

JUNE 1966

Air Force/Space Digest



International

PUBLISHED FOR THE LEADERS OF THE FREE WORLD BY THE UNITED STATES AIR FORCE ASSOCIATION



MOBILITY

FEATURING SPECIAL REPORTS ON:

- ▶ How the U.S. supplies its 250,000 troops over the long pipeline to Vietnam.
- ▶ What the U.S. Army and Marine Corps are learning about mobility in the jungles of Southeast Asia.
- ▶ The new U.S. Army-Air Force agreement which assigns rotor craft to the Army and fixed-wing aircraft to the Air Force.

X-22A FLIGHT IS BIG STEP FORWARD FOR V/STOLs

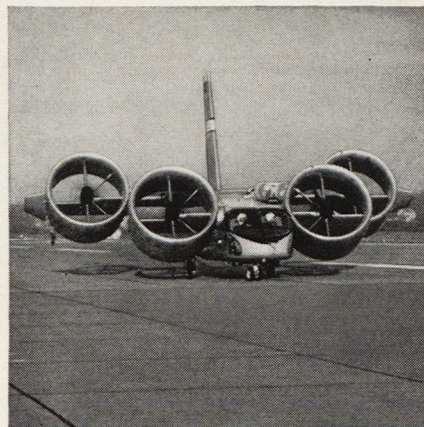
With its four ducted propellers pointed skyward, Bell's X-22A successfully demonstrated man's newest concept in V/STOL aircraft. On its maiden flight, this unique aircraft rose vertically... hovered... made a 180 degree turn... and landed gently under complete and precise control.

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porate a variable-stability system which enables it to simulate a variety of aircraft. This increases its cost-effectiveness by making it possible to evaluate other V/STOL configurations without actually constructing them.

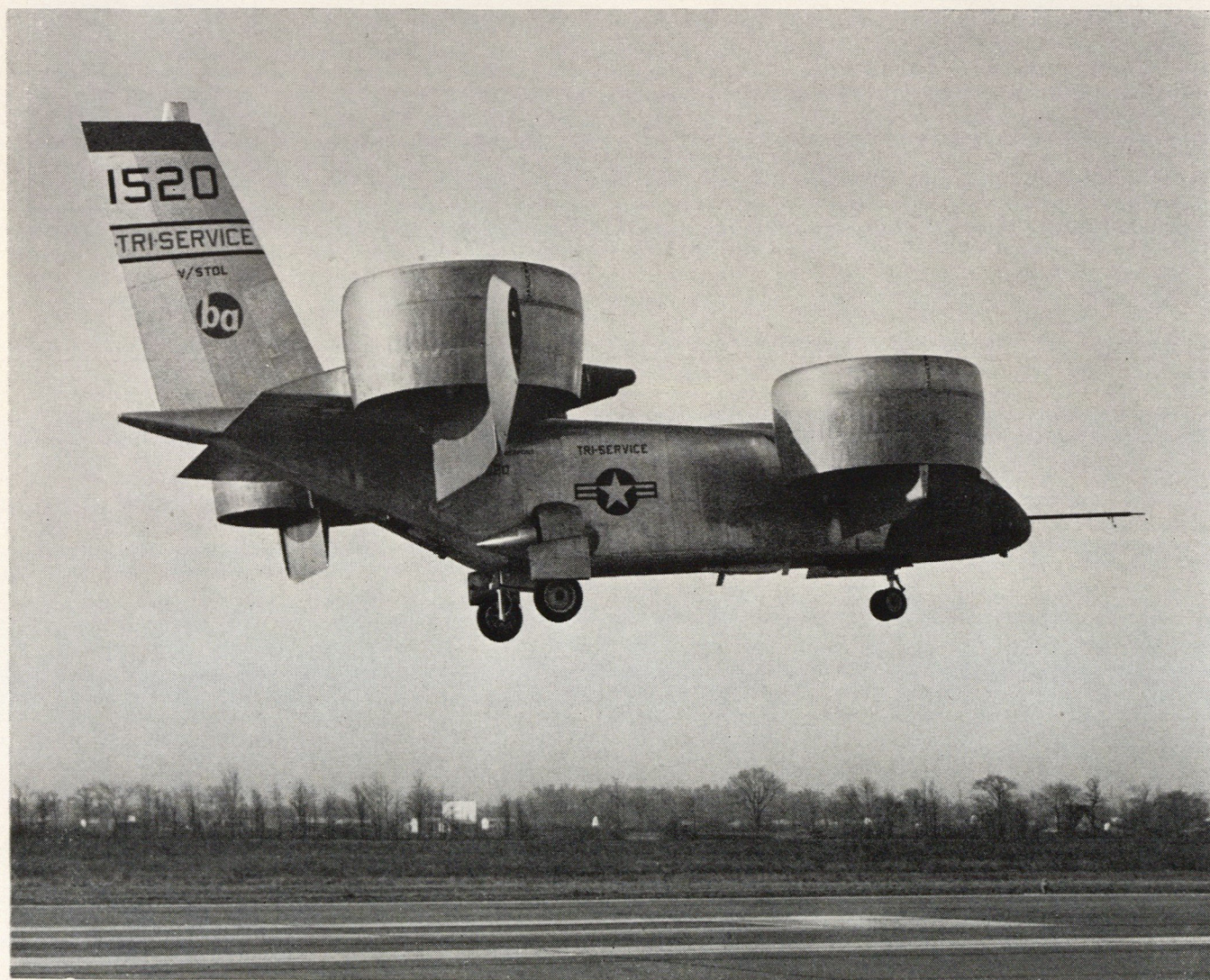
The X-22A features four ducts which not only serve as lifting surfaces (wings) in transition and forward flight but also permit a compact configuration... and, most important for V/STOL aircraft, the ducts increase the thrust of the propellers providing excellent control under all conditions of speed or attitude.

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For takeoff, the four ducted propellers are rotated to the vertical thrust position. At the desired altitude, they are transitioned gradually to the horizontal thrust position for forward flight. The sequence is reversed for vertical landing.

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Air Force/Space Digest International

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Moving supplies to support the more than 250,000 U.S. Army, Air Force, Navy, Marine, and Coast Guard personnel on the other side of the world is the incredibly tough job of U.S. logistics planners who are running the pipeline from the U.S. to Southeast Asia. Cutting through paperwork, devising new systems, and speeding up old ones, the U.S.'s most skilled logisticians are getting the job done. Here is a report on how they do it, always with an eye to further improvements.

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The requirements of limited warfare, particularly in a primitive environment such as in Vietnam, have prompted the development by the U.S. of scores of vehicles to improve mobility on land, sea, and in the air. V/STOL transports, fast new helicopters, new tracked trucks, and armored carriers that will travel on water as well as on land, all are being considered in the search for mobility. AF/SD INTERNATIONAL presents a report, in words and pictures, on the most promising.

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MEMORANDUM

TO: Readers of AF/SD INTERNATIONAL FROM: John F. Loosbrock, Editor

Since we began publication of AIR FORCE/SPACE DIGEST INTERNATIONAL in January 1965, one fact has continued to impress us. This is the fact that interest in and dependence on the advancement of technology knows no national boundaries. More and more it has become clear that no one nation, or one culture, or one geographical segment of the world has a monopoly on technological talent or resources, or the problems which technology can help to solve. Advances in transportation and communications have so shrunk the world that the free flow of information and discussion, so necessary to the continued growth of technology, has stimulated requirements for avenues of communication.

To aid in this flow of ideas is the purpose of AF/SD INTERNATIONAL. Our magazine is now received every month by more than 12,000 persons in 53 countries. This number represents a unique group of readers, unmatched in quality and influence by any comparable international publication. It includes leaders in the civil governments of the nations involved, high-ranking military commanders and planners, industrial executives, and scientific personnel. The many requests for subscriptions we receive each month are carefully screened to ensure that this high quality of our readership is maintained. We have come to feel that we know you, each of you, and we appreciate the warmth and friendliness with which you have welcomed us, through the pages of our magazine, into your professional lives.

Each of you is a very busy man. If you were not, you would not be receiving AF/SD INTERNATIONAL. Our publishing function, we feel, must take this fact into consideration. Hence, our efforts every month to keep you abreast of technological developments, particularly in the areas of aerospace and defense-oriented technology.

We do not pretend, and it would be presumptuous for us to do so, to be expertly informed on what transpires in each of the 53 countries which we cover with our distribution list. Our job, as we see it, is to keep you in-

formed of the latest developments in the country which we do know—the United States of America.

From time to time we emphasize one particular field of interest, such as logistics and mobility, which we examine in this issue. We have looked at seapower, at business and personal aviation, at international cooperative programs, at requirements for tactical air warfare.

In the future we will report on developments in commercial air transport, including the various supersonic transport programs and the new large subsonic jets. We plan a series of articles on the various U. S. Government departments that are heavily involved in advanced technology, such as the National Aeronautics and Space Administration, the Department of Defense, the Federal Aviation Agency, the Atomic Energy Commission, the Civil Aeronautics Board, and others. Future issues will report in depth on such technical areas as computer technology; communications, including the communications satellite program; advanced propulsion systems; and so on.

Thus far, in the relatively short existence of AF/SD INTERNATIONAL, we have been much helped and guided by your comments, which are received with great interest and high respect. We freely invite your continued participation, as consumers of our editorial product, in furnishing guidance as to the kind of information and discussion you want and need. Both the pages of our magazine and the minds of our editors are open to your suggestions. We want to give you the magazine that will be most helpful to the greatest number of readers.

We hope, also, that you will take issue with us when you disagree with what we say or when you feel we have fallen short of the mark. Your own thoughts on the subjects we cover, as well as your own knowledge, can make a useful contribution to the international dialogue. In this way, AF/SD INTERNATIONAL can become a kind of international clearinghouse for information, as well as an international forum for debate.

We welcome your active participation in our editorial task. ☆☆☆

SENIOR EDITOR WINS PROFESSIONAL AWARD

We feel that we have the best editorial staff available in the aerospace publishing field. We are, however, always happy when this belief is reinforced with recognition from other professionals.

Members of our staff have, fortunately, received this sort of recognition quite often over the years. Most recently, Senior Editor Claude Witze has been honored by the Aviation/Space Writers Association, the professional organization for those of us in the aerospace field.

Just before press time, it was announced that Mr. Witze was this year's recipient of the AWA award for the best writing and reporting in U.S. aviation/space publications business. He received the award for his article in the October issue of our domestic edition, AIR FORCE/SPACE DIGEST, "Let's Get Operational in Space," based on an exclusive interview with one of the developers of the German V-2 rocket, Dr. Walter Dornberger, on the eve of his retirement from Bell Aerosystems.

This is the third time he has received this award in the past 5 years. In addition, Mr. Witze was the winner of the James J. Streb Memorial Trophy in 1963, an AWA award for outstanding excellence in aviation writing in all categories of publications.

Mr. Witze has over 30 years' experience as an editor and reporter specializing in military aviation. He was Military Editor of "Aviation Week" magazine before moving to his present post in 1958.

In 1963, he was the only American invited to present a paper at a seminar in London conducted by the International Press Institute and attended by 40 air correspondents and editors from 16 countries.

Letters to AF/SD INTERNATIONAL

AF/SD INTERNATIONAL wishes to maintain an international dialogue with and among its readers (see editorial memorandum on the preceding page). The letters on this page are representative of those we have received so far. We invite comment, criticism, and suggestions on the content of the magazine, the issues we discuss, or what you would like to have covered in future issues. We also suggest that the varied nature of the readership of AF/SD INTERNATIONAL, composed of leaders, planners, executives, and scientists from 53 countries, makes the pages of this magazine an uncommonly good sounding board for your ideas, for calling international attention to your comments, and for communicating on a professional level with readers from other countries. Toward these ends, we will do our best to publish all of the letters that our limited space will permit.—THE EDITORS

Gentlemen: Your April 1966 issue devoted to the Navy was wonderful, not only in its coverage and thinking but also in the spirit of interservice co-operation. We in the Navy are particularly pleased that your readership of the Free World leaders will have this opportunity to update themselves on the U.S. Navy.

Rear Admiral H. L. Miller, U.S.N.
Washington, D. C.

Gentlemen: This magazine is most valuable to me with a view to the need of background knowledge and orientation in the field of technological development and aerospace policies/activities. It is most attractive by the high standard of quality of the articles, brought in such a comprehensive and skilled way.

Brigadier General D. B. De Jong
Hq. 1 (NL) Corps
Apeldoorn, The Netherlands

Gentlemen: I want to congratulate you on the article "The Case for a Common Defense Market" [by Claude Witze, January 1966 AF/SD INTERNATIONAL].

It is an outstanding presentation of a most important and, in my opinion, vital question. I remember that in the only one year of the Brussels Treaty Organization (1948-1949), we tried to set up, for the industry related to the Air Force, a sort of European Common Defense Market. It is, paradoxically, the generosity of the American aid program which did upset our plan and brought each individual country back to its national industry. Since that time no serious attempt has ever been made to revert to the kind of European cooperation laid down and encouraged by the Brussels Treaty.

It is true to say that in view of the accelerated development of technology, a European Defense Market would

have led, by necessity, to the NATO Defense Common Market, favored by Mr. McNamara and his second in charge of that effort, Mr. Kuss. It is remarkable to note that in the field of aviation, for example, the commercial airlines generally buy the most economical aircraft—which, by the way, are mostly American—whereas this healthy principle of economy is often ignored when it comes to military aircraft. Now defense expenses are unproductive and yet are the most necessary of all public expenses. They are, for a country, an economic factor, inasmuch as they allow research and development, and procure work for a specialized industry. For the citizens, however, who pays the taxes, unproductive expenses are considered a necessary sacrifice if they contribute to a justifiable defense organization.

But in many cases, in Europe, one can prove that it is not defense which is the end in itself but the industry which produces armaments at costs many times higher than in the United States. That is why a Common Defense Market would be a solution to help us out of the absurd situation where those who think in terms of defense for the country are blamed by those who defend a national defense industry for itself and not for the forces it has to serve. . . .

General Paul Stehlin
Paris, France

Gentlemen: May I congratulate you on [Stefan Geisenheyner's] excellent article on hydrofoils ["Hydrofoils: Fast, New Sea Legs for Antisubmarine Warfare"] which appeared in the April edition of your magazine. It certainly gave an up-to-date summary of all projects and contracts.

I would mention one error and that is on page 32, where [he] said that Proteus engines power the Supramar

commercial craft shown in the photograph. This is not so; the Proteus has been designated to power the next generation of the civil craft for Supramar.

G. G. Connor
Bristol Siddeley Engines Limited
Ansty, Coventry, Warwickshire
England

Gentlemen: This is a very useful and informative source of information on the latest equipment and thinking on defense matters.

A suggestion: In the long run, the escalating arms race and the proliferation of nuclear, chemical, and toxic weapons may lead to war by accident, miscalculation, madness, and the Nth country problem. President Kennedy warned about this in 1961. The AF/SD INTERNATIONAL might take this into account by having an occasional "think" piece about where we are going, and whether we will be able to stop before we get there.

L. F. J. Ross
Christchurch, New Zealand

Gentlemen: I have read with great interest the copies of AF/SD INTERNATIONAL received to date. Further, I have circulated them to others whose experience, knowledge, and opinion are important to our nation. We are agreed that your magazine is making a very significant contribution to an understanding throughout the Free World of modern airpower and space technology.

Rear Admiral G.G.O. Gatacre (Ret.)
Elliott Automation (Pty) Limited
Revesby, N.S.W., Australia

Gentlemen: Very up to date and thought provoking. I would like to see more emphasis put on weapon standardization among NATO countries.

Guido Polacco
Turin, Italy

Matching a nation's productive resources to the skills and courage of its fighting men is the science, or more properly the art, of logistics. The U.S. has challenged its most skilled practitioners of that art with the task of keeping supplies for over 250,000 men moving smoothly along a 10,000-mile (16,100 km) pipeline to a small, Southeast Asian country . . .

Logistics: Lifeline to Southeast Asia

BY ALLAN R. SCHOLIN, Associate Editor

The United States' principal logistics problem in supporting the force build-up now under way in Southeast Asia is not one of producing the necessary weapons and supplies but in getting them there over a 10,000-mile (16,100 km) pipeline and finding elbow room to exercise them once they arrive.

As of early April, the U.S. had in South Vietnam military forces totaling about 240,000 men—146,600 Army, 48,600 Marines, 32,200 Air Force, and 12,600 Navy and Coast Guard. Another 50,000 to 60,000 men were on Navy carriers and other ships offshore. The figures do not include government civilian employees or contractor personnel working on military projects, nor several thousand Air Force personnel who are helping fight the war from bases in Thailand.

The long-distance pipeline to Southeast Asia offers a real test of the logistics system developed by the U.S. Air Force and Defense Department (DoD) in the years since the Korean War. The stresses of combat operations from newly established bases at the end of this long pipeline have uncovered numerous flaws in the system, but over-all it is working very well.

The NORs—Not Operationally Ready, Supply—rate for USAF aircraft in Southeast Asia is lower than that for the rest of the Air Force. Units often experience temporary shortages of supplies and munitions, but these are primarily the result of distribution problems within the theater and not of the system itself.

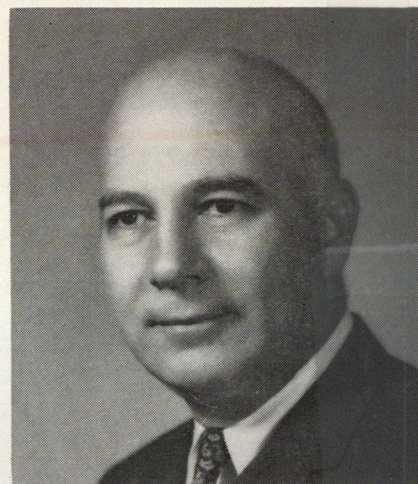
Certainly no system is more thoroughly managed and supervised. Each

echelon in the chain operates a Logistics Readiness Center, manned around the clock to receive and process emergency requirements. There is one at Pacific Air Force (PACAF) Headquarters in Hawaii, at Air Force Logistics Command (AFLC) Headquarters, Wright-Patterson Air Force Base, Ohio, and at U.S. Air Force Headquarters in Washington. The Department of Defense has established a Vietnam Support Expediting Task Force in the Pentagon, headed by Army Brigadier General Hal D. McCown, with USAF's Colonel Harry A. Sachaklian as his military deputy, and with the other services represented by senior logistics experts. Its job is to review any flaws in the system. Working directly under the Assistant Secretary of Defense for Administration, Mr. Solis Horwitz, it has the responsibility to isolate current and potential logistics problems and to report them to the Secretary of Defense.

Initially, the services ran into difficulties in getting approval from DoD intermediate echelons to provide combat units with higher ratios of supplies and equipment than are normally allotted in peacetime. Often the kind of justification DoD insisted on just wasn't available, largely because the President himself had not decided on the degree of buildup that might be required. Military logistics experts knew from experience that increased quantities would soon be needed, but DoD accountants couldn't bring themselves to accept guesses, however well-informed. Meanwhile, the all-important factor of lead time to procure and produce new items reached a critical point.

In this situation, Paul Ignatius, Assistant Secretary of Defense for Installations and Logistics, moved forcefully to reorient the viewpoint of his subordinates so that now, as far as Southeast Asia is concerned, the estimates are honored and the supporting documentation is submitted after the fact.

"The logistician's ideal is to reduce all his operations to a routine," says Colonel Sachaklian. "In practice, his task is to adjust to the unexpected." The efforts to reduce Southeast Asia



Paul R. Ignatius, Assistant Defense Secretary for Installations and Logistics, cleared the way in DoD for more efficient Southeast Asian buildup. "Secretary McNamara told me to see that our forces get everything they need to do the job."



At Saigon's Tan Son Nhut Airport, Vietnamese alert crewman guides Lockheed C-141A StarLifter into position for offloading. Star-Lifters spend minimum time at Saigon, moving on immediately to Yokota AB, Japan. There they pick up sick and wounded, fly non-stop to Travis Air Force Base, California, in 9 hours. With new crews at Wake, Clark, and Yokota, plane completes circuit in 36 hours.

logistics to a routine are showing some success. A substantial buildup of forces in a relatively primitive area with extreme environmental conditions carries with it problems that can be forecast in general, but are difficult to predict on a day-to-day basis.

For example, heat and humidity will shorten the life of a radio set but it's hard to tell whether it will last a week or a year. Yet, it is a tribute to the skill of logistics personnel in Vietnam, and the support system in back of them, that no significant combat operation has had to be revised or canceled because of materiel deficiencies.

Ideally, equipment and supplies would move from U.S. sources to the Far East by the most economical means, which in most cases would be by ship. Materiel would flow to U.S. ports, arriving just as the ships are ready to be loaded, be offloaded promptly at the far end, and just as promptly forwarded to the customer. But it's not quite that simple.

To bring together in manageable form the complex factors of requirements and consumption rates, production and delivery schedules, transportation timetables, and tonnage capacities of ports at either end, of ships and planes plying between them, and of the distribution network within Southeast Asia, requires fast, sure communications to get the information, and computers to assimilate that information and produce master schedules. This machinery is in existence. Refinements are constantly being incorporated to make it work better.

At present, responsibilities for operat-

ing this logistics network are shared among the Air Force Communications Service, which runs the worldwide Autodin network for the Defense Communications Agency; the Air Force Logistics Command and Defense Supply Agency, which receive, interpret, and fill USAF orders; the Military Traffic Management and Terminal Service (MTMTS), which controls movement of goods to embarkation points; Military Sea Transportation Service (MSTS) and Military Airlift Command (MAC), which carry the shipments to Southeast Asia; and USAF's Seventh Air Force (formerly 2d Air Division) in South Vietnam, which delivers them to their ultimate destination.

Air Force Logistics Command employs 2 operating concepts to keep USAF units supplied. One is the "pusher" principle. Where consumption rates are known or can be anticipated, it regularly forwards materiel to using units without prior requisitions. This system covers a wide scope of items—fuel, munitions, aircraft tires and spares, engines, food, clothing, and housekeeping goods. To reduce this system to a routine, AFLC constantly reviews consumption rates and adjusts quantities accordingly.

The second concept covers requisitions initiated by the customer. When a base needs an item, it produces a punched card identifying the base, showing the stock number of the item and the quantity desired, affixing its priority rating, and indicating the date it wants delivery.

From Vietnam this information is fed into the Autodin net, going by cable

to Clark Air Force Base in the Philippines or Kadena Air Base, Okinawa, then by radio to the U.S. and direct to the AFLC depot responsible for stocking the item. There the information goes into a computer which determines whether or not the part is in stock. If it is, the computer feeds back into Autodin a reply to the originating base advising that the part is being shipped. Simultaneously it determines the mode of shipment according to priority, date required, and weight, and adjusts the depot's stock balance records—all this before anyone at the depot is aware the requisition has been received. At periodic intervals each day, depot personnel direct the computer to print out its stored requisitions, draw the items from warehouse bins, and ship them in accordance with the computer's instructions.

Carrying the system one step further, semiautomated warehouse equipment, designed by the FMC Corporation, was recently installed for test at the Ogden (Utah) Air Materiel Area. Instructions from the computer trigger a mechanism to draw the item from its bin and send it by conveyer belt to the shipping unit.

If the requested item is not in stock, the computer searches its memory to find an alternate source—another depot or, on open contract items, the manufacturer; relays the requisition to that point via Autodin; and notifies the requesting agency of the action it has taken.

When the computer cannot turn up a
(Continued on following page)

High-priority cargo for South Vietnam is loaded aboard C-141A at Travis AFB, California. This StarLifter is one of 16 operated by the 44th Military Airlift Squadron, first MAC (Military Airlift Command) unit to be equipped with C-141As. Four squadron, 2 at Travis and 1 each at Dover Air Force Base, Delaware, and Charleston Air Force Base, South Carolina, now fly the StarLifter. The number of squadrons operating the 500-mile-per-hour (800 km/hr) transport will rise to 10 by March 1967.



source for the item, it prints out that information, which then goes to an office within the depot assigned logistics responsibility for the item. This may be the Weapon System Control Point (WSCP), the System Support Manager (SSM), or the Inventory Manager (IM), depending on the type of item requested. It is that office's responsibility to find the part. Armed

with a complete inventory of the location of each such item in use throughout the Air Force, it may call upon a base in the continental U.S. to furnish the part; it may, if time permits, order the part from the manufacturer or other commercial source; or it may recommend a substitute item which will meet the requirement.

To meet requirements in Southeast

Asia, AFLC has had to levy on other USAF units for substantial quantities of equipment. The same is true in the other services. The dollar value of equipment drained from other military bases in the U.S. and Europe is estimated to total more than \$10,000,000,000.

The total weight of supplies airlifted to Southeast Asia by MAC and its contract carriers has risen from 7,000 tons (6,350 mt) in July 1965 to 13,300 tons (12,066 mt) in March 1966. About 40 percent of this tonnage goes to Air Force units. It also airlifts more than 35,000 passengers a month.

More than 200 military transports are regularly operating between the U.S. and Southeast Asia. In a recent month, they logged 36,000 flying hours. Ten commercial carrier lines under contract to MAC, operating Boeing 707, Douglas DC-8, and Canadair CL-44 transports, flew almost the same total; and another 3,000 hours were logged for MAC by the Air Force Reserve, flying Douglas C-124s, and the Air National Guard in Boeing C-97s and Lockheed C-121s.

Lockheed C-141 StarLifters are substantially boosting the MAC airlift capability. MAC has 4 StarLifter squadrons, 2 at Travis Air Force Base, California, and 1 each at Dover AFB, Delaware, and Charleston AFB, South Carolina. The number of squadrons operating C-141s will rise to 10 by March 1967, and eventually MAC will have 284 StarLifters.

