

APRIL 1963 / \$1.00

AIR FORCE

and

DIGEST

The Magazine of Aerospace

Published by the Air Force Association

4th Annual MISSILE AND SPACE ALMANAC

Liftoff of Titan II and
two-man Gemini capsule
from Cape Canaveral—
an artist's conception.



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THREE engines, plus interstage structures and missile skirts are assembled into Minuteman missiles and inspected (above) at Boeing facility adjacent to Hill AFB, Utah.

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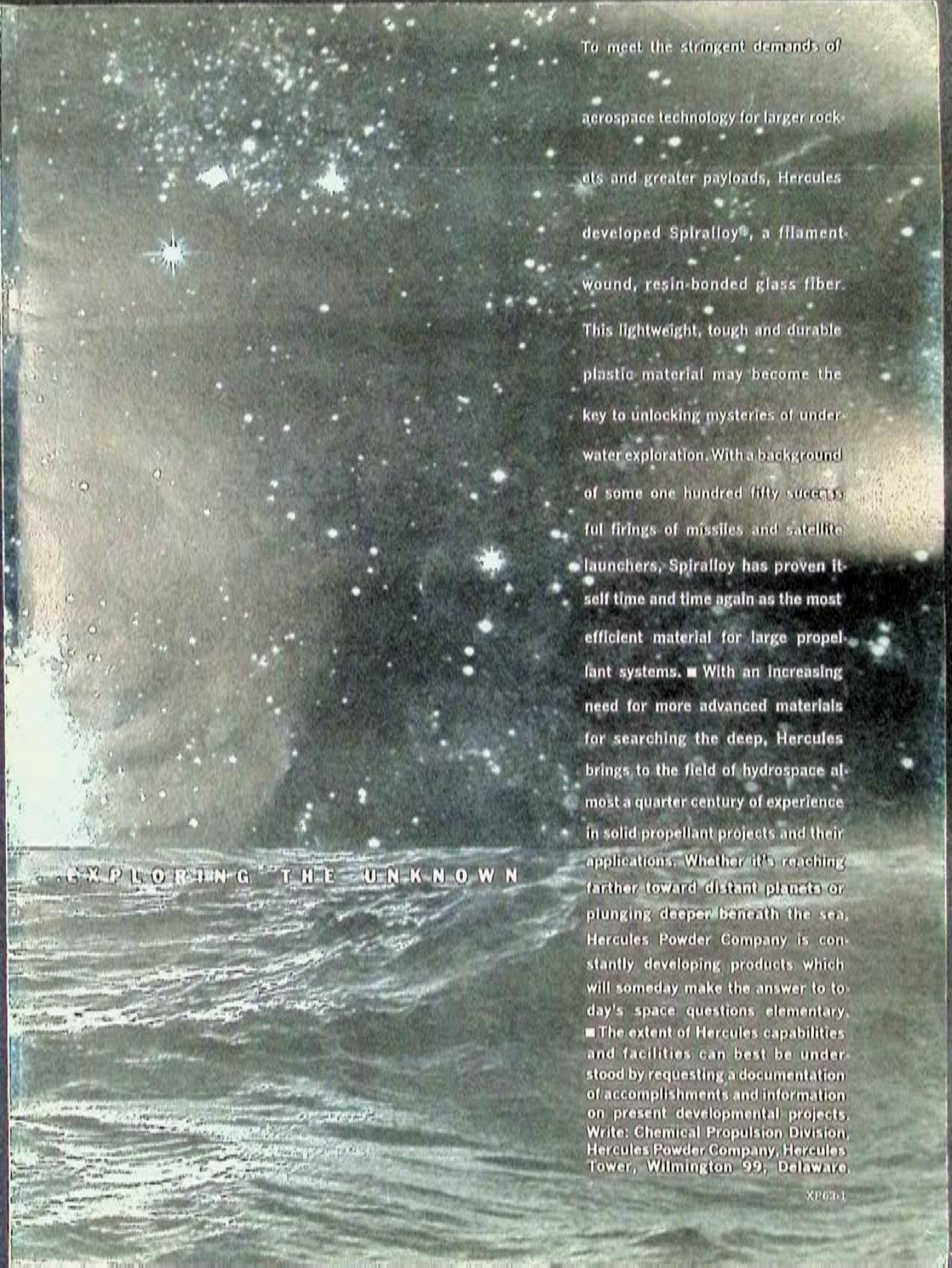
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BPA AIR FORCE Magazine and SPACE DIGEST are published monthly by the Air Force Association, 1901 Pennsylvania Ave., N.W., Washington 6, D.C., Federal 8-6575.

PRINTED in USA, by McCall Corporation, Dayton, Ohio. Second-class postage paid at Dayton, Ohio. Composition by Western Graphic Arts, New York, N.Y. Photoengravings by Southern & Lanman, Inc., Washington, D.C.

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ADVERTISING correspondence, plates, contracts, and related matter should be addressed to AIR FORCE/SPACE DIGEST, Advertising Headquarters, 501 Madison Ave., New York 22, N.Y.

EDITORIAL correspondence and subscriptions should be addressed to Air Force Association, 1901 Pennsylvania Ave., N.W., Washington 6, D.C. Publisher assumes no responsibility for unsolicited material.

CHANGE OF ADDRESS: Send old and new addresses (include mailing label from this magazine), with zone number if any, to Air Force Association, 1901 Pennsylvania Ave., N.W., Washington 6, D.C. Allow six weeks for change of address to become effective.

SUBSCRIPTION RATE: \$6 per year; \$7 foreign. Single copy, 50¢; special issues, \$1. Association membership includes one-year subscription, \$6 per year. (Cadet, Service, and Industrial Associate memberships also available.)

UNDELIVERED COPIES: Send notice on Form 3570 to Air Force Association, 1901 Pennsylvania Ave., N.W., Washington 6, D.C.

AIR FORCE / SPACE DIGEST • April 1963

AIR FORCE



and **SPACE DIGEST**

The Magazine of Aerospace Power
Published by the Air Force Association



VOLUME 46, NUMBER 4

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Now Hercules does something about the weather

There seems to be no end to the versatility of the C-130 Hercules airlifter. Now the giant propjet transport is a weatherbird, too.

High-altitude weather reporting is rapidly assuming a new strategic significance. Last-minute reports of the weather along the route of an airborne task force or of the cloud cover above the target of an amphibious assault can add immeasurably to the nation's ability to contain brush-fire wars on a world-wide basis. To meet this need, the Air

Weather Service of Military Air Transport Service is now operating five WC-130s — the new weatherbird version.

All in all, there are 500 C-130 Hercules in sixteen different versions operating throughout the free world. Most of them are in service with the United States Air Force. Others fly for the U. S. Navy, Marine Corps, and Coast Guard. Still more are in service with the air forces of Australia, Canada, and Indonesia. In addition to military airlift missions, the Hercules is a bird of peace that brings



food and medicine to hungry and homeless people all over the world when disaster strikes. Ski-equipped C-130s support the scientists in Operation Deep Freeze at the South Pole. The list goes on and on and so does the C-130 production line at Lockheed-Georgia. Production will continue simultaneously with the new turbo-fan C-141 StarLifter for years to come at the Giant Marietta airlift manufacturing center.

C-130 Hercules



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Needed: More Noise About Pay

By John F. Loosbrock

EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D. C., MARCH 25

IN HIS budget message to the Congress earlier this year President Kennedy said:

"In this era of increasingly complex weapons and military systems, a large part of the effectiveness of our defense establishment depends on the retention of well-trained and devoted personnel in the armed services."

With this we heartily agree.

The President then went on:

"General military pay was last increased four and a half years ago. Since then, higher wages and salaries in private industry have provided strong inducement for highly trained military personnel to leave the service for better-paying jobs in civilian life."

The facts certainly support this statement.

But the President also said that an attempt would be made this year to redress the pay imbalance.

"To help meet this serious problem, and in fairness to the dedicated personnel in our armed forces, I will shortly submit to the Congress specific recommendations for increases in military compensation rates. . . ."

It would be nice to be able to tack a happy ending onto this noble prologue. Instead, it appears at this writing that the "dedicated personnel in our armed forces" will have to settle for a tragic farce, maladroitly written and ignobly played.

The script was written in the Department of Defense, in the form of a \$900 million pay bill drafted without benefit of counsel of the military personnel chiefs of any of the services, following the current fashion of suspecting the soundness of any advice proffered by a man in uniform, regardless of his credentials. We welcomed the bill in principle and endorsed it on the same grounds before access to its specific recommendations made it clear that it falls far short of its announced purpose—in Secretary McNamara's words, "to attract and retain sufficient military personnel to sustain our military forces at the required state of readiness."

The bill, as submitted, fails to grasp the nettle of civilian-economy competition for skilled and talented people—the key to retention. It does not begin to fill the gap between military pay and federal civil-service pay that has resulted in the unseemly spectacle of the government competing with itself in the job market. And there are other key targets missed by the bill.

At its first stop on the tortuous trip through the Congress, the bill's deficiencies—some of them at least—were recognized by the House Armed Services Subcommittee which is headed by Rep. Mendel Rivers, Democrat of South Carolina. The Rivers Subcommittee increased the rate of pay over that proposed by DoD. As the Air Force Association had urged, the Subcommittee version provided for an effective date earlier than that proposed by the Administration and eliminated the disparity between

Reserve and active-duty pay in the DoD bill. The Rivers Subcommittee improved the method for recomputing the pay of those retired before 1958, to correct an injustice in the 1958 pay bill. All in all, the Rivers Subcommittee recommendations added up to an additional \$600 million, even though falling short of ensuring a military-pay structure comparable with civil-service and postal-worker increases recently granted. The Subcommittee version would be a great improvement over the bill as drafted by the Department of Defense.

In the normal course of events, the House Armed Services Committee, chaired by the veteran Georgia Democrat, Carl Vinson, would have accepted the Subcommittee's recommendations and reported out the amended bill for a House vote. But this is not a normal year. Republican pressure to cut the budget is extremely strong. In reaction, Administration pressure is heavy on all Democrats to at least hold the line on Administration fiscal proposals. Mr. Vinson, who is used to having his way in the House with military legislation, had a closer squeak than usual with the military authorization bill earlier this session. It now looks as though his committee, not wishing to risk a floor defeat, is pulling in its collective neck, will scrap the Rivers Subcommittee recommendation, and even cut a bit from the original DoD bill.

As a result, the military standard of living is once more being ground between the millstones of partisan politics. Military pay legislation has always been vulnerable to such shenanigans. Military people are traditionally apolitical. They represent no identifiable bloc of votes. They have no union. They cannot strike. They seldom write letters to congressmen or even to editors. Often they do not maintain a legal voting residence. They can be counted on to suffer in silence. Or, too often, they simply give up and leave the service.

Maybe it's time to change all that. House action is far from complete, and the Senate has yet to act. Even if our worst fears about House action are realized, a strong Senate version could still be passed and the House would be able to yield gracefully in conference. The families, friends, and supporters of military people—if united—do represent a significantly sizable voting group. Surely the pay legislation is one point on which all of us can unite and make our views known to our elected representatives. For the long pull, the activities and efforts of organized groups such as AFA, the Navy League, the Association of the U.S. Army, Reservists, Guardsmen, retired people, and so on, should be much more closely coordinated than they have been to date.

There's an old saying, "The wheel that does the squeaking gets the grease."

Military people and their friends will just have to make more noise where it counts.—END

$$m_1 + t + m_2 (a c) = d_p *$$

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No Absolute Weapon

Gentlemen: . . . I have read your article "Strategic Retreat from Reality" [January '63]. As a matter of fact, I read AIR FORCE/SPACE DIGEST regularly.

I am just about in complete agreement with the article. As you know, in my own writing I have insisted that a limited-war theory is only valid when one has a massive strategic strike capability, and it is only within the framework of a significant strategic capability that one may indulge in the solution of problems involving lesser force.

Your reference to the likelihood of technological surprise struck a particular note with me: "By that time, the invulnerability of these missiles, not seriously questioned today, may well be compromised by technological surprise in such areas as antisubmarine warfare, ballistic missile defense, or a variety of military applications of space technology." One might add biological and chemical warfare as well, but in any case, it is a fact that we must never overlook. There is no "absolute" weapon system.

I was also struck by your discussion of escalation and the likelihood of escalation downward.

. . . My congratulations for the fine publication that you have and the contribution it is making to better understanding of our national survival problem.

LT. GEN. JAMES M. GAVIN,
USA (RET.)
Cambridge, Mass.

Billions for the Moon . . .

Gentlemen: I look forward with enthusiasm to each issue of AIR FORCE/SPACE DIGEST. Please pass on my congratulations to your Senior Editor, Claude Witze, for his excellent "Farewell to Counterforce" [February '63].

It is a sad thing that so few "Voices in the Wilderness" are heard from these days. Much more common are the insidious comments by "high Administration or Defense Department officials" which have succeeded in forecasting the death knell of most of the current military aerospace sys-

tems. It is incongruous to me, although I am admittedly biased, that a nation committed to spend billions to place a man on the moon is unwilling to spend what is needed to provide a military capability in space. In fact, is unwilling to admit that *there is a need for a military mission in space!*

Must we always wait until Pandora's box is unlocked before we can see what lurks within? How can we look back over the past seventeen years and blithely assure ourselves that the leopard has changed his spots? I believe this is what many individuals in high places are attempting to sell the American public. I further believe that we are placing this nation in deadly peril by so doing.

The sands of time are littered with the wreckage of nations who made only one mistake, not multitudes! Granted, the costs are high but how does one put a price tag on freedom? Can it be expressed in dollars and cents, Gross National Product, or other monetary measurements? I think not, for if it is then thousands of my comrades in arms have laid down their lives for naught.

MAJ. DONALD C. BENNETT
Los Angeles, Calif.

Cast in Concrete vs. Flexibility

Gentlemen: Your recent articles on our stalemate strategy represent a timely and accurate presentation of the extremely serious issue confronting Americans today.

Any weapon system "cast in concrete" will have a short life. The Maginot Line is a pertinent example. . . . It would not surprise me to discover that the concept of this inflexible, unchangeable weapon system was sold to the French government by the "defense intellectuals" of the day as being absolutely impenetrable and, thus, a plausible deterrent justifying the expense. Though manned, there was nothing that man could do to modify or change the manner of employment of this system as designed by its architects and rigidly fixed by the concrete mixers.

Consequently, the Germans, in planning to overcome this system,

were confronted only with known, fixed factors to challenge their ingenuity. It really wasn't much of a challenge.

Singapore, with its fixed emplacements all pointing in the wrong direction, completely incapable of responding to an attack differing in the slightest degree from that for which it was designed, is another classic example.

As you must have deduced by now, I concur wholeheartedly with your reference to a "strategic ceiling—rigid, immovable, and possibly brittle," as a description of the US strategic weapon system of the late '60s and early '70s consisting *only* of ICBMs. I am convinced it will be "brittle"—just as brittle as the Maginot Line. Because here, again, we have a weapon system so fixed in its method of employment that the enemy's problem of neutralizing or degrading the system is simplified. Though the Polaris is better in this respect than the Minuteman, in that it does provide one option of flexibility—movement of the launch position—it suffers the same disadvantages from the moment it is launched. From this point until it strikes the target it acts exactly and inflexibly as it was designed to years before.

In contrast, let me cite a personal World War II experience. I joined a B-26 (Martin) group as Executive just prior to its deployment overseas. For months this group had devoted every waking moment to the development of an effective, *low-level* weapon system. The weapon system, of course, was the group—the aircraft, *crews*, etc. . . . The crews were at home "on the deck"; navigators had adjusted to the difficulties of this environment; pilots knew just how much to allow for "mush" of the aircraft after ducking below a hill or grove of trees. Before it was put together the planners had carefully deduced that this was the manner in which this "weapon system" should be employed. Every indication at the time led logically to this conclusion. It was designed and put together, therefore, to carry out this
(Continued on page 12)



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specific mission, much in the manner of ICBM design and construction. The crucial difference, of course, was that the B-26 group was a combination of men and machines with man the predominant factor. This weapon system was designed to exploit to the maximum man's capability as a highly flexible, ingenious, adaptable and creative creature capable of improvisation to match the immediate circumstances, whatever they might be. The ICBM is not so designed.

When the group arrived in England, we were suddenly faced with the realization that the planners who had designed this weapon system were wrong; not when they did the planning—they were right then—but by the time the group was put together, trained, and deployed, they had become wrong because the enemy had developed a most effective counter to low-level operations.

Nevertheless, because this weapon system had flexibility, the men on the spot were able to deviate markedly from the designed employment, revise the tactics, and get in the fight with minimum delay. . . .

To some extent the same lesson should have been learned from the B-17 groups in England. Formations had to be modified, tactics changed, unplanned fighter escort developed. Fighters are another example. All came off the planners' and designers' desks and eventually from the factory with "short legs." Until this was corrected with long-range drop tanks, they were of little help to our bombers. . . .

Since such flexibility is not built into our ICBMs, the unanswered but crucial question is whether present-day designers and planners have a better crystal ball than their World War II counterparts, or, for that matter, their Any-War counterparts.

If there is the faintest doubt that they do—and I agree with you that there is reason for ample doubt—then Americans somehow must realize that they possibly are being led down a primrose path from which there may be no return.

JACK B. LIMBER
Arlington, Va.

It Ain't Funny

Gentlemen: I occasionally buy AIR FORCE/SPACE DIGEST and RAF Flying Review to see what the allies of the ground forces are up to. Your January article, "The Long Lead Time Directorate," by John Ross Minty, struck me as very funny, as did the one on "The Space Race," by M. J.

Arlen. So, like Little Audrey, I just laughed and laughed.

But after a bit of sober reflection, it seemed to me that neither of them was funny in the least. Not the damn least bit, in fact. Why do you print such horrifying things? If we were to count the times such comfortable things are said about serious threats, we'd need a dozen computers.

As for the Lead Time people, they must exist somewhere, as well as the Office of Applied Snafu, that secret Pentagon group which takes sensible ideas and makes such a mess out of them no one will own up to same, or the Bureau of Rapid Reorganization, which waits 'til things have settled down from the Last Final Rehash of the Forces, and then stirs the anthill anew. How else could we account for the state of things?

I shall quit reading your gazette. Your humor is far too ghastly, and, Lord knows, the facts of today are bad enough. Now, if I can only find a likely hole, and pull it in after me. . . .

JOHN P. CONLON
Newark, Ohio

• Ex-reader Conlon is a columnist for The National Guardsman. — THE EDITORS

Two Who Were Shocked

Gentlemen: I was shocked by the references in both Editor Loosbrock's "Strategic Retreat from Reality" and Dr. Kurt London's "Balance Sheet of the Permanent Crisis" [January 1963], to "nuclear holocaust." Presumably both were written to help our side.

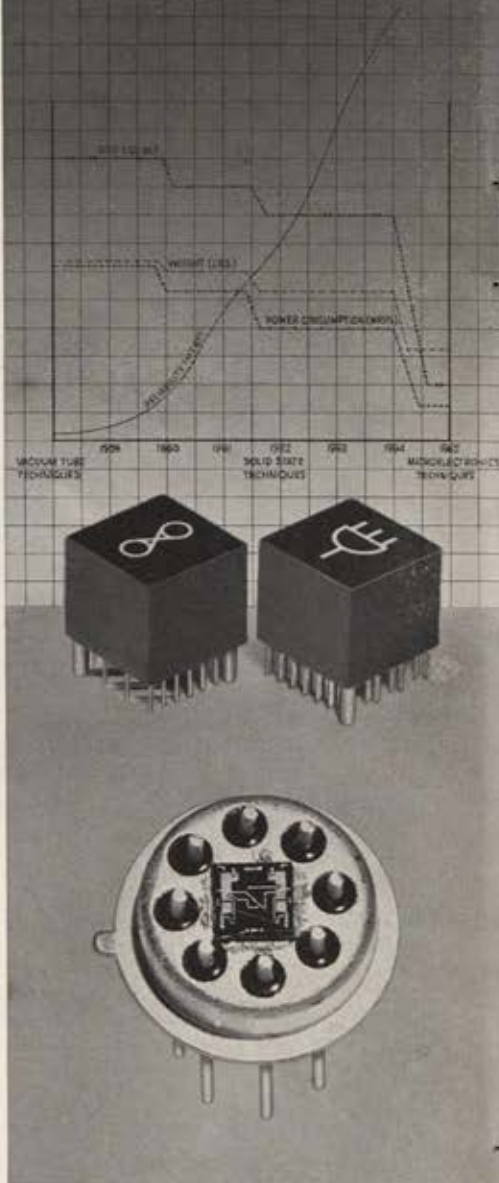
In the course of my work I've had occasion to use nuclear parameters. I don't understand the difference between what I know and the hysteria that incessantly bombards Americans from all news media.

You know better than most about the finite physical limitations of nuclear weapons, their carriers, and the effective measures that can be taken by the people for survival. We stand to lose more from ignorance, resignation, and concessions than from "nuclear holocaust."

