.

Service Members (nonvoting, nonofficeholding): US citizens on extended active duty with any branch of the United States armed forces—\$7 per year.

Cadet Members (nonvoting, nonofficeholding): US citizens enrolled as Air Force ROTC Cadets, Civil Air Patrol Cadets, or Cadets of the United States Air Force Academy—\$3.50 per year.

Associate Members (nonvoting, nonofficeholding): Non-US citizens who

support the aims and objectives of the Air Force Association whose application for membership meets AFA constitutional requirements—\$7 per year.

Objectives

• The Association provides an organization through which free men may unite to fulfill the responsibilities imposed by the impact of aerospace technology on modern society; to support armed strength adequate to maintain the security and peace of the United States and the free world; to educate themselves and the public at large in the development of adequate aerospace power for the betterment of all mankind; and to help develop friendly relations among free nations; based on respect for the principle of freedom and equal rights to all mankind.



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Information regarding AFA activity within a particular state may be obtained from the Vice President of the Region in which the state is located.



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(Coverage Up to \$100,000)

MILITARY GROUP LIFE INSURANCE

AFA's low-cost Military Group Life Insurance features equal coverage, up to \$20,000, for flying and nonflying personnel at the same low premium.

This eliminates the penalty of lower coverage for the man on flying status whose death is caused by illness or ordinary accident.

The accidental death benefit was recently increased to \$12,500—a substantial increase in this benefit for every age.

The only exception to these provisions is that a flat sum of \$15,000, regardless of age, will be paid for death caused by aviation accident while the insured is serving as pilot or crew member of the aircraft involved.

AFA Military Group Life Insurance carries no hazardous duty restriction—no waiting period for coverage of personnel assigned to a combat zone. This insurance plan was designed as a service to our members, and we believe we serve best by continuing to offer the broadest possible coverage consistent with safety for all policyholders.

Policyholders may also keep their insurance in force at

the low group rate after they leave the service, and until age 65—provided their coverage has been in effect for at least a twelve-month period prior to their date of separation.

Net cost of insurance has now been reduced by dividend payments for five consecutive years . . . in addition to major benefit increases made in the policy during the same period.

Other benefits include guaranteed conversion privilege, waiver of premium for disability, choice of settlement options, and a choice of convenient payment plans, including payment by allotment for those on active duty.

All Air Force personnel on active duty, in the National Guard, and in the Ready Reserve are eligible to apply for AFA Military Group Life Insurance.

More than 17,500 participants carrying over a quarter of a billion dollars life insurance in force have selected this unique program—truly the best protection available for all service families.

CIVILIAN GROUP LIFE INSURANCE

This program offers AFA's nonmilitary members \$10,000 of needed insurance protection at the lowest cost we know of for any group term coverage which offers equal benefits:

Double Indemnity is a unique feature of this plan, covering almost all accidental deaths, including death caused by aviation accident unless the insured is acting as pilot or crew member of the aircraft at the time of accident.

Coverage may be continued at low group rates to age 65, when it may be converted to any permanent plan of insurance then being offered by the Underwriter, United of Omaha, regardless of the health of the insured person.

The plan also provides many other benefits including waiver of premium for disability, and a choice of convenient settlement options.

Any member of AFA, man or woman, who is not on active duty or in the National Guard or Ready Reserve, and who is between 20 and 60, is eligible to apply except for members who have left military service but still retain AFA Military Group Life Insurance. (Residents of Ohio, New Jersey, Texas, and Wisconsin are not eligible for this group coverage, but may apply for similar coverage at comparable rates.)

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AFA *guaranteed* Flight Pay Protection is available to rated personnel on active duty. This insurance protects active-duty members on flying status against loss of their flight-pay income because of injury or illness. Protection is guaranteed even against preexisting illnesses after a policy has been in force for a period of twelve consecutive months.

Grounded policyholders receive monthly payments equal to eighty percent of their flight pay (tax free) for periods

up to two years if grounding is caused by aviation accident and for periods up to one year for grounding caused by illness. Because they are tax free, these payments are essentially the equivalent of full government flight pay, which is taxable income.

The plan assures members of no loss of income if they are returned to flying status within the benefit period. And, if grounding is permanent, they are given sufficient time to adjust their expenses to a lower-income level.

COMPREHENSIVE ACCIDENT INSURANCE

This unique accident insurance coverage, available to *all* AFA members regardless of age, offers worldwide, full-time protection against all accidents except those involving crew members in aircraft accidents.