"A basic measure of the productivity of any aircraft may be found in the number of cargo ton-miles it is capable of flying per hour," General Howell M. Estes, Jr., MAC Commander, said in April. "The piston-driven C-124, our 15-

DoD PRIORITY SYSTEM

Unit's Assessment of Need

		A	B	C	D
		1	4	11	16
Forces Activity Designator	I	1	4	11	16
	II	2	5	12	17
	III	3	6	13	18
	IV	7	9	14	19
	V	8	10	15	20

Forces Activity Designator:

- I—US combat forces in action, and other activities designated by Joint Chiefs.
- II—Active and foreign forces in an immediate state of readiness for combat.
- III—US and foreign forces maintained in a state of readiness.
- IV—Selected US and foreign forces scheduled for employment in support of approved war plans.
- V—All other.

Transportation Priority One: Supply priorities 1 through 3.

Transportation Priority Two: Supply priorities 4 through 8.

Transportation Priority Three: Supply priorities 9 through 15.

Transportation Priority Four: Supply priorities 16 through 20.

year-old workhorse aircraft, produces slightly more than 2,500 ton-miles per hour; the propjet C-130 delivers 3,800, and the jet C-135 nearly 7,000. The productivity of the C-141, on the other hand, is some 10,000 cargo ton-miles per hour."

On a typical transpacific mission, the C-141 carries slightly more than 25 tons (22.7 mt) of cargo at a cruising speed of 425 knots. In payload it is exceeded only by the Douglas C-133 Cargomaster, which carries about 27.5 tons (24.9 mt) but cruises at 270 knots. The normal StarLifter route is from Travis to Wake to Clark to Saigon, then to Yokota, Japan, and back nonstop to Travis. Cargo runs are also made over near-polar routes from Dover and Charleston Air Force Bases on the U.S. East Coast via Anchorage, Alaska, and Japan.

On top-priority runs, the C-141 can reach Saigon 18 hours after leaving Travis. It has made the return flight from Yokota to Travis in as little as 9 hours. Outbound, the StarLifter car-

ries priority cargo. On the return trip it normally carries sick and wounded, and men returning from Vietnam and other Far East bases.

Equipped with 463L cargo-handling system elements, the C-141 can take on or offload a full palletized load in less than 30 minutes. The Travis terminal was the first to be equipped with the 463L conveyer and packaging system. Cargo offloaded from trucks can be sorted for shipment by a single operator. Two men can load a pallet carrying 7,500 pounds (3,400 kg) in minutes, and special cargo-loading trucks take the pallets from the terminal to the aircraft. Elements of the 463L system are also incorporated in other MAC transports, and the cargo-loading truck bed can be raised or lowered to the level of the fuselage floor.

Similar cargo-handling equipment is now in use in Saigon and Bangkok, Thailand, and in other MAC terminals in the Far East. The system has paid off by dramatically increasing the daily

utilization rate of military and commercial carriers.

The Defense Department has prescribed rigid standards for cargo eligible to be airlifted by MAC. In the military priority system, each requisitioned item carries a priority of from 1 to 20. This scale is made up of 2 elements—the unit's combat status and its own assessment of how badly it needs the part.

Items bearing priority numbers 1 to 3 are, in turn, designated transportation priority 1; priorities 4 to 8 bear transportation priority 2. These 2 classes are normally eligible for air transport. Priorities 9 to 20 are not (see chart, opposite page).

Cargo entering the terminal at Travis AFB to be flown to Southeast Asia covers a wide spectrum. You would expect to see jet engines and other aircraft spares. But it can also include such surprising items as oil drums, 750-pound (340 kg) bombs, and even desks and typewriters.

(Continued on following page)



Carrying up to 80 litter patients, C-141A StarLifter flies nonstop from Yokota Air Base, Japan, to Travis AFB, California, in about 9 hours. Outbound from Travis, the StarLifter carries as much as 25 tons (22.7 mt) of priority cargo to Saigon in 18 hours, with stops at Wake Island and Clark AB, Philippines. On return trip it normally carries sick and wounded from Vietnam and other Far East bases.

In some Joint Chiefs of Staff-directed projects, as for example the deployment of a combat unit to a "bare base" in Vietnam, all equipment necessary to set up and operate the unit may be assigned transportation priority 1. Hence, a desk and typewriter for that unit might take precedence over an aircraft engine for another base scheduled for installation a week away.

Each service maintains an Air Traffic Liaison Officer (ATLO) at MAC terminals to see that high-priority cargo is moved first, and to decide which items within the same transportation priority will be given preference. Similarly, the services each keep a Water Port Liaison Officer (WPLO) at ship terminals.

Demands of the buildup in Vietnam have swamped the priority system. To relieve the demands on air transport, AFLC initiated a plan with the support of the other services for MSTs to set up a SEA (Southeast Asia) Express, a fleet of ships which handle otherwise air-eligible cargo whose delivery can be deferred for a maximum of 30 days. By giving SEA Express vessels preference, both in onloading and offloading the cargo, the 30-day delivery schedule can normally be met.

But even this service is occasionally

overloaded. At the Army terminal at Oakland, California, recently, when a SEA Express ship arrived at dockside, orders went out to load it entirely with transportation priority-1 cargo. "Okay," replied the dock superintendent. "What priority-1 cargo do you want?" The ship could accommodate a maximum of 10,000 tons (9,700 mt). The port that day had more than 17,000 tons (16,420 mt) of top-priority cargo on hand. It was up to the service WPLOs to decide what would be left for the next shipment.

Most ammunition for Air Force units in Vietnam is handled by a fleet of 15 MSTs ships, designated Special Express, which operate regularly between the U.S. Navy's ammunition port facility at Concord, California, and the South China Sea. These 15 vessels are in a continuous cycle between Concord and the discharge points at Saigon, Da Nang, Qui Nhon, Cam Ranh Bay, and Bangkok. As soon as its cargo is discharged, each ship heads back for reloading at Concord.

A direct military airlift from AFLC's Hill Air Force Base, Utah, is easing some of the strain on the Air Force's air-munitions pipeline to Southeast Asia. Seven special flights each week are helping to relieve the threat of tempo-

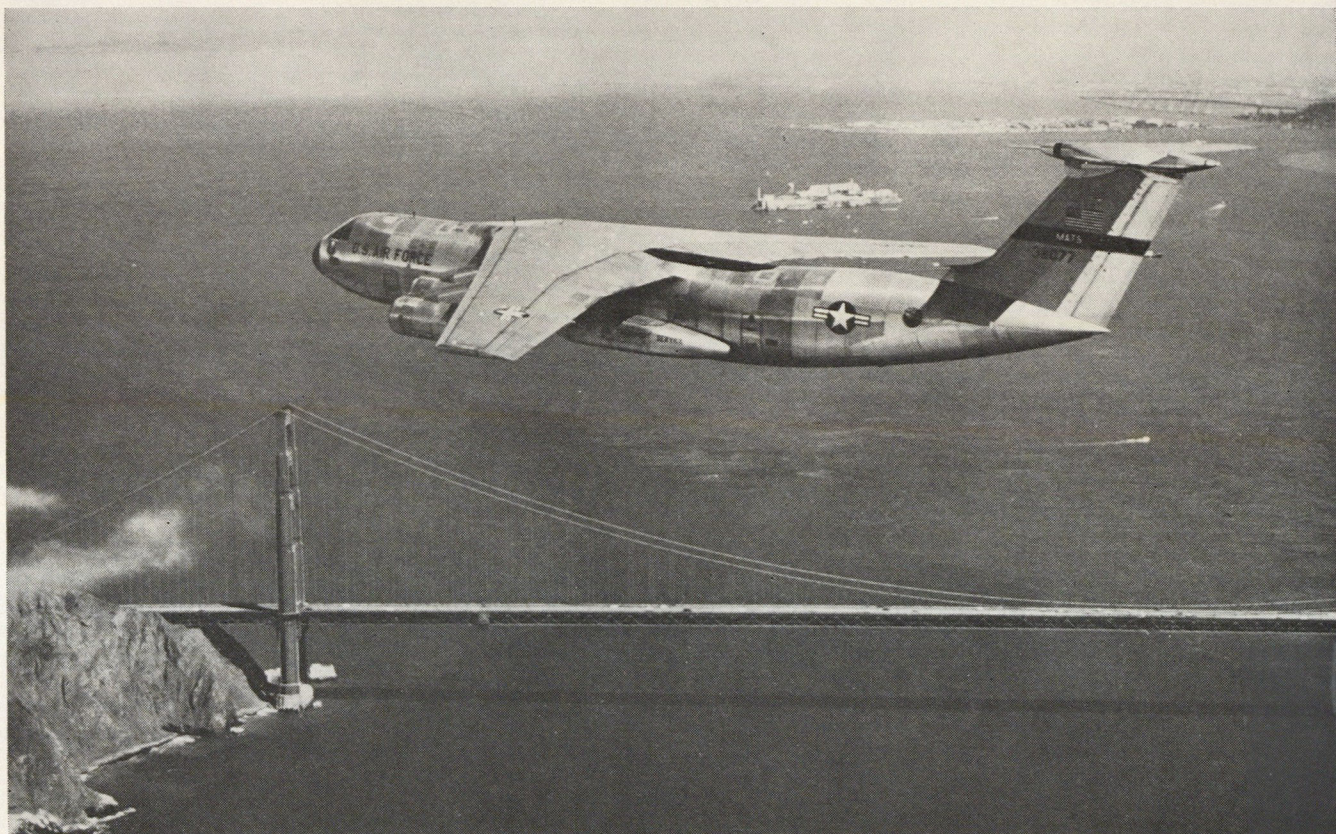
rary shortages in key ordnance items.

Figures on tonnages handled by the Military Sea Transport Service are not released by the Defense Department, but U.S. Navy Vice Admiral Glynn R. Donaho, Commander of MSTs, has noted that airlift delivers less than 2 percent by weight of supplies shipped to Southeast Asia. That would put the total carried by surface vessels at about 600,000 measurement tons (544,200 mt) a month.

Accommodating this flow of supplies from the U.S. has required some expansions in air and water ports of embarkation. When Travis AFB, MAC's primary West Coast port, was swamped last fall, auxiliary aerial ports were set up at McChord Air Force Base, Washington, and Norton Air Force Base, California. Some supplies move direct to the Far East by both military and commercial carriers from Kelly Air Force Base, Texas, in addition to the 2 East Coast fields at Dover, Delaware, and Charleston, South Carolina.

Similarly, the Oakland Army Terminal, California, where most MSTs ships take on cargo for Southeast Asia, frequently bulges with an uncomfortably heavy backlog of materiel. To relieve the pressure there, some MSTs

(Continued on page 11)



Making regular flights over the Golden Gate Bridge, in California, at the start of its long trips to the Far East war zone, the C-141 has substantially boosted MAC's airlift capability. StarLifter can fly 10,000 cargo ton-miles per hour as compared with 7,000 for the Boeing C-135 Stratolifter and 2,500 for the Douglas C-124 piston-driven Globemaster. Eventually MAC will have 284 C-141s.



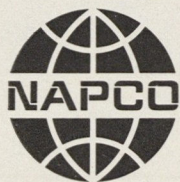
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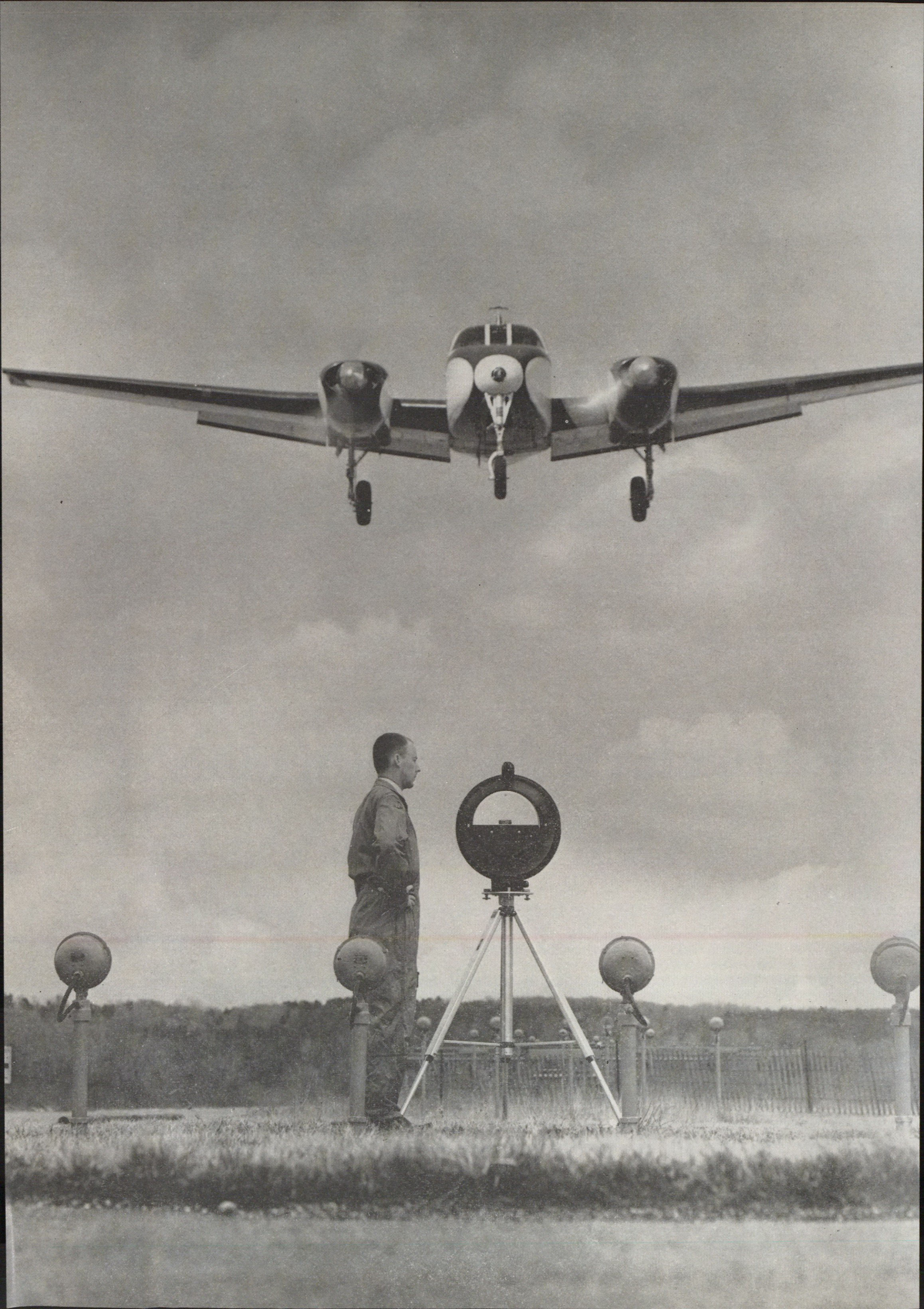
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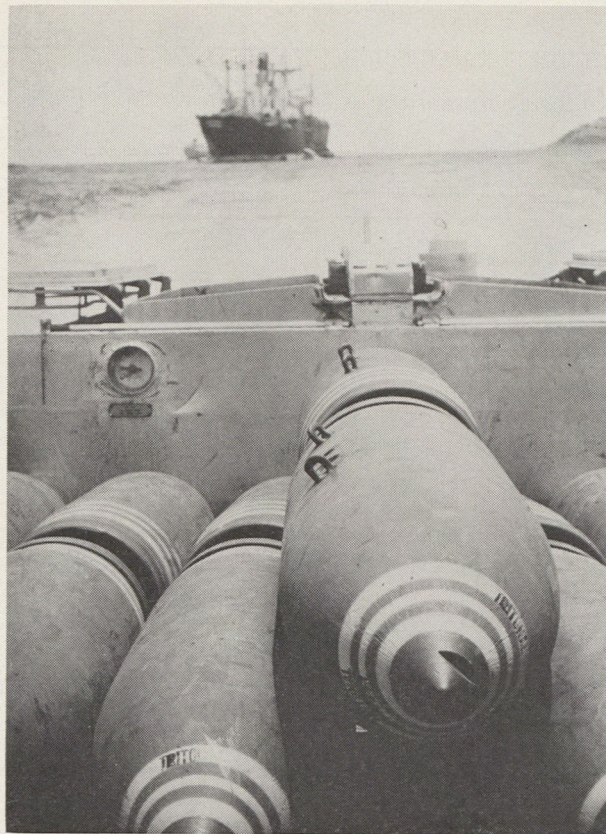
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Sealift shuttle service from U.S. to South Vietnam eliminates need for large and vulnerable dry-land storage sites for munitions. Under direction of Air Force Logistics Command, ships become floating warehouses off coast of Vietnam. Under terms of military assistance agreement, U.S. recently bought back 18,000 bombs from allies for use in Southeast Asia.

ships pick up cargo for Vietnam from other West Coast ports and even from the Gulf and East Coasts.

But the pressures on U.S. embarkation ports are minor compared to those at the other end of the pipeline. There is dock space for only 10 ships at Saigon, reached through a narrow channel that could be blocked by a single ship. As a result, ships often lie at anchor in the South China Sea for days. The record is 40 days, but delays of 10 to 20 days are not uncommon. For this reason, the construction of a modern port at Cam Ranh Bay, 200 miles (320 km) northeast of Saigon, was pushed at top speed to serve U.S. and Vietnamese military units based in the upper half of South Vietnam. The U.S. is also assisting the Thai Government to enlarge its naval base at Sattahip, on the Gulf of Siam south of Bangkok, to support U.S. forces based in Thailand.

Finding ramp space to offload MAC transports also presents problems at South Vietnam's overcrowded airfields. A major airbase was built in conjunction with the new port at Cam Ranh Bay, and at least 8 other fields are under construction in South Vietnam and Thailand. As they are completed, some combat units now jammed into Tan Son Nhut, Bien Hoa, and Da Nang are being shifted, and more fighter groups are programmed to move in.

With new bases available, USAF

was able to drop its former policy of rotating Tactical Air Command (TAC) fighter squadrons and instead is now moving in a full base complement with housekeeping and support personnel. This in turn is relieving the present overload on Clark Air Base in the Philippines and on bases in Okinawa and Japan which have been handling maintenance and backup spare parts for the fighter units.

In summary, the U.S. is, indeed, encountering some problems in maintaining combat forces in an underdeveloped land 10,000 miles (16,100 km) from home. But the logistics problems of the Viet Cong and its backers are infinitely greater. And while those of the U.S. and its allies are being resolved, the Viet Cong's are growing steadily worse.

U.S. aerospace power is vital to the logistics lifeline to Southeast Asia, both in delivering urgently needed supplies and equipment to U.S. forces there and in protecting the ships that carry the huge bulk of the logistics payload.

The U.S. can be thankful that it, and not the enemy, has control of the air over Southeast Asia and its approaches. There's no need to consider the consequences to U.S. shipping if the airpower situation were reversed. If that were the case, U.S. forces wouldn't be in Southeast Asia at all.

☆☆☆

Vietnam, with its jungles, few good roads, and its monsoons, offers the U.S. Army a particularly grueling test of its emerging mobility equipment and techniques. A dozen years ago, French mobile forces succumbed to the combination of forbidding terrain and relentless guerrilla harassment. The author, just back from 6 weeks with the U.S. Army in Vietnam, assesses the reasoning behind the Army's confidence that its mobility, employed with audacity and aggressiveness, can conquer both terrain and foe . . .

Battle Mobility in Vietnam

BY JOHN B. SPORE, Editor, Army Magazine
Contributing Editor, AF/SD INTERNATIONAL

A traveler seeking a foothold on the slippery terrain of military mobility must also be wary of booby-traps hidden in distortions and definitions.

The all-inclusiveness of such a question as "How mobile are armies today?" is clearly trapped with distortions. What kind of army? Fighting in what geographical environment? Against what kind of enemy?

Nor can the mobility of a modern army be judged without reference to its comrades in the air. Since Billy Mitchell defined airpower as "anything that flies," the mobility of armies has depended upon the quality and quantity of the airpower above it. This obviously includes the airpower of an independent air arm as well as such organic air as the army in question may possess. It also includes the airpower of the enemy.

Definition: Battle mobility is maneuverability, not speed. **Amplification:** Maneuverability is affected by an infinite number of variables, of the kind suggested in the preceding paragraphs.

The importance of military mobility today lies in the fact that the equilibrium of battle has been upset for more than a generation by the superiority of firepower to maneuver. Not nuclear firepower alone, but also conventional firepower. The restoration of the equilibrium is behind the search for supersonic aircraft firing even faster air-to-air and air-to-ground missiles, behind the search by land armies for greater protection of the fighting man through

more maneuverability. The day of the armored tank and personnel carrier is not over, but there are few forward-thinking soldiers today who do not see greater promise in improved maneuverability than in improved armor plate.

The terrain (military and political) of South Vietnam is slippery beyond reason, but it may be possible to get a foothold on the essentials of military mobility today by a consideration of the conflict being waged there. Military operations in South Vietnam underscore the significant impact of geographical environment and the nature of the enemy's forces. Mobility in South Vietnam has a meaning altogether different from mobility in, say, Western Europe, or the Caucasus, or on the plains of North China.

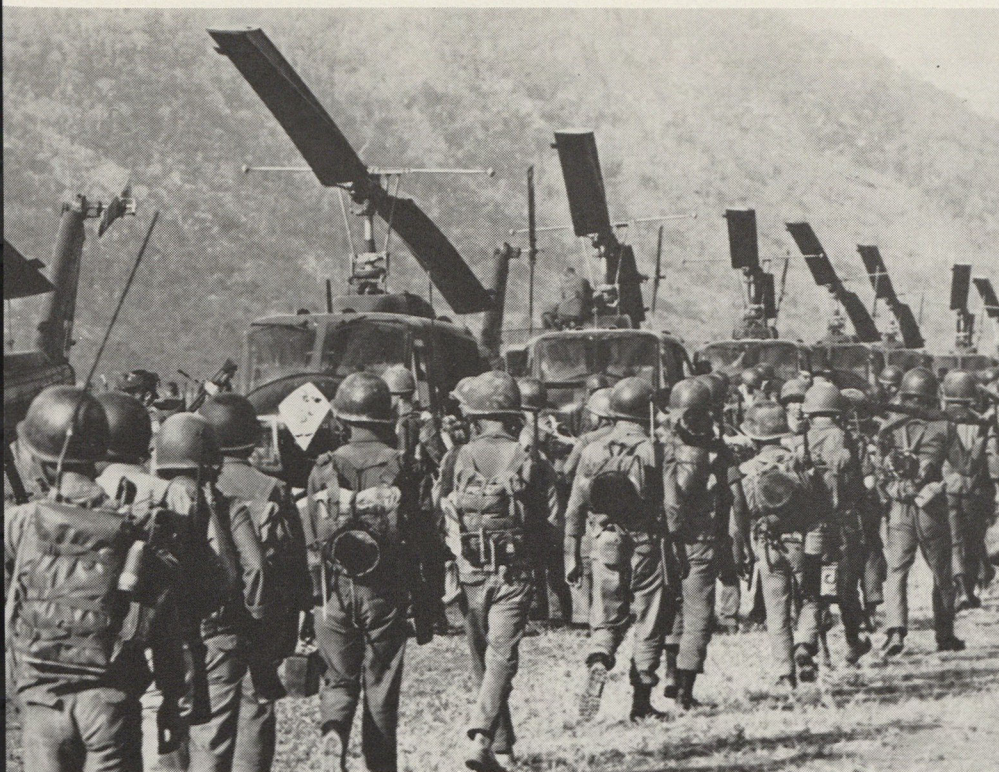
As is well known and often remarked, mobility for U.S. and South Vietnamese forces is the mobility provided by airpower. But for the Viet Cong, mobility is in the stout brown legs of its infantry. That's all it has. All of its weapons, including its heaviest—mortars and recoilless rifles—are propelled to the firing point by leg muscles. By Western standards, the Viet Cong soldier lives a life of despicable meanness. But he is not to be despised as a fighting man, and his adversaries do not do so. He is fitted to his environment. His intimate knowledge of the deep jungle, the forested hills and mountains, the flooded lowlands, intersected by canals, is the secret of his survivability

against the preponderance of firepower and the mechanized mobility of the United States and the South Vietnamese armies.

For political reasons, the United States has imposed limits on the amount of military power it has been willing to commit to Vietnam. The amount committed is more than sufficient to assure that the Viet Cong cannot win a military victory, but it is unable to guarantee that the Viet Cong will lose, and so the conclusion of the war, as with most wars once engaged, remains an enigma wrapped in a mystery.

There are 2 acceptable truisms governing over-the-ground mechanized mobility of modern armies. One is that the mobility of trucks depends upon a road system. Off-road operations are for fully tracked tanks, armored personnel carriers, and weapons. The second is that, even though the rated speed of mechanized rolling stock is many times that of a walking soldier, armies in combat move very little, if any, faster than they did in Napoleon's day. The approach to the battle area may be much faster, but once engaged the pace slows to that of the infantryman.

There are roads in Vietnam, but not many. In enemy sanctuaries, the roads belong to the Viet Cong, except for occasional forays by U.S. troops—which are becoming more common. Around the cities and in areas controlled by the government, the roads belong to the government, except that



"For the U. S. and South Vietnamese soldier, this is a helicopter war. It carries him into battle, partially provides him with a substitute for accompanying artillery, resupplies him with ammunition and food, and evacuates him when he is wounded or when the operation is over. . . ." In practice, says the author, there is little difference between tactics of airmobile 1st Cavalry Division and other Army units, for whom chopper support is also readily available.

convoys moving along them, even on the outskirts of Saigon, are open to enemy sniper and mortar attack. It is commonly heard in Vietnam that much of the countryside is under government control in the daytime and under Viet Cong control at night. The same can be said of roads. The only super-highway in the country—between Saigon and the big Bien Hoa Air Base—is safe for daylight travel, but Americans travel over it at night at some peril.