L. S. ABBOTT
Aircraft Structures Engineer
Wichita, Kan.

• We agree with Reader Abbott's conclusions. But we fail to see how the use of the word "holocaust" in either of the contexts he mentions takes issue with his points. Because the word has been misused by others
(Continued on page 15)

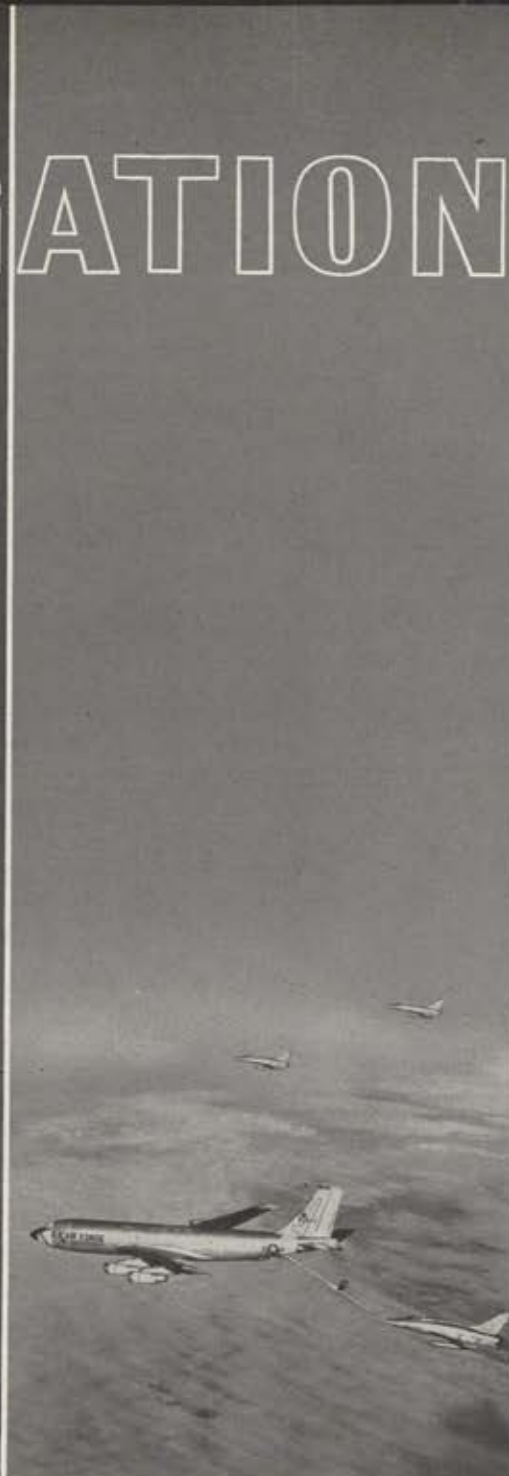
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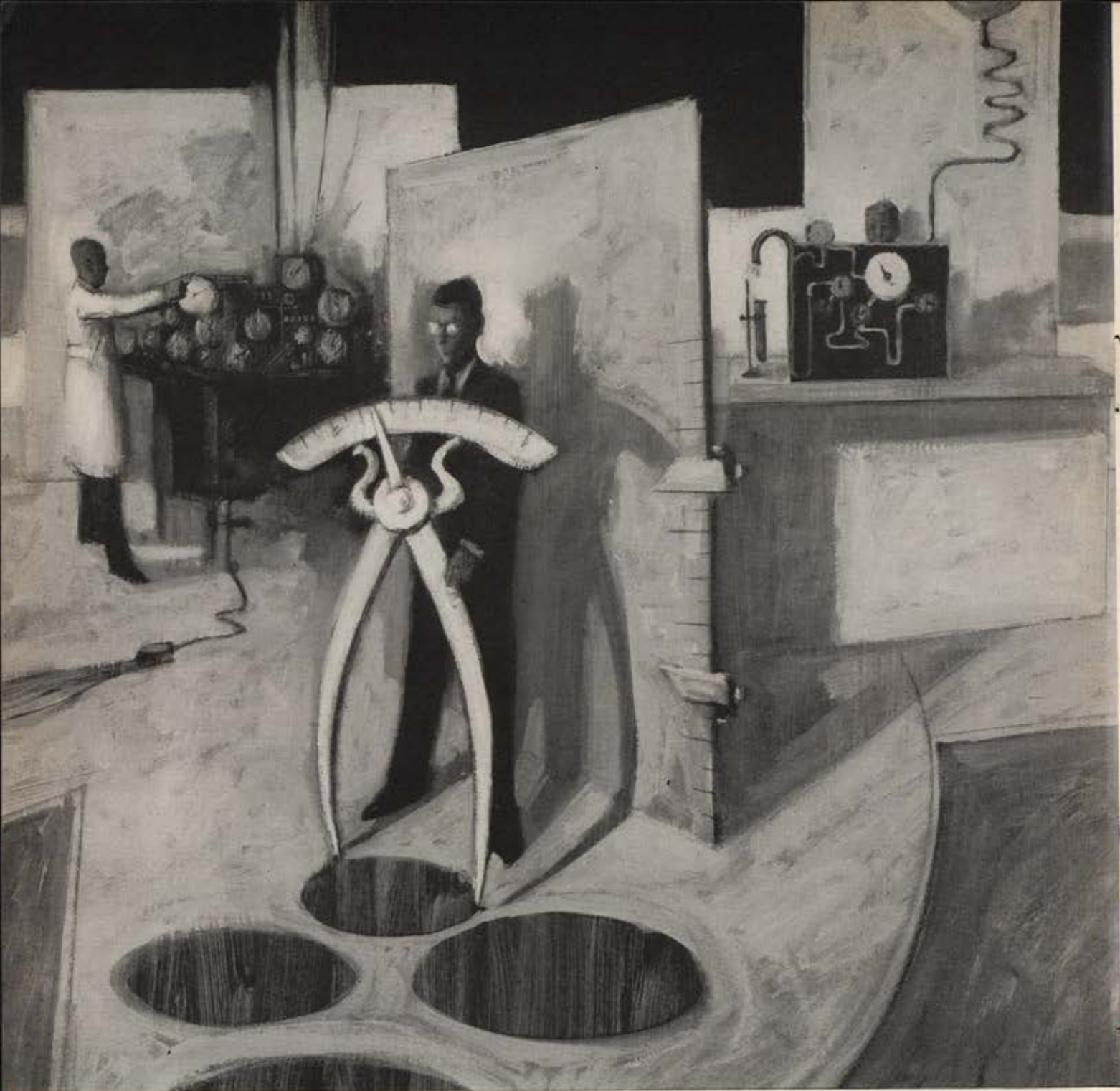
Hoffman is the world's largest maker of equipments for TACAN and DME checkout, with a complete line that includes beacon simulators, peak power calibrators, azimuth error analyzers, portable ramp testers and bench sets. As further demonstration of GSE capability, Hoffman has produced automatic monitoring systems for VOR stations.

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need not bar its legitimate use.—THE EDITORS

Gentlemen: I'm shocked! When I saw that statement "The 70, whether RS- or B-, is dead . . ." I decided Mr. Loosbrock is in the wrong frame of mind.

I figure that the Air Force Association, above all others, should work for the RS-70 all the way and not admit defeat. Our Congress is behind this weapon system, surely.

All I ask is that the AFA doesn't become pessimistic about the RS-70's future. I can't imagine this fine organization giving up on such an important issue.

C/A2C CHERYL MOORE
Plainfield, N. J.

• *Let's say the facts are not conducive to optimism.*—THE EDITORS

Calling All "Old Boulders"

Gentlemen: A small group of us "Old Boulders" are firming up plans for the first reunion of the World War II 17th Photo Recon Squadron. Since our last Stateside base was Peterson Field, Colorado Springs, Colo., before going overseas, we chose the Springs as our reunion spot, in early July.

So far we've had over fifty-five men reply affirmatively. . . . If any other Old Boulder types from the 17th see this letter, please contact the undersigned. We'd like to make this a real wing ding of a get-together. It's been twenty-one years.

Also, if anyone can give us a few pointers on his experiences in planning a reunion we'd really appreciate hearing from him. Our chief concern is housing, entertainment, timing, etc.

COL. KEN HYMAN
6 Yale Ave.
St. Louis 30, Mo.

Pilot from Texas

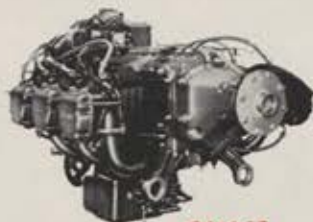
Gentlemen: I would very much appreciate help in locating a World War II US airman. His name is Jimmy Douglas, from Texas.

He was a pilot of a Fortress 2 bomber which was shot down between Mönchen-Gladbach and Rheydt in Western Germany on September 18, 1944, as a result of which he lost his left arm. He was first hospitalized at Giessen, Germany.

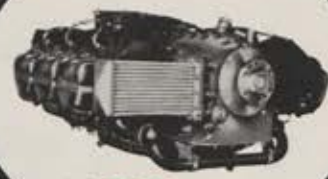
My reasons for finding him are strictly personal and I know, if he is still alive, he will be only too glad to renew a contact.

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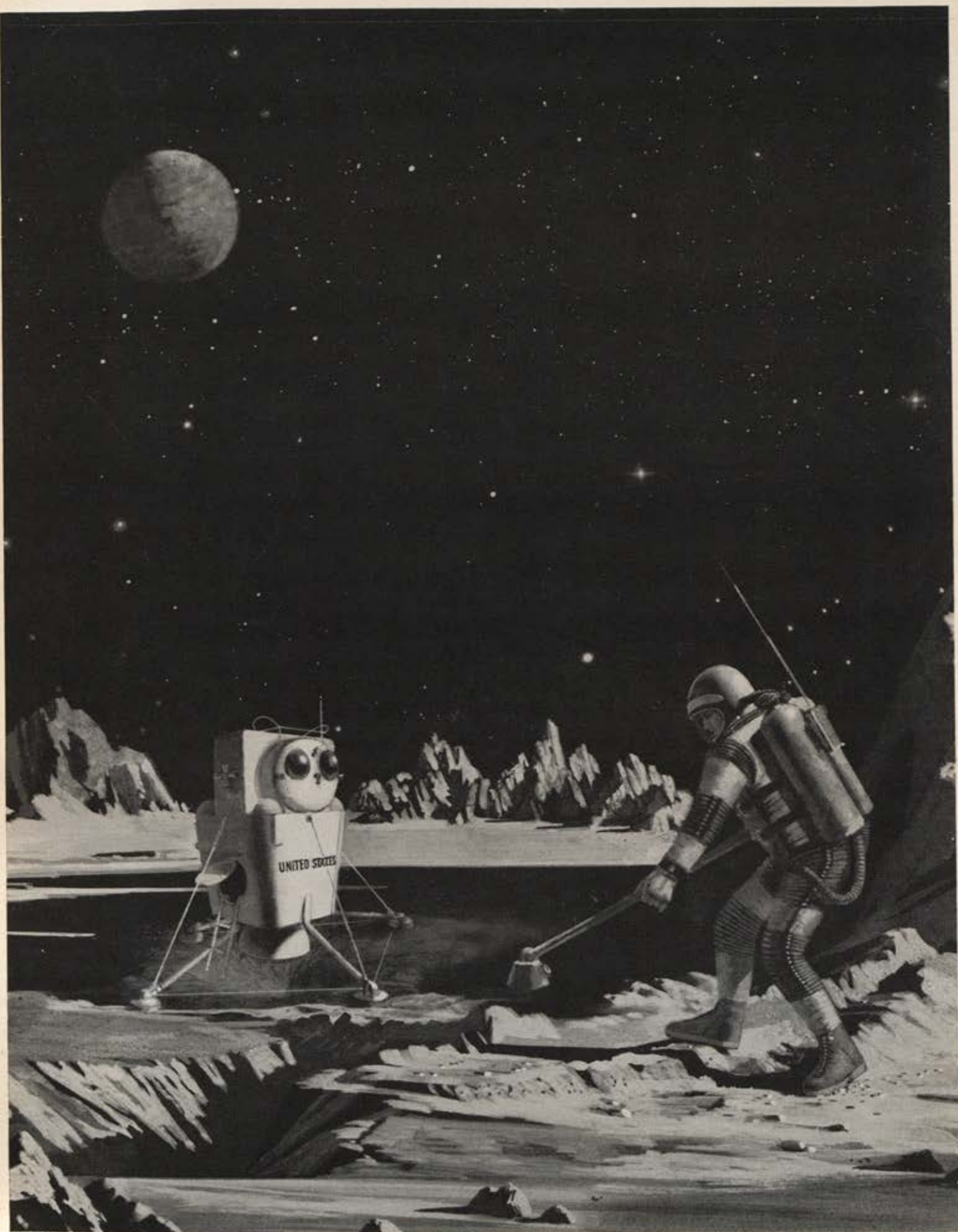


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How do you decide what a man on the moon will need to survive?

...another example of the complicated problems which Douglas and the aerospace industry are helping the Air Force and NASA to solve

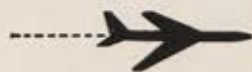
Among the complex research problems now under study at Douglas is lunar survival. Ten years ago you'd probably have branded it ridiculous. Yet Douglas was at work on it as early as 1947, and began a series of detailed proposals, at the request of the U. S. Air Force and the National Aeronautics and Space Administration, on moon bases and the kinds of vehicles needed to explore the lunar surface.

Such problems required the development of a versatile team of experts. Geologists and astrophysicists have determined the probable environment and physical conditions man will encounter. Medical men have worked on the problems of clothing, food, water, artificial atmospheres, as well as the effects of prolonged weightlessness on man's structure and mental attitudes. Logistics experts have evaluated ways to get him to the moon, move him over its surface, return him safely to Earth.

These are just a few of the steps which Douglas began taking long ago to help assure the success of man's first visit to the moon. Today Douglas is far more than a manufacturer of some of the world's most advanced aircraft, missiles and space vehicles. It is an organization of scientists, engineers and technicians equipped with the *vision*, the *knowledge*, the *experience* and the *facilities* to deal with all the complex problems of transportation and weapons systems in the air and in outer space.



his partner in the space ship.



AIRPOWER in the news



By Claude Witze

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

Let's Define the Threat

WASHINGTON, D.C., MARCH 20

It may be that the current Senate inquiry into the choice of a contractor to build the two-service TFX fighter will focus on the real and vital issues involved, but there is small evidence of it so far. We are caught in the vexatious situation of going to press on the eve of Defense Secretary Robert S. McNamara's appearance before the Permanent Subcommittee on Investigations of the Senate Committee on Government Operations, headed by Senator John L. McClellan, Democrat of Arkansas. It is no secret that the Secretary will be geared to devastate his critics. He has set up a special task force in the Pentagon to collate the material and coach him for the quiz. Only the rash are predicting he will come off second best or that his choice of General Dynamics and Grumman over Boeing will not stand as firmly as the dome over the Capitol.

Light has been thrown, literally within the past few hours, on the purpose and intent of the McNamara administration. There has been leaked to the press a few copies of a memorandum called "A proposal to revise bidding and source selection procedures for major research-and-development contracts." The author is John Rubel, an Assistant Secretary of Defense and Deputy Director of Research and Engineering. Mr. Rubel is known in Washington as a caustic critic of the concept that there is a military mission in space—he calls this a "doctrinal abstraction"—and, in general, of military and industrial competence. His memorandum proposes that actual source selection on major contracts be left entirely in the hands of the civilian secretariat. The military, under the Rubel proposal, would be confined to evaluation work, and the findings of the boards "would be reported to those charged with making selections." It is presumed that the present Source Selection Boards, made up of high-ranking military men, would be abolished.

In the McClellan hearings on the TFX award it already has been made clear that the Rubel proposal has had a trial run. There appears to be military agreement that the Air Force and Navy prefer the Boeing proposal and that they have been overruled. In a thirty-two-page defense of this action, Mr. McNamara has spelled out some of his complaints about the military source selection system, and there is no doubt his testimony, soon to come, will add many refinements. He charges that weapon-system costs have run from 300 to 500 percent higher than the original estimates, and he traces the blame. This he has fixed on performance standards that are too high, unrealistic cost estimates, inadequate program definition, poor source selection procedures, and too many cost-plus contracts. He is convinced, and says he is supported by his Defense Industry Advisory Council, that the system can and must be improved.

All of this is understandable, and certainly a manager of Mr. McNamara's credit and claim should be expected



—Wide World Photos

Senator McClellan, chairman of investigations subcommittee probing award of Air Force and Navy TFX fighter contract, draws smiles from Senator Muskie and Arthur Sylvester of the Defense Department; \$6.5 billion contract resulted in new detailed study of Pentagon policies on procurement.

to provoke improvements. But it is perfectly obvious from the Rubel memorandum and the conduct of the TFX matter that the system is not to be strengthened, but destroyed. After the TFX had been through four evaluations and the Chiefs of the Air Force and Navy had recommended the Boeing source reiteratively, there was no further military consultation or feedback from the civilian secretariat. The USAF and Navy Secretaries signed a justification for the choice, along with Mr. McNamara. The military men did not know they had been overruled until after the fact. At no point did the service secretaries approach their Chiefs of Staff or the deputies with criticisms or misgivings about the military machinery that came up with what they considered the wrong answer.

There is another dominant factor. This is the simple insistence of Secretary McNamara that the Air Force and Navy can perform their missions with what is essentially the same airplane. Mr. McNamara says this can be done, with reduced costs and increased reliability, providing there is no "degradation of essential military requirements." He said he felt the challenge on this from "the majority of experts in the Navy and Air Force [who] said it couldn't be done."

The Secretary's perspicuity on this angle was brought out most clearly by an early witness from the Navy. He was George Spangenberg, Director of the Evaluation Division, Bureau of Naval Weapons. His qualifications to speak before the McClellan Subcommittee were clear. He has worked as a civilian for the Navy since 1935, has been involved in design competitions and the selection

(Continued on page 21)

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of new Navy planes since 1939. Mr. Spangenberg told the hearing that the TFX design job was extremely complex and "in fact, the services did not really think it could ever meet the combined requirements."

The witness was asked by Jerome S. Adelman, counsel for the subcommittee, whether this was an effort to get a single airplane that would meet both Air Force and Navy needs. Then, from the record:

Mr. Spangenberg: That is right.

Mr. Adelman: And there was a great deal of fear on the part of both the Navy and the Air Force that this could not be done, is that right?

Mr. Spangenberg: We knew it could not be done, Sir.

The Chairman: Do you say it has not been done now?

Mr. Spangenberg: That is right, to meet the original requirements of the two services with one airplane.

Later, the exchange continued like this:

Mr. Adelman: And don't you feel, even now, with the fourth evaluation, even though this plane will meet the minimum requirements of both the Navy and the Air Force, except in some respects, that you really have the best Air Force plane or the best Navy plane that you could get of this type?

Mr. Spangenberg: I am sure that the services will agree that a Navy airplane for the Navy and an Air Force airplane for the Air Force will give better airplanes for both. . . . The idea of one airplane was a money-saving idea of the Secretary of Defense. The decision to compromise the requirements was levied on the services by the Secretary of Defense. The Air Force was given the administration of the program and said "meet these requirements." All I have said right now is that they were unable to meet the original requirements levied on the services by the Secretary of Defense in one airplane.

The witness, replying to a question from Senator Edmund S. Muskie, a Maine Democrat, said there may have been some persons in the services who thought this

trick was possible, "but I was not one of them." He added that neither the General Dynamics nor the Boeing design was better than the original requirement, but that the Boeing design came closer. He said the Navy usually lists reasonable characteristics in a work statement and tells the contractor they must be equaled or bettered. That condition, the witness told the Senators, was not in the TFX statement, and "we simply did not believe you could do it."

Senator Muskie: And it has not been done, as I understand it.

Mr. Spangenberg: That is right.

Senator Muskie: So, in Navy practice you would not yet have selected a source?

Mr. Spangenberg: We wouldn't have been there in the first place. . . . We have not said that the airplane as it now exists is not a satisfactory airplane. We think the designs are satisfactory. We do not think that they fully meet the operational requirements initially established by the Navy, and we do not think they meet the combined requirements of the Air Force and Navy. And we know they do not meet the initial requirements established by the Secretary of Defense. . . . We have achieved a design that we think will be a satisfactory Navy air fighter and that the Air Force thinks will be an acceptable tactical fighter. They do represent advances over our current inventories. They are both worth buying. But they did not meet the initial requirements. Part of the reason, I am sure, for this extended program that we have been in is because we had somewhat irrational requirements to start with.

The witness also denied flatly the accuracy of several statements in the McNamara-Korth-Zuckert memorandum that tried to justify the final decision.

This exchange, against the background of the Rubel memorandum and the rejection of the military recom-

(Continued on following page)



John Stack, for thirty-four years one of the US government's leading aeronautical engineers, was described before the McClellan Subcommittee as "Mr. TFX." The label was used by Senator Jackson to express his astonishment when Assistant Secretary of Defense Arthur

Sylvester said he didn't know Mr. Stack "from anyone else" but noted that he had testified as an expert.

Since last June, John Stack has been Vice President and Director of Engineering of Republic Aviation Corp. His entire career before that, back to his graduation from the Massachusetts Institute of Technology in 1928, was spent with the National Advisory Committee for Aeronautics and its successor, the new National Aeronautics and Space Admin-

istration. Mr. Stack probably is the most distinguished, and best known, American of his profession.

Only last December at a dinner attended by 2,000 people in Washington, he was awarded the Wright Brothers Memorial Trophy. He is the only man honored twice with the coveted Collier Trophy (1948 and 1952), and his other distinctions reflect the international nature of his reputation. He is a fellow of the Institute of Aerospace Sciences and the Royal Aeronautical Society of Great Britain. He has received the Air Force Association Science Trophy (1948), the medal of the Swedish Society of Engineers (1951), and the Sylvanus Albert Reid Award of the IAS (1953).

Mr. Stack is credited with design of the X-1, the first supersonic airplane, and with a key role in the research and development of the series of experimental aircraft which followed it, up to the present X-15. Referred to in industry as "father of the research airplane," this identification has been extended to cover the concept utilized in the TFX, that of the variable-sweep wing. Mr. Stack also is credited with major contributions to what has been done to design a supersonic transport.

He has been a member of the Defense Department's Scientific Advisory Committee.

mentation in the TFX source selection, clearly relegates to the background those questions involving relative performance and contractor reputation. The ambition of the secretariat is to decide and to make the decision stick. If there are defects in the military source selection system, and early testimony by Air Force witnesses indicate that this is the case, the flaws can and most certainly should be corrected.

Mr. McNamara's confrontation of an aroused committee on Capitol Hill thus appears to be considerably out of focus. The blame for this, again, lies in the Pentagon. The Secretary of Defense repeatedly has shown his obvious disdain for the Senators, just as he has toward his military peers in the armed forces. From the time that Senator McClellan asked him to delay the TFX



—Wide World Photos

House Armed Services Committee leaders, Chairman Carl Vinson (center), Representatives Leslie C. Arends and F. Edward Hébert, meet after 374-33 vote authorizing record \$15,856,391,000 military expenditure for procurement and research and development, testing, and evaluation in fiscal 1964. The bill added \$363,700,000 for further development of the RS-70 project for USAF and \$134,000,000 for two additional submarines to what was requested by the President and Defense Secretary McNamara. This would provide five RS-70s as against three recommended by the Executive Branch of the government. During House floor debate the Secretary was criticized for overriding chiefs of military services and accused of dictating to them. He defended himself in a public address, pointing to Mr. Arends' support of an "irresponsible action" to increase budget.

decision, only to have the General Dynamics choice announced within a few hours, the Secretary and his subordinates have tried openly and without reservation to deride the investigation. The battered head that has taken most of the blame in this area—and deserved a share of it—is that of Arthur Sylvester, the rubber-tongued Assistant Secretary of Defense for Public Affairs. At a press conference one noon, early in the probe, Mr. Sylvester allowed that "obviously you will hardly get a judicial rendering by a committee in which there are various Senators with state self-interest in where the contract

goes. So far there is only one Senator I have seen on the committee, Senator Muskie, who hasn't got an interest in it."

Mr. Sylvester wrote a letter of apology for this remark within three days, but it failed to keep him off the witness stand.

The first question, of course, was from Chairman McClellan, who wanted to know more about the self-interest of his own state of Arkansas, to which Mr. Sylvester had referred indirectly. The Assistant Secretary admitted he knew of no such interest. Senator Karl E. Mundt of South Dakota spoke up for himself and Senator Carl T. Curtis of Nebraska, asking what they might have missed about contracts going to those states. Mr. Sylvester backed down, said he had no evidence. Also in "hot pursuit" were Senators Samuel J. Ervin, Jr., of North Carolina, Thomas J. McIntyre of New Hampshire, and Daniel B. Brewster of Maryland. Later Senator Muskie, who had been singled out as the Galahad in the Sylvester statement, said he was less than flattered by the praise.

This left Senator Henry M. Jackson of the state of Washington, home of the Boeing Company's headquarters. Mr. Jackson wanted to know whether Mr. Sylvester thought he was unfair. The witness, who had praised Mr. Muskie on the basis of what he had read in the testimony, said he had not read enough of the questions and answers to have an opinion on Mr. Jackson's fairness. There followed this exchange:

Mr. Sylvester: . . . We are dealing here with two great contestants. A contract has been let, and an effort is being made by the disgruntled losers to knock the contract down.