It is available in units of \$5,000, to a maximum of \$100,000, and may be purchased for individual protection, or for complete family protection under the popular Family Plan (including all children under age 21)—both at remarkably low rates.

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VIAGREEN, TO CLIMB
AND MAINTAIN 1000 AND TO
CROSS THE HUNTINGDON FAN
WIRE AT 4000 AND THEN
DIECT TO THE "ZAP". HAWAII
AIRSPOT: "HAWAII" IN 10/10/14

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POP! MUSEUM VIA MUSEUM
MUSEUM MUSEUM
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4. CLIMB OUT INSTRUCTIONS REMAIN THE SAME. DO YOU WISH ANY PORTION OF YOUR CLEARANCE REPEATED?

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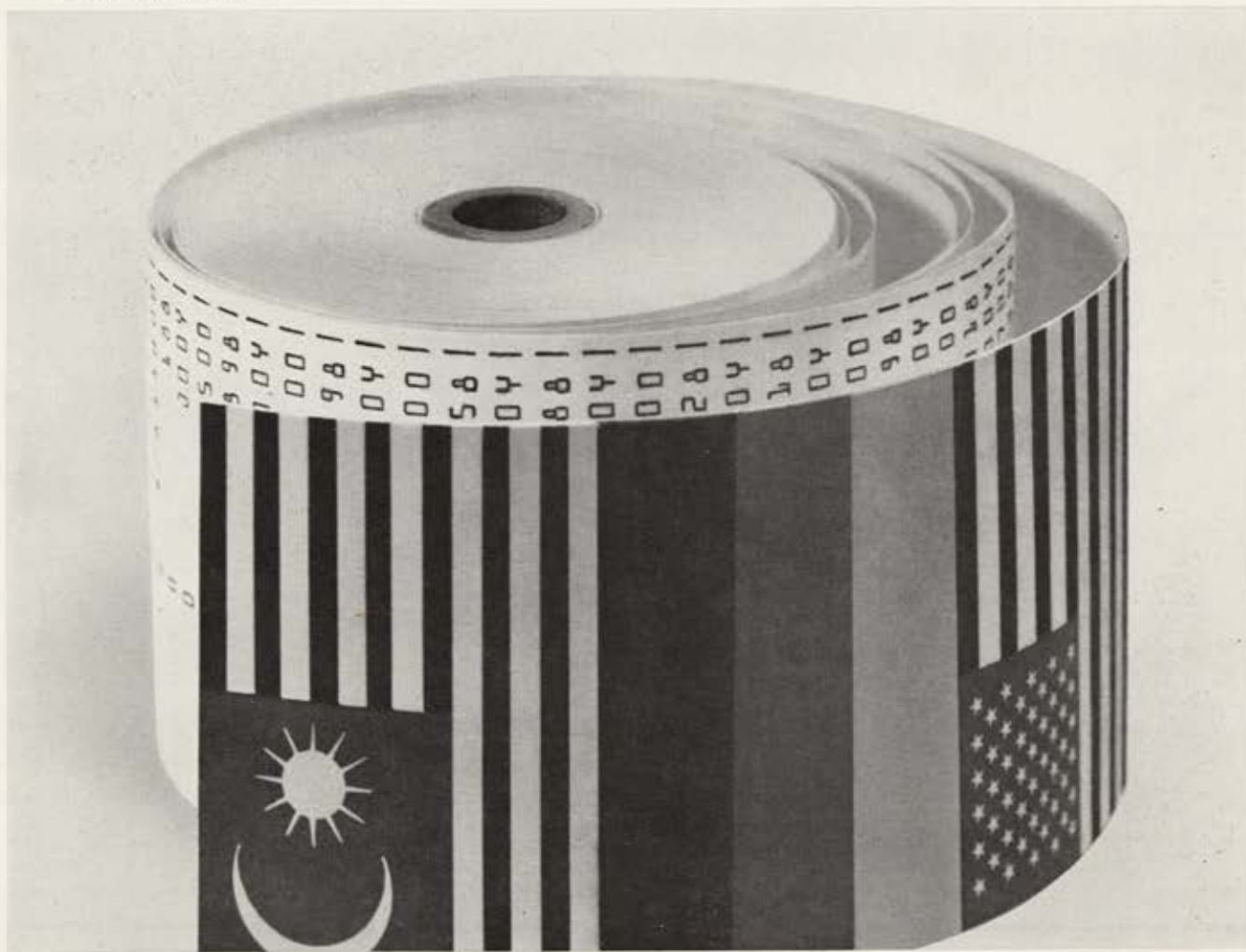
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