Somewhere along Highway 19, which runs from Qui Nhon on the coast to the province capital of Pleiku in the central highlands, is a stone marker commemorating the destruction of a French mobile force by the Viet Minh in the early 1950s. This event is remembered in Vietnam and cited as evidence that mechanized land power is ill-suited to a war in a land where the roadnets are few, off-road operations by mechanized forces are almost impossible, and control is uncertain, since there are no front lines and the enemy is everywhere and nowhere. Today, Highway 19 is "open" to U.S. and government convoys—at the price of constant patrolling, and with armed helicopters circling in continuous figure-8s over moving convoys, while, high above them, Forward Air Controllers of the Air Force circle in their tiny Cessna O-1 observation planes watching for targets on which to call the fury of alert fighter-bomber aircraft. It is over this road that the lifeblood of an army—food, ammunition, and petro-

leum—flows to the airmobile 1st Cavalry Division at its base at An Khe.

Government forces have used the U.S. M-113 armored personnel carrier with some success in all but mountainous and forested regions. In this role it is used, not as a personnel carrier, but as a substitute for an infantry-accompanying tank. The vehicle has been modified by adding a caliber .30 machine gun on each side and gunshields to protect the caliber .50 gunner in the turret. Some are modified

to carry 57-mm recoilless rifles and others to mount 81-mm mortars. In the delta this carrier has proven capable of crossing soaked rice paddies and canal ditches and able to swim through the deeper canals and across the rivers. The enemy's 57-mm and 75-mm recoilless rifles, rocket launchers, and 82-mm and 105-mm Chinese-made "Panzerfausts" can penetrate the armor plate of the carrier, but the enemy's lack of mobility restricts the

(Continued on following page)



M-113 armored personnel carrier is often employed in Vietnam in role of infantry-accompanying tank. It has been modified by adding more machine guns, recoilless rifles, or 81-mm mortars. Heavy Viet Cong weapons can hurt it, but are seldom encountered.

number of these weapons he can deploy. American advisers report that few of the personnel carriers are lost to enemy action and that casualties to operating personnel are low.

In infantry "search-and-destroy" operations, armored carriers of this type can lend a valuable helping hand, when the terrain is right, by either attacking the enemy force the infantry has uncovered or acting as a mobile force that can move around the flanks of the enemy and block his retreat. These are, of course, standard tactical ploys of all armies. Their interest in the specific case of Vietnam lies in the fact that the use is quite limited by geographical conditions.

Less favorable results were experienced with the U.S. Army's lightweight M-114 command and reconnaissance vehicle. This light, fully tracked vehicle carries sufficient armor for protection from shell fragments and small-arms fire. It is armed with a caliber-.50 machine gun in the cupola and a 7.62-mm machine gun protrudes from the rear. The configuration of the vehicle, specifically its low-hanging frontal armor plate, renders it inoperative in climbing steep dikes and canal banks. The machine hangs up on its protruding frontal armor.

In early March of this year, a tank battalion of the 25th Infantry Division arrived in Saigon from Hawaii. Early one morning it began a march down a Vietnamese highway to the division base at Cu Chi. With armed helicopters flying cover overhead and machine gunners on every tank watching warily for snipers, the convoy had proceeded hardly a mile when it and civilian traffic became snarled at the crossing of a small stream. There was a long delay during which the convoy might well have been attacked, but wasn't. This incident was a breakdown of traffic control, but it is also indicative of the difficulties and danger of over-the-ground travel in Vietnam. During operations in the rainy season last winter a brigade of the 1st Infantry Division, operating in the Viet Cong's "Iron Triangle" sanctuary north of Saigon, spent a great deal of time and effort helping an accompanying armored carrier unit of the Vietnamese Army get out of the mud and in protecting it from enemy ambush.

Artillery is similarly hampered. The U.S. Army today has more mobile self-propelled artillery than ever before, but its mobility is of little use in Vietnam. South Vietnamese divisions rarely move their U.S.-supplied towed artillery, using it almost entirely for the protection of its headquarters and base camps. U.S. practice is not dissimilar. The difference is that it has heavier artillery with greater range. At



Vietnamese soldiers prepare to climb aboard U.S. Air Force C-123 assault transport to be airlifted to new operating area. Troop movements are performed almost entirely by air. C-123 is workhorse of intratheater airlift, supplemented by 4-engine C-130 Hercules and CV-2A Caribou. The latter are being transferred from Army to Air Force.

all of the brigade and division bases, in addition to organic 105-mm and 155-mm howitzers, there are 8-inch (20 cm) howitzers and 175-mm rifled guns, the latter with a range of 35,000 yards (32,000 m). The guns of the 3d Brigade, 1st Infantry Division, based at Lai Khe well up in the enemy country, can almost reach the Cambodian border. In cracking the hard nut of the Iron Triangle and War Zone D, the 1st Infantry Division will not often be out of range of its emplaced artillery. The same is true of the 25th Infantry Division, encamped at Cu Chi, north and west of Saigon. This Division, with the help of 1st Division units, literally had to fight the enemy for its base camp. During the weeks the base was being developed, infantry battalions had many sharp and bitter fights within a half-hour march of the base perimeter.

By thus establishing its bases deep in enemy territory, U.S. forces are overcoming in part the limitations of environment on their mechanized mobility.

The penalty for this is in the cost of supplying the bases. Supply over roads is hazardous and subject to land mines and ambush. An essential requirement, therefore, is an airstrip for cargo aircraft at all bases.

In Vietnam, as never before in war, logistics are airborne. Isolated Special Forces camps depend entirely on air resupply. Both South Vietnamese and U.S. units on operations expect to be resupplied by air. Aeromedical evacuation is habitual. The performance of the "Dust Offs," as the Army medical evacuation helicopter teams are known, is phenomenal and largely responsible

for the high rate of recovery of the wounded and injured.

Air resupply of the smaller, and isolated, camps may be by helicopter, although airstrips sufficient for Army-flown Otter and Caribou aircraft usually exist. However, there is a limited number of these aircraft in Vietnam, and the difference is made up by USAF Fairchild Hiller C-123 Providers and the larger Lockheed C-130 Hercules turboprops. Extension of existing airstrips to accommodate the latter is going on at various bases throughout the country. This has been an additional burden placed on engineers and engineering equipment coincident with the port, base, and other construction imposed by the sudden American buildup that began last summer. If there had been a larger number of Army Caribous (or, more desirably, the new turboprop Buffalo, also made by de Havilland of Canada) in the Army's fleet of cargo aircraft, some of the airstrip extension projects could have been delayed.

(The recent announcement that all Army Caribou and Buffalo aircraft will be turned over to the USAF by the end of the year will not increase the over-all airlift capacity of the U.S. services by a single pound. It will release a certain number of U.S. Army pilots and crew members to the growing helicopter fleet. The Army is extremely short of pilots and aircraft mechanics and ground personnel. This fact could well have been immediate motivation for the decision. The Army-Air Force agreement on the transfer effectively puts the Army out of fixed-wing intratheater air transport and



U.S. Army soldiers of the 101st Airborne Division move out from the landing zone as helicopters fly in more troops during a securing operation at Deo Mang Pass in Vietnam. Lack of enemy air opposition leaves unanswered the question of whether U.S. Army could employ helicopters as it does if they were exposed to enemy fighters.

goes back to the system that existed before the formal agreement of 1953 signed by the then-Secretaries of the Army and Air Force and the amendments to that decision made by Secretary of Defense Charles Wilson in 1956. The agreement does authorize a joint or unified commander to assign control of intratheater-type cargo aircraft to subordinate field commands of the Army during specific operations.)

In the specific situation of Vietnam today the problem in intratheater airlift is in full and efficient utilization of the available fleet. Demands are heavy and insistent. Priorities and allocations are crucial. It has been suggested that an Airlift Control Center organization, similar to the Tactical Air Control Centers (TACC) that have proven so effective in conducting close-support operations, might make for greater efficiency in airlift operations. One of the pleasant developments of the Vietnamese War has been the high degree of Army-Air Force teamwork in tactical close-support operations. The efficiency of the TACC system has to be credited with a share of this success and the accomplishment suggests that a somewhat similar organization for intratheater tactical airlift could pay equally good dividends. How seriously this proposal has been considered and at how high a level is unknown.

For the U.S. and Vietnamese soldier this is a helicopter war. It carries him into battle, partially provides him with a substitute for accompanying artillery (especially during the crucial landing phase), resupplies him with ammuni-

tion and food, and evacuates him when he is wounded or when the operation is over.

He still walks. He patrols. He is helicopterborne to the site of search-and-destroy missions—and then walks. His small-unit attacks (and this is a war of platoon and company operations—a multibattalion operation is an event) are in the customary pattern of fire and movement, of rush and taking cover. Most of his casualties occur during the first minutes of a meeting engagement. His is the task of defining the shape and size and location of the enemy force. When he has done this, airpower and artillery take over, and the enemy takes his losses, usually much greater ones. This pattern has many variables as all good tactics must have, but it is indicative of the kind of war it is.

Ambush is a favorite tactic of the enemy. He uses it because of 2 advantages he has. One is his knowledge of what U.S. and Vietnamese forces are up to. The Viet Cong is part of the population, and so is all but faceless. His wife may be in a work crew employed by the U.S. He may sit impassively in a village and watch a U.S. unit march by. He ducks into the jungle, joins his unit which sets up an ambush. Later in the day he is back in his village, comparing the number of Americans who return with the number who went out in the morning.

The response to ambush is fast reaction by airpower and artillery, and the helicopter lift of reinforcements into the ambushed area. This is battle mobility.

A brigade of the 1st Infantry devised

a method for counterattacking an ambush by allocating one side of the enemy ambush to attack by airpower and the other side to artillery attack. Fire control comes from the brigade commander's command-and-control helicopter.

One ambush of an isolated battalion while on a 6-day search-and-destroy mission was defeated by this means. In the counterattack the Air Force flew 61 sorties dropping more than 30 tons (27 mt) of bombs and firing a half-million rounds of 20-mm ammunition. The artillery fired some 2,000 rounds of 105-mm, 8-inch (200 mm), and 175-mm ammunition. Two hundred enemy dead were counted on the battlefield and another estimated 300 were killed by the air and artillery. One F-100 was lost (the pilot ejected safely) and one helicopter crashed with a loss of several lives. Total friendly casualties killed or wounded were less than 30.

The airmobile 1st Cavalry Division with its 438 helicopters has established an enviable record of audacity and aggressiveness, and the concept of airmobile operations has paid off—at least in the peculiar environment of South Vietnam. It was long tested before commitment to battle, and its only outstanding departure from its test operations has been in the air movement of artillery. It has used its Chinook transports (CH-47) to airlift 105-mm howitzers into battle and its CH-54 Skycrane to lift 155-mm howitzers. The 155s are sling-loaded, but the 105s can be carried inside the copter. The advantage of carrying weapons inside is that the enemy does not see the artillery being moved to hill masses that would be impossible to reach over the ground. These pieces are towed artillery. Self-propelled artillery with its heavy transmission, powerplant, and tracks cannot be lifted by helicopter.

In actual practice there is little difference in the airmobile concepts practiced by the 1st Cavalry Division and that of other U.S. units. In the latter case, helicopters are attached to units for specific operations. There are some 1,600 or more Army helicopters in South Vietnam and most of these are assigned to the helicopter battalions of the 12th and 17th Aviation Groups. They serve not only the U.S. Army but also government forces throughout the country.

The monsoon season during this summer of 1966 will test the mobility of the Army in Vietnam to the fullest. It is during this period that airpower, including helicopters, are often grounded by inclement weather and low ceilings. The heavy rains make ground travel of heavy equipment nearly impossible. The Viet Cong, un-

(Continued on following page)



Modern method of moving artillery pieces is demonstrated by this Boeing Vertol CH-47 Chinook of 1st Cavalry Division as it lifts 105-mm howitzer to new location. Helicopters can readily concentrate firepower, even on hilltops inaccessible by road, to smash an enemy concentration, and disperse it again as soon as the action is over.

inhibited by weight of materiel and lacking airpower, customarily go on the offensive during the monsoon seasons. The U.S. Army believes it is in position to meet these attacks, even without the valuable support of tactical airpower. This is one reason it has moved so much heavy artillery into the country. The tanks of the 25th Infantry Division—and it is the only U.S. unit in South Vietnam with armor—may be less than fully mobile, but their firepower will be a welcome addition to the defensive and offensive fire support of the division.

The situation in Vietnam is unique in that the enemy does not have any airpower. Therefore, an unanswered and unanswerable question is whether helicopters, as they are now being used by all U.S. units, could be so used if the enemy had air. The Army believes they can, if the U.S. Air Force is able to achieve air superiority over the enemy. It points out that it has a potent air-defense weapon in its Hawk missile batteries and in individual air-defense weapons, such as the Redeye shoulder-fired missile weapon now in development. The Army acknowledges that its helicopter fleet would sustain some losses from enemy aircraft that managed to penetrate such defenses, but believes these will be so few in number that they could be absorbed easily. The full testing of the Army's airmobile concepts against an enemy with a sophisticated air capability will have to await a battlefield other than the one in Vietnam.

Another battlefield would presumably be one in which the Army's rolling stock would be operable under favorable or at least typical conditions. This means that armored and mechanized forces would play a dominate role. For this purpose, the Army over the last several years has come up with a variety of self-propelled

wheeled and tracked vehicles and weapons (see page 36).

Among the latter are the M-60 tanks, which will remain standard until the new U.S.-West German Main Battle Tank of the 1970s comes off production lines. Armored personnel carriers with new models having firing ports which will permit the occupants to fight as well as ride are expected to play an important role. Self-propelled artillery from 105-mm to 175-mm are in the inventory. It will depend upon the U.S. Air Force for protection from enemy air attacks, although it has developments under way for local air defense.

It has several new antitank weapons on the way.

The tracked Sheridan reconnaissance and antitank vehicle mounts a 152-mm gun-launcher. This weapon can either fire a conventional antitank or antipersonnel round or a heat-seeking antitank missile. Another antitank weapon in the Army's developing inventory is the ENTAC guided missile which will replace the SS-10. Both are made by France's Nord Aviation. The ENTAC is a wire-guided missile firing a solid propellant. The somewhat similar TOW antitank missile, developed by Hughes Aircraft Company, is a lighter weapon. It is optically tracked in flight and commands are automatically relayed to it by wire.

The MAW (medium antitank missile) is being developed by McDonnell Aircraft Corp. It will be a 1-man weapon. The operator aims through a telescopic sight and commands are automatically relayed during flight. It will hit what the gunner sees in the crosshairs of the telescope.

Airmobile forces with their own armed helicopters will move along the flanks of these armored armies and plunge forward to secure critical terrain features, such as river crossings, in surprise attacks.

Over the ground, logistic support for these mechanized armies will use articulated wheeled vehicles that will not be dependent upon a hard roadway to move. Also, air-resupply of ammunition for the voracious appetites of fast-firing artillery, of food for hungry soldiers, and of fuel for thirsty diesels will be standardized.

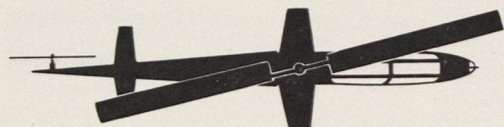
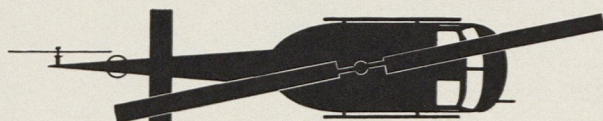
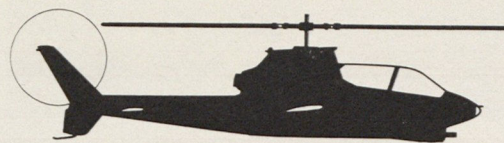
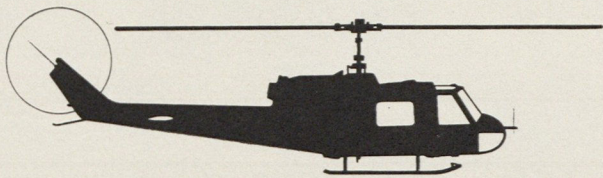
Theoretically and probably practically the U.S. Army has an incomparable cutting edge and great potential mobility on an open battlefield. But there are unanswered questions.

One is the effect on its mobility of a powerful modern enemy air force. If such a force could penetrate the air defenses provided by the USAF and ground-based air defenses, the land mobility of the Army's weapons might quickly become a minus factor.

A second consideration is derivative of the Vietnamese experience (but also goes back to the second World War). This is the enemy's use of mines. Both the Germans and Russians used a great many mines in the second World War, and it can be assumed that the possibilities of stopping an attacking force through the use of millions of mines has occurred to the Soviets and the Chinese. Mines are, of course, essentially a defensive weapon, and the use of mines by the NATO allies could be of great importance in turning back a land attack against Western Europe.

The recent reports from London that the U.S. may have proposed the use of nuclear mining to stop a possible Soviet attack of Western Europe (see AF/SD INTERNATIONAL, February 1965) poses another slippery problem for the mobile minded.

Indeed, the whole terrain of mobility is slippery. Whether mobility has or can catch up with firepower is a subject of consuming professional interest and international concern. ☆☆☆



BEFORE

AFTER

(Put a Huey on a diet and it turns into a lethal snake. A HueyCobra.)

There's nothing *wrong* with the Huey's figure.

In fact, when it's an armed troop carrier you want, there's nothing *like* the proven, dependable UH-1B Huey.

But Bell's engineers figured if they slimmed it a bit here, trimmed it a bit there, the result would be a lean, mean *weapons* carrier with dynamite in its strike.

And they were right.

Compared with its chubbier forbearer, the HueyCobra will deliver twice the firepower, protect its crew better, and operate in the target area three times as long.

Plus going like Gangbusters. For which we can take at least part of the credit since we make the HueyCobra's T53 gas turbine engine.

The T53 is one thing Bell *didn't* change when they sweated-down the UH-1B to pure brawn and brawl. Be-

cause the T53 *is* the brawn. Fourteen-hundred shaft horsepower. Tough. (A T53-powered 'bird in Vietnam recently completed its mission and returned safely to base with a V.C. bullet-hole in its engine big enough to shove a horse chestnut through.)

And the T53 is *proven*. By more than 2,000,000 operational hours, many in Vietnam, where Avco Lycoming gas turbines power 9-out-of-10 helicopters. And by capturing 21 out of Uncle Sam's 35 world's helicopter records. For speed, rate-of-climb and altitude.

What more could Bell ask for?

Plenty. For a starter, more T53s.



LYCOMING DIVISION
STRATFORD, CONN.



THE AIR WAR IN VIETNAM

From the six-cylinder Bird Dog to the eight-engine Stratofort, from the 365-mph Skyraider to the Mach 2.5 Phantom II, the war in Vietnam is putting every piece of aerial equipment in the United States inventory through a grim test.

Improvisation and modification is the rule of the day. The Gooney Bird of World War II, now armed with three Miniguns firing 6,000 rounds per minute, is found re-enlisted under the name of Puff the Magic Dragon. The largest U. S. strategic bomber, re-equipped with conventional bomb racks, is now used effectively against guerrilla forces.

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FOR SPACE RESERVATIONS
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NEW YORK—CHICAGO—LOS ANGELES—SAN FRANCISCO

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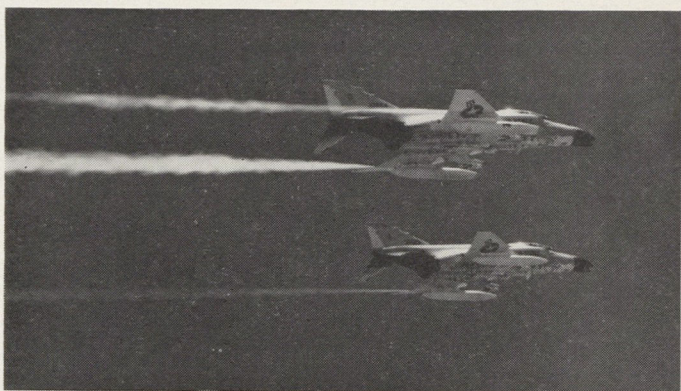
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LONDON — PARIS — FRANKFURT — BRUSSELS

Air Force / Space Digest International • June 1966

A "logical division," giving rotor craft to the Army and fixed-wing aircraft to USAF, was suggested by Secretary of the Air Force Harold Brown in an address at the Air Force Association's recent convention. Two weeks later, Chiefs of Staff of the Army and Air Force agreed to assign responsibility for the control and employment of rotary craft to the Army and all fixed-wing aircraft performing supply or troop-lift functions to the Air Force. Secretary Brown also discussed progress in airlift, the development of VTOL capabilities, and a balanced fighter force made up of aircraft, each designed to do one mission extremely well . . .

Strategic and Tactical Airlift— A Deterrent to Limited War

BY DR. HAROLD BROWN
Secretary of the U.S. Air Force

The U.S. Army and U.S. Air Force have agreed to a new delineation of responsibility for the control and employment of tactical airlift planes and helicopters. The Army, in effect, will be confined to rotary wings. The Air Force will operate all fixed-wing aircraft performing supply, resupply, or troop-lift functions. When necessary, these USAF vehicles will be attached directly to Army echelons in the field.

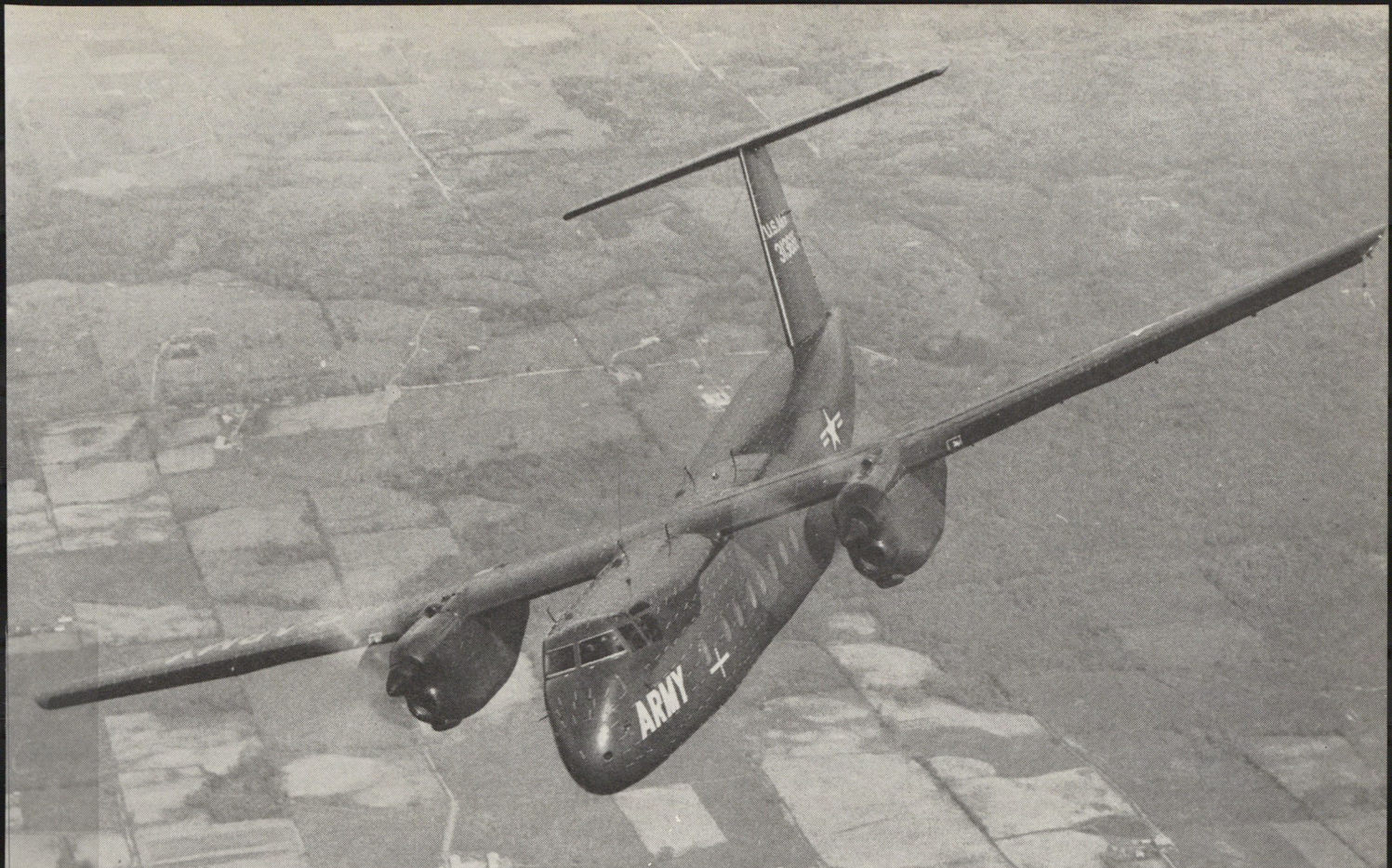
Under the joint decision, made by the Chiefs of Staff of the two services, the Army will turn over all its CV-2 Caribou and CV-7 Buffalo aircraft to USAF. This involves 146 planes. Other type fixed-wing aircraft are not affected. No personnel or bases will be transferred.

The Army is given complete responsibility for all rotary-wing support for intratheater movements, fire support, supply, and resupply. USAF's only helicopters will be those needed for Special Air Warfare and Search and Rescue.