Senator Jackson: Now, wait a minute. Just get something clear, Sir. The Boeing Company never asked for this hearing. Do you understand that? I asked for it. They did not ask me. Now, what information do you have that they asked for this investigation?

Mr. Sylvester: I have no suggestion [*sic*], and I have never made any.

Senator Jackson: You are just making one, you said a disgruntled loser, in effect, asked for it. . . . Will you explain what effort is being made by the disgruntled loser?

Mr. Sylvester: I will simply have to refer you, Senator, to my impression that I got from the testimony to date. I would say from reading it, only one side has been put in.

Senator Jackson: That isn't what I said. You just got through saying that an effort is being made by a disgruntled loser to knock this contract down. Back that statement up.

Mr. Sylvester: It is a judgment on my part.

There was more of this, and the Senator finally cut it off with the comment that the witness, who used to be a newspaperman, is "a little careless with words."

Mr. Sylvester is a prominent man in the civilian secretariat. If he wore a uniform he would be subject to military discipline, even if this involved nothing more severe than a possible shift to a berth on Ascension Island.

Yet it is clear that the Defense Department, under Mr. McNamara and abetted in this case by Mr. Rubel, is determined to weld together a concept that would put crucial decisions—such as the selection and source of a weapon system—up to politically appointed civilians who are free to ignore military recommendations. If the McClellan hearing on the TFX does nothing more than expose this ambition as a threat to national security—and the democratic process—it will have proven the value of the congressional investigation as a check on the Executive Branch.—END



Babcock command-control systems go digital

Babcock, a leader in analog-type command guidance and stabilization systems, is now developing digital equipment that meets both the economic limitations and the more stringent reliability and accuracy demands of combat surveillance and missile target vehicle programs. By taking advantage of decreased bandwidth requirements and utilizing time-sharing techniques, Babcock makes it possible to control several vehicles simultaneously from a single ground-station installation without mutual interference. This development is another example of Babcock's basic ability to convert advanced techniques into low-cost operable hardware.



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AEROSPACE WORLD

By Allan R. Scholin

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D. C.
MARCH 22

Along with the coming of spring, there were budding but still very tender signs that the patient tenacity of USAF Chief of Staff Gen. Curtis E. LeMay may be having some effect. Secretary of Defense McNamara is expressing second thoughts about Dyna-Soar, with its implications for a military space program—and even about a strategic weapon system beyond the

be placed in orbit with controlled reentry . . . in late 1964, if I recall the date correctly. Dyna-Soar proposes to place one man in orbit at a later date and with a lesser capability."

But in Seattle he learned—apparently for the first time—that the Dyna-Soar will not only have greater flexibility than the Gemini, but will accommodate a larger payload.

McNamara then asked both design teams to consider how their vehicles,

committee, chaired by Rep. Carl Vinson of Georgia—with whom he had clashed on the RS-70 last year—that he has asked the Air Force to come up with a new proposal for an air-launched ballistic missile system.

He lectured the committee on his concept: "I don't want to mislead you on this, and I don't think that you yourselves fully appreciate that the term 'manned bomber' applies to two entirely different weapon systems,"



NASA's James Webb, left, checks Saturn V work at Boeing's Wichita plant with Manager Ben Wheat and Maj. John Allison, plant rep. In rear: Cong. G. E. Shriver of Kansas.

When flood swamped Morocco's Rabat province recently, Air Force furnished aid. Capt. Edwin Roth of Sidi Slimane AB examines an unhappy child in a worried father's arms.

B-52 and the Minuteman and Polaris.

Secretary McNamara made a two-day fact-finding trip to the Boeing Company in Seattle, and to NASA's Manned Space Flight Center at Houston, Tex., March 13-14, to review the Dyna-Soar and Gemini programs.

Before he left Washington he had expressed his views on Dyna-Soar to the House Armed Services Committee: "The future of the program is in doubt, in my mind, because events appear to have overtaken it. The Gemini program provides for two men to

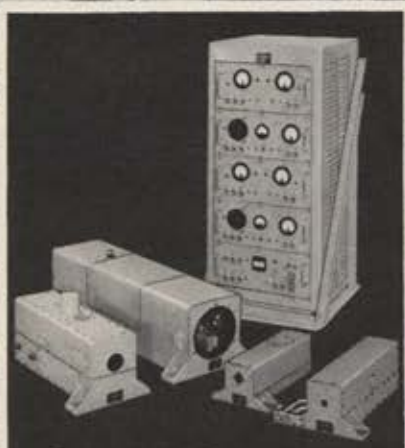
or a combination of the two, could be adapted to effect a rendezvous in space with another vehicle, inspect it, and, if necessary, destroy it. In this respect, at least, he is clearly thinking of each—or a possible hybrid—in terms of performing a military mission in space, one which is out of NASA's purview. (For a fuller comparison of Dyna-Soar and Gemini, see "Building Blocks . . . But No Building," page 56.)

His interest in a future manned weapon system was also expressed before the House group. He told the

he said. "One is a system that depends on the gravity bomb. . . . That system . . . will become completely obsolete, I believe, in the early 1970s. The other manned bomber system depends on missiles and is no different from any other missile-based system."

The type of aircraft he had in mind has been the object of study and interest by the Air Force for a number of years. But the state-of-the-art hurdles are at least as formidable as for other systems that have been

(Continued on page 26)



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AEROSPACE WORLD

CONTINUED

tossed out by DoD on the grounds of "technical infeasibility."

"It [the aircraft described by Mr. McNamara] would be a long-endurance plane that could fly two to five days and carry a large load of a new type of missile," wrote newsman Richard Fryklund in the *Washington Star*. "The planes could take off at the first alarm and just fly around, almost invulnerable to attack, until our ICBMs had been launched at the enemy. Then they could fly to the enemy, launching supersonic, low-altitude missiles at their targets." A big order. (See "The Future of Manned Aircraft," by J. S. Butz, Jr., in the March '63 *AIR FORCE*.)



Future spacemen will have little desire to RON on Venus, according to the readings on that planet radioed back to earth by Mariner II last December. The findings—gorged, digested, and interpreted by computers and scientists of NASA's Jet Propulsion Laboratory—were released in March.

Under its solid cloud cover, Mariner II reported, Venus is hot, windy, dry, and bare. Beginning its pass on the dark side of Venus, Mariner's radiometers scanned for forty-two minutes, reporting surface characteristics from darkness to bright sunlight.

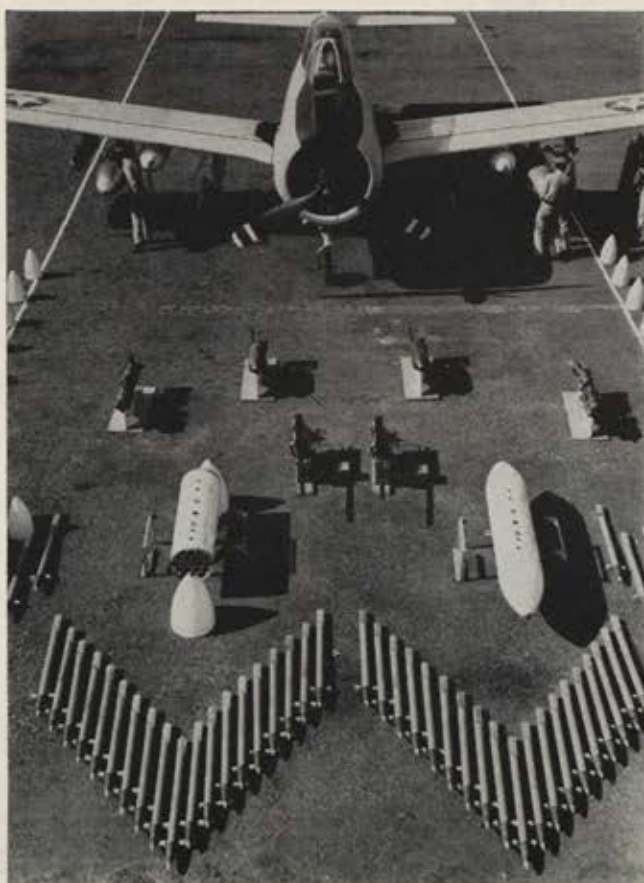


AWARDS—To Gen. Thomas D. White, former USAF Chief of Staff, the Billy Mitchell Memorial Award of

It gauged Venus' surface temperature at about 800 degrees throughout, apparently maintained at that level in sunlight or darkness by tremendous winds that circle the planet. Its readings provided no real clue, however, to the composition of the cloud cover.

Though it raised almost as many questions as it answered, Mariner II remains the most spectacular and rewarding of man's space exploits—at least until the Soviets' probe reaches Mars this summer. In its next deep space probe in 1964, NASA plans to visit Mars, then Jupiter and beyond.

Meanwhile, a close look at Mars obtained by a balloon-mounted telescope on March 1 offers almost no encouragement that life as we know it might exist there either. The unmanned balloon, Stratoscope II, sponsored jointly by NASA, the National Science Foundation, and the Navy, was lofted from Palestine, Tex. At a height of 77,000 feet it trained a giant telescope on Mars. It found only a fraction of one percent of water vapor in Mars's atmosphere, and its sponsors concluded that "life on the planet would be marginal at best."



Forbidding array of firepower used by North American T-28B is displayed during first anniversary open house of Vietnam's 516th Fighter Squadron at Nha Trang. It includes 2.75-in. rockets and rocket pods, two .50-caliber machine guns, two 20-lb. bomb clusters, two 100-lb. general-purpose bombs. Mounted under wings are two bombs and two napalm tanks, each weighing 500 pounds.



Capt. Donald W. Klick of Cambridge Research Labs, Hanscom AFB, Mass., won AFA award as best AF author on engineering subjects, presented by Executive Director James H. Straubel.



For meritorious service as Chief of Staff of NATO's Southern Europe Allied Air Forces, Maj. Gen. Alfred F. Kalberer was awarded the DSM by USAF Chief of Staff, Gen. Curtis E. LeMay.



Kennard Weddell, right, USAF Small Business Adviser, received Exceptional Civilian Service Award from Maj. Gen. W. T. Thurman. Center is John Horne, US Small Business Administrator.



James E. Lehrke, Assistant to Director of Supply at Hq. AF Logistics Command, accepts Exceptional Civilian Service Award from Gen. Mark E. Bradley, Jr., who is AFLC Commander.

New York City's Aviator's Post No. 743, American Legion, for outstanding contribution to air progress, to be presented in New York, April 17, by Billy Mitchell, Jr.—General White's son-in-law. . . . To Gen. Lauris Norstad, former NATO military commander, the James Forrestal Memorial Award for 1962, presented to "that person who has most effectively applied Mr. Forrestal's ideals to the concepts and requirements of national security," by the National Security Industrial Association, in Washington, March 28. . . . To Maj. Gen. Alfred F. Kalberer (*see cut*), the Distinguished Service Medal for meritorious service as Chief of Staff of NATO's Allied Air Forces, Southern Europe, presented by USAF Chief of Staff Gen. Curtis E. LeMay in the Pentagon March 8. General Kalberer, who was to retire March 31, has logged 22,000 military hours—more than any other USAF pilot. . . . To Kennard Weddell, Small Business Adviser at Hq. USAF, and James E. Lehrke, Assistant to the Director of Supply at Hq. AFLC (*see cuts*), USAF's Exceptional Civilian Service Award. Mr. Weddell's award was presented in the Pentagon by Maj. Gen. W. T. Thurman, USAF's Director of Procurement Management; Mr. Lehrke received his award from Gen. Mark E. Bradley, Jr., AFLC Commander. . . . To Capt. John E. Catlin,

Jr., and Donald W. Klick, and Mr. Walter E. McCartha, awards for outstanding contributions to civil engineering; Captain Catlin was named Military Engineer of the Year; Captain Klick (*see cut*) received an Air Force Association Award as the year's top author on engineering subjects; Mr. McCartha was cited for his work in counseling young people on engineering and scientific careers. Awards were presented during a special National Engineers' Week ceremony at Ft. Myer, Va., led by Maj. Gen. A. W. Minton, USAF Director of Civil Engineering. . . . To Mayor Robert F. Wagner of New York City, the Frank M. Hawks Memorial Award of the American Legion's Air Service Post 501, for leadership in developing civil and military aviation in New York, presented by Maxwell A. Kriendler, Post Commander and a member of AFA's Board of Directors.



LAUNCHINGS—It was a busy month for military missileers, with a total of twenty launchings at DoD's three military ranges. Only the Army came through the month with an unblemished record. At White Sands the Nike-Zeus was successfully fired in all three stages on February 15 and 20, while two Pershing shots went ac-

(Continued on page 29)

F-104/Sidewinder



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When maneuvering in supersonic combat, a fighter seldom has a second shot at its target. Therefore, the P-445-E wing tip launcher power supply on the Lockheed F-104 must launch its Sidewinder missile with absolute reliability under adverse conditions of shock, vibration, temperature and altitude.

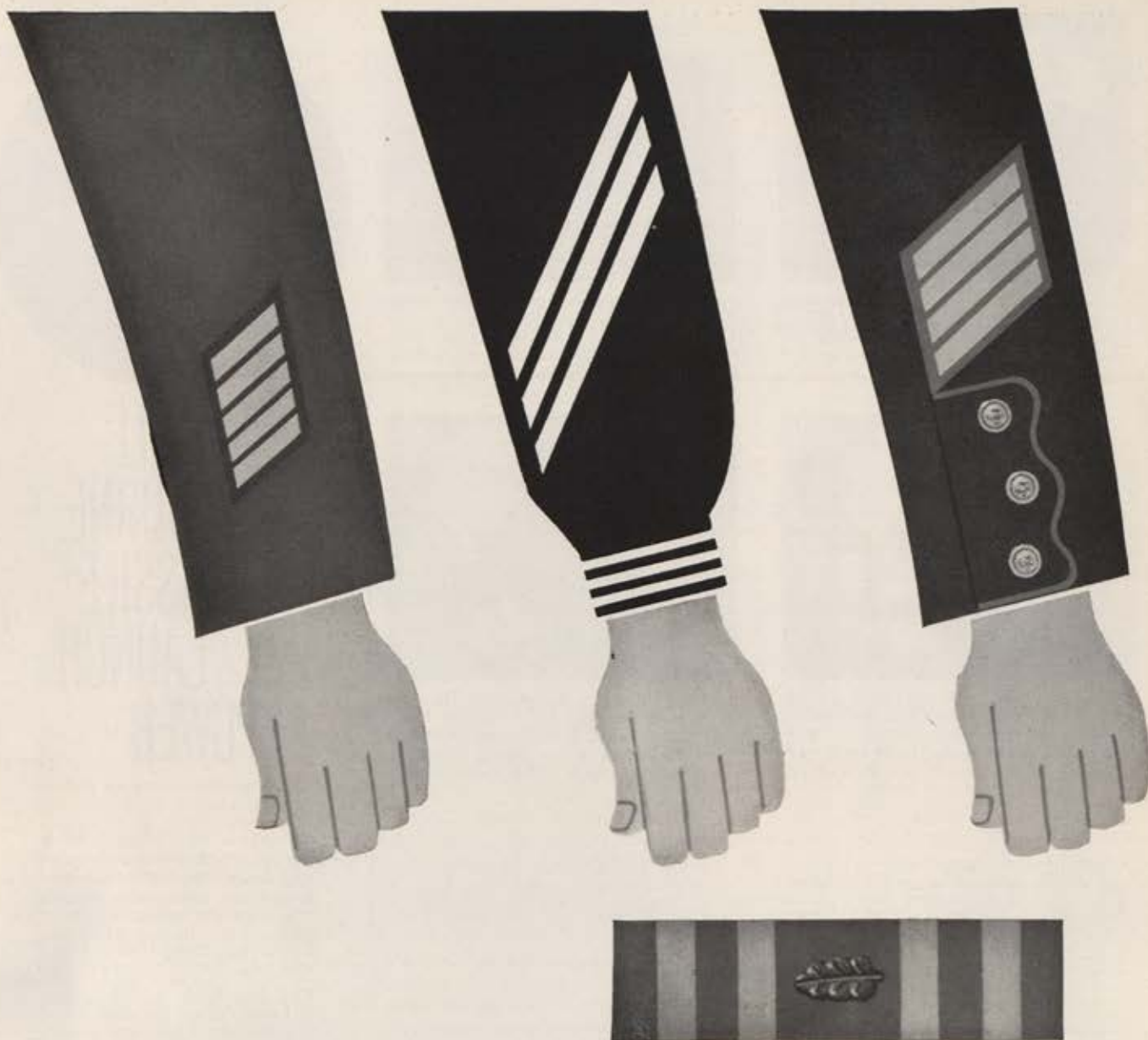
ITT has been building the P-445-E wing tip contoured Sidewinder Launcher power supply for the F-104 for more than three years. In addition to supplying launch power, it triggers the firing mechanism, activates the firing squibs, provides launch control interlocks, and supplies audio signals to the pilot.



ITT for reliable airborne missile launch power. For further information, write Power and Space Systems Department for data file ASD-2066-2.

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cording to plan at Cape Canaveral on February 25 and March 4.

The Air Force logged the first successful flight of its new thrust-augmented Thor-Agena space booster (TAT) at Vandenberg AFB, March 18, after an earlier attempt failed on February 28. The TAT employs three Thiokol solid-propellant strap-on motors to increase total thrust from 170,000 lb. to 330,000 lb. They are dropped on burnout. In the February launch, one strap-on motor failed to ignite and could not be dropped, causing the vehicle to wander off course and necessitating its destruction.

USAF's first launch in the ABRES series—an advanced ballistic reentry system, testing new nose-cone structures—was successful at the Cape on March 1. The Atlas-F booster also carried five pods alongside, four containing life science experiments, the fifth testing the passenger pod itself.

Other Air Force shots at Canaveral were Minuteman launchings on February 20 and March 18, with the latter destroyed after two and one-half minutes when it deviated from course. At Vandenberg, SAC crews attempted six Atlas ICBM launches, only three of which were successful. A Titan II silo launch failed when the missile destroyed itself after rising to 18,000 feet. Two classified Blue Scout probes were apparently successful.

The Navy suffered the worst percentage for the period. It launched two Polaris A-3 missiles from Canaveral, on February 18 and March 19, and ran into troubles with the second stage each time.

At a spaceflight testing conference at Cocoa Beach, Fla., March 19, Dr. Ivan Gettling, President of Aerospace Corporation, said most launch failures could be avoided by more careful design and redesign processes before committing the missile to the pad.

"There is an unfortunate tendency in our rush to meet end objectives and time schedules, and in our desire to save money within the program, to cut out important steps in developmental tests and ground systems tests," he said.

"Not only are such economies false, but they impinge on our reputation as a nation for excellence in scientific achievement and engineering design."

The USSR launched Cosmos 13 on March 21, in the series it claims is intended to check magnetic fields, radiation, etc. The Soviets are reportedly planning another manned space spectacular—possibly orbiting several

vehicles simultaneously, with at least one woman astronaut aboard.



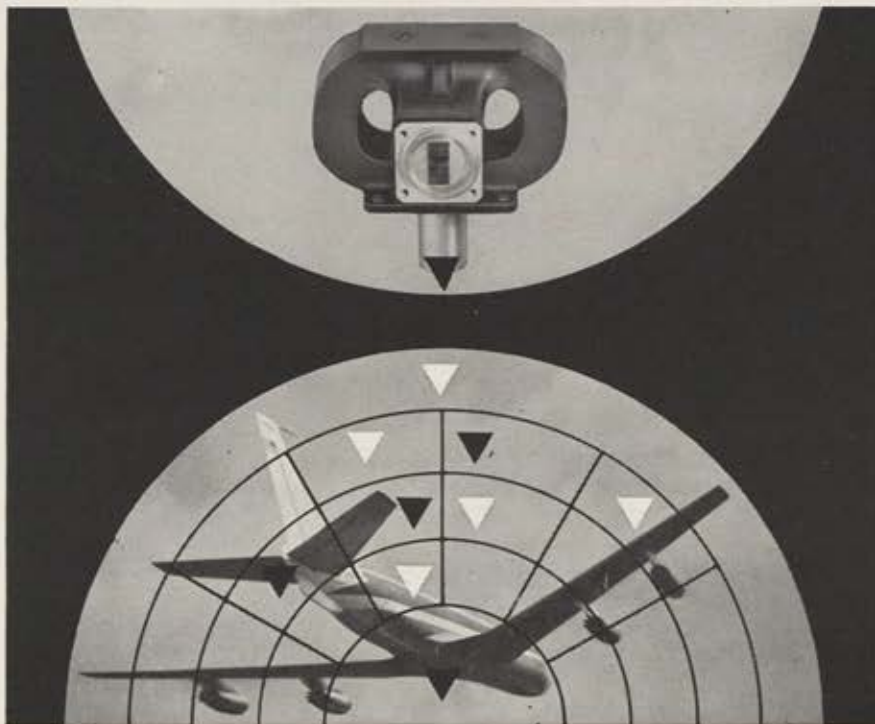
STAFF CHANGES. . . . Maj. Gen. Sam W. Agee, from Director of Operations, DCS/Plans & Operations, Hq. USAF, to Deputy Commander, Hq. AFCS, Scott AFB, Ill. . . . Brig. Gen. Horace D. Aynesworth, from Commander, 837th Air Division, to Commander, USAF Tactical Air Reconnaissance Center, TAC, Shaw AFB, S. C. . . . Maj. Gen. John M. Breit, from Deputy Inspector General for Security, to Deputy Inspector General of the Air Force, Hq. USAF . . . Maj. Gen. Robert A. Breitweiser, from Assistant Chief of Staff, Intelligence, to Assistant to DCS/Personnel, Hq. USAF (General Breitweiser will become Commander, Caribbean Air Command, in September) . . . Maj. Gen. Edwin B. Broadhurst, from Assistant DCS/Operations, to Assistant DCS/Programs & Requirements, Hq. USAF . . . Brig. Gen. Richard F. Bromiley, from Deputy Commander, WESTAF, MATS, Travis AFB, Calif., to Deputy Chief, US Military Supply Mission, India . . . Lt. Gen. David A. Burchinal, from DCS/Plans &

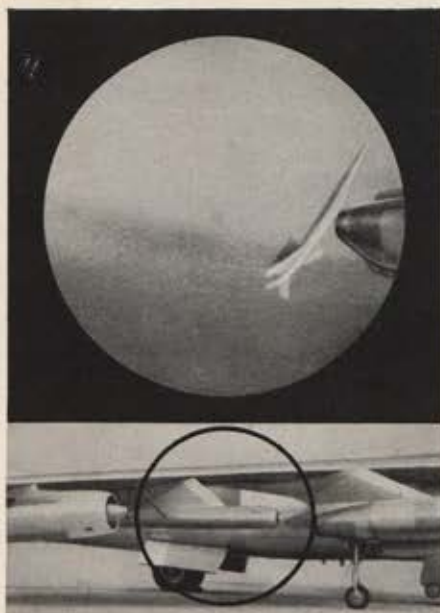
Programs, to DCS/Plans & Operations, Hq. USAF.

Brig. Gen. Joseph J. Cody, Jr., from Commander, 6595th Aerospace Test Wing, Vandenberg AFB, Calif., to Deputy for Systems Management, Hq. SSD, AFSC, Los Angeles, Calif. . . . Lt. Gen. Gabriel P. Disosway, from DCS/Operations, to DCS/Programs & Requirements, Hq. USAF . . . Lt. Gen. James Ferguson, from DCS/Research & Technology, to DCS/Research and Development, Hq. USAF . . . Maj. Gen. Robert J. Friedman, from Director of Programs, DCS/P-P, to Director of Aerospace Programs, DCS/Programs & Requirements, Hq. USAF . . . Maj. Gen. Jamie Gough, from Deputy Director of Operations, DCS/O, to Director of Operations, DCS/Plans & Operations, Hq. USAF . . . Brig. Gen. Bertram C. Harrison, from Director of Inspection, to Deputy Inspector General of the Air Force, Norton AFB, Calif. . . . Maj. Gen. Earl C. Hedlund, from Deputy Commander, Ogden AMA, Hill AFB, Utah, to Commander, Warner Robins AMA, AFLC, Warner Robins AFB, Ga. . . . Brig. Gen. Robert H. Herman, from Deputy Executive Director for
(Continued on following page)

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Logistics Plans and Systems, Washington, D.C., to Commander, Defense Construction Supply Center, Defense Supply Agency, Columbus, Ohio . . . Maj. Gen. Joseph R. Holzapple, from Assistant to DCS/Systems & Logistics (Systems), to Director of Production, DCS/S&L, Hq. USAF.

Brig. Gen. David M. Jones, from Deputy Commander for GAM-87 (Skybolt), to Deputy for Systems Management, Hq. ASD, AFSC, Wright-Patterson AFB, Ohio . . . Maj. Gen. Alfred F. Kalberer, from Chief of Staff, Allied Air Forces Southern Europe, to retirement on March 31.

Brig. Gen. Gerald F. Keeling, from Director of Procurement, to DCS/Procurement and Production, Hq. AFSC, Andrews AFB, Md. . . . Brig. Gen. Harold Kelley, from Deputy for Civil Engineering, to Vice Commander, Hq. BSD, AFSC, Norton AFB, Calif. . . . Brig. Gen. Richard T. Kight, from Chief of Staff, Allied Air Forces Northern Europe, to Principal Air Staff Officer, Allied Forces Northern Europe, SHAPE . . . Brig. Gen. William E. Leonhard, from DCS/Procurement and Materiel, to Chief of Staff, Hq. AFSC, Andrews

AFB . . . Brig. Gen. Henry C. Newcomer, from Commander, Los Angeles ADS, ADC (NORAD), to Director of Inspection, Office, TIG, Norton AFB, Calif. . . . Brig. Gen. Norman L. Peterson, from Commander, Air Weather Service, MATS, Scott AFB, Ill., to Commander, Pacific Communications Area, AFCS, with additional duty as ACS/Communications-Electronics, Hq. PACAF.

Brig. Gen. Charles H. Roadman, from Director, Aerospace Medicine, Office of Manned Space Flight, NASA, Washington, D.C., to Command Surgeon, Hq. ADC, Ent AFB, Colo., effective July 1 . . . Brig. Gen. Jay T. Robbins, from Director of Flight Safety, to Director of Aerospace Safety, Office, TIG, Norton AFB, Calif. . . . Brig. Gen. Marion C. Smith, from Director of Systems Services, to Deputy Director of Production, DCS/S&L, Hq. USAF . . . Brig. Gen. Pinkham Smith, from Deputy Director for Operational Forces, DCS/O, to Deputy Director of Operations, DCS/Plans & Operations, Hq. USAF . . . Brig. Gen. Robert W. Strong, Jr., from Deputy Director of Personnel Planning, DCS/P, Hq. USAF, to Commandant of Cadets, USAF Academy, Colo. . . . Brig. Gen. Jack E. Thomas, from Deputy Assistant Chief of Staff, to Assistant Chief of Staff, Intelligence, Hq. USAF.

Maj. Gen. William T. Thurman, from Director of Procurement Management, to Director of Procurement Policy, DCS/S&L, Hq. USAF . . . Brig. Gen. William W. Veal, from Commander, Defense Electronics Supply Center, Defense Supply Agency, Dayton, Ohio, to Auditor General, Office, AF Comptroller, Hq. USAF, effective August 26 . . . Brig. Gen. John W. Vogt, from Assistant Director of Plans for Joint and National Security Council Matters, DCS/Plans & Operations, Hq. USAF, to Director, Policy Planning Staff, Office, Assistant Secretary of Defense (International Security Affairs), OSD . . . Maj. Gen. Horace M. Wade, from Assistant DCS/P-P, to Assistant DCS/Plans & Operations, Hq. USAF . . . Brig. Gen. Tarleton H. Watkins, from Deputy for Operations, 9th AF, TAC, Shaw AFB, S. C., to Director of Assault Airlift, Hq. TAC, Langley AFB, Va. . . . Maj. Gen. James F. Whisenand, from Assistant DCS/Research and Technology, to Assistant DCS/R&D, Hq. USAF.

RETIRED . . . Maj. Gen. Donald P. Gaul, Maj. Gen. Charles W. Schott, Maj. Gen. Moody R. Tidwell, Jr.—END



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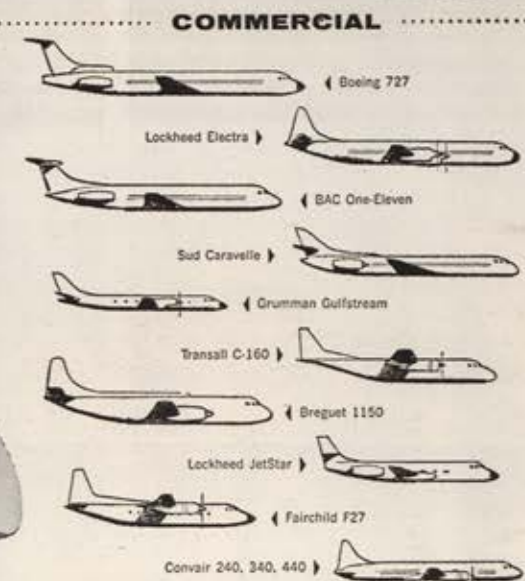
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SPACE DIGEST

VOLUME 6, NUMBER 4 • APRIL 1963

THIS April 1963 Missile and Space Almanac issue of AIR FORCE/SPACE DIGEST is, we believe, the most significant edition we have ever offered to a broad and growing readership. Not only the Air Force personnel and members of the Air Force-industry team who have created the major portion of the military strength of the United States, but also an increasing number of Americans in all walks of life look to this publication for forceful and candid appraisals of present and future positions of aerospace power and technology as vital factors in the defense of freedom.

This issue has been produced against a background of controversy over defense policies that is raging in Washington and across the land, much of it having to do specifically with the military space mission.

The content of this April 1963 Missile and Space Almanac divides itself naturally and by editorial design into identifiable segments. The sections are interrelated in meaning and significance, yet each explores, in individual articles by contributors and staff writers, subjects that merit individual attention.

The first section reports the views of top Air Force leaders on the challenges to the country and the Air Force in the space-age cold war. Secretary of the Air Force Eugene M. Zuckert points up forcefully the fact that the Air Force's present and future mission is national defense, and he traces the jobs that the Air Force must be prepared to do across a broad spectrum of ongoing and potential conflict. Gen. Curtis E. LeMay, USAF Chief of Staff, explores the potential security threat posed by space-capable aggressors.

He lists the range of capabilities the Air Force will need to meet such potential threats. Lt. Gen. James Ferguson, Deputy Chief of Staff, Research and Development, traces these needs in detail and provides a working blueprint for tomorrow's aerospace force.

These statements lead naturally into the second section, which *in toto* represents an analytical—and we believe broad and unparochial—view of current national space policy. Technical Editor J. S. Butz, Jr., explores the Department of Defense's "building-block" philosophy and measures its adequacy. Following is a story that all too few Americans know—the enormous extent to which the military, and primarily the Air Force, has contributed to the *nonmilitary* space effort. And in his article on Spaceport USA, Associate Editor Allan R. Scholin takes the reader to Cape Canaveral, where much of this drama has unfolded. Senior Editor Claude Witze examines the muddled history of congressional approaches to the national space effort.

The next section covers the broad subject of the relation of technology to politics in the context of the US-Soviet confrontation. Dr. Ivan A. Getting relates the old problems of human conflict to the realities of space. Associate Editor William Leavitt calls for bold national use of space and other technology as an instrument of conflict control. The distinguished former chairman of the Atomic Energy Commission, David Lilienthal, comments on the danger of disarmament for disarmament's sake.

The final section carries the space-age reference handbook that we trust will be a useful appendix.

—THE EDITORS



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The US Air Force's job is the application of aerospace power to the defense of the US and the free world. This job encompasses superiority across the broad range of potential conflict, flexibility, and control of military response to aggression at every level, and the need for preparation to protect ourselves against extension of aggression into space. The Air Force requirement to meet this multifold assignment is the greatest challenge in the history of the air arm . . .

AIR FORCE

APRIL 1963

SPACE AND THE COLD WAR

By the Hon. Eugene M. Zuckert

SECRETARY OF THE AIR FORCE

IT WAS suggested that I discuss the future of the Air Force in space. As both starting point and finish line for everything I say, just keep in mind that the job of the Air Force is not space; it is defense. It is not research and development, not strategic, not tactical, nor any of these. It is the application of airpower or aerospace power to the defense of the United States and the free world.

Some of my remarks may be responsive to the suggestion about space, but it seems more important to me to talk about the future of the Air Force in the defense of the United States. The future is from now on, and now is cold war.

The cold war, reduced to essentials, is a confrontation of sovereign powers in which one side maintains a pressure of aggressive expansionism, forcing the other to maintain a defense against it. The most urgent requirement of that defense is to deter the aggressor from using military force to attain his ends. We are the defenders.

I would like to make four points about that defense.

First, we must have superiority at the top level of intensity of war, and must extend that deterrent superiority to lower levels in order to contain or limit war and aggression.

Second, we must have flexibility and control of the application of destructive power at each level.

Third, we must be prepared to protect ourselves against the extension of aggressive pressure into space, and

Fourth, the Air Force role in this over-all defense requirement presents the greatest challenge in the history of any military organization.

In this cold-war confrontation, the technological and industrial capabilities of both sides are such that sooner or later, if not now, the unrestrained use of that power for nuclear destruction would make its employment in war a net losing proposition for both sides. The defender must have power to wreak unacceptable damage on the aggressor as a first requirement of his defense. This is where strategic deterrence starts.

But an aggressor whose political system may make expansion a necessity will, if deterred by fear of retaliation from using his full power, seek other opportunities. He will try to find the place to apply his power which he calculates will not provoke his own destruction. Close one avenue to him and he tries another. He can logically be expected to stay short of triggering his own destruction. The aggressor naturally has the initiative in this game so we must be able to apply whatever force is necessary to deny him his objective.

So far, we have been able to do so. The risk has been too great for him. We must keep it that way. We have our own reasons for desisting from war but until we can make him apply the same reasoning to his national behavior, we have no choice but to make sure—and make sure he knows—that war—any war he starts—means certain military defeat for him. We know, of

(Continued on following page)



Men still matter in the Air Force global deterrent mission and as typified by these SAC crewmen (*above*) shown at briefing prior to going on extended alert. Newest dimension of USAF aerospace power is the instant retaliatory capability afforded by the solid-fueled USAF Minuteman ICBM (*right*), shown blasting off from its protected silo during flight testing at Cape Canaveral.



course, that all-out war makes no sense for either side, nor for the rest of the world.

The defender, of course, has to maintain a force adequate to prevent ultimate defeat. This requirement may change, but the use of the force is his final effort. Two courses are then open. The defender can, as a matter of judgment, wait and weigh each application of the aggressor's power in order to or until he can decide it is sufficiently threatening to warrant the jugular response. As a second course, he can prepare to overcome the aggressor's military power before that point is reached. It seems to me that the first course is closed at the end. A sensible defense is to be ready to respond at a lower level with whatever force is deemed necessary to stop the aggressor—and at a net loss for his attempt.

The United States is leader of the free world, in President Kennedy's words, by both strength and conviction. Our conviction, both moral and military, is that we must be prepared to stop aggression at levels of intensity below the level of the maximum destruction.

Our basic strength, our power to deter aggression, our ability to defend ourselves must always be greatest at the top. In our strategic bomber and missile forces, we maintain power adequate to deter an enemy from striking for our jugular. Strategic forces, of course, have the capability of counterforce attack which does not constitute total devastation of a nation.

We have to maintain this superiority at the top, but we must also have it at levels of war more likely to be brought against us. That is why we are building deterrence down from the top level of intensity. The reason is simple. The only way we know of forcing an aggressor to keep down his use of military force is to make each level of intensity of conflict more certain of defeat for him than the one below it. He won't be deterred

unless he knows that as his commitment goes up, his chances go down.

One hears talk about the danger and probability of escalation. The effect of my first point, extending the deterrent with superiority at each level, is to make escalation a penalty and not an opportunity for an aggressor.

At each level where we determine we want to stop aggression, we must be prepared to make the most efficient possible use of every resource available to us, skillfully employing advancing technology to save human resources. It is imperative that, for the long haul, we hold the investment at each level to the absolute minimum necessary to maintain effective deterrent superiority. The cheapest way to stop war is at the lowest level of conflict with the quickest possible stop to aggression. To me, this means we use tactical nuclear weapons whenever we determine the military situation demands their use, whether by Army, Navy, Marines, or the Air Force.

If we would have the aggressor desist from any course of action which may be desirable to him but unacceptable to us, we must have him know that we will use whatever force it takes, nuclear or non-nuclear, to stop him. This kind of deterrence employs all services.

The President has made clear his determination to have more choices than no response or total response. This is the purpose of counterforce. This is the reason we must have flexibility in strategic forces. This is why the great increase in what has been called tactical forces, now designated in the budget as General Purpose Forces. One phase of the buildup is the combining of ground power with airpower in the new STRICOM, headquartered at MacDill Air Force Base, Fla.

At the Air Force Special Warfare Center at Eglin AFB, the accumulated experience of four decades of

air operations is being applied to the job of developing airpower techniques for the very low rungs on the ladders of war's intensity. This is the AFGCOIN program, or the Air Force part of the nation's preparation for counterinsurgency struggles.

For this work, we are trying out beefed-up T-28s and B-26s with more power and more weapons—fourteen .50-caliber machine guns and a dozen external ordnance stations, for example, on a B-26 with a thousand more horsepower than the original.

Support techniques are keeping pace. We can snatch a 10,000-pound cargo package off a C-123 without touching down. We can get a C-130E fully loaded into a grass or clay runway of less than 1,000 feet. We are working on a system for snatching a cage-like capsule of twenty to twenty-five men off one of these planes without landing it. This technique will be a big help to the Army in getting over that first difficult period of concentration of men during an airborne operation.

For the general roles of air superiority and interdiction, our effective power will go up by an order of magnitude with the advent of the F-4C added to the F-105, with both then to be supplemented by the first fighter designed from scratch for dual-service use—the F-111, better known as the TFX.

While we are extending downward the effectiveness of our deterrent power, great changes are taking place at the level of the strategic deterrent. Missiles are coming into the inventory to provide a very special kind of delivery system for nuclear explosives.

The concept of strategic deterrence, of course, is a progression from the strategic bombing concepts of the '30s. The B-47s and B-52s, also progressions from those early bombers, will continue to carry the burden of strategic deterrence for some years. Current projections of the strategic forces, however, assume that a major part of the job can be done by missiles—land based or sea based—at a lower investment of men, money, and machines than would be possible with manned bombers of today's design.

In other words, the B-52 is passing the heavy explosive delivery part of its job on to the missiles. The Air Force believes that the effective life of the B-52 could be extended, in a joint role with missiles, through

use of the Skybolt, but the return on the projected Skybolt investment was judged not worth the cost in the light of all the factors involved.

The missiles do only the explosives delivery job. They have to be pretargeted and, once launched, cannot be recalled or redirected. They cannot follow a movable target. They cannot discriminate. They cannot assess damage, nor report battle conditions. They make for a rigid defense posture. While they necessarily carry the brunt of the strategic strike, total dependence upon them would not be consistent with our objective of controlling destruction and preserving always some foundation for ending the conflict.

Because of the variety of such requirements in our approach to strategic warfare, some type of manned system seems called for. The type of aircraft we've been calling strategic bombers are characterized by extreme range capabilities, very high ceiling, great load-carrying capacity, long endurance, multiman crews, and multijob possibilities. Our current studies are directed at determining the possible application of these flight characteristics at the point within the missions bracket between missiles on one side and high-performance fighters on the other. The RS-70 is the most advanced of these concepts, but it is not by any means the only type of manned system of significant strategic potential.

We can't say now just where we will come out, but there doesn't seem to be any question as to the value of manned vehicles able to stay aloft for long periods, travel very great distances, fly high or fly low, and fly fast. There are many jobs to be done, reconnaissance-strike missions, observation or surveillance, command and control, or weapon launching.

We can get the flexibility of my second point with airpower. This is one reason why I have no taste for the salty beer that results from the crying into it by those who seem to write off manned systems because of the job changes I've mentioned.

But the main reason why I don't intend to join in drinking any tear-salted beer is that while we still have to do all the old jobs assigned to airpower, we have the difficult, demanding, challenging, and expanding new job to do in space.

(Continued on following page)



Eugene M. Zuckert was named Secretary of the Air Force by President Kennedy in 1961 after a long and distinguished career in law, business, and government service that has included pioneering efforts in the legal aspects of atomic energy, membership on the Atomic Energy Commission, the Assistant Secretaryship of the Air Force under the first Air Force Secretary, now-Sen. Stuart Symington of Missouri, membership on the faculty of the Harvard Graduate School of Business Administration, and many important advisory posts in the defense field. A native of New York City, he received his law degree from Yale University. Mr. Zuckert has also served as a director of the President's People-to-People Health Program, which sponsors the USS Hope seaborne medical mission to underdeveloped countries of the world. He is also one of the principal architects of statistical control systems used by the Air Force. The above is condensed from a speech delivered by the Air Force Secretary to personnel at the Air Force Missile Test Center, Patrick AFB, Fla., March 3, 1963.



Above, USAF's new Air Commandos, inheritors of proud World War II tradition, ready for training exercise in low-level supply and personnel-drop techniques. At right, a SAC B-52, carrying its deadly Hound Dog missile, awaits its scrambling crew who are dashing toward their craft during alert training mission.



Before I say anything about our future in space, let me establish two bench marks. The first is that the Air Force needs everything it can get from NASA. NASA needs us, too, as the record of how NASA puts things into space indicates, but if there weren't a NASA, the same facility and capability would have to be created some other way.

There is reassuring precedent for the principle of having an outside-of-defense civilian agency provide the type of support we need. The case at point is the Atomic Energy Commission. Our own nuclear weapon flexibility as well as the Polaris-carrying submarine is sufficient testimony.

The clear lesson for us in the space field is that we must put requirements on NASA to meet whatever part of our needs can be met in this way. We must utilize every possible resource to build the necessary military capability, and I can assure you that NASA is ready to respond. Jim Webb, the NASA Administrator, harbors no illusions about NASA's responsibilities in support of national defense requirements.

The second bench mark is that there is no such thing as peaceful space or military space. There is just space. A new and massive space program in a civilian agency was launched nearly five years ago, with—for reasons which seemed not unreasonable at the time—a great hullabaloo about peaceful objectives.

The nation is holding to those peaceful objectives, but we also know that the military services will have to do the same thing in space that they have always done in the media of the land, sea, and air. The Air Force forward space program is, therefore, aimed at two general objectives.

The first is to acquire the capability to utilize space in support of the military forces operating in the familiar environments of land, sea, and air. Space offers new aids. Observation, warning, communications, military geodesy, and meteorology are areas for the

application of space technology to defense. All of the services have requirements of their own, and it is up to the Air Force to provide them the access they need for their purposes. The Secretary of Defense has assigned the responsibility to us.

Right here, let me caution against letting any interservice differences blur either judgment or vision. It is my position that competition in ideas among the three services is desirable. The imaginative, strong-minded people we need in this business are going to have differences, and they must be resolved constructively.

Our second general objective is to acquire the necessary defense capability for the aerospace regions themselves. We must be able to protect the peaceful activities in space of the nations of the free world. We believe that space can be free to all for peaceful activity only if somebody keeps it free. We are that somebody. The job involves mastering the space environment in order to deny to a hostile power the uninhibited military exploitation of space. We can only do this if we have the ability to detect and counter any military threat. We believe that both manned and unmanned systems will be required, but we cannot say now in what relative investment.

We have a lot to learn. The recent agreement with NASA for joint participation in the Gemini program is one way. That agreement represents an answer from both DoD and NASA to critics who said there was no place in space for military man. Our own activity directed toward manned space vehicles will increase, and with NASA's backup we'll attain the needed capability earlier than we would otherwise.

A term you hear around Washington to denote the areas of cooperation between government agencies is "interface." Such terms usually leave me pretty cold but this one does have some descriptive value.

There will be plenty of problems between the Air Force and NASA, but not by any means all at the

"interface" points such as Cape Canaveral. Neither of us would be true to trust or tradition if there weren't. Any machine as big as the national space effort is bound to have some kind of friction. But just remember, a clutch is a friction interface. Its purpose is to join two shafts for the transmission of power.

The power we can get will provide protection for the free world in space. This was my third point—to make sure that no aggressor can exploit space, either for expansionism on earth or interference in space with the peaceful pursuits of the free world.

The people of the United States know they must have an Air Force second to none if they are to apply their strength constructively in peace. My fourth point covers just a few things, then, that the Air Force officer must believe, know, and practice.

Get these ideas straight:

The Air Force is at the highest state of readiness and response capability in all its history.

It is strengthening that posture almost monthly.

It needs better people than ever before. It has more

opportunity for their professional growth and potential contribution to the nation's defense than ever before.

It needs the old skills, but to a far greater degree, for AFCON and General Purpose Forces, for airlift and air defense, and for the new mission of heavy multiman-crew, long-endurance aircraft.

And then it needs that whole new range of skills, the skills and techniques which are being developed by the Slaytons, the Coopers, the Grissoms—and all of their colleagues, civil and military—to enable America to keep her place as freedom's leader by strength and conviction.

The Air Force is an organization of professionals. It takes brains and hard work to keep up. The competition is tough, but the opportunities to serve your country and make a mark in the service to which you have dedicated your lives will continue to expand.

It all adds up to a reminder for those who wear the Air Force uniform that the wild blue yonder is still beyond.—END

Technological Teamwork: How USAF Boosts the National Space Program

In recognition of the increased impact of space programs on our national resources and their direct effect on our future national security, Air Force space activities are closely coordinated with the National Aeronautics and Space Administration. One example is the recent agreement between the Department of Defense and the National Aeronautics and Space Administration on the Gemini program. The intent is to ensure that the scientific and operational experiments undertaken as a part of the Gemini program will be directed toward satisfying both military and National Aeronautics and Space Administration requirements and objectives.

The Air Force has made significant progress during the past year in its programs related to space. We have formulated a forward space program to meet space defense requirements.