First public disclosure that such an agreement was under consideration was made at the Air Force Association's Twentieth Anniversary Convention in Dallas, Texas, on March 25. This was less than 2 weeks before USAF's General J. P. McConnell and the Army's General Harold K. Johnson signed their agreement. The proposal and the reasoning behind it were discussed for the AFA delegates by Harold Brown, the civilian Secretary of the Air Force. Here is the portion of his speech in which he anticipated the new USAF-Army alignment.—THE EDITORS

In the area of airlift [the U.S. Air Force has] made tremendous progress in the past 5 years. Since 1961, our airlift capacity has more than doubled as we have introduced the Boeing C-135 Stratotanker, Lockheed C-130E Hercules, and Lockheed C-141 Star-Lifter into the Military Airlift Command. Our present capability will again double by 1970, and almost quadruple by 1972 when the Lockheed C-5A will be operational. The bulk of this expansion is in strategic airlift, which, through rapid worldwide deployment and support capability, multiplies the effectiveness of our ground and air forces.

The next step—one on which we are working hard—involves the extension of our air line of communications (ALOC) from the continental U.S. all the way into the battle area. We have 2 interrelated objectives in refining the air line of communications. First, we want to interface—or join—strategic and intratheater airlift delivery as far forward as it is feasible to operate our heavy transports. Next, we want to reduce the number of intratheater trans-



U.S. Army's CV-7A STOL (short-takeoff-and-landing) transport will be transferred to Air Force inventory as a result of the decision to shift all Army fixed-wing aircraft to the Air Force. The CV-7A Buffalo flies at 232 knots, lands in less than 1,000 feet (304 m) over a 50-foot (15 m) barrier, and carries a 4-ton (3.6 mt) payload. Army retains helicopters for front-line mobility and support.

shipments to a minimum for rapidity of service and economy of manpower and equipment. Ideally, we want our assault transports to airlift cargo right up to the combat area.

In some situations, final delivery of men and materiel will have to be made by Army organic transport—land or rotary-wing aircraft. The break point between Air Force and Army lift is falling very close to the battlefield. This points toward a logical division of intratheater airlift, with rotary-wing craft organic to the Army, and the Air Force managing all other airlift aircraft (fixed-wing aircraft and those with vertical-takeoff-and-landing capability).

A true VTOL (vertical-takeoff-and-landing) capability would allow us to deliver cargo to ground-force front-line positions. Theoretically, then, VTOL aircraft, which would not have the inherent disadvantages of rotary-wing vehicles, would appear to be an optimum objective. However, for some years to come, the cost penalty in both payload and system complexity will probably continue to keep the VTOL aircraft in a poor competitive position compared with short-takeoff-and-landing (STOL) types.

Also, worldwide helicopter experience shows that absolute vertical takeoff and landing is used—even

when available—for only a small fraction of total missions. Our next generation of assault transport is likely to be a STOL aircraft with payload in the Fairchild Hiller C-123 Provider range, perhaps with a VTOL capability at half that payload. Its size depends to some degree on what the C-130 may be followed by—perhaps another aircraft with VTOL capability and the C-130 payload, perhaps with a VTOL capability of half that size.

The cost differential associated with vertical takeoff will tend to come down, however. Eventually we will have a V/STOL capability in our airlift forces, probably followed by an advanced reconnaissance and observation V/STOL and still later by a V/STOL close-support aircraft.

As our air line of communications is further developed and refined, it will have a significant effect on our logistics systems, and I mean that of the Army even more than the Air Force. In fact, rapid air transportation and cargo handling, in combination with increasingly sophisticated automatic data-processing equipment, will change the entire scope of logistic support over the next decade. The trend is already clear. There is no question that as we continue to improve and speed up our computation of requirements

and processing of demands, we will be able to drastically reduce prestockage points, inventory levels, and pipeline times.

Refinement of our tactical air-strike and airlift capabilities may provide a deterrent to limited war in much the same way that strategic superiority has deterred general nuclear war.

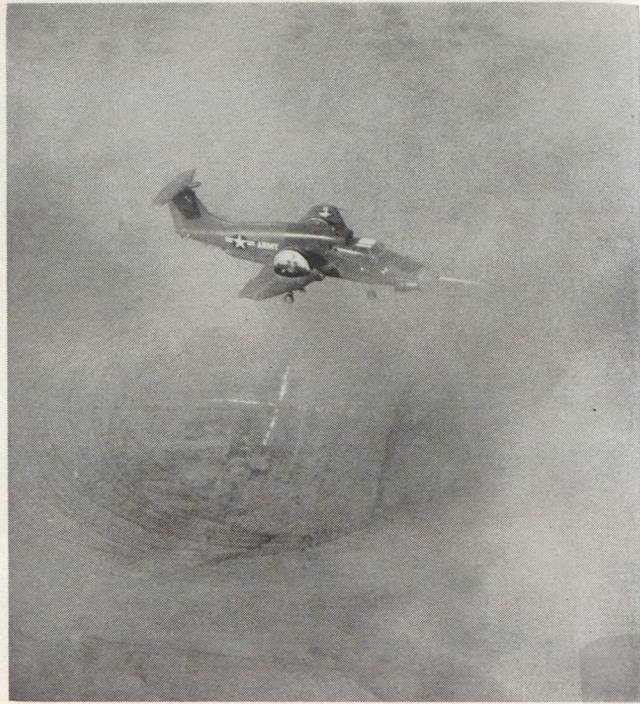
What characteristics will be required in tactical air forces if they are to be a truly effective instrument for limited-war deterrence?

First is the ability to win the tactical air battle under the most difficult circumstances and against the most sophisticated enemy. It is against the most capable enemy that we stand to gain or lose the most, and the quickest. We must not forget that, even in primitive areas of the world, external enemy air assistance could be expanded rapidly. And we must remember that tactical air superiority has a cumulative effect. Not only do we gain the opportunity to use fully our tactical air capabilities; we keep the enemy from effectively using his against us, and against our surface forces or those of allies.

For these reasons we must build for the future a balanced fighter force. This should include a family of aircraft, (Continued on following page)



Possibility of rescuing downed pilot by lowering cable from hovering V/STOL aircraft is demonstrated by XV-5A, shown here winching in a 235-pound (106 kg) dummy. XV-5A, built by Ryan Aeronautical Company, employs General Electric lift-fan design.



In this descent upon unprepared desert surface, XV-5A's lift-fans blow sand away from beneath plane, affording pilot clear view of landing site. Although XV-5A has performed well in tests, Secretary Brown sees no practical use for it at present.

each designed to do one mission extremely well—counterair, close support, interdiction, or reconnaissance—and one or more others creditably well. A most important member of this family should be a fighter which will defeat the best enemy aircraft in air-to-air combat.

The avionics for our tactical aircraft is particularly important. While our present equipment is good, it is primitive compared to what it will be in the future. If we do the job right, future reliability and capability will increase markedly. For example, innovations in microelectronics promise dramatic increases in circuit reliability, which will be passed along as improved combat capability.

For the close-support, reconnaissance, and interdiction missions of tactical airpower, we need very accurate navigation—an internal capability to position an aircraft within a stone's throw of desired coordinates. I mean that literally, although we may have to accept slingshot ranges for a few more years. We must improve greatly our ability to spot and destroy targets at night and in bad weather. Finding the enemy has always been a major problem in warfare; we have the basic knowledge now to develop better ways. We intend to do just that.

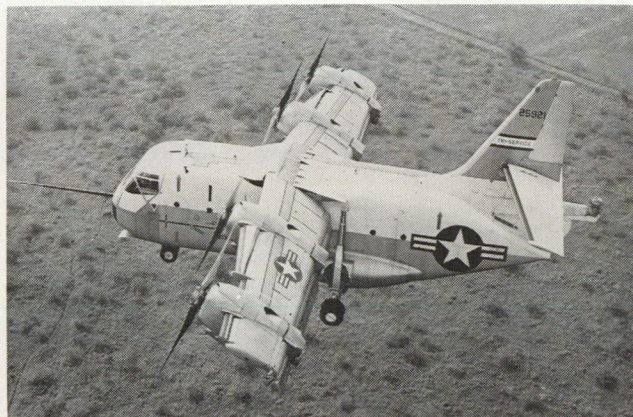
The savings which can be made by accurate delivery of ordnance is phenomenal. We want to be able to hit the target, on the nose, not just miss

it by a little. When we have achieved that degree of accuracy, a single sortie will accomplish a job which now may require many sorties, each one risking irreplaceable lives and valuable resources. In limited war or operations against insurgents, where avoiding civilian casualties is most important, further advantages of such improved accuracy are apparent.

I believe we can eventually get our accuracy down to the point where we can, with great confidence, expect to hit the target on the first pass—if our reconnaissance and target-acquisition capabilities become good enough to tell us where the target is. However, a more immediate goal will be to pro-

vide accurate enough navigation to put the pilot of a modern jet fighter where he can better acquire the target with present equipment, including the human eyeball.

In all of our planning for the future, there is one thing we must never forget. The best-laid plans sometimes are negated by enemy countermoves. Our thinking about problems of the future has to be both imaginative and flexible. This makes technology particularly important. We have to stay ahead in the scientific/technological race. But unless the technology is applied by designers who know what the user's criteria of effectiveness are, it is likely to be wasted. ☆☆☆



First application of V/STOL capability in operational aircraft is likely to be in transports, Dr. Brown suggests. USAF recently awarded configuration study contract to Ling-Temco-Vought for potential production version of its XC-142 V/STOL transport shown here.

FROM THE LARGEST PRODUCER OF TACTICAL WHEELED VEHICLES



M44 SERIES
2½ TON 6 x 6 TRUCK



M39 SERIES
5 TON 6 x 6 TRUCK

KAISER Jeep CORPORATION

That shouldn't come as any surprise. When it comes to off-the-road mobility from multi-wheel drive, no other manufacturer has had our experience.

Our know-how in this field goes back to the original military 'Jeep' vehicle of World War II. And our present ability to build incredibly rugged vehicles that stand up to almost any kind of terrain—like the 2½-ton and 5-ton 6x6 trucks shown here—has been proved and improved since then.

The production know-how and experience of KAISER Jeep CORPORATION are a major asset to the Armed Forces of the entire free world.

To keep up with military requirements, we recently acquired substantial truck facilities in South Bend, Indiana. Now we're better equipped than ever to continue serving the Armed Forces.

KAISER Jeep CORPORATION TOLEDO, OHIO 43601

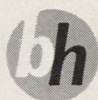


**Design Concept from Bell R&D
...Based on a
Practical V/STOL System**

Copter Versatility with Transport Speed

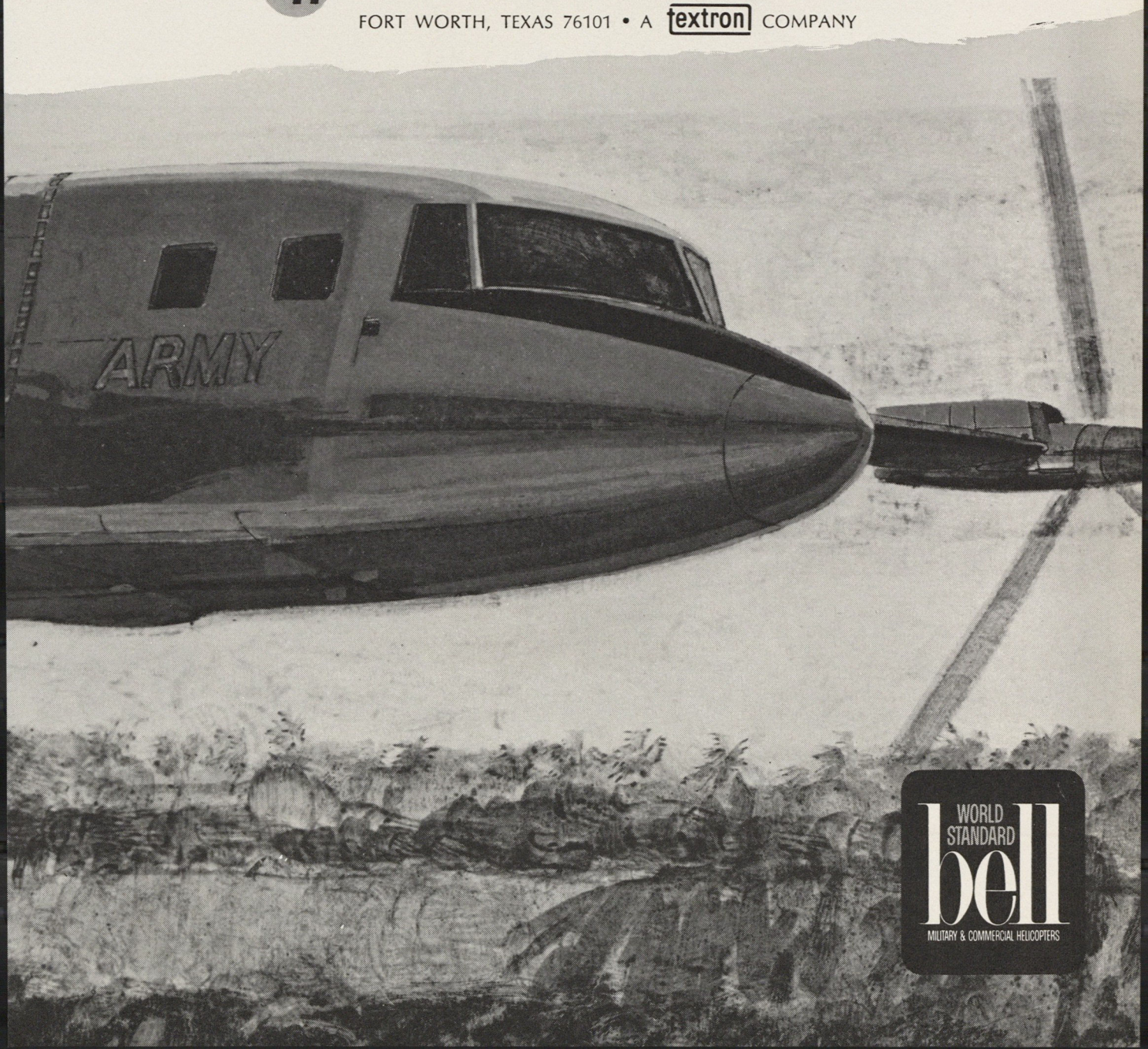
The proven Bell fixed-wing/tilt-proprotor design concept ... in combination with modern gas turbine powerplants ... is a low-risk technical approach to a proposed air vehicle which best blends the characteristics of the helicopter and the airplane. ■ The concept, currently under further study on Army contract, was pioneered in the Bell XV-3 research vehicle. ■ Delivered in 1958, government testing of this aircraft demonstrated the operational practicality of the fixed-wing/proprotor concept with safety and reliability comparable to helicopters.

Normal flight maneuvers were performed throughout the range of conversion angles from 0 to 90 degrees. Full deflection aileron rolls, steep turns and stall maneuvers were accomplished. Power-off reconversions and autorotational landings were safely performed. High propulsive efficiency, high lift/drag ratio, low disc loading and low empty weight have been designed to provide maximum cost effectiveness. ■ Such creative R & D helps Bell to advance the art to insure practical designs for the future.



BELL HELICOPTER

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The Martin Company's Orlando Division in Florida has opened a new special facility designed to simulate precisely flight, guidance, and control parameters for new missile systems. It is expected to cut drastically the development time for tactical-missile guidance systems and be a big step forward in the race to produce new weapons before they can be made obsolete by new countermeasures . . .

The Guidance Development Center— Keeping Ahead of Obsolescence

BY EDGAR ULSAMER

Special Correspondent

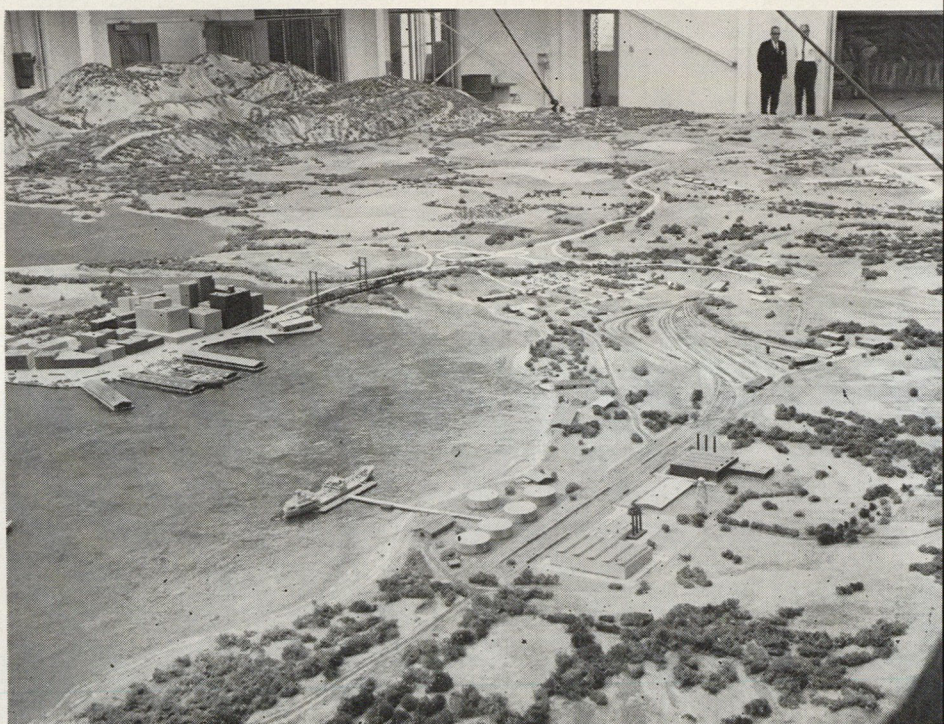
The Martin Company's Orlando Division in Florida has put into operation a novel and imaginative facility to speed up the development of and to improve air-to-ground and ground-to-ground missiles employing electrooptical or electromagnetic target-seeking devices.

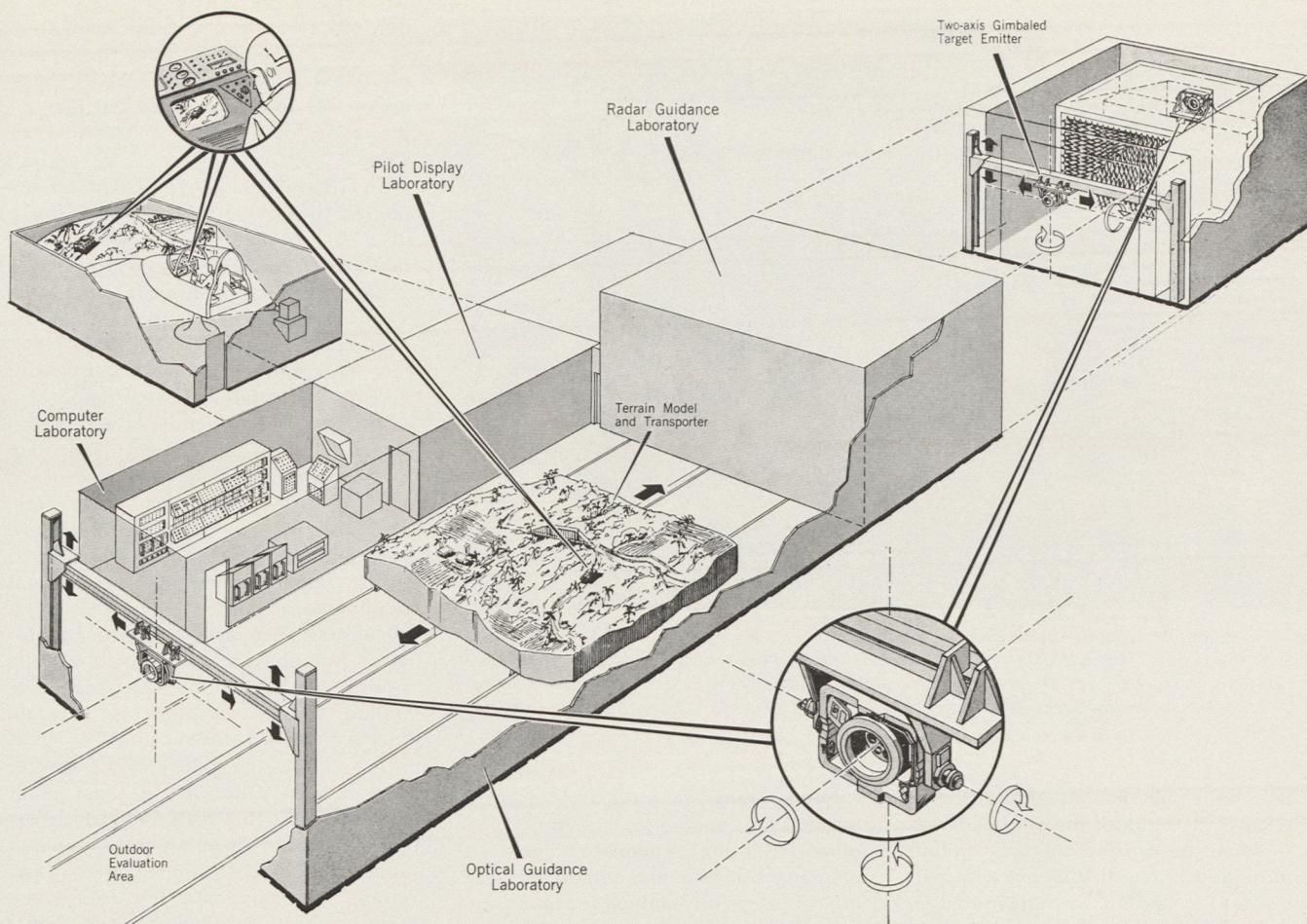
The \$2,000,000 Guidance Development Center, which was almost 3 years in the making, is capable of simulating precise flight conditions and allowing evaluation of the guidance-and-control factors of a system much more easily and more accurately than by actual test flight. Typical of the enthusiasm

with which Martin's missile designers greet the new facility was this remark by the Executive Director of Technical Operations John P. Butterfield: "As far as we are concerned, the Guidance Development Center is to the missile what the wind tunnel is to the aircraft."

Another Martin executive predicted

Heart of the optical portion of Martin-Orlando's novel Guidance Development Center is a composite and scaled terrain model—40 by 40 feet (12 by 12 m) in size, and equivalent to 20 square miles (52 km²) of a wide variety of topographical features. The scaled terrain model can be moved laterally as well as tilted, furnishing, in conjunction with the movable sensors, 6 degrees of freedom. The terrain depicted includes targets in Vietnam.





The Martin Company's Guidance Development Center in Orlando, Florida, furnishes tactical missile flight-test capability in a fully controlled laboratory environment. The key elements of the facility are separate laboratories to simulate optical as well as radar guidance. Both operations are controlled and programmed by an analog computer system, which simulates the aerodynamics of the missile airframe, trajectory, and control systems for either homing mode. Conditions that can be simulated within the optical area are displacement, velocity, acceleration, range closure, altitude, target and background terrain, angular displacement and rate, aspect angle, secondary perturbation rates, and light levels. Targets moving within the background terrain can also be simulated. Conditions simulated within the radiation area include displacement, velocity, acceleration, range closure, altitude, target radiation, target scan, angular displacement and rate, aspect angle, and secondary flight perturbation rates. It is also possible to simulate multiple radiating targets with a variable separation. The optical and radiation facilities simulate on a direct scale of 300:1 up to 3000:1 providing for mission ranges of up to 40 miles (64 km) and speed of up to 3,000 mph (4,830 km/hr). A pilot display tests man's role in the system.

that the Guidance Development Center would usher in a new era of unprecedented precision and higher efficiency in American missiles.

Martin's corporate president, W. B. Bergen, said that the new facility was "particularly timely in light of the current Vietnam experience," adding that it would result in better guidance of tactical missiles of all sorts, including those intended for air attack at short range.

The opening of Martin's Guidance Center has significance beyond responding to the missile requirements flowing out of the war in Southeast Asia—which point strongly toward air-to-ground missiles. It is no accident that it coincides with the final selection phase of SRAM (Short Range and Attack Missile), a \$170,000,000 project of great prestige value.

Martin's chances in this competition may well be enhanced by the capa-

bilities of the Guidance Development Center. Further, the usefulness of the facility to the television-controlled Walleye glide-bomb project, which the Martin Company won just recently from the U.S. Navy and which, according to company spokesmen, is being considered for deployment by the U.S. Air Force, is obvious.

Martin executives underscore the importance of their new facility by citing 3 practical facets of the potential and the design of tactical missions.

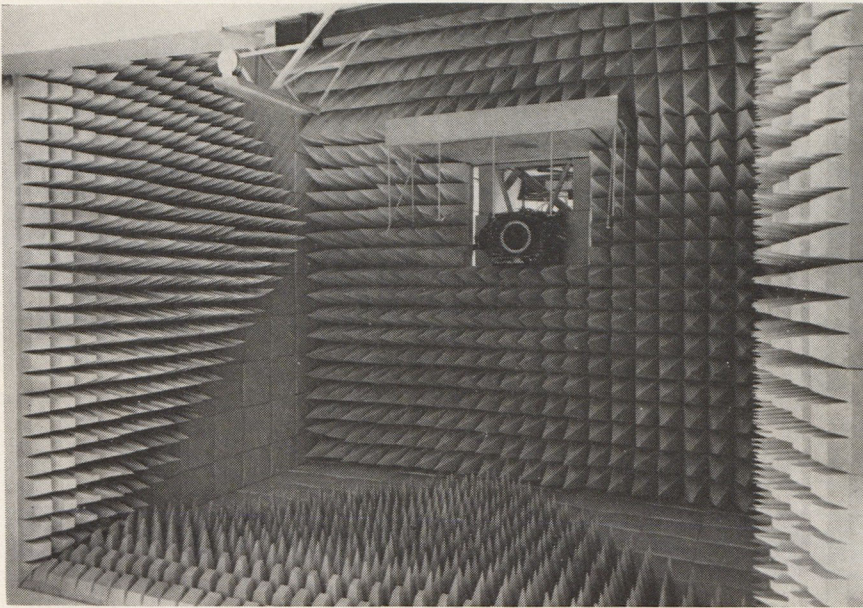
Quoting a Vietnam report by J. S. Butz, Jr., in the April issue of "Air Force/Space Digest" on a typical daily requirement of 360 sorties by U.S. aircraft to interdict 30 choke points in the North Vietnamese roadnet, Mr. Butterfield projected revolutionary gains through the use of advanced tactical missiles:

"The number of bombs required, per day, figures out to be 2,160 to hit the

30 choke points. If the bombs could have been delivered where they could be most effective, it would have required no more than 30 sorties to knock out the 30 choke points, rather than the 360 or so which are reportedly actually flown. As a matter of fact, if each plane could drop half its load on each of 2 targets, the sorties could be reduced to 15. The effect of this sort of change on aircraft attrition and the need of aircraft carriers and air bases is obvious."

What is needed in the opinion of the Martin Company are "air-delivered tactical weapons of pinpoint delivery accuracy." Tracing efforts in this direction to Bullpup, a radio-controlled, aircraft-launched missile, which entered the original development phase in 1953 and first became operational in 1959, Mr. Butterfield stressed the protracted lead-time requirement inherent in tactical weapons.

(Continued on following page)



Missile guidance systems that home on radar signals can be tested in the anechoic chamber at the center. Housed in a facility which is electromagnetically shielded, it features radio-wave absorbers which soak up and reflect radio energy, and a radar transmitter—a target for radar-seeking systems. Targets and seeker are on movable platforms.

tical missile systems. He added that in the case of Bullpup, the warhead was too small to do the job of roadnet interdiction in North Vietnam and that, therefore, it had to be redesigned in 1964 and was first deployed successfully in 1965.

So the actual time required to produce this missile, from drawing board to truly combat-effective configuration, amounted to 12 years, a period during which, according to Butterfield, "the enemy had not been idle" in preparing countermeasures. Further, he said, this type of system has a serious built-in drawback insofar as the pilot who steers it must also follow it and thereby is exposed to enemy fire for prolonged periods.

Launch-and-leave missiles, which home optically on a given target, represent the current generation of tactical missiles, but are affected by lead-time requirements longer than the less-sophisticated radio-controlled systems, he said. Meanwhile, in the opinion of the Martin Company executive, opportunities for the design of radically novel and desperately needed all-weather launch-and-leave missiles go begging because under the "present circumstances we can evaluate so few systems that we are apt to overlook the best."

From the financial point of view, the new facility should pay for itself in short order, company officials predict. They point out that in "terms of dollars, the guidance system makes up half the value of a missile." In development costs, the guidance components may even exceed this ratio.

Finally, they claim the *bête noire* of the missile builder is "dead-end engineering"—the complete cycle of planning, building, and component testing of a given tactical missile until final prototype testing establishes that the basic guidance parameters are inadequate and the entire missile has to be redesigned from the ground up. This waste of funds, men, materials, and time should be curtailed sharply or even eliminated by the new guidance development installation, Martin Company officials claim.

Here is how the Martin Company's Guidance Development Center is expected to function and why it should even exceed flight testing as a means of accurately determining the relative merits of a given missile system under test:

To date, designing and developing a missile meant spending an inordinate amount of time, money, and engineering talent on flight testing the equipment in the field. It meant the use of expensive aircraft, time lost waiting for the right kind of weather, the right kind of equipment, and, not infrequently, the entire effort was for nothing if the data acquisition system failed to function during the fleeting moment of test. In addition, of course, there was the expenditure of the missile and guidance unit during the free-flight phase of the test.

The answer, obviously, is to do as much of the flight-test phase as possible in the laboratory.

Accuracy is a big problem. Using a scale system for simulation of distance, velocity, and acceleration means

that any small errors in the simulation system are multiplied many times, and represent large actual errors. If these errors are too large, then the test information obtained is misleading or useless.

The Martin Guidance Center is expected to provide the answer to many of these problems. A realistic reproduction of a varied terrain provides a scale model of a 20-square-mile (32 km²) target area. This model, driven by a computer, moves on tracks to simulate the approach of the aircraft and/or missile to the target in real time.

The guidance system being tested is mounted in a transport that can move horizontally and vertically and is also gimballed to provide roll, pitch, and yaw motion. These motions are very accurately scaled on a real-time basis. This combination of movement duplicates accurately any motion that an aircraft or missile would encounter in an actual flight. In effect, then, the vehicle can "fly" in the laboratory, controlled by the computer to simulate true flight characteristics.

A separate laboratory in the Center also makes it possible to test guidance systems that home on radar. This lab, located in a completely shielded anechoic chamber (or radiation dark-room), can duplicate the free-space environment of a missile in actual flight.

A complete analog computer is a vital part of the Center. The computer controls the various movements involved to simulate all the effects operating on the aircraft and missile: guidance controls, propulsion, aerodynamics, etc.

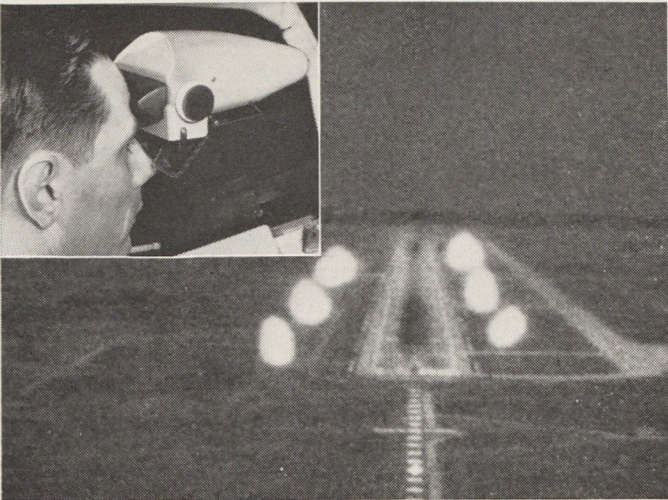
Test missions can be flown from a pilot display room where actual cockpit controls are used to guide the aircraft to the target area and "launch" the missile under test.

Closed-circuit television provides the operator with an over-all picture of the target area, as well as a television display showing the target as seen by the guiding sensor. The operator can then follow the missile on in to visual impact. Automatic plotting machines provide permanent performance records for evaluation.

The Martin Company sees as the prime incentive for the new facility the fact that "the time of weapon development has become so long that there is an increasing likelihood that a new weapon will be obsolete by the time it first reaches the field. The enemy simply cannot be depended upon to stand still while we develop the weapons to meet his current threat," a spokesman said.

The new facility should go a long way toward meeting this challenge.

☆☆☆



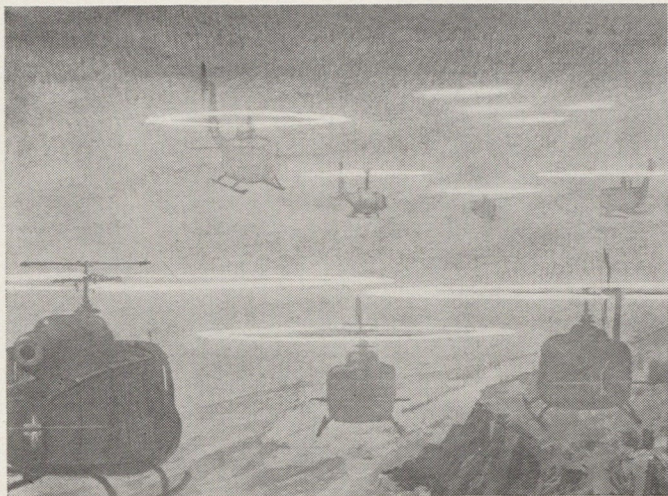
Zero-visibility landings. Microvision's "heads-up" cockpit display defines a fog-bound commercial runway or blacked-out military landing strip. The pilot sees the radar "lights" directly in his field of view (see insert).

See...



Pathfinding. Unfamiliar routes or corridors safe from ground fire can be defined for planes overhead by means of microsecond interrogation which triggers microvision transmitters set up along the way.

see...



Formation flying. Pilot "sees" other aircraft by means of radar beacons mounted on the blades of other helicopters in the formation.

see...



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Bendix International Operations



The U.S. commitment in Vietnam has placed new demands on the mobility of ground units. Although airpower has done much to meet these demands, over-the-ground, mechanized mobility is still essential to winning battles and keeping ground troops supplied. In a country where there are very few roads, and in a war where there is no such thing as being safely "behind the lines"—where truck convoys are under constant danger of ambush—maintaining the mobility of trucks requires all the initiative and skill that a field officer can muster. Here, from a U.S. Marine Corps officer in the field, are some ideas on how to maintain closer rapport between the infantry and motor transport personnel that can help reduce the ambush hazard of . . .

Tactical Motor Transport

BY FIRST LIEUTENANT ROBERT M. McCOLLOM, USMC

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The modern concept of warfare places increasing emphasis on a fighting unit's mobility. Infantry units have always had to bear the brunt of the fighting, whereas motor transport units have always been concerned with the moving of supplies, equipment, and personnel.

The distinction between these duties, however, is not as hard and fast as it may appear. Guerrilla warfare is predominant in many areas of the world. We can no longer expect to have our support areas completely devoid of enemy. Plans to move troops and supplies within our own front lines are inhibited. This is true in conventional warfare where we can still expect some guerrilla-type activity, and when opposing a foe employing guerrilla tactics exclusively. Actions in Vietnam have pointed out that motorized troop movements will not be left out of the fight. There now exists a great need for more coordination between infantry and motor transport units.

Control

Control presents a problem in tactical motor movements when the motor transport support comes from an attached or a supporting unit. The leader of the truck unit feels that, since the movement is being made in his ve-

hicles, he should be in command. The commander of the troops being transported, however, feels that, since it is his troops that are being hauled, he should command the movement.

I have observed tactical convoys in which no one really knew who was in command of the movement. These resulted in convoys departing behind schedule. It led to chaos at subsequent ambushes by aggressor forces.

Who does have command? The rule for the U.S. Marine Corps states that, regardless of rank, the commander of combat troops will be in command of tactical motor movement. The commander of the supporting transportation unit acts as subordinate commander and as the technical transportation adviser to the tactical commander. This rule satisfies the requirements for unity of command. But does this method of control give us the flexibility needed for all types of tactical motor movements?

There will be cases where infantry units are called upon to furnish protection to convoys that are moving supplies. Since the primary mission of this type of convoy is to haul cargo rather than to tactically displace troops, and the infantry is acting as the supporting unit, shouldn't the over-all command rest with the commander of the transportation unit? I believe that a rule is needed which gives com-

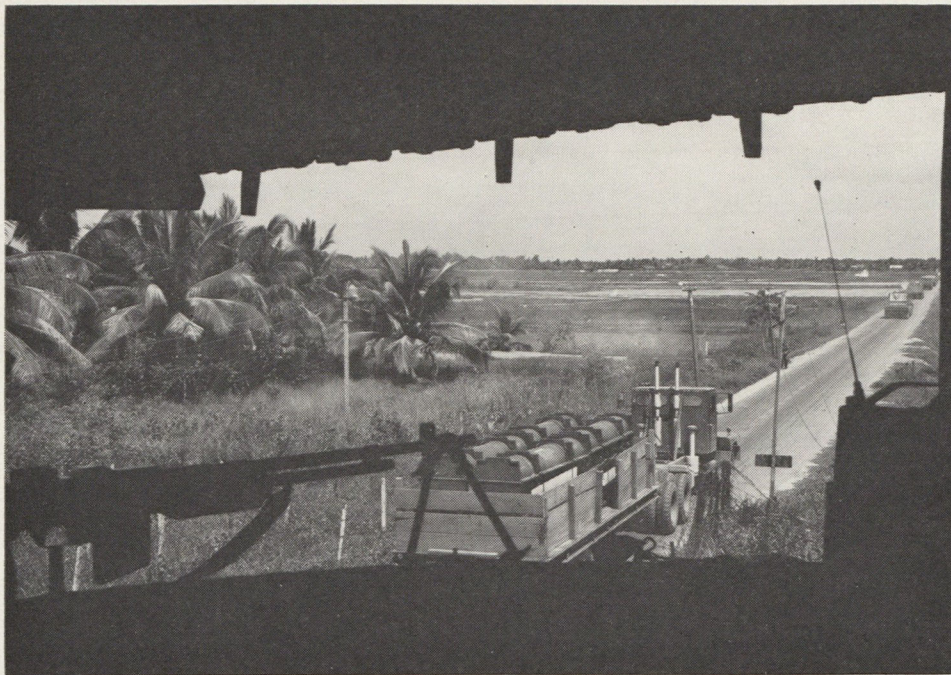
mand to the senior member of the supported unit. This would still allow maintenance of unity of command. It would also eliminate all questions concerning command of tactical motor movements.

Planning

Having presented a recommendation in regard to command, I will address myself to planning. There are several steps which should be taken to increase the chances of successful accomplishment of the mission.

If the route to be traveled by a convoy is not prescribed by higher authority, the commander of troops and the transportation commander plan their route. Generally speaking, time and the situation will not allow a physical reconnaissance. Valuable map information used in planning foot movements can be equally useful when applied to motor movements. Certain points along the route (sharp curves and high ground) can be picked out as likely areas for an enemy ambush. Maps will show bridges and culverts which could be mined. A thorough map reconnaissance will allow the commander of the movement to plan security steps for these areas.

Communication is vital to a tactical convoy. Unless complete radio silence is in effect, radios should be evenly



Truck convoy rolls past a guard post between Cat Lai and Bien Hoa, South Vietnam. Many precautions are taken to protect the trucks, their occupants, and cargo against enemy attack. In addition to equipping some of the vehicles with .50-caliber machine guns, sandbags are used for protection against exploding shells, grenades, and mines; tarpaulins, bows, and side panels are removed from troop transports; windbreakers and glass windows from cabs.

spaced throughout the convoy. If radio communication is prohibited, hand and arm signals, whistles, and other expedients should be utilized to facilitate communications and control among the elements of the convoy.

Organization and Tactics

Whether the infantry is aboard the vehicles for the purpose of their own transportation or assigned to a convoy to protect whatever cargo is being transported, they should be organized into "truck teams." Each truck team should have a designated leader. Drivers and assistant drivers of vehicles should be included in these truck teams. Assistant drivers of vehicles equipped with .50-caliber machine guns should be assigned to the weapons.

Sandbags should be placed in the cabs of all vehicles and in the beds of vehicles which are to transport troops. This protects the drivers and personnel aboard from the fragments of exploding artillery shells, mines, and hand grenades. Vehicles carrying troops in the bed should have the tarpaulins, bows, and side panels removed.

The troops should be seated facing outboard with the tailgate of the truck down or removed. This allows the infantrymen better observation and fields of fire. They can dismount with greater speed. Cabs of vehicles should be stripped of windbreakers and all glass should be removed. Chicken wire should be placed over the cab to give the driver better observation and to prevent hand grenades from being thrown through open windows.

Whenever a convoy approaches a

sharp curve, a roadblock, or any other type of danger area, a scouting team should be sent forward to reconnoiter. Should an attack halt the convoy, vehicles should be dispersed. Dispersion is the best passive defense against artillery, mortar, grenades, or small arms fire. Dispersion should also be used to provide a passive defense against an enemy air attack which could easily destroy an entire convoy.

Number the vehicles in the convoy and instruct the drivers of even- and odd-numbered vehicles to pull off on opposite sides of the road in the event of an air attack. This serves to double the distance between vehicles on the same side of the road, thereby lessening the possibility for complete destruction. After pulling off the road, vehicles should be halted and the engines turned off. All personnel in the convoy except assistant drivers manning the .50-caliber machine guns should dismount and seek cover for the duration of the attack. Assistant drivers should remain with their weapons and attempt to bring down the aircraft. Drivers, when dismounting, should take fire extinguishers with them and remain near their vehicles.

By its very nature, a convoy is not an offensive movement. Passive and active defenses must be planned. In addition to the passive defenses mentioned previously in regard to air attacks, the same considerations must be given to the gap (following distance) of vehicles. A gap must be maintained which will not permit 1 artillery shell to destroy more than 1 vehicle, or 1 automatic weapon to cripple several vehicles with a few quick bursts of fire.

Modern antiguerrilla doctrine states that a gap of 100-150 yards (90-135 m) is proper between vehicles. It is important that the gap be sufficient not to invite the disasters mentioned, yet not so great as to cause loss of control among elements in the convoy.

Active defenses are accomplished by the scouting teams, by the alertness of each individual in the convoy, and by coordination and communication between the commander of the movement and his truck teams. If attacked, the commander must choose to use 1 or more of his truck teams to engage the enemy for the purpose of either routing him, or to delay and occupy the enemy while the rest of the convoy establishes a defense.

If it can possibly be avoided, troops should not be placed in the lead or rear vehicle of a convoy. These vehicles are the most susceptible to a frontal or rear attack. They should be used to carry the supplies. A second point which seems to be often overlooked is that the supporting weapons should not all be placed in 1 or 2 vehicles in the same general section of the convoy. A rifle company will split its weapons platoon for a heliborne or amphibious assault, but for some reason this principle is often discarded in tactical movements. Company commanders have frequently loaded their troops on vehicles in an administrative manner during a tactical move. This results in the entire weapons platoon riding in 2 or 3 consecutive vehicles. It is superfluous to point out the disaster that could result should that part of the convoy be hit by enemy attack.

☆☆☆

The U.S. Air Force research-and-development community, spearheaded by the U.S. Air Force Systems Command, is working hard to meet the difficult technological challenges of the Vietnamese War. For the Systems Command, it is a new kind of task, much different in many ways from the vast management effort that built the intercontinental nuclear missile force. Here is a special report on . . .

USAF's Technological Response to Limited War

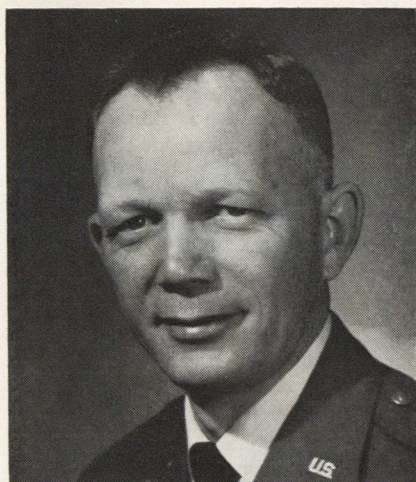
BY WILLIAM LEAVITT

Senior Editor/Science and Education

After spending billions of dollars to build a massive nuclear deterrent arsenal, it is ironic that the United States Air Force is fighting a jungle war in which intercontinental ballistic missiles and other such massive weapons are irrelevant and unusable.

But as a character in one of novelist James Gould Cozzens' books about World War II remarked: "We face conditions, not theories."

It is a coincidence that the novel, "Guard of Honor," happens to be about the Air Force in World War II.



Brig. Gen. Henry B. Kucheman, Jr., USAF, is focus of Air Force Systems Command response to technological requirements of the Vietnamese War. The General is Deputy for Limited War at AFSC's Aeronautical Systems Division.

But the remark aptly describes the U.S. Air Force's current task: finding ways and means of applying technology to a conflict in which mobility, logistics, and precision targeting are vital to victory over opponents who make up in elusiveness what they lack in advanced equipment and modern rear-echelon support.

The main focus of this technological response is in the Air Force Systems Command. AFSC was created for the missile/space age in which the most "crash" of development programs was inevitably measured in years. Now it is facing in the Vietnamese War perhaps the most complex challenge of its relatively short history.

Observers have wondered if the management techniques which produced complicated and expensive missile and space systems in both quantity and quality can respond just as quickly and effectively to the sometimes sophisticated and sometimes simple—but always urgent—requirements of a jungle war.

Air Force Systems Command planners believe they can do the job. But they recognize frankly that the Vietnamese job is a tough one and like no job Air Force research and development has ever done before.

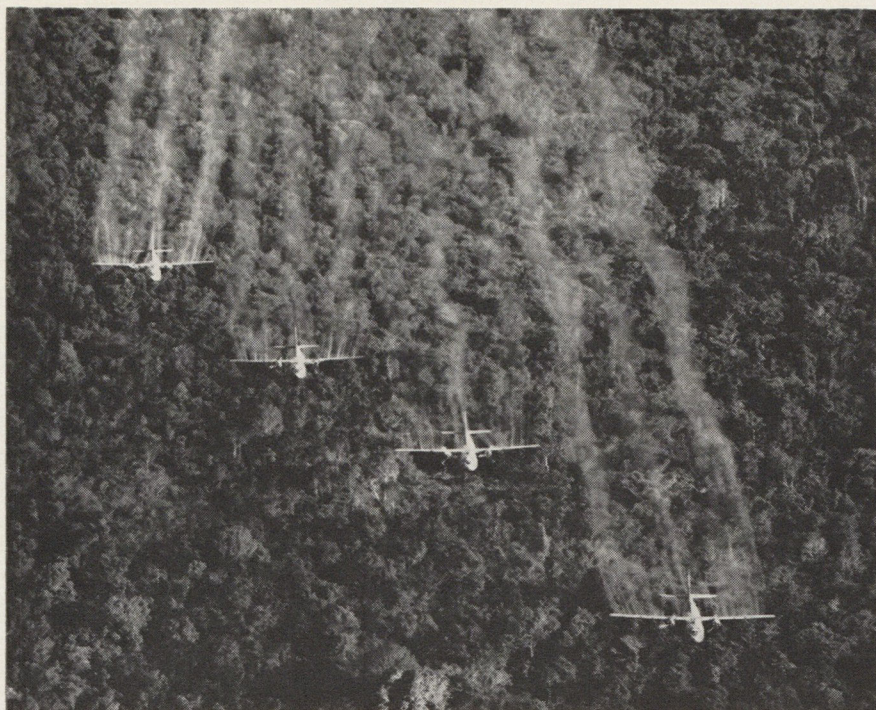
As Major General Joseph J. Cody, Jr., Deputy Chief of Staff for Systems, at Systems Command Headquarters at Andrews Air Force Base outside Washington, D.C., puts it, the Vietnamese conflict is not even the kind of limited war the Air Force and most other military planners were looking at only a

few years ago, in light of the Korean War experience. There are no fixed battle lines and the physical environment makes airpower more difficult to deploy with the effectiveness one could expect from field testing. The problems are endless.

Just to complicate things further, the U.S. is fighting 2 kinds of war at the same time: in South Vietnam, against a mixed force of guerrillas and regulars, where airpower is used tactically and for close support, and a more conventional, yet limited, strategic bombing effort in the North. Even the existing weapon systems are generally being used in reverse—strategic B-52s tactically in the South and F-105s, F-4, and other primarily tactical aircraft strategically in the North.

Meeting Requirements

To meet the technical requirements that are flooding in from Vietnam in the form of SEAORs (the acronym for Southeast Asia Operational Requirements), the Systems Command has set up a special organization that links the fighting forces in Vietnam with Systems Command Headquarters, involves all the major field organizations of Systems Command, and is connected with the Air Force research-and-development staff in the Pentagon and other involved Air Force commands. Requirements flow into the Pentagon and into Systems Command Headquarters via the most direct channels possible, and the effort to find answers to Vietnamese airpower-deploy-



The thick jungle growth is a special problem for both air and ground forces fighting Viet Cong. A partial answer to the problem has been airborne defoliation effort, in which aircraft spray overgrown areas with weed-killing chemicals. An interesting side effect is that many Viet Cong think the chemicals are poisonous to humans. They are not.

SEALO is manned by specialists from Systems Command who spend 90- to 120-day tours in Vietnam. The frequent rotation is designed to make sure that SEALO keeps a fresh outlook.

How does the SEAOR system work? This is how General B. A. Schriever, Commander of Systems Command, describes the process: "Under the SEAOR procedure, the Seventh Air Force, by TWX, identifies an operational need to its headquarters in the Pacific, and simultaneously provides the same statements of need to Air Force Headquarters, the Air Force Systems Command, the Tactical Air Command, and the Air Force Logistics Command. If the Headquarters, Pacific Air Forces, concurs in the operational need . . . the Aeronautical Systems Division [General Kucheman] and the appropriate agency within the Tactical Air Command simultaneously prepare Best Preliminary Estimates. If Headquarters Air Force agrees with the proposed technical solution, we move out quickly to provide the desired near-term fix."

Within the Systems Command, General Kucheman has, according to General Schriever, "total accountability of Systems Command research, development, test, and engineering . . . and an effective communications net to tie together all of the Systems Command's divisions and centers in responding to the needs of limited war."