First, let me cite some of the accomplishments of our current program.

During the past year, there have been several firings of large solid-rocket motors. A joint NASA-Air Force program for the development of large solid-rocket engines has been established.

Titan III is being developed to provide a large payload launch capability for future national space programs. Phase I of this development has been completed. This consists of the formal process whereby preliminary engineering and management planning are accomplished with the contractor in order to arrive at definitive specifications and refined cost and schedule estimates. Contracts have been negotiated with three major contractors for a booster which can meet anticipated payload requirements of 25,000 pounds.

The Discoverer project continues to provide essential data on environment and component performance.

During this year, basic design of the Dyna-Soar vehicle will be completed. Fabrication and test of spacecraft components and subsystems will continue. Assembly of two flight models for system integration and testing will be started. We will use the Titan III to launch the Dyna-Soar.

We have continued to explore technical problem areas associated with the achievement of an aerospace plane capability. The Air Force envisages this vehicle to be manned, operate from SAC-type bases, and deliver into

orbit and retrieve orbital payloads at costs far less than today's. It will be able to make critical orbital-plane changes within the atmosphere. Its recoverable booster characteristic will permit routine, repetitive military space operations.

The Air Force has been recently assigned the responsibility for developing, procuring, launching, and controlling the satellites for the DoD Communications Satellite Program. We have a development plan, and we are preparing to request proposals from industry for the program.

Now, let me discuss our long-range space program.

Our forward space development program integrates the R&D work of many years into a cohesive space program. Funding for all facets of the program is not included in the FY 1964 budget, but the program will provide a guide for Air Force space activities for the near future.

The Air Force has developed a solid foundation of space on which military capabilities can be built. These efforts have brought us to a point where significant military space possibilities are clearly apparent. Utilizing the technological base so far established, the Air Force must translate these technical capabilities into actual defense systems. The time required to move from a development stage to operational systems is measured in years. Yet, it is the ready military capability, not the technological base, that accomplishes deterrence. Accordingly, the Air Force proposes to begin some of these conversions at once.

The forward program aims at two basic objectives:

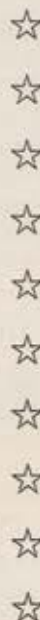
First, to enhance the general military posture of the United States by building a defense capability in space. Space is not only a new area of vulnerability to attack, but also affords important means of supporting the terrestrial forces of the United States in relation to a military threat posed by a hostile power.

Second, to provide a capability within the space region for the purpose of denying to a hostile power the uninhibited military exploitation of space, and to provide a system of protection for US scientific activities in space.—END

The foregoing is from Air Force Secretary Zuckert's statement before the House Committee on Armed Services, United States House of Representatives, February 21, 1963.

The military implications of space technology may prove far more dangerous and significant than the vast impact of the airplane. Against this prospect the Air Force must attain not only the technological capabilities but also the systems and manned operational experience that will in the future be vital if this country is to succeed in . . .

KEEPING SPACE FREE



By Gen. Curtis E. LeMay, USAF

CHIEF OF STAFF, US AIR FORCE

THE President has characterized the exploration of space as "one of the greatest adventures of our time." He has said he regards his decision to expedite the National Space Program as among the most important decisions he will make during his incumbency. There have been statements by other officials to the effect that man's future lies in space and that successful pioneering of space holds the key to man's well-being.

Our space efforts pose unprecedented problems in astrophysics, mathematics, communications, chemistry, biology, medicine, materials, engineering, and mechanics.

Research and development are commanding the attention of our finest management talent.

Stimulated and nourished by government space programs, our laboratories, industrial plants, and universities are concentrating our best scientific and engineering brains in the largest-scale attack on new knowledge in man's memory.

As a result of this national effort, new ideas, new products, and new technology are literally gushing out of our satellite programs, our missile programs, and our manned spaceflight programs. Back in June, the Denver Research Institute had isolated 145 separate examples where industry was already making products or using processes originating in space science.

It doesn't take much imagination to see how this new space science will benefit the American economy.

The field of materials is rapidly changing. Miniaturization is affecting such diverse applications as weather forecasting, improved packaging techniques, self-contained power supply units, and communications.

Medicine and education are undergoing significant changes.

Lessons learned in our space program will improve the physical and intellectual well-being of all peoples.

The new space science has the potential to create an order of magnitude of economic, cultural, and scientific wealth that could significantly change the whole fabric of our society in a few short years. It could affect our world more than all the scientific breakthroughs of history—the work of men such as Copernicus, Newton, and Darwin that changed the world of their day and forms the scientific basis for our present thrust into space.

Space is also a new dimension of man's dangers. It is an infinite region that begins only a few miles above the United States. It is a medium through which—and from which—vastly lethal machines such as ICBMs can move even now. There is no basis for doubt that future space developments could threaten us with even greater dangers. We could be threatened, not merely with new spaceborne weapons, but with a whole new region of possibilities for aggression.

If there is any doubt about this last statement, I direct your attention to Soviet Defense Minister Mali-

novsky's congratulatory telegram to the Vostok Cosmonauts which stated in part:

"Let our foes know what technology and what militance are in the possession of Soviet power."

Are we to shrink from these implications? *Of course not, and we aren't!*

The National Space Program, on which the United States is embarked, consists of two parts. One part—that of scientific explorations into space—is the function of NASA, the National Aeronautics and Space Administration. The other part—that of providing necessary military capabilities in space—is the function of the Department of Defense. The two parts of the National Space Program work in coordination; indeed, all of the space shots so far attempted have been lifted by rockets developed in the military program—and all of the Astronauts have been military personnel. NASA's space operations, however, are not intended to develop military space capabilities. This is due to the fact that NASA does not bear military responsibilities and has all it can do within its capabilities to execute its nonmilitary space program.

The military capabilities I'm thinking of are: interception and inspection of unidentified or noncooperating space objects, operation of weaponry, observation, and a multitude of others.

On the other hand, the basic space science revealed by NASA activities is, and will continue to be, useful in respect to military applications. Just recently the Air Force began participating with NASA in the Gemini man-in-space program.

What does this cooperation mean?

As you can readily understand, certain items of military equipment, which may ultimately be destined for application to unmanned space vehicles, are much easier to test in their earlier phases with an intelligent and technically trained man present to facilitate the tests. This wouldn't necessarily be true if we had to develop a manned vehicle for the purpose of conducting these particular tests. But given a manned vehicle, such as Gemini, which is going to fly for other reasons anyhow, we can do collateral testing.

The Air Force will use, to the benefit of military space capabilities, all scientific advances and acquisition of knowledge achieved by NASA. We don't plan to wait for a program of fallout—if we can hasten advancement or increase its utilization through collateral efforts. This we are doing, in the national interest, to-

ward advancing our considerable space testing and development of approved space programs.

The military space program is necessary because military capabilities address themselves to military threats and are capable of reacting quickly to enemy aggression.

For example, at this time a significant military threat to the United States is posed by intercontinental ballistic missiles. These missiles pass through space en route to their targets. In the over-all flight of a ballistic missile, much the greater part of its trajectory is through space. It may be found that the threat of offensive missiles can be dealt with only by utilizing defensive systems involving space orbiting or rendezvous operations. That raises the question of the in-flight survivability of our own missiles. By this I mean we must know whether space can provide an aggressor with means of intercepting *our* counterattacking US missile force. Thus, a prime requirement is to become familiar with military operational factors in space. To seek such defensive opportunities as may be afforded us in space, it is only logical that we must learn to operate militarily in that medium.

Space also affords unparalleled opportunities for observation and communications. These are critical factors from a military viewpoint. No nation can afford to allow an enemy one-sided exploitation of space or any other medium for communications and observation in wartime. If one of two opponents possesses military capabilities relative to space and the other does not, there can well be one-sided military exploitation of space in wartime.

Yet the threats from space are perhaps most profound and most deadly in those aspects which cannot yet be described. Space is a new medium about which military knowledge is sketchy. The medium of air, in which military operations have been conducted for less than fifty years, provides a warning. When the aircraft was first seen in flight, no man visualized a great bomber delivering a nuclear bomb on Hiroshima. The military implications of space may prove to be even more dangerous and even more revolutionary than those that have evolved with the aircraft. For our own safety, we must take the lead and remain in the forefront of whatever developments may come. Otherwise, some dark day could witness the space equivalent of the nuclear bomber, except that the

(Continued on following page)



Gen. Curtis E. LeMay, Chief of Staff of the US Air Force since 1961, is probably the world's best-known exponent of military aerospace power. A native of Columbus, Ohio, General LeMay started his military career in 1928 after completing flight training at Kelly Field, Tex. An engineering graduate of Ohio State University, General LeMay's flying career predates World War II, during which he earned fame as a bomber commander, and includes such pioneering efforts as prewar long-distance B-17 flights and the development of overseas flying ferry routes that were used during the war. During the war he developed much of the strategic bombing doctrine that was used to such effect in the Allied air campaign against the Axis powers. After World War II, he served with the newly-established Air Research and Development Command, headed US Air Forces in Europe, and commanded the Strategic Air Command. He became Vice Chief of Staff in 1957. Above is condensed from an address by General LeMay to the Executives Club of Chicago, delivered in that city on February 1, 1963.



Air Force-Army teamwork in conventional war was shown at last year's Carolina Swift Strike airdrop exercise, viewed by STRICOM Commander, Gen. Paul Adams, USA, left, with AF Chief of Staff, Gen. Curtis LeMay.

Patrick AFB's Toup twins, 2d Lts. Ronald, left, and Leon, perform key missile roles. Ronald plans instrumentation for missile-range ships; Leon is an Atlas launch officer. Both are Georgia Tech ROTC graduates.



The men who'll fly the Dyna-Soar: Left to right, Capt. William J. Knight, USAF; NASA's Milton O. Thompson; Capt. Henry C. Gordon, USAF; Capt. Albert Crews, USAF; Maj. James W. Wood, USAF; and Capt. Russell J. Rogers, USAF. Dyna-Soar pilots, grouped in photo in front of Titan III booster mockup, were introduced to nation at 1962 Air Force Association Convention at Las Vegas, Nev., during ceremonies attending first unveiling of the Dyna-Soar.

KEEPING SPACE FREE

CONTINUED

target could be in our own country. We must remember that any medium—be it land, sea, air, or space—where man can function and operate military systems—for either offensive or defensive purposes—can be a region of danger to peace and security. In this new medium of space I believe that the military defenses of the western world must be objective, applicable, and evident.

I want to emphasize the factor of time by which space threats and counterthreats are governed. If an unforeseen threat emerges in the new medium of space, months or years will be required to devise, develop, and render operational the necessary defense against that new threat. A military capability for defense is the product not only of technology, but also of training and operational experience.

To attain this capability now, the Air Force space program is directed toward both the development of hardware and the training of the man.

In regard to the latter, we believe that preserving

the peace in space cannot be completely relegated to a black box. The trained man, whether in a manned space vehicle or in a ground surveillance control point, will be one of our most valuable assets in our national space effort—and for our survival.

Keeping space free for peaceful purposes is a fundamental responsibility of the American people.

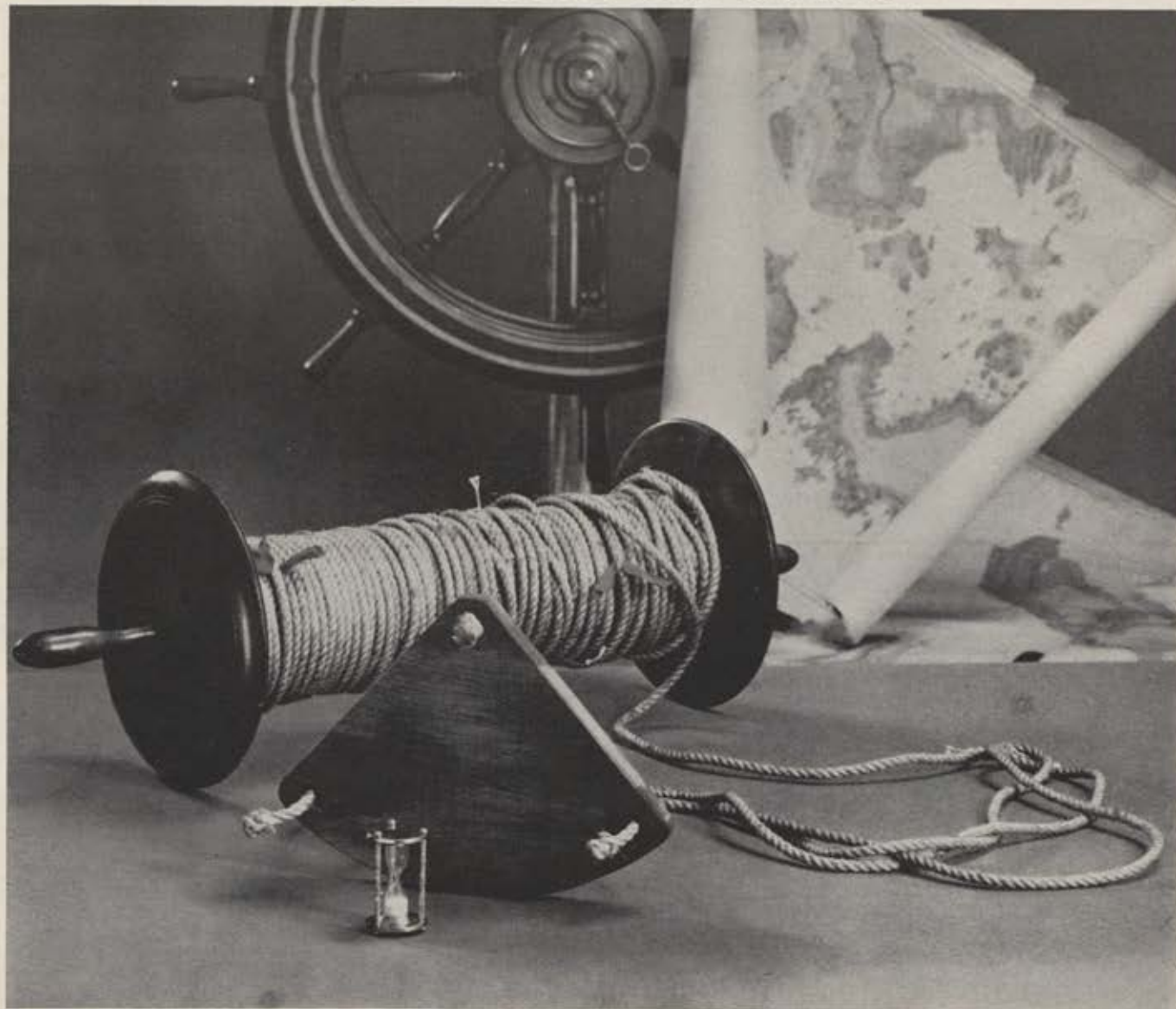
Other generations of Americans have borne burdens that were heavy and difficult. Abraham Lincoln, speaking of his period of American growth a century ago, said this:

"We cannot escape history. The fiery trials through which we pass will light us down, in honor or dishonor, to the latest generation. We, even we here, bear the burden and share the responsibility."

Lincoln's words were applicable to the problem of his American generation: to preserve the Union. Lincoln's generation met its responsibility. We cannot afford to do less.

(Continued on page 45)

FROM CHIP LOG TO ACCELEROMETER



Chip Log (19th Century)—The earliest device known to measure a ship's speed. The chip was attached to a line knotted at specific intervals and drawn through the water during a measured 30 seconds. The knots were then counted, indicating the nautical miles per hour the ship was making. (Dossin Museum)

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Our record proves our ability to develop and produce precision guidance system components, and to deliver them on time, at low cost. We welcome the challenge to prove our capabilities and solve your guidance problems. Contact Director of Sales, AC-Milwaukee.

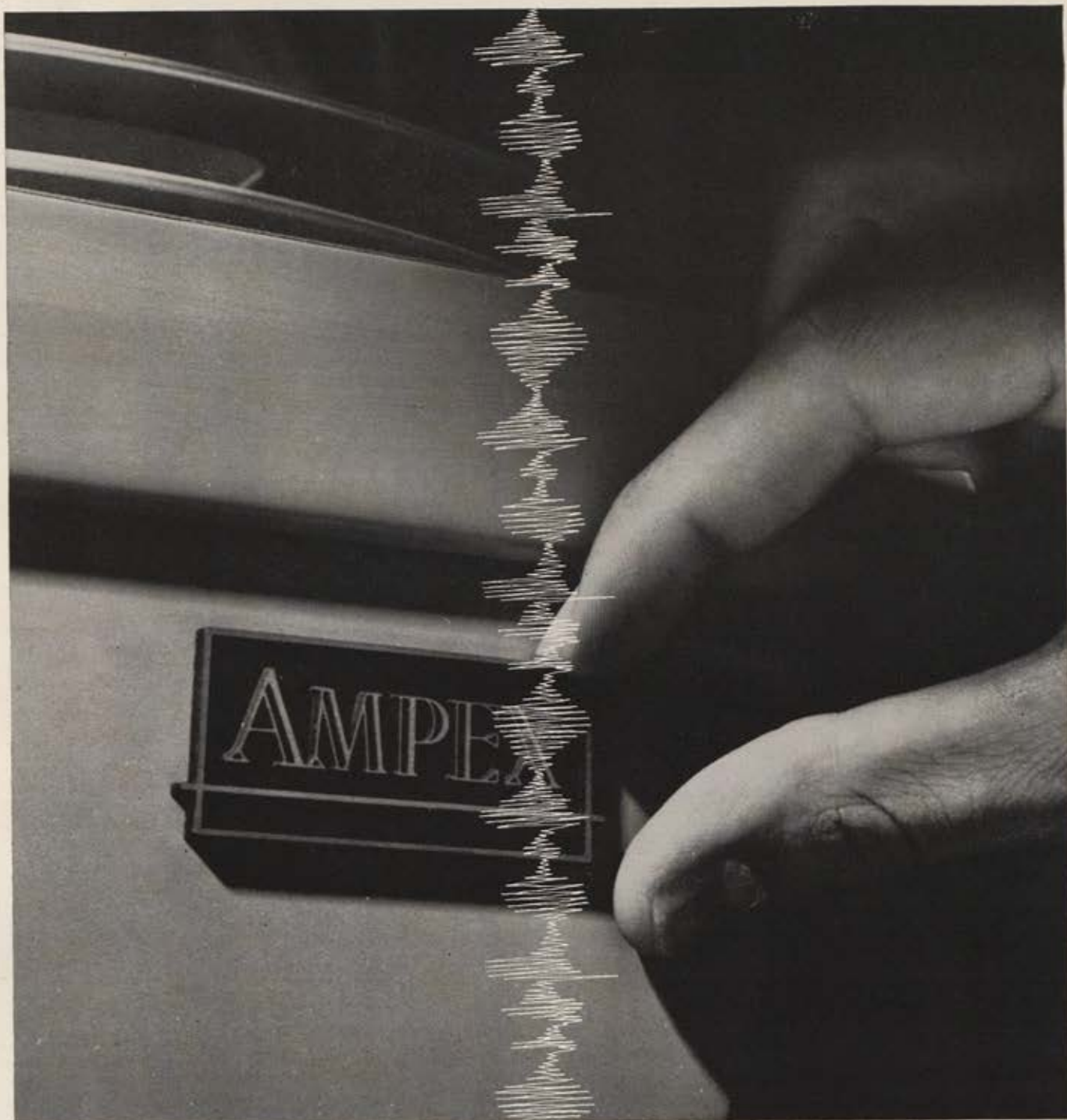
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AC SPARK PLUG • THE ELECTRONICS DIVISION OF GENERAL MOTORS

7929 South Howell, Milwaukee 1, Wisconsin



What name is on the first 1.5 Mc recorder?

AMPEX

Here it is: a 1.5 Mc per track, multi-track recorder! And Ampex is the first to have it. It's called the FR-1400. It will give you the broadest bandwidth yet in longitudinal recording. What's more, it utilizes solid state electronics throughout—all in one rack. It has four speeds, each electrically switchable with no adjustments needed. And it comes with tape search and shuttle to provide quick data location and permit any portion of the tape to run repeatedly without operator attention. What about per-



formance? Outstanding! It offers better rise time and minimum ringing on square waves, low intermodulation distortion, and improved flutter. Ampex also brings you a new 1.5 Mc tape. In both you'll find the same engineering precision, the same superior quality, that has made Ampex first in the field of magnetic recording. Write the only company providing recorders and tape for every application: Ampex Corp., 934 Charter St., Redwood City, Calif. Worldwide sales and service.

AMPEX

A unique generation of Americans now governs the life of this country. I am speaking, of course, not merely of government officials, but of all the millions of Americans who take part in steering the great industrial, agricultural, social, and humanitarian triumph that is the United States. This vast complex that we call America is, by far, the most advanced achievement of man. And this present generation of Americans has helped to achieve it, has defended it in painful wars, and now executes for America the task of assuring its continued growth and security. This should be enough to ask of one generation. It has been and is a heavy burden, sometimes a desperately difficult task. Yet, it is this same generation of Americans that now faces the greatest task to confront man since the beginning of time—opening the door to infinite space. We will pass through that door and confront the challenges, the dangers, the uncertainties, and the failures that are sure to come. We will be required to make decisions that will profoundly affect the future of mankind. We

will go into boundless space and deal with its unpredictable events, garner its benefits, surmount its threats. We will go where, in billions of years, earthly man has never been. Space is the newest and the greatest task of this unique generation. Future generations will only refine what you and I have the opportunity to pioneer.

And Americans are professional pioneers.

I have stated my beliefs on the importance of space—its importance to the future well-being of our country—its importance to the future progress and, possibly, survival of the world.

I have noted some of the implications affecting this new medium—the peaceful ones of scientific research—the threatening ones of aggression.

I have also indicated paths that will open unmeasured horizons to man—paths where our nation's security may lie—paths that lead straight up, where Americans will pioneer in a new challenge—perhaps the greatest challenge of all—space.—END

Meeting the Potential Soviet Challenge from Space

In his address via Telstar to the Air Force Association Convention in September 1962, the President noted that in the field of space, the Air Force must make sure "that no nation secure a position in space which would threaten the security of the United States and the free world." The Air Force supports this objective, as it is axiomatic that any medium which an aggressor can use to his advantage will be so used. Maintaining the peace in space, as elsewhere, will be accomplished through deterrence. Deterrence can be achieved only through the existence of ready military capabilities to operate in the area in question.

The Soviets have made significant progress in their exploration of space. A review of Soviet space accomplishments to date makes it very clear that the USSR has been engaged in a well planned, long-term program, heavily emphasizing manned spaceflight. The Soviet record includes: orbiting the world's first earth satellite; orbiting by far the world's heaviest satellite; launching the first vehicle to impact on the moon; launching the first vehicle to get pictures of the back side of the moon; launching the first vehicle to transfer from earth orbit to a trajectory toward a planet; the first successful orbiting and recovery of a man; and, most recently, the launching of two one-man space vehicles in proximate orbits and subsequent successful recovery of both vehicles. These successes represent technical achievements of the first order.

The Soviets could be proceeding actively to develop space systems for military application. We believe the Soviets will produce and deploy those military space systems which they find feasible and advantageous in comparison with other types of weapons and military equipment.