Industry's Role

Industry is vital to the effort. Under Systems Command's Project 1559, which is monitored by a small staff in Lieutenant General James Ferguson's research-and-development office with-

(Continued on following page)

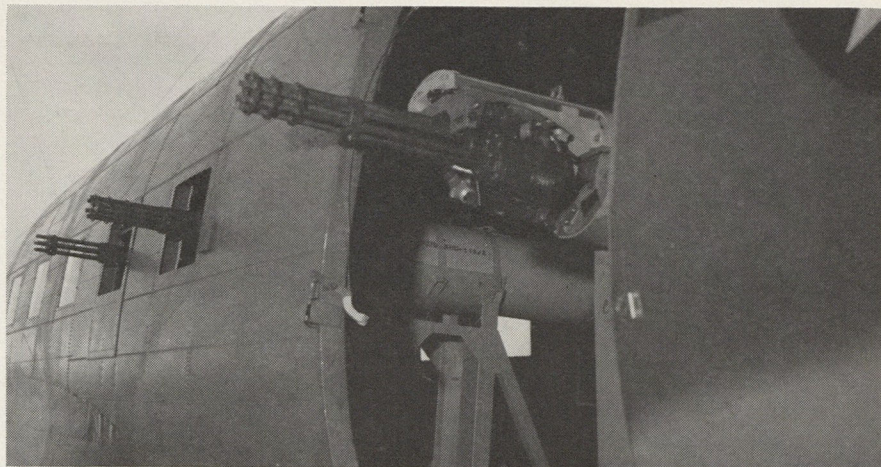
ment problems gets under way rapidly.

The effort began in earnest in 1965. In General Cody's words: "We began to examine our organization for limited war to see where the deficiencies were and tried to set up the quick channels needed for this kind of job. Here at Systems Command Headquarters, in what we call the SEA BROOM ROOM in the basement, we're examining problems constantly [and] working with people [from the Pentagon]. We've got about 200 different tasks on our charts down there, and we keep track of every one of them, with the most important ones marked for special treatment."

All of Systems Command's major elements have been required to set up focal points for limited war. At the center of the effort is the designated "lead" division for limited war—the Aeronautical Systems Division at Wright-Patterson Air Force Base, Ohio, commanded by Major General Charles Terhune, Jr. Heading the Vietnamese response effort at Wright-Patterson as ASD Deputy for Limited War is Brigadier General Henry B. Kucheman, Jr., until recently a space-systems development officer on the West Coast.

General Kucheman has direct access in his limited-war capacity to Systems Command Headquarters. From his office at Wright-Patterson requests fan out to the various Systems Command centers and divisions for ideas

and solutions to problems associated with the Vietnamese campaign. And into his office flow industry and Air Force proposals. At Wright-Patterson, the General also receives reports from the Air Force Systems Command's Southeast Asia Liaison Office (SEALO), which is located with the Seventh Air Force at Saigon. SEALO's job is to keep track of Air Force operational requirements as observed in the field.



An important example of technological response to airpower requirements in Vietnam is the outfitting of the venerable C-47 "Gooney Bird" transport with rapid-fire machine guns that are fired from the side of the aircraft. The armed C-47 is known as the AC-47 (A for Attack). AC-47 has shown effectiveness in slow-orbiting, close support of ground troops.

in the Air Staff in the Pentagon, the Command can buy, test, and try out limited-war hardware concepts suggested by industry. Prototypes can be bought as well as sample quantities of promising items. The funding for this effort, which has been monitored by Major General Andrew J. Evans, Jr., has risen from a paltry \$500,000 to some \$6,000,000. It is expected to go up to \$8,000,000 in the next budget. A recent count of Project 1559 efforts showed some 60 jobs in process. Including Project 1559, there are some 1,500 Air Force research-and-development projects having to do with Southeast Asia requirements. They range from the Air Force Logistics Command's airplane-modification efforts (engine changes, such as fitting jet pods on the C-123; airframe changes; and weapon fittings, such as the mounting of side-firing Miniguns on the C-47 to convert it into the now-famous "Puff the Magic Dragon" weapon platform), to the Tactical Air Command's counterinsurgency studies, among many others.

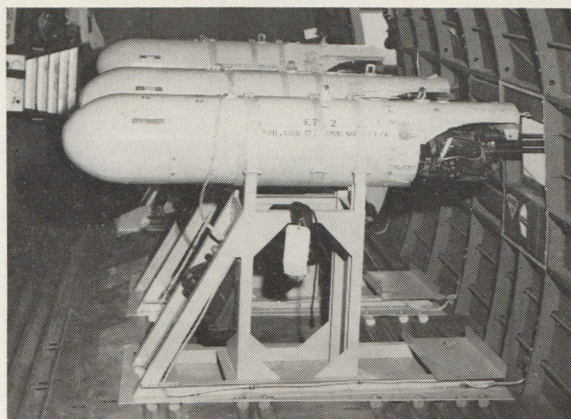
Air Force research-and-development planners have been talking to industry audiences around the country. They have briefed National Aeronautics and Space Administration specialists, have met with British Defense Ministry and Royal Air Force people, and with U.S. military staffs in Europe, in their campaign to solicit ideas and interest in the problems of limited-war airpower deployment, tactics, and hardware.

Meanwhile, Air Force research-and-development planners are not sitting on their hands waiting for problems to come in from Vietnam. They are working on known problems to see if off-the-shelf items can provide new capabilities or improve existing capabilities in the field.

The variety of current efforts—just in Project 1559—is striking. They include such items as a special grenade launcher for the Colt AR-15 rifle; dust suppression mixtures to stabilize surfaces of assault landing strips; "intrusion alarm" systems for protection of airfields; disposable parachutes to prevent reuse by the enemy; better flying suits to beat the heat and dampness of Vietnam; optical tracking systems; laser techniques for target marking; life rafts built to hold as many as 25 people; portable lighting systems to determine flight ceilings; simplified rifle sights; hard hats for protection against small-arms fire and shrapnel. These are just a few.

Armaments: A Major Effort

A sizable amount of effort in Systems Command support of the Vietnamese War is in munitions. The



This is how AC-47's machine guns look from the inside of the aircraft. Three gun pods are mounted in the fuselage and are controlled from the cockpit of the plane. AC-47 has come to be called "Puff the Magic Dragon," after a popular U.S. song of a few years ago.

importance attached to the effort is underscored by the recent designation of what used to be known as Detachment 4 at Eglin Air Force Base, Florida, as the Air Force Armaments Laboratory.

The Laboratory's main jobs are enhancement of existing munitions and development of new concepts applicable to the peculiar and difficult Vietnamese environment. The Lab is a component of Systems Command's Research and Technology Division, commanded by Major General Marvin C. Demler. More than 300 military and civilian specialists man the Florida facility, backed up by nearly 2,000 testing personnel at Air Proving Ground Center at the same location, and at latest count contracts currently in force run over \$50,000,000.

As evidence of the rapid growth of the effort, General Demler points out that as late as 1961 the Lab was staffed by only 72 people. The funding increase is shown by the rise to the present \$50,000,000-plus funding from a low of some \$460,000 for conventional munitions in the late 1950s.

Key areas being emphasized at the Armaments Lab in support of the Vietnamese War are: increasing area coverage for weaponry; increasing the lethality of conventional weapons (such as improving warhead for the 2.75-inch (70 mm) folding-fin aircraft rocket and development of napalm-B for greater adhesion and burning on the ground); increased weapon accuracy with crew safety (laying down ordnance from 150- to 200-foot (46 to 61 m) altitudes so that bombs explode far enough behind the moving aircraft to assure crew safety); the use of air-to-ground missiles; increasing the operational limits of conventional weapons (protection of munitions from effects of supersonic flight); increased payloads (multiple ejection racks for bomber aircraft); adaptation of existing systems to Vietnamese War requirements (Miniguns for the C-47; jungle-penetration bomblets that are fuzed to as-

sure detonation on or near ground rather than in treetops; the Sadeye ordnance cluster fired ahead of the aircraft for wide-area ground coverage); and new concepts (such as miniaturized long-delay proximity fuzes that are fail-safe for airborne crews; and aerial mining).

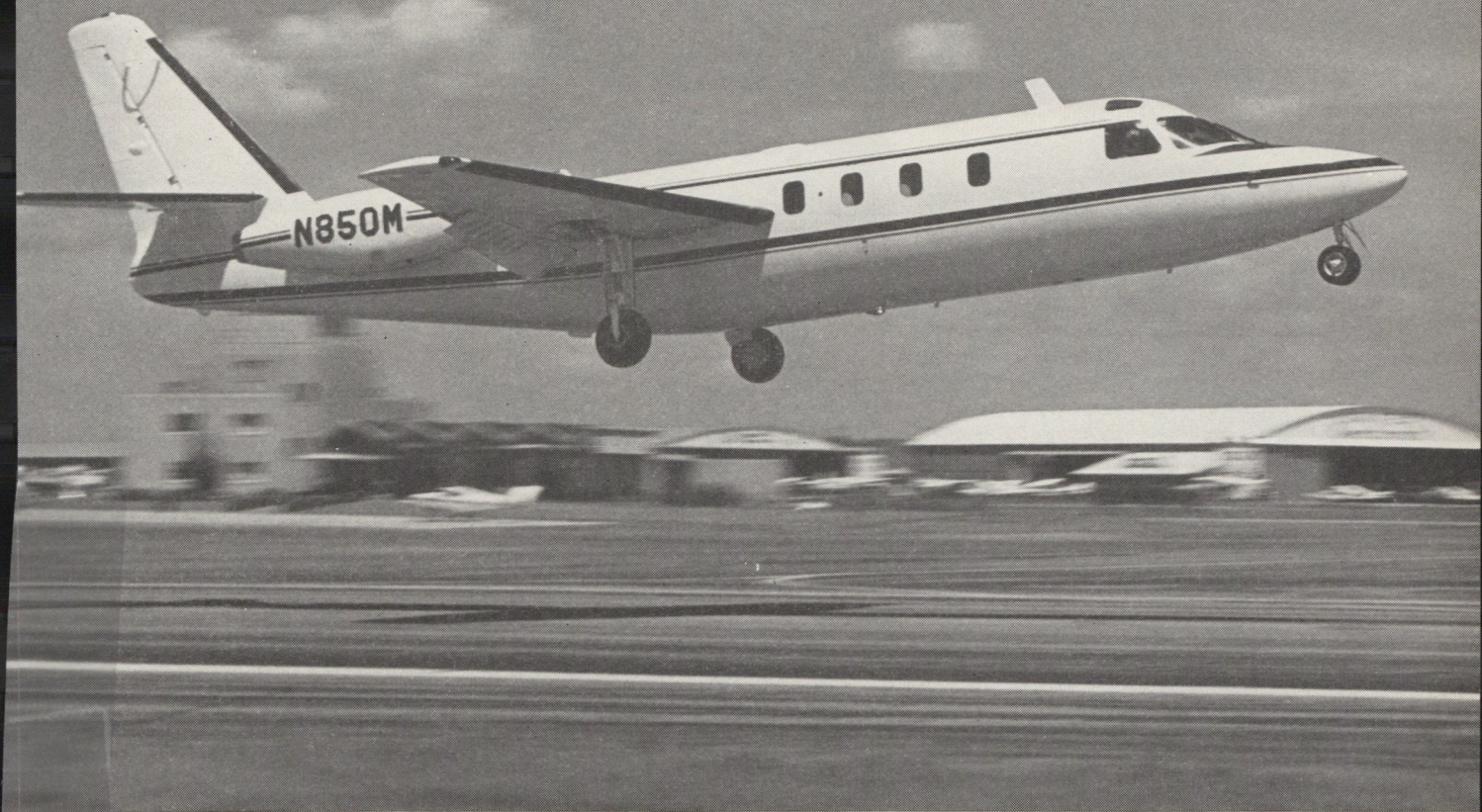
No one at Systems Command or in the general Air Force research-and-development community is claiming that every one of the myriad Southeast Asia problems is being answered adequately and fast enough. But the job is being attacked vigorously. At the same time, the planners are concerned about the long-range technological problems of limited war, beyond Vietnam.

Vietnam, as knotty a challenge as it is, is but one of the many kinds of "twilight wars" USAF may have to fight in this tumultuous era. To meet such a broad array of potential requirements, the exact nature of which cannot be foreseen any more than the Vietnamese effort could have been forecast precisely, the Systems Command has circulated on a classified basis to industry a Limited War/Counterinsurgency Technical Objectives document. Some of the problem areas foreseen in the document are: weaponry, airframe/control and protection systems, propulsion, penetration aids, reconnaissance, human factors, communications, command-and-control systems, ground equipment, navigation, and guidance.

In all these areas, the Air Force is looking for reliable, rugged, easily maintainable, lightweight, and effective equipment.

For the Air Force research-and-development community and for the industry that has traditionally backed it up with ideas and expertise—whether for aircraft back in the days when Wright Field was called just that or for greatly complex and expensive missile and space systems—an enormous job, symbolized by the complexities of Vietnam, lies ahead.

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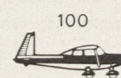
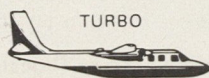
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Requirements of limited warfare, particularly in a primitive environment, have prompted development in the U.S. of scores of vehicles to improve mobility on land, sea, and in the air. Here, in words and photos, AF/SD INTERNATIONAL presents . . .



Trucks and supplies to support U.S. forces in Vietnam are unloaded from Navy LST.

A Gallery of Mobility Vehicles

First With the Most

BY ALLAN R. SCHOLIN, Associate Editor

Since long before Confederate Civil War General Nathan Bedford Forrest quaintly described it as "gettin' there fustest with the mostest," mobility has been a basic principle of military strategy. The development in the 1950s of silo-based intercontinental ballistic missiles tended to diminish attention on the subject until the war in Vietnam—and the possibility of other limited conflicts—stimulated renewed efforts in projects to improve mobility on land and sea as well as in the air.

A full discussion of the equipment and techniques being produced or projected in the U.S. to improve mobility would fill volumes, since they range from footwear to protect soldiers from poison-tipped stakes in the jungles of Vietnam to such exotic prospects as passenger rockets. The following, then, represents only a small cross-section of programs now under way in the U.S. and directed primarily toward limited-warfare applications.

U.S. Army

Perhaps the outstanding example of U.S. Army efforts to improve its mobility is the airmobile division, now in Vietnam combat, which depends pri-

marily on helicopters for movement of troops, ammunition, and supplies. The airmobile division has its disadvantages, notably in lack of heavy organic firepower, but it is proving well suited for counterinsurgency warfare, as in Vietnam, and the U.S. Army plans to add at least 2 more airmobile divisions.

Principal helicopters in the airmobile force today are the Bell UH-1B, which carries up to 14 troops, and UH-1D, whose weapons help suppress enemy fire in the landing zone; and the Boeing Vertol CH-47 Chinook, carrying 33 troops or up to 6 tons (5.4 mt) of cargo. These aircraft have been described in previous issues.

An improved version of the UH-1D, the 2-seat HueyCobra, now in production, carries more weapons and ammunition and flies faster and further than the UH-1D. It will be the Army's primary armed escort helicopter until the Lockheed Advanced Aerial Fire Support System (AAFSS) enters service in 1970.

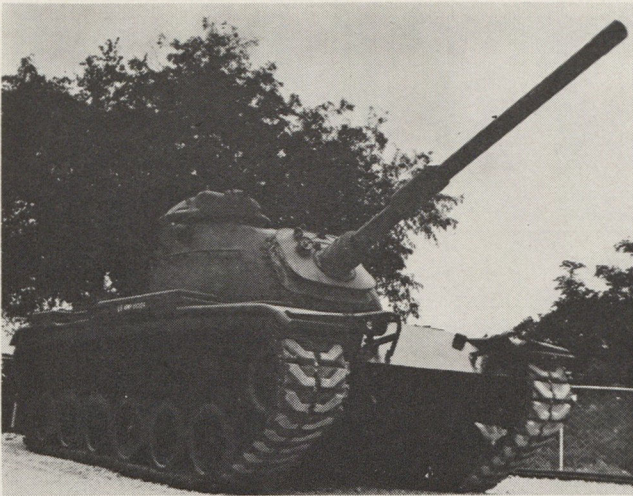
The AAFSS will cruise at 200 knots, powered by a 3,400-horsepower General Electric T64-12 gas-turbine engine. Flown by a 2-man crew, it will mount various combinations of weap-

ons, including machine guns, grenade launchers, rockets, and antitank missiles. It will have an all-weather capability.

A number of vehicles are in development to improve the Army's ability to move men and equipment across open country as well as on roads, to



Bell UH-1D, UH-1B, HueyCobra.



Principal armored weapon system of U.S. Army until joint U.S.-West German Main Battle Tank of '70s becomes available is the MB60A1 tank. Built by Chrysler Corporation and powered by Continental V-12 air-cooled diesel of 750 horsepower, it will go 250 miles (400 km) without refueling.



Firestone rolling liquid transporters (GOER-towed)

protect men from enemy fire, and to knock out enemy defenses.

Major international interest is centered on development of the Main Battle Tank of the 1970s, a joint project of the U.S. and West German armies. The 2 nations are working together on a common design, which will then be produced separately by manufacturing teams in each country. The major contractors are General Motors and German Development Corporation, for the U.S. and Germany respectively, with Continental Motors in the U.S. and Daimler-Benz responsible for engines.

For traversing open-country terrain, the Army is evaluating a family of GOER vehicles, inspired by heavy road-building equipment developed by Caterpillar Tractor and LeTourneau. Apparently nearing production awards are 3 8-ton (7.2 mt) GOER vehicles—a tanker with 2,500-gallon (9,450 l) capacity, a wrecker capable of handling a 10-ton (9.07 mt) load, and a cargo-troop carrier vehicle. Also under consideration are 16-ton (14.4 mt) GOERs, with double the capacity in each category.

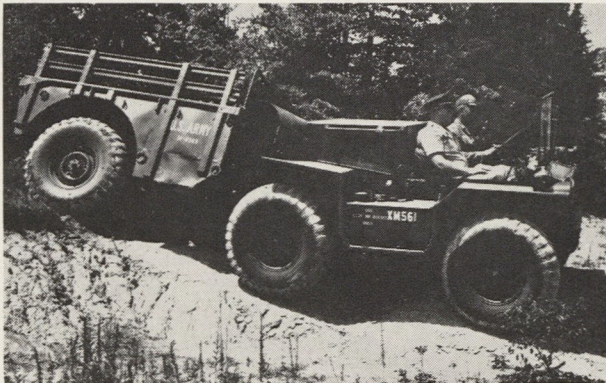
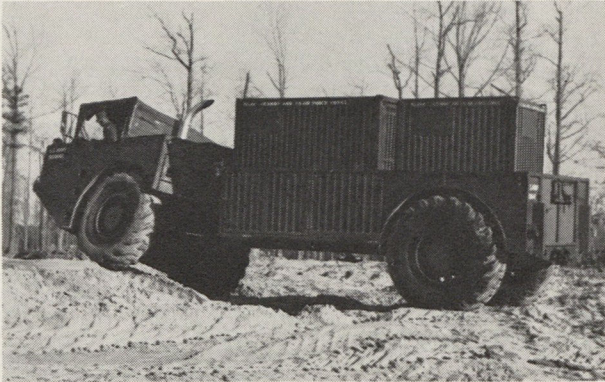
Dependent on the GOER to tow it is a novel Firestone-designed technique to haul fuel in huge rubber wheels. The rolling fuel tanks can be towed in pairs or linked together in a long train. Their wide tread enables them to roll over rough or soft terrain or float on water.

Ability to "swim" rivers is a characteristic of most new Army vehicles, including the Ford XM656 5-ton (4.5 mt) truck, the LTV XM561 Gama Goat, and Canadair's XM571 Dynatrac troop or cargo carrier.

The Gama Goat, a dual-bodied, 6-wheel, articulated-drive vehicle, carries up to 2,500 pounds (1,134 kg) or 10 troops. It is so constructed that all 6

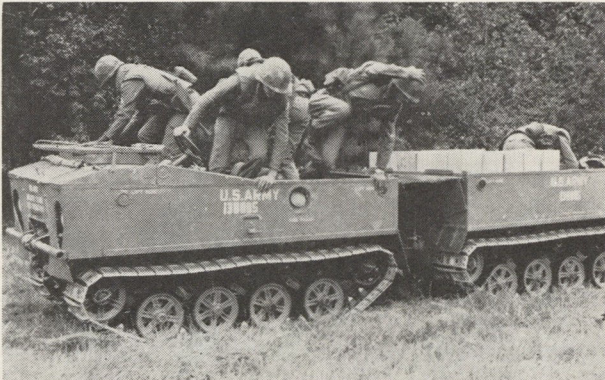
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Caterpillar 8-ton cargo GOER



LTV Gama Goat

Canadair Dynatrac





Cadillac-built General Sheridan armed reconnaissance vehicle is entering operational service in June. Its 152-mm gun-launcher fires conventional rounds or the new Shillelagh guided missile.



U.S. Army is testing RN110 track-truck, built by Nodwell in Canada, for Arctic operation. Powered by 6-cylinder diesel engine, it will traverse snow and tundra at 12 mph (19 km/hr).

wheels remain in contact with the surface, no matter how rough. Built by Ling-Temco-Vought, and powered by a Detroit Diesel 80-horsepower, air-cooled engine, it will do 55 mph (88 km/hr) on roadway. With conversion kits it can take on multiple missions—weapons carrier, firing platform for missiles or recoilless weapons, ambulance, command post, or fire direction center.

Canadair's XM571 is a fully tracked 2-unit aluminum vehicle. The forward unit can be operated independently. Carrying 10 troops or 2,000 pounds (907 kg) of cargo, it will travel 30 mph (48 km/hr), climb 60-percent slopes, swim waterways, and navigate in marshy terrain or snow.

Ford's 5-ton (4.5 mt) truck is one of 3 new wheeled vehicles ordered by the Army which also merit mention. Kaiser has been awarded a production contract for the XM715 1¼-ton (1.13 mt) truck, designed for operation in both rear and forward military areas. Powered by a 6-cylinder in-line Kaiser "Tornado" gasoline engine, with 230-cubic-inch (3.77 l) displacement, its

top speed is 50 mph (80 km/hr). It will ford water up to 30 inches (76 cm) deep, or twice that depth when modified with a special fording kit.

Ford Motor Company is producing 2 trucks—the ¼-ton (227 kg) M151 "Mutt"—military utility tactical truck—and the 5-ton (4.5 mt), 8-wheeled XM656.

The Army has ordered more than 32,000 "Mutts," latest in a line of successors to the famed Jeep of World War II. It employs a 4-cylinder, 70-horsepower motor built by Continental Motors Corporation. Top speed is 65 mph (104 km/hr).

The XM656, now in advanced production engineering, employs a 210-horsepower, Army-designed engine, which can operate on diesel oil, gasoline, or other fuel interchangeably without readjustment. With all 8 wheels powered, it can travel across open fields or swim rivers. The chassis can be fitted with a tanker or wrecker body in place of its troop or cargo carrier. Highway cruising range of the durable vehicle is about 400 miles (640 km) at

Ford M151
Mutt



Ford
XM656
Truck



Cadillac-Gage
Commando

a top speed of 50 mph (80 km/hr).

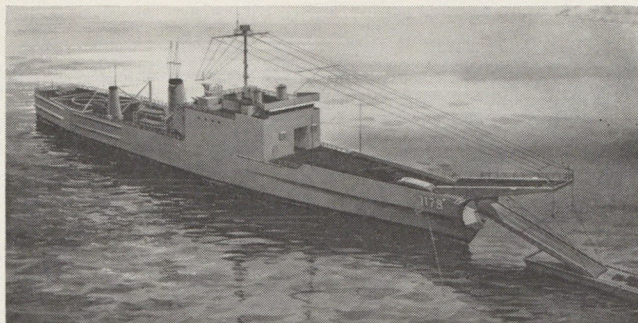
An armored vehicle, the Commando, is being produced by Cadillac-Gage for U.S. allies under the Military Assistance Program. It can carry 11 combat troops, and is equipped with a turret that mounts weapons ranging from twin .30- or .50-caliber machine guns to a 90-mm cannon. It is powered by a 210-horsepower, V-8 engine, giving it a top speed of 65 mph (105 km/hr). It can swim streams under its own power and is equipped with a winch to extricate itself when mired down.

U.S. Navy

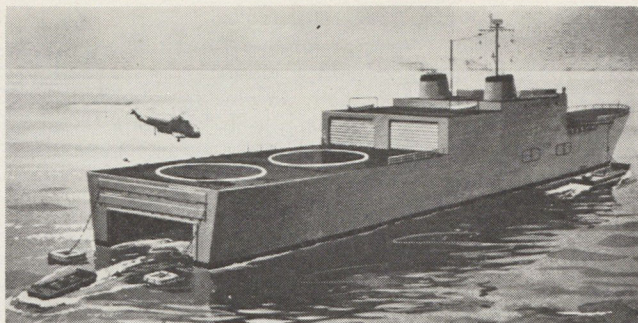
A number of craft with novel features are being tested to meet the operational requirements of amphibious and unconventional warfare.

The Navy is developing 2 fast ships to carry assault forces and their equipment, and a variety of amphibians to deposit them on the beach or far inland.

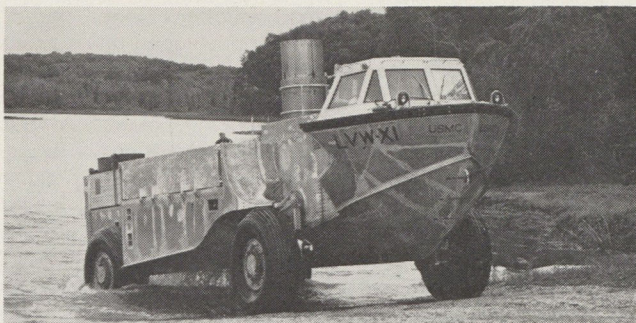
To replace its World War II fleet



Navy 1179-class LST



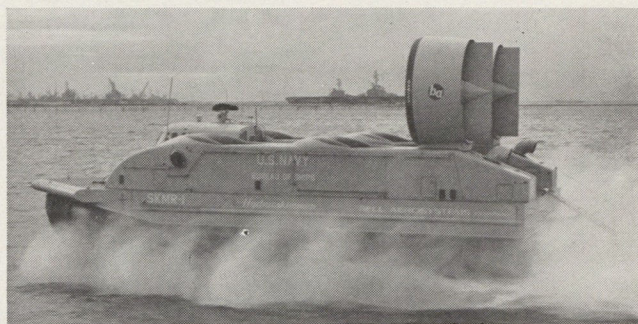
Fast Deployment Logistic Ship (FDL)



Ingersoll Landing Vehicle, Wheeled (LVW)



FMC Corporation's Hydrofoil Landing Vehicle (LVHX)



Bell Hydroskimmer (SKMR-1)

of LSTs (Landing Ship, Tank), the Navy has designed a sleek new 20-knot LST incorporating both a stern gate for amphibious vehicles and an over-the-bow ramp for "nonswimmers." Three prototypes of the 1179-class LST are under construction at the Philadelphia (Pennsylvania) Naval Shipyard. After tests, contracts will be let for quantity production.

Also in early development is a Fast Deployment Logistic Ship (FDL), designed to carry heavy Army divisional equipment, which would be prepositioned offshore from strategic areas.

"Such a ship would be particularly useful for carrying, without disassembling, heavy wheeled and tracked vehicles as well as helicopters," Secretary of Defense Robert S. McNamara has explained. "Its relatively high speed would permit it to deliver cargo within the critical first 30 days even from the continental U.S. to a distant area."

"We propose, however, to use these ships as forward mobile depots stationed close to potential trouble areas and in no event for carrying peace-

time cargoes."

To reduce manning requirements, FDL ships will employ an automated propulsion plant, probably a lightweight gas turbine. Cargo will be loaded and discharged either through roll-on, roll-off methods adaptable to existing port facilities, or at sea using heavy amphibians such as the 60-ton (54 mt) capacity LARC 60.

The FDL is being designed to complement the U.S. Air Force's C-5A transport in effecting swift delivery of an entire Army division and its equipment anywhere in the world on short notice.

After many years of neglect, the Navy is now engaged in an intensive program to develop a ship-to-shore amphibian for the U.S. Marine Corps. Prototypes of 4 designs are being evaluated, of which 2 are hydrofoils and one a modified air-cushion vehicle. These are the LVW, Landing Vehicle, Wheeled; the LVHX-1 and -2, Landing Vehicle, Hydrofoil, Models 1 and 2; and the Hydrokeel (LCVPK).

The LVW, a planing hull, wheeled

amphibian, operates at a gross weight of 42,500 pounds (19,278 kg), carrying a 10,000-pound (4,536 kg) payload, at a speed of 30 knots on water and 35 mph (46 km/hr) on land. Two prototypes have been built by Ingersoll Kalamazoo Division of Borg-Warner Corporation. It employs a Lycoming TF-2036 gas-turbine engine with 1,500 horsepower and has an endurance of 6 hours at full power.

Each of the 2 hydrofoil landing craft now under test also carries a 10,000-pound (4,536 kg) payload. Model 1, built by Lycoming Division, Avco Corporation, is equipped with a Lycoming T53 gas-turbine engine generating 1,100 shaft horsepower. Employing submerged foils, it has a range of 210 miles (338 km), with top speed of 40 knots on water and 40 mph (64 km/hr) on land.

Model 2, developed by FMC Corporation and powered by a Solar Saturn 1,080-horsepower gas turbine, achieves virtually the same performance, utilizing a surface-piercing foil forward and

(Continued on following page)

submerged foil aft, both retractable.

The Hydrokeel, developed jointly by Bell Aerosystems and Anti-Friction Hull Corporation, is essentially an air-cushion vehicle which, employing relatively modest fan power, maintains a thin sheet of air under its planing bottom. It is 36 feet (11 m) long, and carries an 8,000-pound (3,629 kg) payload.

Two other types of high-speed ships employing some form of air cushion are also in experimental stages. They are the Bell Aerosystems SKMR-1 Hydroskimmer, a 28-ton (25 mt), 70-knot vehicle, and the XR-1, a captured air bubble (CAB) craft developed by the Navy's Bureau of Weapons.

The SKMR-1 employs 4 1,080-horsepower Solar Saturn turbine engines to drive 4 lift fans, enabling the Hydroskimmer to hover 1 to 2 feet (30 to 60 cm) above the surface, and 2 10-foot (3.05 m) variable-pitch propellers to provide forward propulsion. It is able to skim over water, swamp, or dry land, passing across the beach to inland staging areas.

The XR-1 obtains some support from an air cushion beneath its hull but is also partially lifted by planing action. It is 52 feet (15.8 m) long, weighs about 10 tons (9.07 mt), and has been tested at speeds above 40 knots. Air forced under the hull is restrained by thin side keels that extend into the water. Planing surfaces forward and aft provide additional lift while helping also to seal in the air bubble. Towing tank tests indicate that the captured-air-bubble technique improves in effectiveness as size increases, leading to predictions that huge CAB ships could be developed to cross the oceans at 100-knot speeds.

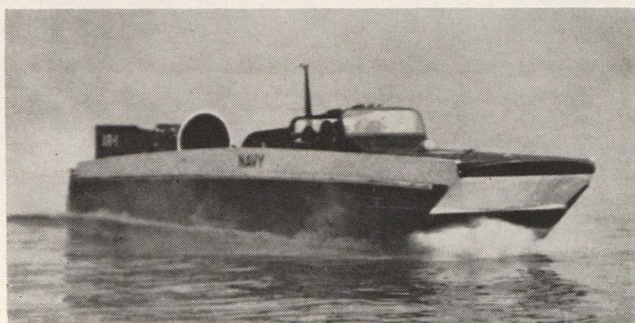
Both the Marine Corps and Army are testing the Marsh Screw Amphibian, built by the Chrysler Corporation. Using Archimedes screw pontoons for propulsion and flotation, it moves equally well through mud, water, or deep snow. It carries 6 troops or 1,050 pounds (475 kg) of cargo, plus driver, at speeds up to 20 mph (32 km/hr).

Also in operational test are several

larger hydrofoil ships, latest of which is the Plainview (GEH-1), largest in the world. It is 200 feet (61 m) long and displaces 300 tons (272 mt). Built by Lockheed Shipbuilding and Construction Company, it is powered by 2 General Electric J79 gas-turbine engines, each developing 15,000 horsepower.

Smaller but faster is the Highpoint (PCH-1), designed by Boeing Company. It is 115 feet (35 m) long, displaces 100 tons (91 mt), and has made test runs at speeds of 60 knots, powered by a pair of Bristol Siddeley Proteus gas turbines.

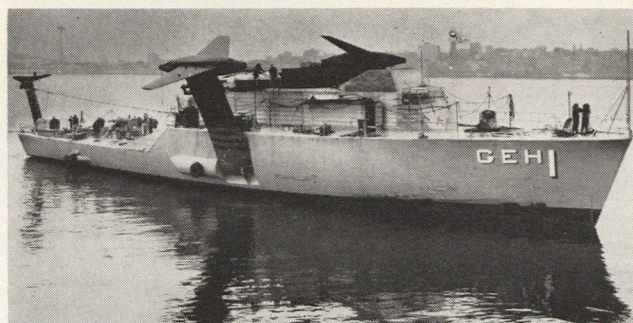
Two light boats are in production for the Navy and Coast Guard to patrol coastal waters and inland waterways in Vietnam. Larger of the 2 is the aluminum-hull Swift, which the Navy has designated PCF—patrol craft, fast. Built by Sewart Seacraft, Inc., it is 50 feet (15.25 m) long with a 13-foot (3.9 m) beam. A pair of General Motors V-12 diesel engines gives it a speed of 25 knots. Carrying a 6-man crew, it is armed with 2 .50-caliber machine guns



XR-1 Captured Air Bubble (CAB) Craft

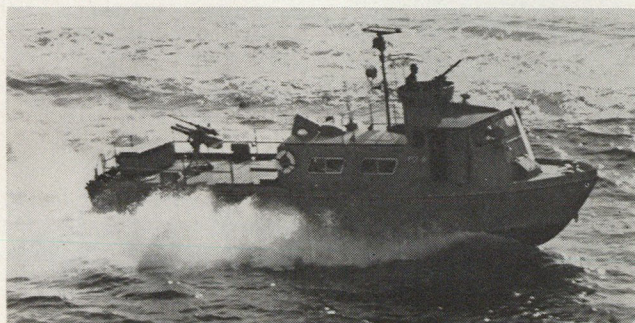


Chrysler Marsh Screw Amphibian



Lockheed Shipbuilding Plainview (GEH-1)

Sewart Seacraft Swift (PCF)



United Boat-Jacuzzi (PBR)





Lockheed C-5A nose-loading mockup



Lockheed C-141A dropping paratroopers



LTV-Hiller-Ryan XC-142



North American OV-10A LARA

on top of the wheelhouse and another .50-caliber gun atop an 81-mm mortar on the afterdeck.

For river patrol duty, the Navy is acquiring a fleet of 120 plastic-hulled boats built by United Boat Builders and powered by 2 Jacuzzi diesel 220-horsepower water-jet propulsion systems, the first such engines to be used by the Navy. The craft is 31 feet (9.4 m) long and 12.5 feet (3.8 m) wide. It carries a 4-man crew—coxswain and 3 gunners who man a pair of .50-caliber machine guns forward and a .30-caliber weapon aft.

U.S. Air Force

A major factor in improving mobility of both the Air Force and the Army in the past year has been the Lockheed C-141 StarLifter transport. As General Howell M. Estes, Jr., Commander of the Military Airlift Command, notes elsewhere in this issue, "a basic measure of the productivity of any aircraft may be found in the number of cargo ton-miles it is capa-

ble of flying per hour." The Douglas C-124, he points out, produces 2,500 ton-miles per hour; the Lockheed C-130 delivers 3,800, and Boeing's jet-powered C-135 nearly 7,000. In comparison, the C-141 produces 10,000.

Four squadrons, each equipped with 16 StarLifters, are now in operation. Six more squadrons will acquire the C-141 by March 1967. A total of 284 StarLifters are on order.

When the huge Lockheed C-5A enters service late in this decade, it will far eclipse even the C-141's prodigious capacity, delivering, in General Estes' words, "on the order of about 50,000 ton-miles per hour."

At the other end of the cargo spectrum, the Air Force will soon acquire 157 North American OV-10 light armed reconnaissance aircraft (LARA). The Marine Corps is also scheduled to get 100 LARAs.

While the OV-10A is primarily intended for attack and reconnaissance, an alternative fuselage enables this versatile plane to perform light utility missions, carrying up to 12 troops or

3,000 pounds (1,360 kg) of cargo at a speed of 230 mph (370 km/hr).

Among other personnel and cargo transports deserving of inclusion in this gallery, we may close with one which seems destined to lead to the first U.S. operational V/STOL aircraft. This is the triservice tilt-wing XC-142, now undergoing operational suitability tests. It was developed by Ling-Temco-Vought, with assistance from Ryan Aeronautical Company and Fairchild Hiller.

The Air Force recently contracted with LTV to make a configuration evaluation study for a potential production version.

Four General Electric T64 turboprop engines of 2,850 shaft horsepower each are linked together to power 4 wing-mounted propellers, enabling the XC-142 to lift an 8,000-pound (3,630 kg) payload vertically or 12,000 pounds (5,440 kg) with a short takeoff run. It cruises at 430 mph (688 km/hr) over a range of 460 miles (735 km) with maximum payload. Ferry range is 3,000 miles (4,800 km).

☆☆☆

Sales of the new Douglas DC-9, a jet transport for airlines with short- and medium-range routes, already total 323. The airplane is proving popular not only with domestic U.S. carriers, but also in the world market. The Douglas goal is to sell at least 800 . . .

DC-9: An Expanding Market

It is about a year since the first DC-9, a new short- to medium-range jet transport, was rolled out of the Douglas Aircraft Company plant in California.

The company reports that it now has firm orders for 323 of these airplanes and options for about 131 more. The purchases are being made by 28 airlines, domestic and foreign.

The original estimate was that there would be a worldwide market for about 1,000 aircraft of the DC-9 type and that the Douglas share of this market would be 400. Company spokesmen now say they have doubled these figures, to 2,000 medium-range jets on the world's airways, of which Douglas expects about 800 to be its DC-9.

The DC-9 is about one-third the size of its predecessor—the long-range, 4-engine DC-8. It is designed to operate from short runways—less than 5,000 feet (1,525 m)—and over routes that vary from 100 miles (160 km) to more than 1,500 miles (2,420 km).

It has 2 fanjet engines mounted on the aft fuselage and a high horizontal stabilizer on top of the rudder. In normal operations, it is designed to carry 50 passengers and baggage on a 600-mile (960 km) flight, making 2 intermediate stops without refueling.

The airplane is offered to airlines in 2 basic versions. The Series 10 DC-9 is 104.4 feet (32 m) long. It can carry up to 90 passengers with 600 cubic feet (16.9 m³) of cargo space under the floor. The wingspan is 89.4 feet (27.3 m).

The Series 10 aircraft is powered by a Pratt & Whitney JT8D fanjet engine. It will have a top cruising speed of 560 mph (900 km/hr).

Maximum seating for 115 passengers can be provided in the Series 30 DC-9, which is 119.3 feet (36.4 m)

long and has a wingspan of 93.4 feet (28.5 m). There are 895 cubic feet (25 m³) of cargo space. This model carries the JT8D-7 engine, with a higher takeoff thrust. Combined with wing slats and flaps, this engine provides good short-field performance.

The airplane has been designed for easy maintenance and easy servicing at smaller airports, many of which will get their first jet service from the DC-9.

Foreign airlines that have placed

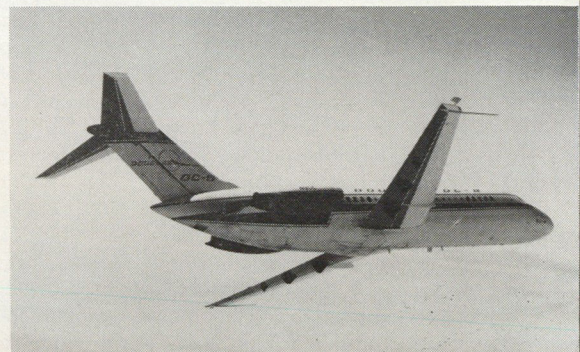
orders for the DC-9 so far are Aeromexico, Air Canada, Alitalia, Ansett-A.N.A., Iberia, KLM Royal Dutch, Korean Air Lines, S.A.S., Saudi Arabian, Sudflug, Swissair, and Trans-Australia.

U.S. airlines that have ordered the DC-9 are Allegheny, Bonanza, Caribair, Continental, Delta, Eastern, Hawaiian, North Central, Northeast, Overseas National, Ozark, Pacific Southwest, Southern, Trans-Texas, Trans-World, and West Coast. —CLAUDE WITZE



The DC-9 design emphasizes easy maintenance and servicing at small airports. During the entire development program, only 2 test flights of the DC-9 were terminated before completion; only 7 were delayed by component or system malfunction.

To date, approximately 454 twin-jet DC-9s have been ordered or optioned by 28 airlines, both U.S. and foreign. Eastern Air Lines recently ordered an additional 22 to bring its total purchase order up to 64.



An Air Force "Big Eye" radar plane is helping U.S. fighters in early encounters against North Vietnam's MIG-21s. . . .

While 2 firms vie for the U.S. supersonic transport, 2 more are studying hypersonic configurations. . . . Ten foreign scientists become associates of the U.S. National Academy; Spain joins in tracking spacecraft; New York University plans a Mach 14 wind tunnel; and the Army's OH-6A light observation helicopter sets 23 world records. It was a month for . . .

High Mach and LOH Marks

BY ALLAN R. SCHOLIN, Associate Editor

Expanded tactics by U.S. aircraft in operations over North Vietnam seem designed to challenge the North Vietnamese Air Force to come up and fight.

The tactics had resulted in several air-to-air fighter battles when this was written, including the first MIG-21 casualty in combat, shot down by an Air Force McDonnell F-4C.

Despite growing numbers of Soviet-furnished surface-to-air (SAM) missiles and heavy automatic antiaircraft weapons, Air Force and Navy fighters are striking targets closer than ever to Hanoi and North Vietnam's major port of Haiphong.

Big B-52 bombers from Guam are now hitting targets above the 17th parallel, though still well out of range of SAM missiles and MIG-21 fighters.

Contributing to the success of Air Force and Navy fighters in raids over North Vietnam are Lockheed EC-121 radar-equipped transports. Appropriately known as "Big Eye," they accompany the fighter planes, keeping their pilots posted on movements of enemy aircraft and SAM missile firings.

The announcement that EC-121s are now operating in Vietnam also disclosed that they assisted U.S. fighter pilots in the first MIG-17 fighter "kills" in Vietnam last summer. Radar operators track the MIGs on powerful scopes in the EC-121 while weapons-control officers vector McDonnell F-4s into optimum position for attack.

The F-4 Phantom is the only U.S. aircraft now in Vietnam which can fight on relatively even terms with the MIG-21. It has the speed and power to out-

climb, outdive, or outrun the MIG, the range to outlast it, and the armament to shoot it down. The MIG, however, has one important advantage—the ability to turn well inside the Phantom II, which means that, in a one-to-one situation, the Phantom must hit the

MIG on its first pass or break off contact.

The F-4 would be an even more potent weapon in North Vietnam if it were equipped with inboard cannon, which would be more effective at close range

(Continued on following page)



Size of new Boeing 747 jetliner in comparison with present 707-320 Intercontinental is shown in this double exposure. The 707, largest airliner now in service, is 152 feet (46.3 m) long, with 145-foot (44.2 m) wingspan. It weighs 164 tons (148.7 mt) fully loaded, carrying up to 199 passengers. In contrast, new Boeing 747 is 228 feet (69.5 m) long, with wingspan of 195 feet (59.4 m). It will weigh 340 tons (308.4 mt), carrying 490 passengers. First order for 25 747s was placed by Pan American World Airways.

than its Sidewinder and Sparrow missiles. The missiles are deadly if the MIG is taken by surprise from behind or, in the case of the Sparrow, from any angle, but MIG pilots have proven able to elude many of the missiles when they see them coming.

F-4s can carry cannon externally on wing pylons for attack against ground targets, but they cut down its speed too much for air combat. McDonnell is now developing a fighter version of the RF-4C reconnaissance plane, incorporating a nose cannon in place of the RF-4C's cameras, which may meet the requirement.

* * *

The U.S. National Academy of Sciences has elected 10 distinguished scientists as foreign associates of the Academy.

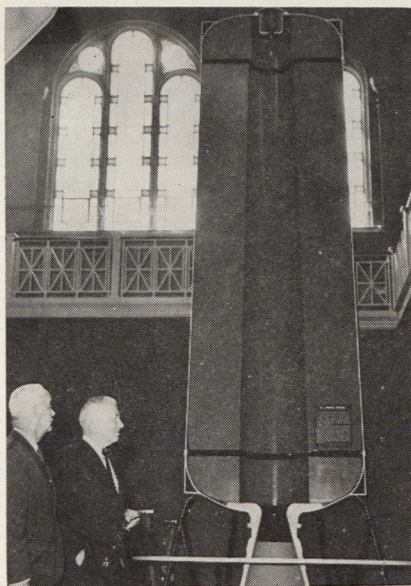
They are: Hannes Alfvén, Professor of Theoretical Electrodynamics and Mathematics, Royal Institute of Technology, Stockholm, Sweden; P.M.S. Blackett, President, The Royal Society, London; Sir John Eccles, Professor of Physiology, Australian National University, Canberra; Manfred Eigen, Professor, Max Planck Institute of Theoretical Chemistry, Göttingen, Germany; Ephraim Katchalski, Professor, Department of Biophysics, Weizmann Institute of Science, Rehovoth, Israel.

Konrad Lorenz, Professor and Director, Max Planck Institute for Behavioral Physiology, Bavaria, Germany; Jean Piaget, Professor of Psychology, University of Geneva, Switzerland; Bruno Sander, Professor Emeritus of Mineralogy and Petrography, University of Innsbruck, Austria; Pol Swings, Professor and Director, Institute of Astrophysics, University of Liège, Belgium; and Hiroshi Tamiya, Professor, Institute of Applied Microbiology, University of Tokyo, Japan.

The National Academy of Sciences is a private organization of distinguished scientists and engineers devoted to the furtherance of science and its use for the general welfare. The Academy was established in 1863 by a Congressional Act of Incorporation signed by President Abraham Lincoln.

Election as a foreign associate is one of the highest honors that can be bestowed by the Academy on a scientist who is not a U.S. citizen. Foreign associates are entitled to present papers before the Academy at its meetings or through the "Proceedings" of the Academy. This latest election brings the total of foreign associates to 78, in addition to 745 U.S. members.

Dr. Harrison Brown, Professor of Geochemistry at the California Institute of Technology, was elected to a second 4-year term as Foreign Secretary of the Academy.



Cutaway replica of world's first large segmented rocket was presented recently to Smithsonian Institution in Washington, D. C., by Joseph Barr, left, Vice President of United Technology Center, which developed it as first of generation of giant rockets. With him is S. Paul Johnston, curator of Smithsonian's air museum.



Recent visitor to Strategic Air Command Headquarters at Offutt Air Force Base, Nebraska, was the Prime Minister of Denmark, Jens Otto Krag, shown here with USAF General John D. Ryan, SAC Commander in Chief.

In that role, Dr. Brown is responsible for the Academy's relations with its sister academies abroad, in providing for participation by U.S. scientists in international scientific organizations and programs, in furthering the exchange of scientists and information with other nations, and in encouraging the progress of science and technology in developing countries as an instrument of economic development.

* * *

The Federal Aviation Agency has advanced from October 15 to September 1 the date for submission of final design proposals by 2 airframe and 2 engine manufacturers participating in

the supersonic transport (SST) development program.

Brigadier General J. C. Maxwell, Director of U.S. SST Development, said the change in dates will enable FAA to complete its evaluation of the competing airframe and engine designs by December 31 as scheduled.

"If we adhered to the original date for submission of design proposals," he added, "we probably could not meet this end-of-the-year deadline. We are determined that there be no slippage in the program schedule as we move from the current design phase into the prototype construction phase."

From its evaluation of the competing design proposals, General Maxwell said, FAA expects to select 1 airframe and 1 engine manufacturer to push ahead with SST prototype construction in 1967. The first of these aircraft should be flying by 1970 with certification of the production model in 1974.

Participating in the current 18-month competitive design phase ordered by President Johnson on July 1, 1965, are 2 airframe manufacturers, the Boeing Company and the Lockheed Aircraft

Corporation, and 2 engine manufacturers, the General Electric Company and the Pratt & Whitney Division of the United Aircraft Corporation. All 4 are working under Government cost-sharing contracts which run through December 31 of this year.

* * *

Twenty-three new world records for rotary-winged aircraft have been claimed by the U.S. Army's Hughes OH-6A light observation helicopter.

The new records—12 for speed, 5 for distance, and 3 each for altitude and time-to-climb—were set in classes E-1.C, E-1.D, and over-all.

All but 2 of the records were set at



Twenty-three world records are claimed by U.S. Army for its Hughes OH-6A light observation helicopter, including nonstop, unrefueled flight of 2,230 miles (3,590 km). Marks have been submitted to Fédération Aéronautique Internationale for certification.

Edwards Air Force Base, California. Those 2, establishing new over-all and Class E-1.C helicopter international records for distance in a straight line, were set on a nonstop, unrefueled flight of 2,230 miles (3,590 km) from Culver City, California, to Ormond Beach, Florida, by Robert G. Ferry, a Hughes test pilot. He topped a flight of 2,105.49 miles (3,387.7 km) logged last year by a Sikorsky SH-3A.

Top speed achieved in the record attempts was 172.41 mph (277.4 km/hr) over a 3-km straightaway course, far exceeding the record of 123.45 mph (198.6 km/hr) for class E-1.C helicopters held by a Hiller H-23G.

Over-all helicopter class records claimed, in addition to the distance flight, were 1,739.8 miles (2,799.3 km) traveled in a closed circuit, 141,523 mph (227.7 km/hr) speed over a 2,000-km closed course, and 26,448 feet (8,061.35 m) sustained altitude in horizontal flight.

Sixteen records surpassed by the OH-6A are held by the U.S. Of the others, 4 had not previously been claimed, 2 are held by France, and 1 by the USSR. Marks have been submitted to the Fédération Aéronautique Internationale in Paris for certification as official world records.

* * *

Spain's Instituto Nacional de Técnica Aeroespacial (INTA) will share in the operation of the U.S. space station near Madrid, which maintains radio contact with unmanned probes to the moon, Mars, and Venus, and will support the Apollo astronauts on their flight to the moon.

Spanish engineers and technicians

are receiving training to fill positions in the operation and maintenance of the National Aeronautics and Space Administration station located near Robledo de Chavela, 40 miles (64 km) west of the Spanish capital.

They will be assigned to tracking, telemetry, communications, and support positions on the U.S.-Spanish team to operate and maintain the station.

Some of INTA's key personnel are undergoing special training at NASA's Deep Space Facilities, Goldstone, California, to be followed by further training in the U.S. and on the job at the station in Spain.

Spain and the U.S. have renewed agreements for joint operation of

NASA's manned spaceflight station on Grand Canary Island to cover 3-man Apollo spaceflights. The station was established in March 1960 for tracking Mercury and Gemini spacecraft.

The 2 nations are also cooperating on a scientific sounding-rocket program, covering 4 Nike-boosted rocket launchings to be conducted by INTA in Spain with NASA assistance.

* * *

Parachutes and bombs that go up instead of down—at least initially—are under study by the U.S. Air Force.

The parachute idea was advanced by the Hudson Institute, a private, non-profit New York research firm under contract to the Defense Department. It was prompted by the fact that many pilots parachuting from disabled planes over Vietnam might be rescued if they could stay aloft until the prevailing westerly winds carried them away from land and over the South China Sea.