The Air Force has under development technological building blocks from which military capabilities could be subsequently created to ensure strategic deterrence. These efforts have brought us to a point where significant possibilities are clearly apparent. The present area of military interest is within the sphere bounded by the synchronous orbit—an orbit in which a satellite remains in a fixed position over a point on earth. It is in this area that we can

augment existing terrestrial defenses through the use of space.

The United States military achievements in space will be expensive. Our objectives will be difficult to accomplish and the risks in some programs will be large. However, as in all previous military progress, risks will diminish with experience and can be minimized in early stages by thoroughly planned decision points. We must not risk the danger of waiting for the enemy to demonstrate a capability before we undertake development of our own. The visible threat to our national security requires a vigorous military space program.

I have given you a brief review of the elements of US aerospace power—its accomplishments, its capabilities, and its needs. And finally, I should like to stress again that deterrence continues to be our theme and objective—deterrence of conflict of any kind, from a show of force to general war. To be deterrent, however, the forces must have the capability to enter any point of the spectrum of conflict and assist in defeat of the enemy. This the Air Force can do with its:

(1) People—trained and equipped to accomplish missions required in support of US diplomatic and military actions.

(2) Tactical air forces to include the airlift and counter-insurgency forces.

(3) Strategic force of manned bombers and missiles hardened, dispersed, and protected by an air defense system.

These capabilities are costly, but events during the past year have certainly proved their worth. The details on what is being requested this year by the Department of Defense in order to maintain these essential military capabilities are included in the budget request under consideration.—END

The foregoing is from Air Force Chief of Staff, Gen. Curtis E. LeMay's statement before the House Committee on Armed Services, United States House of Representatives, on February 21, 1963.

"Prudence dictates that we move rapidly to learn about the military implications of space and . . . gain . . . military operational experience in the region. Firsthand experience and knowledge are essential ingredients in performing a military mission. Just consider . . . how well we could conduct the air defense of this country if we were suddenly called upon with no real experience in that field. Only with experience can we have assurance that we can handle the tasks . . . national security requires. In space such experience can allow us to gain an elementary basis upon which to erect defenses against those threats which can now be foreseen or those yet seen only dimly . . ."

Guided home by radar, its hypersonic speed dissipated as it approaches land, the Dyna-Soar X-20 aerospace craft touches down neatly at the proper speed and approach angle in fashion of the X-15 rocket aircraft, as visualized in this artist's sketch.



Needed: Military 'Stick Time' in Space

By Lt. Gen. James Ferguson, USAF

DEPUTY CHIEF OF STAFF, RESEARCH AND DEVELOPMENT, US AIR FORCE

AN OBJECTIVE of the United States, as stated repeatedly by the President, is to maintain peace in space. In this connection the President has directly charged the Air Force to see to it that no nation achieve a position in space which threatens the security of the United States. We must ensure that peace is free for the peaceful pursuits of mankind. To do so requires that we develop an ability to deal with threats that may arise in this medium. The maintenance of peace in space may well hinge on the availability of ready strength applicable to this region.

The first reason the Air Force is concerned with space from a national defense standpoint, of course, is this: The Commander in Chief has directed that we be so concerned. The second reason for military concern is that the space region constitutes a source of potential danger to the nation. The most lethal threat posed against the United States today, *i.e.*, enemy ballistic missiles would approach the United States through space.

The greater part of the trajectory of an ICBM lies in space. Effective defenses against ballistic missiles are not yet available. In seeking such defenses, we would be remiss to omit the most thorough investigation of the military possibilities afforded by the space region.

Space is not remote. Vostoks have traversed the United States many times. In doing so, they passed closer to our inland cities than have any enemy craft ever before in our history, by land or sea or air. Space is a medium that hangs over every square mile of the United States. No other medium provides routes for such rapid access to every part of our country as does space. This new medium is, therefore, a potential new dimension of danger and a threat which we cannot afford to ignore. Space vehicles can carry megaton weapons; Mr. Khrushchev took the trouble to tell us so in plain language. A space vehicle orbiting overhead carrying a warhead could be capable of executing an attack in half the time of an ICBM flight.

Moreover, space is a region particularly well suited to purposes of observation and communications. The wartime advantage to any nation which could have the exclusive use of space for observation and military communications would be enormous.

Space is an infinite region in which the United States hopes to pursue great scientific explorations for the expansion of knowledge and the betterment of mankind. Our opponents might conceive it to be in their interests to prevent American space exploration. It is possible that an enemy might try to demonstrate his power by imposing a space blockade, halting US scientific progress into space. Indeed, he might interpret any lack of evident free-world strength there as an invitation. Certainly if history conveys a useful military lesson, it is that ready strength is important to the protection of our peaceful interests. This means that military capabilities applicable to the space region should be at hand, though we would hope they would never be used. Indeed, their mere availability may avert the necessity for their use.

There can be little doubt that the Soviet Union has military applications in mind for the space region. In a 1962 publication on military strategy, recently translated [see "Soviet Military Strategy," by Murray Green, *March '63 AIR FORCE*, p. 38], Marshal of the Soviet Union Sokolovskiy has the following to say: "An important problem now is warfare with artificial earth satellites, which can be launched for diverse reasons, even as carriers of nuclear weapons." Marshal Sokolovskiy says further: "Soviet military strategy takes into account . . . the use of outer space and aerospace vehicles." Even with the difficulties of translation, the meaning is fairly plain. The basic reason for this Soviet military interest in space is not difficult to understand.

The Soviet Union is faced with formidable free-world defenses relative to the mediums of air, sea, and land. But in space, the new medium, they see no evident and applicable Western world defenses. In this new medium the Soviet strategist may well hope to attain strategic ascendancy. But he can only entertain that hope if we fail to achieve the timely development of military capabilities for space. Both we and the Soviets know that the advent of human space activity exposes an open flank, even though the precise dimensions of the flank are not clearly perceived. Obviously,

we cannot afford to ignore such a flank and do not propose to do so.

I have touched upon some of the military threats from space that are within the existing capabilities of our enemies. Yet the foreseen dangers associated with enemy dominance of space are probably minor when compared with those we do not now foresee. Consider the record relative to other mediums. When the first aircraft flew, only sixty years ago, who foresaw the nuclear bomber? When the first submarine put to sea, who visualized the Polaris launcher? But these, air and sea, are limited mediums with which mankind has centuries of experience. How much less likely, then, are we to foresee the military developments that can emerge in a new medium, space, with which we have relatively no experience?

Prudence dictates that we move rapidly to learn about the military implications of space and to gain military operational experience in the region. First-hand experience and knowledge are essential ingredients in performing a military mission. Just consider, if you will, how well we could conduct the air defense of this country if we were suddenly called upon with no real experience in that field. Only with experience can we have assurance that we can handle the tasks which national security requires. In space such experience can allow us to gain an elementary basis upon which to erect defenses against those threats which can now be foreseen or against those yet seen only dimly.

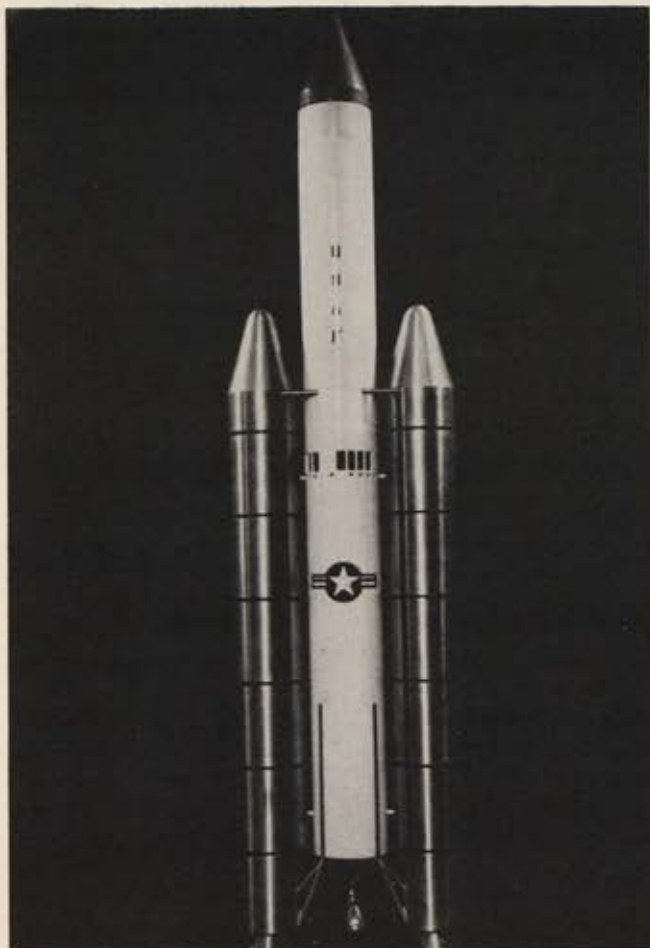
The space activities of NASA have produced and will continue to produce highly important data which is available for application to problems of national security. This committee is well aware of the extent of Air Force-NASA cooperation. At the Washington level, we have the Aeronautics and Astronautics Coordinating Board. We also have innumerable staff contacts. And we have a Deputy to the Commander of the Air Force Systems Command, Maj. Gen. Osmond J. Ritland, located at NASA headquarters. He can call upon the full resources of the Systems Command in support of NASA.

In seeking to identify and advance the development of military capabilities for space, the Air Force wishes to take full advantage of the important knowledge NASA acquires. We strongly support, in both thought

(Continued on following page)



Lt. Gen. James Ferguson is Deputy Chief of Staff for Research and Development, US Air Force. Born in Turkey of British parentage, General Ferguson became a naturalized US citizen in 1930. After completing his course of study at Fullerton Junior College in California, he enlisted in the Army Air Corps in 1934, became a flying cadet in 1935, completed his flight training in 1936, and received his commission later that year. The General participated in pre-invasion air war in Europe during World War II and later went to the Pacific theater. During the Korean War he was Vice Commander of the Fifth Air Force in Korea. From 1952 through 1961 he served in a number of staff and research-and-development posts and was Vice Commander of the Air Research and Development Command and its successor, Systems Command. He was named Deputy Chief of Staff, Research and Technology, in 1961, the post later renamed DCS/Research and Development. The above is condensed from General Ferguson's formal presentation to the House Science and Astronautics Committee at hearings held by the committee on March 1, 1963.



Powerful new USAF booster currently under development for use with Dyna-Soar X-20 manned aerospace craft and potentially useful for broad range of other military space systems is Titan III, featured by two "strap-on" solid-fueled rockets. Cost would be about \$400 per pound of payload.



'STICK TIME'

CONTINUED

and action, the necessity and value of NASA's scientific explorations. But it is not possible for NASA to develop military capabilities as such. This is because a military capability consists of a combination of technical knowledge, military organizations with operational experience, suitable military equipment, tactics, and doctrine. Most of these are factors which can be developed only within a military service.

At the present time, a joint planning board composed of NASA and DoD representatives is working on the delineation of requirements of both agencies with respect to Gemini. The Air Force has military objectives relating to manned spaceflight for which Gemini can be very useful. We, of course, will not interfere with Gemini's contribution to the lunar project. For example, the production of additional vehicles, if that is required, presents no problem. The scope of our participation in Gemini has not yet been fully defined, but we certainly expect to benefit from it.

Of course, we cannot rely on this to give us all the firsthand operational experience we seek. A military space program is essential for military space capabilities.

To this end, there is at hand a substantial and diverse body of space technology. The success of the Mercury project has validated manned space possibilities and many of our intuitive expectations have become realities. These great American achievements were corroborated and more than matched by Russian accomplishments in the longer duration orbits of Titov in August 1961 and the dual launch capability demonstrated in August 1962 by Vostoks III and IV. These continued successes by the Soviets clearly demonstrate their progress in space technology, and their comments reveal the direction of their thoughts. Listen again to Mr. Khrushchev after Titov's flight:

"If you want to threaten us from a position of strength, we will show you our strength. You do not have fifty- and 100-megaton bombs. We have stronger than 100 megatons. We placed Gagarin and Titov in space, and we can replace them with other loads that can be directed to any place on earth."

Lest we be tempted to believe that the Communists can be dissuaded from developing the military potential of space simply by avoiding it ourselves, we might consider the lessons of history. The idea of peace without adequate defense has not worked well in the modern world: The United States had no military strength in Southeast Asia before Communist aggression began in that area. There was little evidence of American military power in Korea when the Communists attacked there. When Communist forces invaded and crushed Hungary, they certainly had not been provoked by the presence of powerful military strength.

In contrast, where US military capabilities have been strong and evident and our intent to defend was

(Continued on page 53)

President Kennedy, on his visit to Cape Canaveral in September 1962, with Vice President Lyndon Johnson, examines latest configuration of the Martin Titan III space booster, showing five-segmented strap-on motors which add two million pounds of thrust to that of the Titan II core.



Itinerant tropo scatter systems

Making a tropospheric scatter communications system is one thing. Making it air transportable and mobile is another. By distributing weight equally in vans, we've done it with the AN/MRC-98, which we are supplying for the U.S. Air Force Rome Air Materiel Area.

Any of the three vans or antenna trailers can be carried in a C-130 type aircraft. And ten men can set it up in 12 hours, to provide a completely self-contained communications terminal, including prime power.

The MRC-98 as currently delivered can relay 24 voice messages and 12 teletype messages at a time, by bouncing radio waves off the troposphere in hops of approximately 200 miles. It has the built-in capability of handling 60 voice messages and 48 teletype messages. This quadruple diversity

system is reliable 12 months a year, even under the poor atmospheric conditions of the winter months.

Principal components of the AN/MRC-98 10 KW system are the AN/FRC-39(V) receiver-transmitter, the AN/FCC-17 multiplexer set, in-band signaling equipment CV/566-GT, order-wire equipment, two 28-ft. parabolic reflector antennas, two 150 KW generators. It operates in the 755 to 985 mc band.

The system is compatible with the Defense Communications System long-haul circuits, and offers an economical and quick means of extending communications to new areas. For more information on this tropo scatter system, and/or militarized mobile or fixed ground stations for satellite communications, write us care of Government Marketing in Baltimore 4, Maryland.

Bendix Radio Division

THE **Bendix**
CORPORATION



MANNED OR

Aircraft & missiles can now fly automatic, ground-

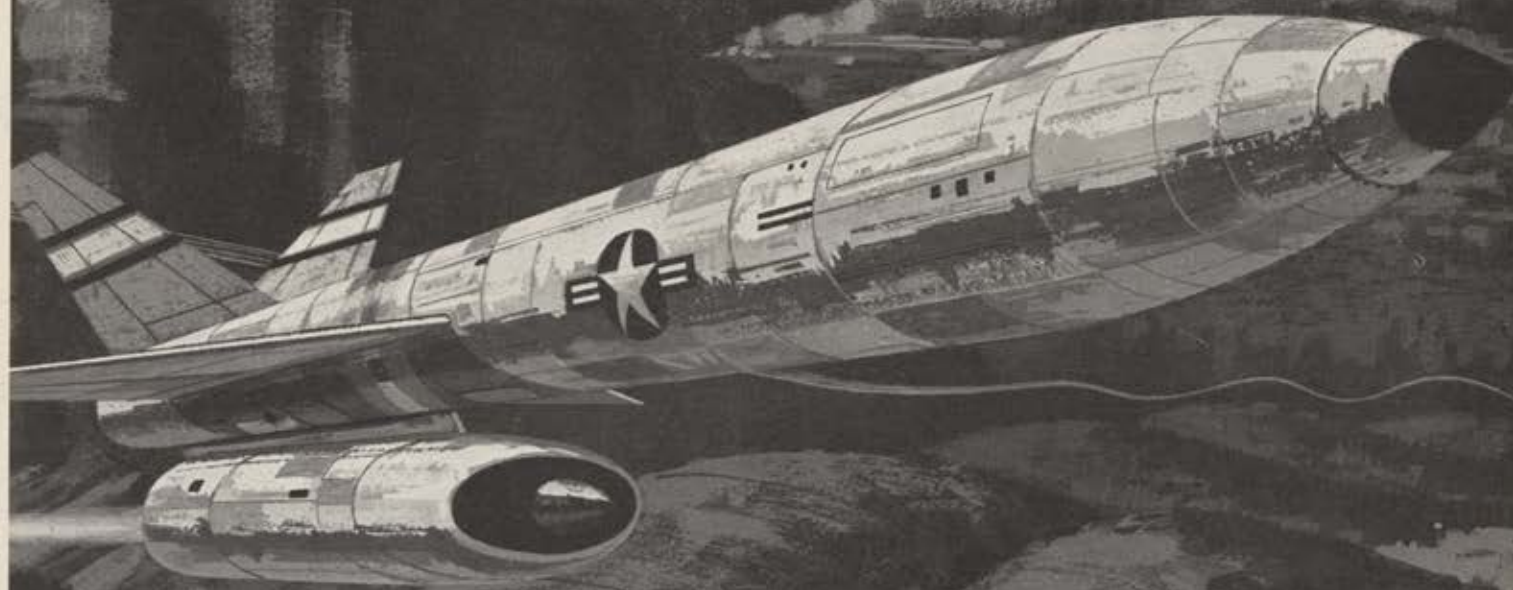
Terrain Following Radar now enables air-to-ground missiles, drones and aircraft to fly automatically at selected low altitudes permitting penetration below early warning radar. This new on-the-deck mission capability and many others can be added to all types of aircraft by the General Dynamics|Electronics Terrain Following Radar. The system, which detects all terrain obstacles and transmits continuous instructions to pilot or autopilot, is suitable for both military and commercial aircraft.

***THOROUGHLY TESTED** — More than 25,000 miles of actual low level flight tests and 200,000 miles of computer simulation have proven the system's capability and reliability. In one test an aircraft flew at 400 feet from San Diego, California, to Las Vegas, Nevada, over some of the roughest terrain in the United States without the pilot having touched the controls. Available now, the versatile General Dynamics|Elec-

tronics unit is suitable for manual or automatic blind flying at speeds from 100 knots to well in excess of Mach. 2.5.

COMPACT, LIGHTWEIGHT — The General Dynamics|Electronics Terrain Following Radar is the only thoroughly and successfully tested system compact enough to fit in any aircraft and is readily adaptable to air-to-ground missiles. The low-powered, lightweight system weighs only 40 lbs. and occupies $\frac{1}{2}$ cubic foot. The design is so simple that preflight calibration and alignment are not necessary.

APPLICATIONS — Besides adding all-weather, low-level mission capabilities, the system permits safe, automatic let down through cloud cover to non-instrumented air fields. It also protects aircraft flying through unfamiliar mountainous terrain in periods of poor visibility. During any ground-hugging flight the radar system frees the pilot to observe or operate navigation and other equipment.



UNMANNED

Charles W. Hays

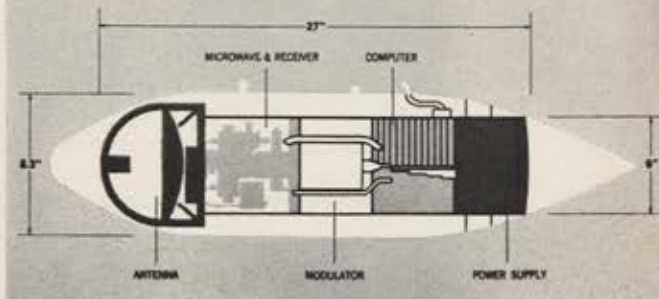
hugging missions with compact, proven radar*

RELIABILITY — As a result of simplicity of design the system is highly reliable and requires an absolute minimum of maintenance. This factor is enhanced because there is no scanning antenna and no requirement for a radar scope. For further information on Terrain Following Radar, write to Department D-16, General Dynamics|Electronics — San Diego, P.O. Box 127, San Diego 12, California.

SPECIFICATIONS:

FREQUENCY: Ku Band
POWER IN: 1 amp, 28v d-c, 2 amps, 115v a-c, 400 cycles
POWER OUT: 10 KW peak
WEIGHT: 40 pounds
CIRCUITRY: transistorized

TFR can be mounted in pod for fast, field installation.



GENERAL DYNAMICS | ELECTRONICS **G|E** SAN DIEGO

YESTERDAY, IMPOSSIBLE; TODAY, ROUTINE



MASS PRODUCTION OF LITTON INERTIAL NAVIGATION SYSTEMS FOR AIR FORCE F-4C

Within a few months after receipt of contract, Litton recently delivered an LN-12A Inertial Navigation System, the first of several hundred in production for McDonnell F-4C all-weather tactical fighters. It was also the first inertial navigation system selected for use in manned aircraft by the U.S. Air Force. Additional systems have now been shipped, and substantial quantities will follow during the months to come. Litton's ability to accomplish quick-reaction delivery of this order of brevity on a system as sophisticated and complex as the LN-12A is attributable to nearly a decade of pioneering effort in the design and manufacture of *more than one thousand* inertial navigation systems. As a result, Litton

had several proven inertial systems already in production at the time requirements for the F-4C were publicized. Because of its background, Litton was also able to rapidly marshal the people, facilities, and technology required to commit the system to production almost immediately. Fast reaction time and production type components will mean low program costs, not only for the system, but also for all associated test and support equipment and services. For complete information on Litton capabilities in the engineering and production of inertial navigation and flight management systems, write: Marketing Director, 5500 Canoga Avenue, Woodland Hills, California, or telephone: 346-4040.



LITTON SYSTEMS, INC.
GUIDANCE & CONTROL SYSTEMS DIVISION

THE WORLD'S LARGEST PRODUCER OF INERTIAL
NAVIGATION SYSTEMS FOR MANNED AIRCRAFT



Left, Titan II-boosted Gemini capsule nears end of powered flight far above earth. After booster falls away, two men in capsule (foreground, in drawing above) will attempt to rendezvous with Air Force Agena stage previously fired into orbit. Project will prove out rendezvous techniques for moon program.

MILITARY 'STICK TIME' IN SPACE

CONTINUED

unmistakable, acceptable peace has been maintained. For example, in the eleven years since the commitment of US forces to the defense of NATO territory, not one inch of Western Europe has been lost to Communist control. A more recent example was the Cuban situation. Our existing, ready military capabilities permitted the execution of the President's decision to take serious action to prevent the Soviet Union from obtaining a position in Cuba which could threaten the security of the United States. Technical knowledge could not have done this: Ready military capabilities were required. Fortunately, the United States had the needed military capabilities at hand ready for instant action.

In respect to space, we have not yet attained the flexible military capability for which we strive. We are living in an age of so-called exploding technology, but new capabilities are still not attained quickly. We are concerned, for example, about the lead time necessary to develop a defense against a possible threat from space which is now unforeseen. This lead time is usually a matter of years; it is a key reason we seek urgently to attain maximum knowledge, experience,

and flexibility through our military space program.

It is axiomatic that we will learn the military meaning of space in one of two ways: Either through exploring the military potentials of space ourselves or by observing demonstrations made by our enemies. In the latter case, it could be too late to make use of our dangerously acquired understanding.

History records that an acceptable peace in any medium has been maintained only through the existence of ready military strength applicable to that medium. Unfortunately, it also records that every medium affording military possibilities has been used for military purposes.