The Hudson Institute suggested that each pilot's chute-pack include a folded balloon and compressed helium container—together no larger than a shoe box—which the pilot could inflate instead of using his chute if he were over enemy-held territory. Once out of enemy range, he could deflate the balloon and open his parachute, or perhaps be snagged in midair by a rescue plane and reeled in.

The plan admittedly isn't perfect; winds might be in the wrong direction, or the balloon might be punctured by ground fire, but it would improve the pilot's chances of evading capture.

The upward bomb release is being investigated by the Air Force as one technique to permit high-speed aircraft to attack at extremely low alti-

(Continued on following page)



New type of communications satellite scheduled for launch by U.S. Air Force in July is this 30-foot-diameter (9.1 m) sphere developed by Goodyear Tire & Rubber Co. After being inflated in space, balloon's skin will photolyze, or disappear, with wire grid remaining rigid to reflect radio waves.

tudes. Engineering studies indicate that upward ejection would increase bombing accuracy while providing more time for the delivery aircraft to escape the bomb blast. In principle, the system works something like a pilot's ejection seat, with the weapon shooting up about 150 feet (45 m) above the aircraft before falling back to earth.

* * *

When New York City and many surrounding areas were "blacked out" by a massive power failure last fall, the city of Hartford, Connecticut, was able to restore electrical service almost immediately because it was equipped with an auxiliary system.

Its auxiliary power was provided by the J75 turbojet engine, manufactured by Pratt & Whitney Aircraft in East Hartford.

Partly as a result of last fall's failure, numerous other cities have decided to reinforce their power supply by adding standby turbojet-powered generators.

Pratt & Whitney recently announced sales to 9 power companies of J75 engines modified to drive electrical generators. The converted engine is designated the FT4.

Twenty-four engines have been ordered by Public Service Electric and Gas Company, Newark, New Jersey, to power 3 plants, each generating 121,000 kilowatts. Other orders for auxiliary systems were placed by utility companies in Atlantic City, New Jersey; Boston, Massachusetts; Philadelphia, Pennsylvania; Washington, D.C.; Columbus, Ohio; and San Diego, California.

Jet-powered generating plants are designed for use during hours of heaviest demand for electrical power. Compact, fully automatic, and independent of any other power source, the units can reach full power in from 2 to 4 minutes.

The thrust of the jet is converted to horsepower by directing the hot exhaust gases of the engine through a free turbine. A shaft attached to the spinning turbine drives the electric generator.

* * *

Characteristics of gigantic hypersonic transport airplanes capable of flashing between continents at speeds of more than 4,000 miles per hour (6,437 km/hr) were discussed in Tokyo recently by E. R. Heald, Director of Military Advanced Design for the Douglas Aircraft Division.

Addressing the annual meeting of Japan's Society of Aeronautical and Space Scientists, Heald described a hydrogen-powered commercial transport which could carry a 60,000-pound (27,200 kg) payload 5,750 miles (9,250 km). This means it could fly more than

Armed Boeing Vertol CH-47A Chinook is being tested by U. S. Army at Fort Benning, Georgia.

Weapon under nose delivers 40-mm grenades at rate of 200 rounds per minute. Mounted over forward landing gear are 2.75-inch (70-mm) rocket pods and 20-mm machine guns; 2 7.62-mm machine guns protrude from fuselage.



280 passengers nonstop between Los Angeles and Tokyo or between Los Angeles and Paris in less than 2 hours. New York and Paris could be linked in about 1½ hours.

Power for the airplane envisaged by Heald would be provided by a combination of turbojet and ramjet engines, the former to push the transport up to Mach 3—3 times the speed of sound—and the latter to cruise at Mach 6.

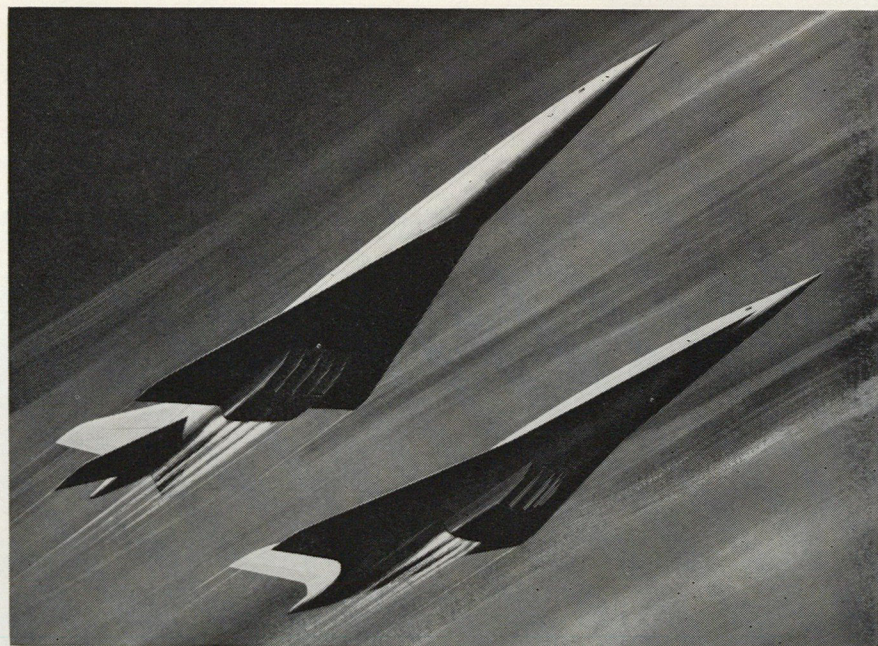
Hydrogen, used successfully in rocket launch vehicles, is the most promising fuel for a hypersonic transport, the Douglas engineer said.

Over-all characteristics of the HST are affected more by the selection of hydrogen as the fuel than by any other single factor. "Its low density results in

relatively large storage volumes which tend to 'size' the vehicle," Heald said. However, the high cost of hydrogen may impose a severe economic handicap on the HST.

General characteristics of the HST include a gross takeoff weight of 500,000 pounds (226,800 kg), nearly twice that of current long-range jets but about the same as the proposed supersonic transport. The fuselage would be about 344 feet (105 m) long. Its cross-section would be shaped like a figure 8, with passengers in the upper lobe and fuel in the lower. Area of the sharply-swept delta wings would be about 10,000 square feet (929 m²).

Engines would provide a combined total thrust of 280,000 pounds (127,000 kg) on takeoff, for a takeoff speed of



This artist's conception of hypersonic aircraft was prepared by Convair Division of General Dynamics, based on studies performed for National Aeronautics and Space Administration. Douglas Aircraft Company is also developing data on hydrogen-fueled plane.

170 knots. Speed at touchdown would be 135 knots.

* * *

The Firefish target system, a remote-controlled boat for gunnery practice, built by Ryan Aeronautical Company, San Diego, California, will be marketed in overseas areas by a Belgian industrial firm under an agreement announced by R. C. Jackson, Ryan President.

Named as manufacturing and sales licensee for the Firefish is the Manufacture Belge de Lampes et de Material Electronique (M.B.L.E.) of Brussels, Belgium.

The Belgium company produces components for Hawk missile systems and F-104 control systems for NATO; a new, small drone system, the Epervier; and other military equipment.

Placed in operational use by the U.S. Navy early in 1965, the Firefish target boat is designed to simulate a hostile torpedo boat.

M.B.L.E. will handle Firefish target systems in Europe, the United Kingdom, Scandinavia, the Middle East, and Australia.

The British Navy recently placed an order for 3 Firefish target systems for use in an evaluation program to be conducted in Singapore. Navies of

several other nations, including Italy, Belgium, Germany, Sweden, and France, have also expressed interest in the system.

* * *

Development of a revolutionary landing system for aircraft, which will bring them to a smooth stop on a cushion of air rather than on wheels, has been described by Bell Aerosystems Company of Buffalo, New York.

It consists of a giant rubber tube, perhaps 3 ft. (.9 m) in diameter when inflated, encircling the bottom of the plane's fuselage. The reinforced bottom or "tread" of the tube is pierced by thousands of tiny vent holes. The pressurized air jets out through them, forming the air cushion on which the plane floats several inches above the ground.

When the plane is in flight, the tubing would be emptied of air and would retract smoothly against the curving undersides of the plane's fuselage, giving a configuration almost as smooth as a conventional plane with undercarriage retracted.

In landing, the plane's forward speed is checked by reversing propeller pitch or jet thrust. For final braking, valves can be closed inside parts of the rubber tubing, cutting off the air cushion beneath that portion of the

tube and permitting it to drag on the ground. The friction is taken on a series of strakes or ribbed projections, similar to the lengthwise skids along the hull of a ship; they are faced with replaceable "wear shoes."

Since the landing aircraft need not come in physical contact with the ground until its forward motion has been brought to a complete stop, it can use long stretches of open water, ice, snow, swampland, sand, or dirt for most of its "runway." Only the actual debarking, service, and terminal areas would have to be surfaced.

* * *

A solid-state version of the NASARR radar is being developed for the Italian Air Force's F-104S by North American Aviation's Autonetics Division.

Autonetics has received a \$2,000,000 contract from Lockheed California Company, F-104 prime contractor, to develop the radar, designated R21-G. Flight tests are scheduled next year, according to Autonetics Vice President W. F. Sauers.

Plans for 1967 radar production also are being made between Autonetics and its European NASARR licensee, Fabbrica Italiana Apparechi Radio (FIAR), Milan, Italy. Development will be done at Autonetics, with a production line at FIAR.

* * *

The U.S. Navy and Douglas Aircraft Company are negotiating for procurement of an improved version of the Douglas Skyhawk attack bomber, designated the A-4F.

Greater capability of the A-4F results from refinements in the design of 4 earlier Skyhawks flown by the Navy and Marine Corps since October 1956.

The Skyhawk combat version currently in production is the A-4E, first flown July 12, 1961. It has seen extensive service over Vietnam.

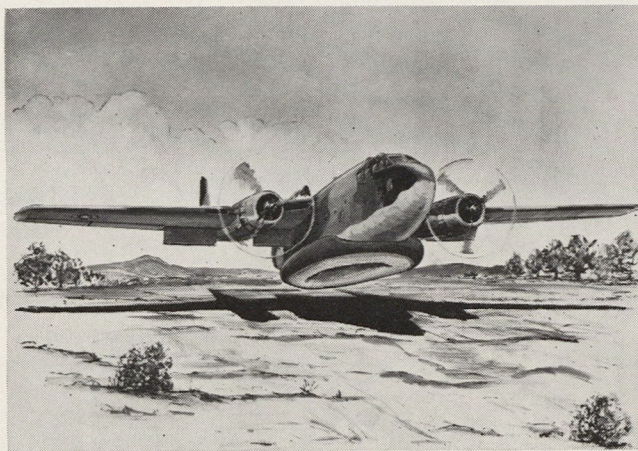
More than a year ago, the Navy contracted with Douglas to build a 2-seat version of the A-4E as an advanced combat trainer. This trainer, designated the TA-4F, combines all of the proven capabilities of the A-4E with a number of improvements. The A-4F, a growth version of the A-4E, in turn incorporates the TA-4F's improvements into a single-seat Skyhawk.

The A-4F will be powered by a Pratt & Whitney J52-8A engine with 9,300 pounds (4,218 kg) of thrust. This compares with the Pratt & Whitney J52-6 engine, with 8,500 pounds (3,856 kg) of thrust, in the A-4E.

In the A-4F, the pilot can eject safely at zero altitude and zero speed. Also incorporated in the A-4F are nose-wheel steering, updated avionics, and a wing-lift spoiler, which gives better performance in a crosswind.

(Continued on following page)

Air-cushion concept has been extended to landing gear in this design proposed by Bell Aerosystems Company. Giant rubber tube, inflated just before landing, is pierced by thousands of vent holes, forming air cushion on which plane floats over surface to landing point.



Contract will soon be let by U. S. Navy for single-seat fighter version of this 2-place TA-4F Skyhawk trainer. New plane, designated A-4F, will be powered by Pratt & Whitney J52-8A engine, with thrust of 9,300 pounds (4,218 kg).



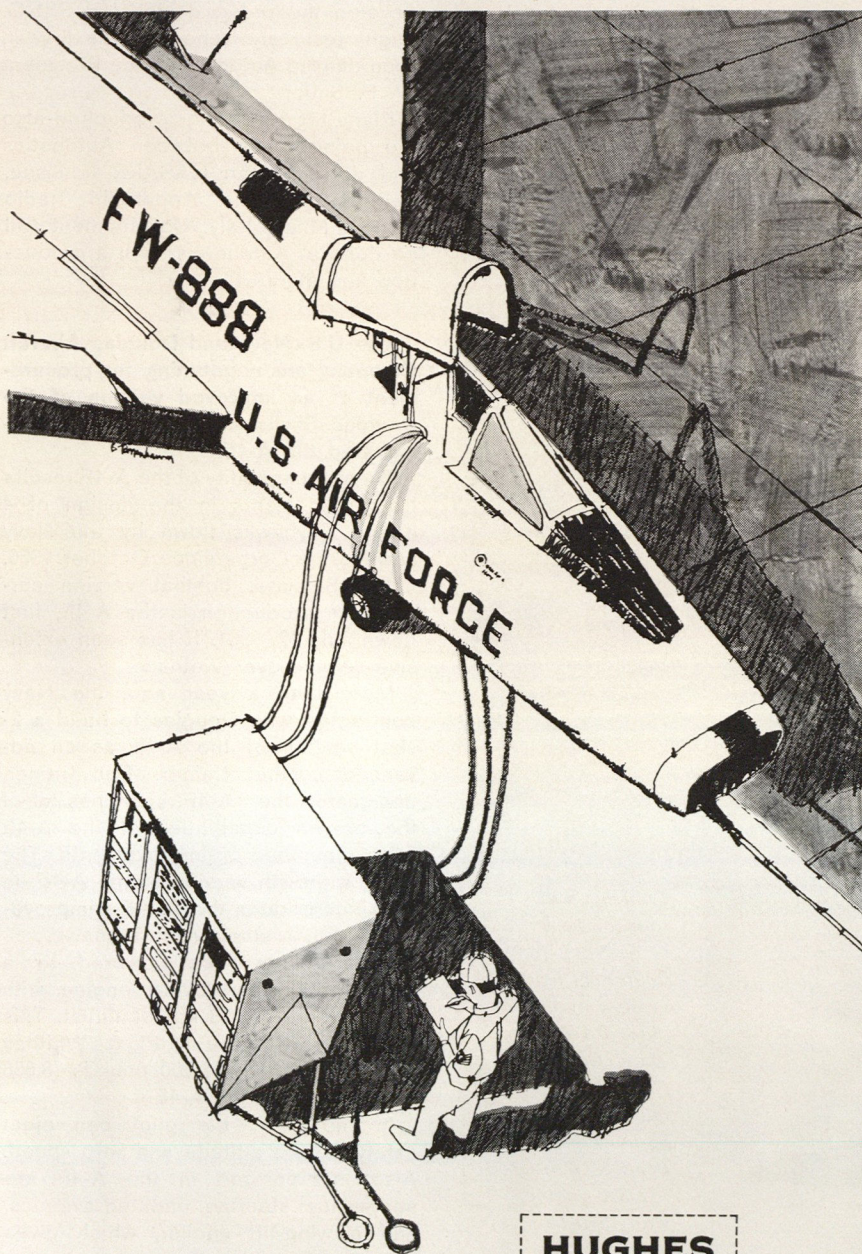
TAC HAD A NEED TO KNOW (DO YOU?)

The Tactical Air Command believed that a modern wiring analyzer used at field level could provide significantly improved weapon system reliability and availability.

Many months of testing in the field proved that TAC's concept was correct. Air Force technicians, working at the field level, programmed, adapted, operated and maintained the wiring analyzer. The net result was a substantial increase in readiness and **operational** reliability.

Official objectives and results of this test program are available now—presented in detail in Air Force Test Order 64-96, for qualified recipients of Air Force documentation.

The Hughes FACT (Flexible Automatic Circuit Tester) was used for providing this new dimension in maintenance test technology. Information is available from: Hughes Aircraft Company, El Segundo Division, Mr. L. W. Risner, FACT, P.O. Box 90426, Los Angeles, California 90009.



HUGHES

HUGHES AIRCRAFT COMPANY

A unique Mach 14 wind tunnel is being built and tested for installation in a New York University-National Aeronautics and Space Administration (NASA) Aerospace Laboratory now under construction at NYU's School of Engineering and Science in New York City.

The tunnel will produce Mach 14 velocities for 4 full seconds—a dramatic increase over the millisecond testing times available in tunnels of comparable speeds. Its accuracy in simulating actual flight conditions for scale-model tests is expressed in a Reynolds number of 10^7 or 10^8 —at least 10 times greater than the Reynolds number achieved for any other facility of its kind.

Dr. Lee Arnold, Professor and Chairman of the Department of Aeronautics and Astronautics at NYU's School of Engineering and Science, said the new laboratory will enable his faculty to enhance and expand current research on airframe designs for supersonic transports, space planes capable of round-trip flights to orbiting satellites, and supersonic combustion engines.

Professors Antonio Ferri and Victor Zakkay, designers of the Mach 14 tunnel, had to design significant innovations in heating and pressure storage techniques to achieve its unique capabilities. Professor Ferri, an authority on high-speed aerodynamics and propulsion and the man who directed the development of the world's first jet plane, the Campini jet, is director of the NYU-NASA Laboratory.

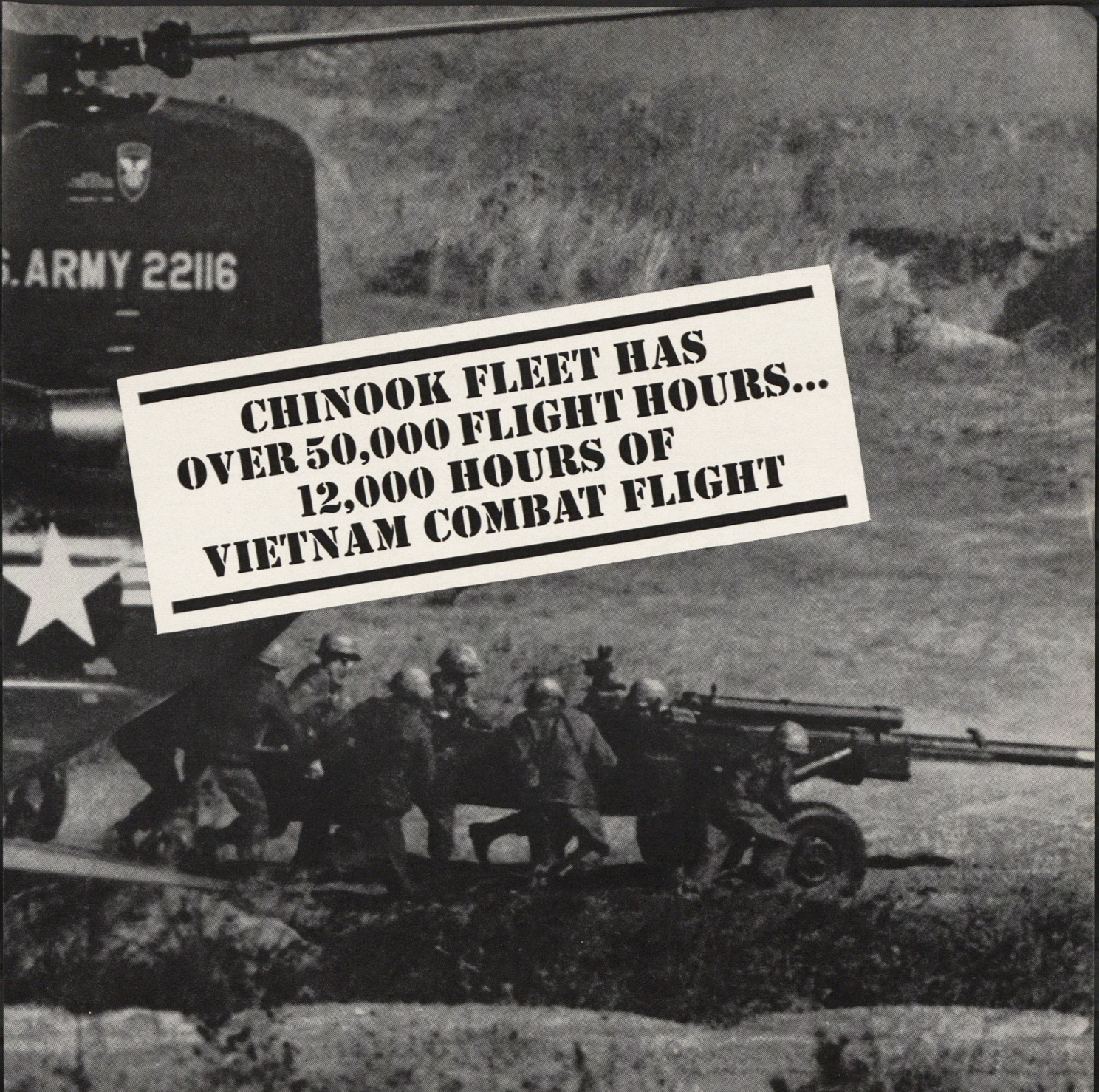
Problems the 2 researchers overcame included containing the explosive pressure of air compressed to 30,000 pounds per square inch (2,109 kg per cm^2) and heated to 2,000 degrees F. (1,093 degrees C.). At this pressure, air is almost as dense as water—a liter of it weighs more than 2 pounds (.96 kg).

In describing the new wind tunnel, Dr. Ferri stated, "No other facility I know of offers this combination of Mach number, extremely high Reynolds number, and extended testing time."

"It is the long-sought tool that will open the doors for research in the development of recoverable space vehicles, space planes, and large-scale hypersonic aircraft for flight within the atmosphere."

The development of all such vehicles, he said, demands experimental investigation of the complex phenomena within the boundary layer or region of wildly turbulent eddying, friction, and heat transfer close to the skin of high-speed vehicles. The combination of capabilities designed into the NYU equipment will enable aeronautical engineers to reproduce and study these phenomena better than ever before.

☆☆☆



**CHINOOK FLEET HAS
OVER 50,000 FLIGHT HOURS...
12,000 HOURS OF
VIETNAM COMBAT FLIGHT**

Surprise, neutralize, destroy

Guerilla warfare. Shifting, difficult, bitter — full of traps. How do you cope with it? Against the surprise of guerilla tactics, the U.S. Army can deliver its own brand of surprise — right out of its CH-47A Chinook transport helicopters.

To pin down the enemy, the Chinook can carry — into areas inaccessible to surface transport — a complete artillery section, including two howitzers, ammunition and gun crews. All in one load.

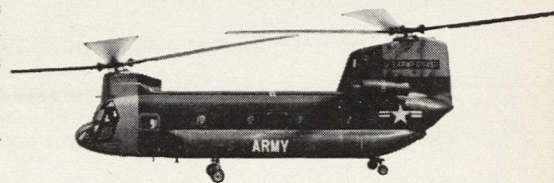
Hitting the enemy with troops where he least expects it, the Chinook can debark a fully-equipped combat platoon. And then lift away in seconds as the last man comes charging off the rear loading ramp.

Over 30 feet long and 7½ feet wide, the Chinook's cargo compartment can be loaded with Pershing Missile system components, or with infantry support weapons or the latest combat vehicles. Because of its large capacity, the Chinook reduces the number of helicopters needed for an air mobile mission, lessens traffic congestion and permits the use of smaller assault landing sites.

Now operating with the 1st Cavalry Division (Airmobile) in Viet Nam, the CH-47A Chinook has become the U.S. Army's standard medium transport helicopter.

The U.S. Army's foresight, guidance, and support, joined with the resources, man-

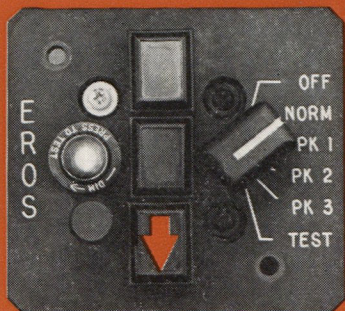
agement, and technical capabilities of the Boeing Company, have made the Chinook a performance-tested tactical transport.



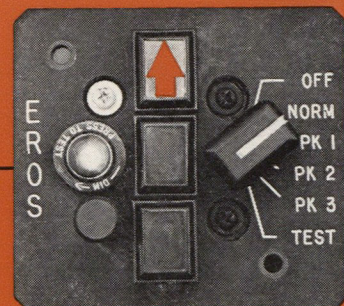
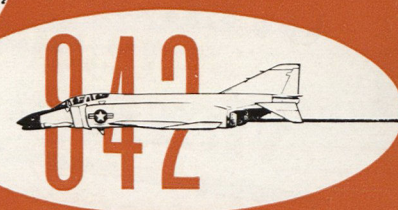
BOEING

VERTOL DIVISION

MORTON, PENNSYLVANIA



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AIRBORNE

COLLISION

AVOIDANCE

One of the most challenging requirements of the air age has been the development of an economical and effective method of collision avoidance. Utilizing a unique synchronization technique which permits precision high speed timing for range and range-rate measurements, McDonnell is now flight evaluating a coopera-

tive system for this assignment. Called Elimination of Range Zero System* (EROS), airborne units function in cooperation with each other to provide positive, unambiguous cockpit instructions for collision avoidance.

The system provides a 60 second warning for aircraft closing at speeds up to Mach 4.

*Patent Pending

MCDONNELL

For additional information, write on letterhead to: TORS Systems, McDonnell, Dept. 03, St. Louis, Missouri, 63166.