Accordingly, it is the Air Force's objective to develop military capabilities applicable in space which (1) strengthen the general defense posture of the United States, and (2) protect the specific interests of the nation in the space region.

The military space program should develop a broad range of capabilities to operate effectively in this new medium. Greater knowledge of the military possibilities afforded by space should be gained; military

(Continued on following page)

equipment designed to deal with these possibilities should be developed; experience in the application and control of space-oriented military capabilities should be achieved. All of these fundamentals should be advanced at a rate consistent with the fact that the time of a space-based challenge to the security of the United States is unpredictable.

The various elements of the proposed Air Force space program would combine to form a stream of advance toward useful military capabilities in space, some of which can be realized almost immediately, others being dependent upon further technological progress.

Region of Concern

In general, the military interest in space *at this time* is within the region bounded by the stationary orbit: The Air Force Five-Year Space Program seeks capabilities within this sphere.

We wish to learn to operate, on an effective and economical basis, both manned and unmanned systems within the near-earth environment. Operational systems to meet some requirements, such as communications, will extend out to synchronous orbital distances, and we will be concerned with the possibilities of even deeper space environment. However, our principal interest is focused on ensuring that the *near-earth* environment is not dominated by a hostile power.

The Air Force Space Program

Over the next five years, the Air Force has proposed efforts toward two objectives:

- To augment, by use of space systems, the existing military capabilities of United States terrestrial forces.
- To develop a military patrol capability for the protection of United States interests in space.

A word on each of these. First:

Augmentation:

By use of space devices, we expect to enhance the capabilities of the earth-based defense posture of the United States. For example,

- Space-based communications can improve the reliability and scope of command-and-control systems;
- Surveillance of atmospheric weather from space can provide information regarding cloud conditions in target and refueling areas;
- Space systems may furnish a means of active defense against ballistic missiles and of
- Warning that a missile attack is under way.

And about our second objective:

Military Patrol:

The term "military patrol" refers broadly to an ability to determine at all times what is happening in near space, whether there is a threat present, and to deal with it if necessary. Military patrol capabilities for the space region could provide on-call protection for US space activities, both scientific and military, in

event of hostile enemy actions in the space region. This objective includes:

- An improved detection and tracking system.
- A means of inspecting unidentified space devices.
- A means of disabling hostile satellites, if this should be required in the national interest.
- Lastly, a system for continually monitoring such space phenomena as radiation and solar flares; the latter being essential for prolonged space operations.

Technical Building Blocks

The Air Force Space Program also includes elements which form the basic R&D building blocks for a military man-in-space program. Key elements of this group already in development are: the Titan III launching systems, Dyna-Soar, and Air Force participation in the Gemini program. In this connection, I think I made it clear that the NASA/DoD agreement of this January on a joint Gemini program was most certainly welcomed by the Air Force. Another key element we propose is a military test space station. The technologies represented by Gemini, a military test space station, Dyna-Soar, and Titan III are fundamental to any future manned military space capability.

The aforementioned portions of the Air Force space program have primarily considered short-term objectives; however, there are other efforts which must be pursued *now* to advance basic technological disciplines if future objectives are to be realized. These efforts involve such subjects as advanced air-breathing propulsion, electromagnetic warfare and countermeasures equipment, possible space weaponry, space applications of nuclear power, basic research, and studies and analyses aimed at finding solutions to military problems through the use of space systems. We are working very closely with NASA on certain of these technological efforts. As an example, NASA and the Air Force reached agreement this past fall on a joint two-year program of hypersonic research; such research can contribute much to the aerospace plane concept the Air Force is pursuing. The hypersonic research program includes aerodynamics, propulsion, structures, and materials. We know that joint endeavors such as this one will contribute significantly to the achievement of the necessary technical basis for broader space activity, and thereby can assist us in attaining military space capabilities. . . .

The military space program we have proposed would be expensive, and it involves expenditures substantially beyond the current level of military space effort. Although it includes a number of projects that are now under way, it also includes others, some of which may involve considerable R&D technical difficulties.

Nonetheless, I consider the program a prudent one in a dangerous world. If we are to ensure that peace is maintained in the space region, the United States must acquire a range of military capabilities in that region. We should do this with deliberate speed, since we do not know and cannot predict the time of need.

—END



Scott put the **LIFEGUARD** on the Mercury Spacecraft

The two-stage Scott regulator used to support the reaction controls system of the Mercury spacecraft played an important role in helping Astronaut John Glenn successfully complete his historic mission and return safely to earth.

Scott's part in NASA's Project Mercury and the McDonnell spacecraft is indicative of the esteem prime contractors hold for Scott products. This reputation for quality, precision, and reliability has earned Scott a

leading position in helping win the race for space. Scott leads the way, too, in the development of environmental control and life support systems for many of today's advanced aircraft and weapons systems.

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With Dyna-Soar and Titan III being reevaluated in the doleful manner that so often presages cutback or cancellation, the future of the military space program is fuzzy, lacking even "commonality" of view in the Pentagon. Bits and pieces are being worked on, but no one's putting together the parts. There are . . .

BUILDING BLOCKS ... BUT NO BUILDING

By J. S. Butz, Jr.

TECHNICAL EDITOR, AIR FORCE/SPACE DIGEST

WASHINGTON, D. C., MARCH 18
DYNA-SOAR's future, at this writing, is in the hands of Secretary McNamara, who says he'll make a decision within "the next several weeks." On this decision rides a good deal more than just another space project.

On it will depend any real hope of building an operational US space force by 1968 and probably even by 1973 or later.

Congressional testimony strongly indicates that the outcome of the Dyna-Soar decision will carry with it the fate of virtually all of the key points in the Air Force's basic concepts and requirements for an operational space force.

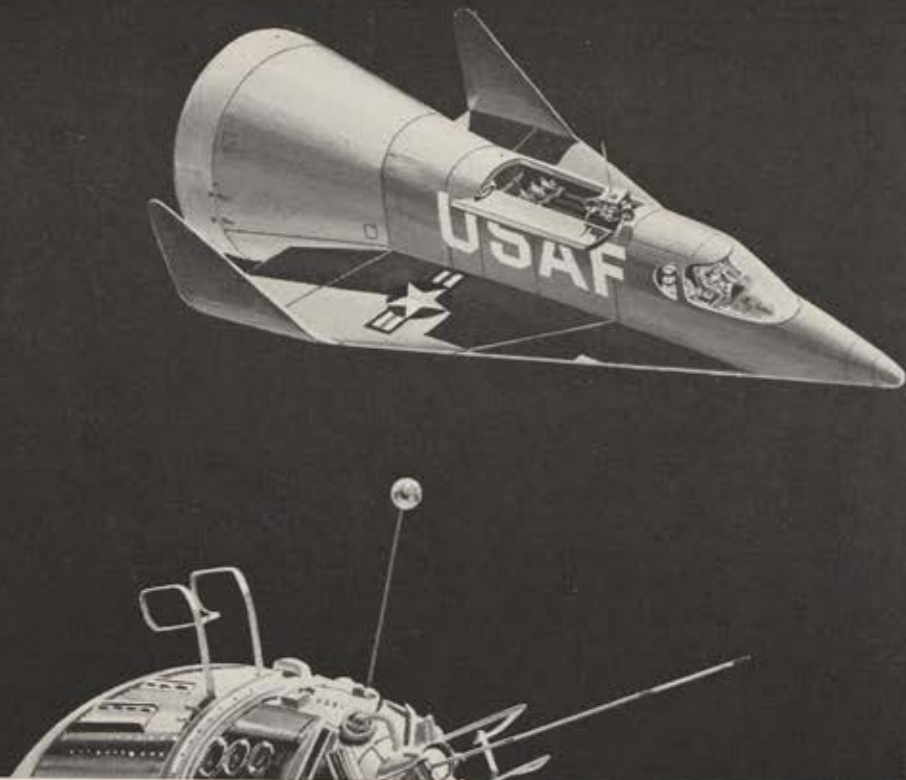
Logic, experience, and dozens of studies clearly indicate that effective military space operations must be conducted along the same lines as current operations in the atmosphere. Space systems must be able to respond almost instantaneously to a threat, able to operate on an all-weather, twenty-four-hour basis, able to function repetitively with the least amount of down time for servicing. Meanwhile, costs must be kept as low as possible, reusing expensive equipment to the maximum.

Space vehicles to date have not begun to meet all these requirements. Rather, they have featured known launch times and throwaway systems. Purely scientific space systems will likely continue in this direction. It would raise their cost unduly to aim for much else.

With the unique military requirement in view, the Air Force has pushed hard for two key vehicles, the Dyna-Soar vehicle and the Titan III booster, with the idea that they would form the backbone of any effective operational system during the 1966 to 1970 period.

Dyna-Soar has two unique advantages over any existing space vehicle—including Gemini. First, its internal volume is relatively high, and it thus can carry inside the reentry body a substantial load of the electronic and mechanical equipment and power supplies needed for military activities. In contrast, the Gemini's volume is limited, and it can be made to perform a military job in orbit only by attaching a large adapter section to the reentry capsule. The equipment in the adapter section must either be thrown away on each flight, or be wrapped in a re-entry shield. This last solution would cause operational cost to go up quickly because of the extra weight, because of the recovery forces needed to locate the capsule, and because of the extensive refurbishment and checkout of its equipment before the next flight. As an operational military test vehicle, Gemini just doesn't pass the cost-effectiveness hurdle.

Dyna-Soar's second great military advantage is its ability to maneuver widely in the atmosphere during reentry. It can stretch or cut a glide to any desired landing spot in an area 6,000 miles long. More important, it can turn to reach a point 1,500 miles to either side of its flight path. By comparison, the Gemini's



—DRAWING BY GORDON PHILLIPS

A Dyna-Soar glider equipped to perform the satellite inspector mission is shown above in an artist's conception closing with an unidentified space vehicle. The equipment bay is open and a sensor module has been extended. During this first phase of the interception, various sensors are used to observe the unidentified vehicle and to check any signals that it might be transmitting or receiving. Later phases of this mission call for possibly boarding and/or disabling hostile vehicles. Air Force studies show that a human crew

aboard the interceptor vehicle can materially broaden the possible action that can be taken against hostile satellites, will lower over-all vehicle weight to accomplish complex missions, and will improve reliability. The large adapter section, mostly containing fuel to operate on-board power systems and the maneuvering rocket, will remain attached to the back end of the glider until it begins reentry. Most of the devices necessary to inspect and disable hostile satellites can be carried in the reentry glider and can be reused.

"footprint," or maneuvering latitude, is only 1,000 miles long, and its key lateral turning range is only 150 miles to each side. This means that Gemini can return to a given landing area during only a small fraction of time during a given number of orbits. Dynasoar can come down on a given spot during a much larger percentage of its time in orbit. And it is likely that further development can raise the lift/drag ratio of glider reentry vehicles, so that this percentage can be raised significantly. This growth factor is lacking in Gemini-type capsules. The tactical usefulness of any orbital vehicle will hinge largely on its maneuverability in space and during reentry. Any vehicle which cannot change orbits rapidly or leave space on short notice will be highly vulnerable.

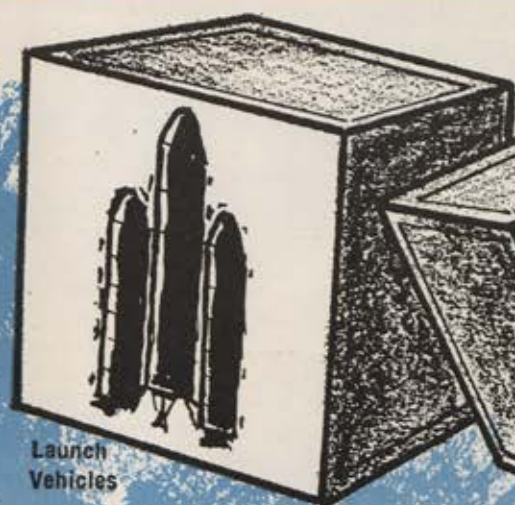
The Air Force wants to participate in the Gemini program primarily to get "stick time" in space, to begin testing men and equipment in 1964, before the Dyna-Soar would be ready for its first manned flight in mid-1965. Gemini was not considered competitive with Dyna-Soar, nor as a replacement for it. This view was echoed by Dr. Lawrence L. Kavanau, Special Assistant to Dr. Harold Brown, Director of Defense Research and Engineering, when Dr. Kavanau told Congress two months ago that "... the X-20 [Dyna-Soar] and Gemini projects are not duplicative," while pointing out that continuing both projects would mean very high costs.

In his lengthy military posture testimony before the House Armed Services Committee in February,

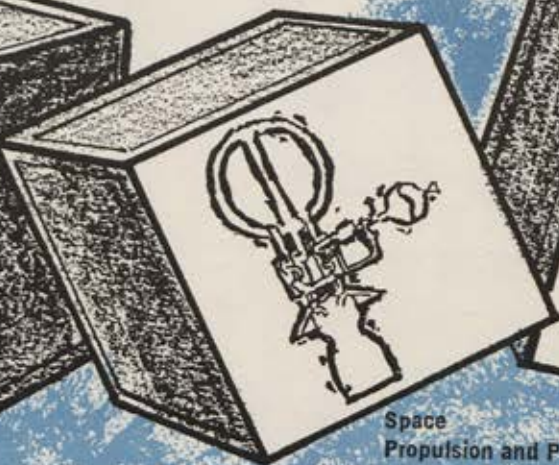
Secretary of Defense McNamara contradicted the Air Force completely and Dr. Kavanau partially. He said, "In any event Gemini is a competitive development with Dyna-Soar in the sense that each [is] designed to provide low-earth-orbit manned flight with controlled reentry. Dyna-Soar does it one way with flexibility and Gemini does it another. . . . I guess that we will find that Gemini has a greater military potential for us even though it is a rather ill-defined military potential, than does the Dyna-Soar and, moreover, it will be available much sooner than the Dyna-Soar. . . . The real question is what do we have when we finish it [Dyna-Soar]." Obviously, he got an answer on his recent visit to the Boeing plant, an answer that has caused him to take a second look at the project.

Air Force interest in Titan III has rested primarily on the fact that its solid-propellant first stage and storable-liquid upper stages allow it to be launched at short notice. The second argument for the Titan III is that it will cut launch costs down to about \$400 per pound compared to \$800 per pound for NASA's Saturn C-1. However, this wasn't a primary consideration because the Saturn C-5 (now called Saturn V), the Apollo moon rocket, has a much larger payload and apparently will get launch costs down to about \$300 per pound. In addition, NASA operational philosophy is moving toward a few launches each year of very large vehicles, with orbital payloads in the 200,000- to 1,000,000-pound range. This is considered

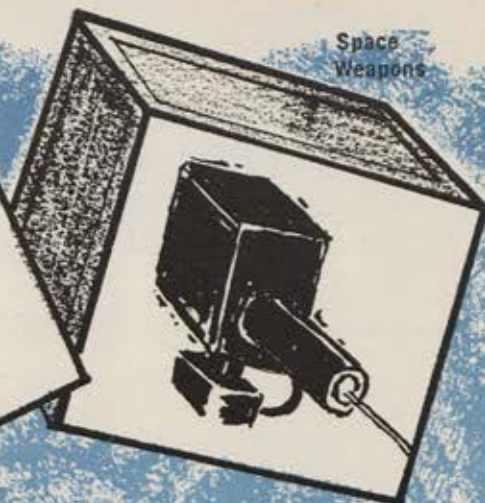
(Continued on page 61)



Launch Vehicles



Space Propulsion and Power



Space Weapons

THE ABC'S OF SPACE BUILDING BLOCKS



Communications

Space building blocks fall generally into nine major areas, as follows:

- **Launch Vehicles.** Work is currently in progress on Titan III, and development has begun on large experimental solid-propellant boosters, 156 and 260 inches in diameter. Funds for a five-year developmental and test program on these very large engines have been programmed. The Air Force also is interested in the nuclear rocket program and is putting about \$19 million this year into its continuing studies on the Aerospace Plane or the advanced hypersonic airplane, as it is now being called.

- **Space Propulsion and Power.** Considerable progress is being made with throttleable, fairly-high-thrust, liquid-rocket engines which can be kept in an operable condition for very long times in the space environment. They are needed to give space vehicles of all types maneuverability, the ability to change orbits widely and rapidly. Fuel-stingy, low-thrust ion engines to keep station and make slow orbit changes are in the experimental stage. Small nuclear powerplants to provide long-term auxiliary power aboard space vehicles are being developed jointly by the USAF, NASA, and AEC. Solar-heated auxiliary power units also are under advanced study.

- **Space Weapons.** A variety of space weapons are being looked at. Some which have been mentioned publicly are: pellets accelerated by high-explosive charges, "focused" nuclear weapons of relatively small yield, electronic countermeasures gear, and electronic counter-countermeasures equipment. Lasers are in an early experimental stage. No one yet attributes any revolutionary

qualities to them, but interest is high enough to keep support at a very high level.

- **Bioastronautics.** This probably is the weakest area in the entire US space program, civil or military. Little building has been done on a solid foundation of excellence in aviation medicine and the demonstrated ability to use animals as test subjects in space. Many fundamental questions about the effects of the space environment on all levels of organisms remain unanswered even though the US has had the ability to find answers for more than two years, as bioastronautics organizational bickering has brought the whole effort near a standstill. A long list of questions about the effects of prolonged weightlessness and other aspects of the new environment on humans can only be answered through the operation of a space station. Yet no such station is planned today by either NASA or the Defense Department.

NASA is ahead of DoD in one important aspect; top officials in the space agency have no questions about the future of man in space. In discussing the lessons of Project Mercury, D. Brainerd Holmes, NASA's Director, Office of Manned Space Flight, has said, "Perhaps most important of all, we have learned that man can materially contribute to the exploration of space. He can enhance systems reliability through his capabilities as an engineer and test pilot. . . ." After John Glenn's three orbits last year NASA reports were more explicit, with statements such as: "By giving man a major role in systems operation, as in aircraft practice, the most rapid and efficient attainment of advanced missions will be possible; manual corrective measures [by Glenn] can be extrapolated to the design



Bioastronautics



Rendezvous
and Docking



Reentry,
Recovery,
and Landing



Ground
Facilities



Understanding
the
Environment

and operational philosophy for highly complex multistage missions of the future. It is clear that man must play an integral role." The flights of Carpenter and Schirra have strengthened the case, and many space agency engineers want to give the Astronauts manual control of boosters as well as spacecraft.

DoD's Dr. Lawrence Kavanau (*see page 57*) has told Congress, "The subject of man's usefulness in space operations for military applications has been controversial, to say the least. . . . Our early thoughts—many of them still prevalent in many quarters—were that there was nothing man could do in space that could not be done automatically, reliably, over long periods."

- **Rendezvous and Docking.** In mid-1964, demonstrations of rendezvous and docking and all basic aspects of orbital operations are scheduled to be demonstrated in NASA-Air Force flights in Gemini. Launch at a precise time, midcourse flight-path correction during the ascent, much like the vectoring of an air defense fighter, terminal guidance and control as the two vehicles approach each other, the final docking maneuver, and the ability of crewmen to operate effectively outside their spacecraft are the basic ingredients of orbital operations. Studies so far indicate that all phases can be handled.

- **Reentry, Recovery, and Landing.** Successful tactical operations in space during a conflict would depend heavily upon the ability of spacecraft to enter and leave space near the earth very quickly. The ability to maneuver widely in the atmosphere is essential if a vehicle is to leave low orbit and return to its base on short notice. The Dyna-Soar is by far the best reentry vehicle on the horizon in this respect.

- **Communications.** Instantaneous, secure, and reliable communications are vital today for a sound strategic war posture, and they will be equally important if space forces become operational. Requirements for higher message volume and greater transmission distance and probably higher reliability will be placed on space systems. As a result studies of radio and radar equipment are being augmented with investigations of infrared, maser, and laser systems. Good progress is reported in all areas of these investigations.

- **Ground Facilities.** Ground control, tracking networks, large computer facilities for programing and controlling launch, flight and reentry operations are basic parts of the ground system needed to support military space operations and to keep tab on foreign vehicles. A good start has been made in this area, but continual improvement apparently is needed if the US is going to be able to handle the job even if the volume of space traffic does not increase any faster than it has in the past couple of years. Dispersed launch sites and landing fields would be essential for military operations. The vulnerability of a single launch facility such as the one at Cape Canaveral would be unacceptable.

- **Understanding the Environment.** This is a vital continuing process, and good progress is being made. The Air Force in its Discoverer satellite series has contributed important basic data as has NASA, primarily through activities at Goddard Research Center. Much work still must be done before solar flares, the Van Allen radiation belts, the incidence and effect of meteoroids, and the peculiarities of the upper atmosphere are understood.—J. S. B., JR.

Decision-Making: Logistics Support... What, Where, When?

Centuries ago the critical factor in logistics support was providing basic supplies—food, armaments, raw materials for simple industries. A few decades ago, carrying capacity—sea and land transportation—ruled as the decisive element. Within the last decade, a new critical element in logistics support has emerged. It has been created by the complex, interfacing governmental, industrial and military structure of today. This new factor is up-to-the-minute information—gathered from afar, varied in content, immense in volume.

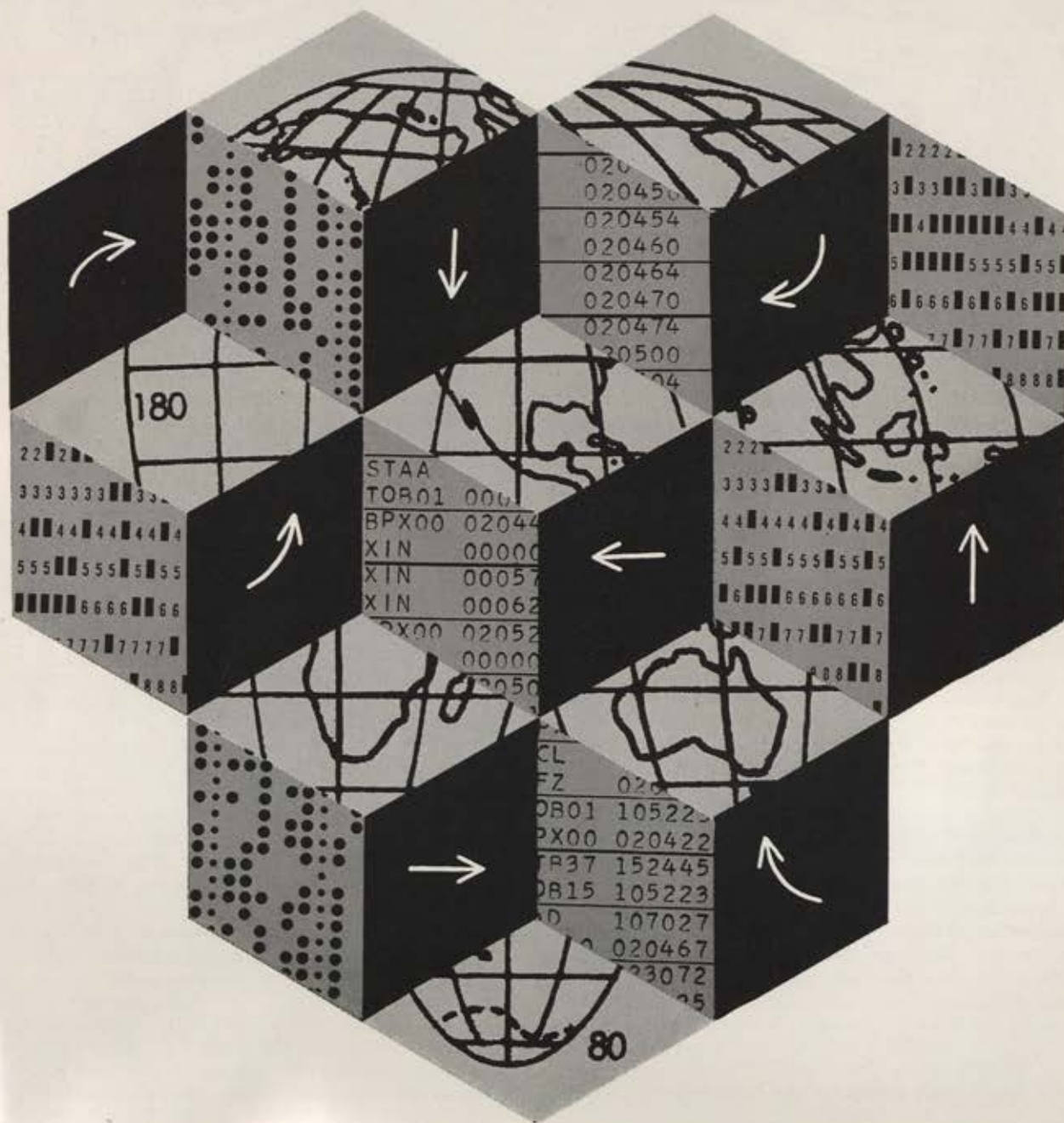
To help provide and control this flow of information, SDC scientists, and engineers

have helped create a new technology: information systems which aid managers in determining the "what, where and when" of logistics support for world-wide and continental activities and forces.

In developing these systems which provide information processing assistance, SDC scientists and engineers have evolved an interdisciplinary approach. Teams of operations research scientists, engineers, computer programmers and human factors scientists work together in these major system development steps: analyzing the system, synthesizing the system, instructing computers within the system, training

the system, evaluating the system—and helping adapt the system to the changing needs of its users.

Scientists and engineers interested in joining this growing field are invited to write Dr. H. H. Best, SDC, 2423 Colorado Ave., Santa Monica, California. Positions are open at SDC facilities in Santa Monica; Washington, D.C.; Lexington, Massachusetts; Paramus, New Jersey; Dayton, Ohio. "An equal opportunity employer"

**SDC****System Development Corporation**

to be much more economical for their purposes than the military plan of launching many smaller payloads (around 25,000 pounds each) on a repetitive basis.

Mr. McNamara told the Congress "... this project [Titan III] is justified primarily as a cost-savings program; its continued development will depend upon the achievement of the cost objectives."

The Dyna-Soar decision, thus, will probably indicate the future of Titan III. Dyna-Soar is the only major space-vehicle program tied directly to the Titan III. Both NASA and the Air Force can perform any testing or space exploration jobs with the Saturn C-1 just as well as with the Titan III. Payload launch costs would be higher with the C-1, but a sizable over-all savings could be made by canceling the Titan III development, which Mr. McNamara estimates as an \$800 million to \$900 million program. Simple arithmetic shows that, under the best circumstances, about eighty Titan III launches, sending around 2,000,000 pounds into orbit, would be needed before the Titan III could show any total savings over the Saturn C-1. The Saturn C-1 is about two years ahead of the Titan III and shows signs of being a good performer.

Titan III and Dyna-Soar together represent the basic equipment for the foundation of an operational military space force. Without them, if such a force should ever be needed, it would be necessary to start over to build a basic orbital reentry vehicle and a basic booster.

Perhaps even more important are the long-range implications of Dyna-Soar which have not been spelled out by DoD to the Congress thus far. Dyna-Soar is unique in one vital way. It has wings designed to operate in the atmosphere at speeds up to 18,000 mph. If the X-15, with its 4,000-mph speed, was important—and no one has denied this—then Dyna-Soar is doubly so. The new technology of materials, aerodynamic design, and manufacturing techniques developed for Dyna-Soar is advanced far beyond X-15 knowledge, and it could reshape the future of aerospace development. If Dyna-Soar doesn't fly, some future flight test program will have to prove out the new technology so that it can safely be applied to the design of operational vehicles.

The main beneficiaries of Dyna-Soar "hot-wing" technology would be the aerospace plane and various types of recoverable boosters now being studied by both the Air Force and NASA. These show promise of fundamentally altering the economics of spaceflight. Most of the designs under study have hot wings. They will be able to cruise at hypersonic speeds, send payloads into orbit, and return to the launch site. Hopefully, they could be launched many times to bring the cost per pound of payload into orbit down to the neighborhood of \$10 a pound or less. In some studies the vehicles are called hypersonic-cruise airplanes, in others rocket airplanes, or aerospace planes, or air-breathing boosters, but regardless of name or powerplant, an efficient recoverable booster will need hot wings.

Dyna-Soar would substantially hasten the day when



Dyna-Soar atop a Titan III-C booster is shown ready for a dawn launch from Cape Canaveral in the artist's conception above. On early R&D flights the Dyna-Soar will skim the top of the atmosphere, and begin its reentry over the Western Pacific, gliding to a dead-stick landing at Edwards AFB.

such economical vehicles can be built, when the cost of operating a military space force would begin to equal the cost of operating SAC today. It is hard to quarrel with the statement by Herman H. Koelle, Director of Future Projects at NASA's Marshall Space Flight Center, in the November 1962 *Astronautics*:

"It is . . . quite clear that the nation that manages to decrease the specific transportation cost most rapidly will be the unchallenged leader in space exploration and spacepower." To delay the technology of the hot wing and to cancel an experimental glider which could prove it in flight is dangerous and fallacious economy.

Pentagon space policy as defined in Mr. McNamara's posture hearings testimony does not clearly recognize a foreseeable need for an operational space force. Mr. McNamara put it this way: "Speaking broadly, approximately half of our space effort is directed to relatively well recognized and understood military requirements, such as satellite communications and navigation systems. The balance of our efforts, however, is aimed at creating a broad base of new technology, devices, and even systems for possible future applications."

If the Administration has no specific plan to create a space force beyond passive support systems such as communications and the like, it must believe that a space force will not be needed during the next five to eight years. The assumption must be that the Soviets could not or would not put weapons in space which could tip the strategic balance of power.

This assumption would seem to rest on shaky ground—militarily, technically, and historically.

The most rudimentary space weapon is the orbiting bomb. It is about the only one that can be described in detail today and for which the technology clearly is available. However, even a cursory look shows that conceivably it could be more of a threat to US security than Soviet ICBMs.

Essentially, an orbiting bomb is an intercontinental missile which is already halfway to its target at the

(Continued on following page)



Large wind-tunnel model of the Titan III-C is readied for testing in transonic tunnel at Cornell Aeronautical Laboratory (below). Assembly and checkout of Titan III booster will take place in a building 215 feet high at Cape Canaveral (sketch above). Little checkout will be needed on the pad.



time of launch. Its delivery time would be half that of an ICBM, or about fifteen minutes, if the weapon is popped out of orbit with a small rocket and glides to its target. To be effective the warhead would need to be maneuverable, with a terminal guidance-and-control system. Terminal guidance systems are within the state of the art and maneuvering power can be provided by either small rockets or by shaping the reentry heat shield to produce aerodynamic lift.

Cutting the flight time of an enemy ICBM in half undoubtedly would cause added troubles for any ground-based antimissile defense this nation succeeds in getting into operation. However, it is possible for an orbiting bomb to be much more dangerous than the glide type just described. It is possible to place very large yield devices in orbit which have virtually an instantaneous delivery time. Detonated at orbital altitude such a weapon could set fire to a large part of the United States (see "Space Technology: Today's Tool for Controlled Peace," page 106).

Militarily, such a weapon would have appeal for a nation which is temporarily behind in the strategic weapon numbers race. One large orbiting bomb could match many score ICBMs in destructive power. Such a weapon could provide "instant parity" for an aggressor. In a stalemate situation it could provide "instant superiority."

Psychologically, an orbiting bomb would be an instrument for nuclear blackmail.

Technically, the Soviets have already demonstrated that they can handle most of the tasks involved in putting a big bomb in orbit. Nuclear experts agree that a nation which can detonate a sixty-megaton device, as the Russians have, can also build one of much greater yield in the class described. There are no doubts that Soviet rockets can put 15,000 pounds in orbit, or about the excellence of their guidance, or the fact that they can handle the precise operation of bringing two vehicles into an orbital rendezvous ready for docking. The only two missing links are demonstrations of actual docking and of Cosmonauts working on the outside of their spacecraft. Studies indicate that these missing links are the easiest to meet of all the requirements for "orbital operations." Orbital operations will be required to maintain a space station and would be a vital element in the erection and maintenance of orbiting weapons. Periodic human inspection and repair of such a weapon would seem an absolute requirement for the protection of the owners.

Recent history leaves little uncertainty about the prospect that the Soviets will put all the pressure on the US they believe they can get away with. Crises have come in endless succession since World War II, and the latest one in Cuba leaves no doubt that Russia's boldness and its constant probing for Western weakness survived Stalin's death. Putting weapons in space, especially if unopposed, fits in with this philosophy so well that this course may be inevitable.

Yet, all US space systems, beyond unmanned communication, navigation, reconnaissance, and weather

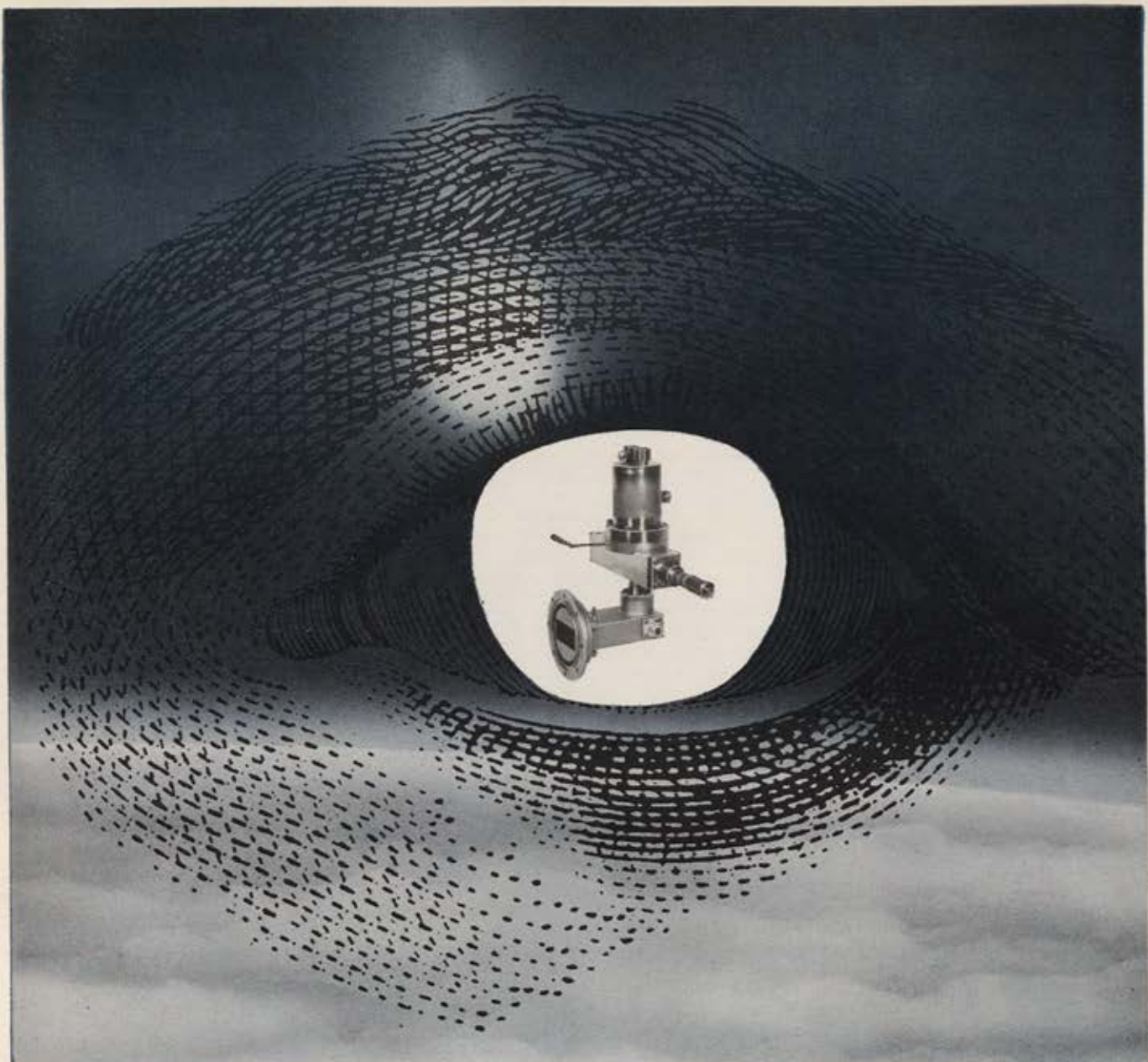
(Continued on page 65)



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The Sperry Model D61C1 is a non-degenerate C-band parametric amplifier designed to meet military specifications. A temperature-controlled model of this amplifier was recently incorporated into a military radar system requiring extreme stability and low noise figure—gain changes of less than 0.5 db

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satellites, are in the technology building-block stage as described by Mr. McNamara.

The satellite inspector project is in this category, and Mr. McNamara discusses it and the threat it would operate against as follows: "... attack from enemy satellites is not a very likely threat for the immediate future, [but] it is a possibility and we must develop the necessary techniques and equipment now so that we can quickly provide a defense if the need ever should arise." Here again, the final decision on Dyna-Soar will provide a reliable weather vane for future activity in this area.

Dr. Kavanau has described this development program in more detail. He says that the "basic element" in this system, a means of detecting and tracking satellites, has been available for some time in the NORAD SPADATS system.

Originally, the idea was to put the interceptor vehicle into the same orbital plane with its target. Now a more sophisticated approach has been selected, and the program, says Dr. Kavanau, has been "... re-oriented ... as a longer term effort to continue to advance the basic technology and operational concepts while other alternatives, such as, for example, direct, crossing-course intercept, are more fully explored and developed."

The propulsion systems for maneuver, power for internal equipment, sensors for inspecting unidentified satellites, the means for disabling a hostile vehicle, and all the other items needed for a satellite defense vehicle are in the technology building stage. In DoD parlance they are among the building blocks that could be turned into a system on short notice.

There can be no argument that building blocks are vital to any future space program. Any future system would draw on technical developments in virtually all of the building-block areas.

But the building-block philosophy takes only the first of two essential steps toward creating a military capability. Training personnel and gaining operational experience is just as important and time consuming as preparing the technology (see page 46).

In the final analysis the argument over the adequacy of the US military space program comes down to the question of lead times. The Administration position again has been spelled out by Dr. Kavanau. He says: "Only in this way [preparing building blocks] can we offset the handicap for development lead times which can be as great as five or ten years—or longer for a useful operational system." His implication is that the building blocks can be put together to form a vehicle system and placed in operation in remarkably short time, less than the five-plus years it took to get an Atlas squadron in operation after the go-ahead was first given. Few familiar with the ICBM programs believe that this can be done.

In the case of the Atlas most of the building blocks were in an advanced state when the program got the green light. Technology had to be improved in some ways to make the program successful, but the basic engines, guidance system, controls, etc., either had been under development for other systems or the con-

cept had been thoroughly proven through extensive applied-research programs.

The analogy with the military space program, while not perfect, is striking. All the ballistic missile program needed was a top-level management decision to go ahead, coupled with the resources to do the job, a streamlined, red-tape-cutting management setup at the working level, and a timetable. If this had not been done the ballistic missile program would be only just now reaching an operational capability.

The Eisenhower Administration's speedup of the ICBM was sparked by the urgent report of the von Neumann Committee in February 1954, only four months after it had been formed by Trevor Gardner. A report by the House Committee on Government Operations described the von Neumann conclusions in the following manner: "More important than the technical problems of target accuracy, warhead weight, reentry, guidance, launching time, and base protection, all of which were considered, the von Neumann Committee believed that the most urgent and immediate need in the ICBM program was to set up a new management-development agency for the whole program ... the von Neumann Committee put the time period [for development to an operational state] at six to eight years—providing its recommendations were adopted."

The sense of the committee's management recommendations was accepted, and the program, resting on a firm foundation of building blocks, beat the von Neumann estimate and got the first Atlas squadron into operation in a little more than five years. Later strategic missile programs shaved a bit off this record, but systems of ICBM complexity generally are expected to require a four- to five-year development lead time at best.

Even a rudimentary operational space force is much more complicated than an ICBM program. Fewer operating units are involved, but on every other count a space force would have more severe requirements. Larger launch vehicles, larger payloads, more ground facilities, more severe guidance requirements, and long periods of exploratory and training flights are just a few. The solid consensus of military men and engineers is that a truly operational, quick-reaction time system, capable of countering hostile action in space as soon as it begins, will require more development time than the ICBM program regardless of the advanced state of the building blocks from which the system is formed.

If this is correct, then the US could not have the first elements of a space force operational until after 1968 and more likely 1970, even if the highest national priority were affixed today.

The climate today is strongly reminiscent of 1953, when talk of a "missile gap" first began to be heard. A concern is developing, in Congress and in the press, over the possibility of military surprise from space. This concern reflects military testimony and prominent scientific opinion which have been increasingly gloomy over the past two years.

(Continued on following page)

Unless the Russians stop their manned flights or stop making them public there is little doubt that the Administration will receive more and more criticism in the future. The strong comment after the Popovich and Nikolayev flights last August can be expected to grow in response to future Soviet space activities. The Administration will be accused, as was the Eisenhower Administration, of dragging its feet in failing to meet a major threat to US security.

The word "gap" will probably be avoided for it has become somewhat suspect after the bomber and missile "gaps" failed to materialize.

However, the vital point about the missile gap is that the Soviets now are credited with the missile power to wreck the United States. If the Eisenhower Administration hadn't literally been forced into adopting a crash ICBM development program, the US today would be in an extremely critical situation. There could have been a gap had we not acted—and strongly.

Without Mr. Eisenhower's missiles the US position today would be untenable.

By 1953, the possibility of a missile gap was clear to a large body of scientists, engineers, and military officers. Great progress was being made in the US with large rockets and small hydrogen warheads. Available intelligence showed that the Russians were moving rapidly in the same direction. It appeared possible for both sides to develop a new and perhaps decisive weapon.

But the Pentagon dragged its feet. Concern in the military, scientific, and technical communities overflowed into congressional hearings and public print.

The result was that, despite much resistance and protestations over costs and the Soviets' "inability" to match such an advanced development, a crash ICBM program was begun. As one Democratic wag put it, Dwight Eisenhower and Charlie Wilson were dragged, kicking and screaming, into the nuclear age.

Little more than three years after the program commenced, US radar tracked closely spaced Soviet rocket firings at ICBM ranges. Indications were that they were well ahead of the US test schedule. Dozens of large Soviet rockets were tracked at IRBM speeds each year from 1955 on. The launching of Sputniks I and II in 1957 left no doubt about the Soviets' capability or determination to build an ICBM. There was no doubt that the Administration's go-slow policy would have been fatal if continued.

Now President Kennedy must face up to a much harder decision. There is growing agitation to begin the development of an operational US force which can control space near the earth. Most who were disturbed by our reluctance to build the intercontinental missile are even more disturbed now by our reluctance to move ahead militarily in space.

Official reluctance to begin development of a space force apparently stems from the same factors as the ICBM reluctance. The first is cost, and this is much more serious than before. The US will spend, at the very least, \$20 billion to land two men on the moon. Yet the whole IRBM and ICBM programs—develop-

ment, production, and deployment—for Thor, Jupiter, Atlas, Titan, Minuteman, and Polaris will cost only about twenty-five percent more. Space programs are vastly more expensive than any activity of the past. And repetitive military-space operations are more expensive than the civil expedition variety.

The second factor generally cited against a development program is that the basics of such operations may be within Soviet technical abilities, but they could never afford them on a continuous basis.

Once again the policy dissenters must seek ways to make their dissent effective. Military debate over top-level policy declarations is frowned upon and stifled more than at any time in the past. Hanson W. Baldwin, military editor of the *New York Times*, writing in *The Saturday Evening Post*, says, "He [Mr. McNamara] has downgraded, ignored, bypassed, or overruled the advice of the Joint Chiefs of Staff. . . . [He] is, first and foremost, trying to make the armed services speak 'with one voice' . . . [which is] dangerous to the continued development of sound military advice and effective military leadership." Charles Wilson also was painted as an arbitrary Secretary of Defense, but Charles Wilson did allow a group with the capacity of the von Neumann Committee to review major elements of the defense policy. Today, policy review as well as technical evaluations are handled in-house. Dr. Harold Brown's Office of Defense Research and Engineering is DoD's captive version of the von Neumann Committee.

If advice on crucial matters is not accepted from the services and is not sought from competent persons outside of DoD then the only avenue left for dissenters is the Congress and the public forum. Public debate is fraught with innumerable hazards of politics, technical misunderstanding, and exaggeration. Lately, public criticism also means stronger reaction from DoD. For example, Mr. McNamara has characterized criticism of his policies as "irrational and irresponsible."

However, public debate remains as an indispensable bulwark of our system; it has served the nation well during one major crisis in the age of exploding technology, and it can again.

Today, our military space policy still rests officially on DoD opinion which, as expressed by Mr. McNamara, holds that, "... attack by enemy satellites is not a very likely threat for the immediate future; it is a possibility and we must develop the necessary techniques and equipment now so that we can quickly provide a defense if the need should ever arise."

Many competent observers challenge every part of this statement. They believe the Russians have the ability to put a bomb in orbit and with it create a first-order crisis that could end with many quarters of the Western alliance favoring some form of accommodation. Furthermore, there is no "quick" space defense. If we wait until a threat appears in hardware form then the advantage passes to the Soviets for several years.

A new review, a new von Neumann Committee, seems to be a must, to determine who is right about the threat from space.—END



House power for our moon men will come from an efficient new fuel cell developed by Pratt & Whitney Aircraft for the National Aeronautics and Space Administration's Manned Spacecraft Center. The fuel cell will generate life-sustaining electrical power during the Apollo spacecraft's round-trip voyage to the moon. Pratt & Whitney Aircraft provides design and manufacturing leadership in power for many applications, in and out of this world.

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"Suited-up" for a practice orbital run is the nation's next scheduled earth-circuiting NASA Mercury Astronaut, Air Force Maj. Leroy Gordon Cooper. His service to NASA is symbolic of USAF contributions to nonmilitary space program.

The Air Force Contribution To the NASA Effort

Air Force personnel everywhere and the members of the Air Force-industry team who provided so much of the nation's present military missile strength can be proud of the contributions USAF has made and continues to make to America's nonmilitary space efforts . . .

By William Leavitt

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

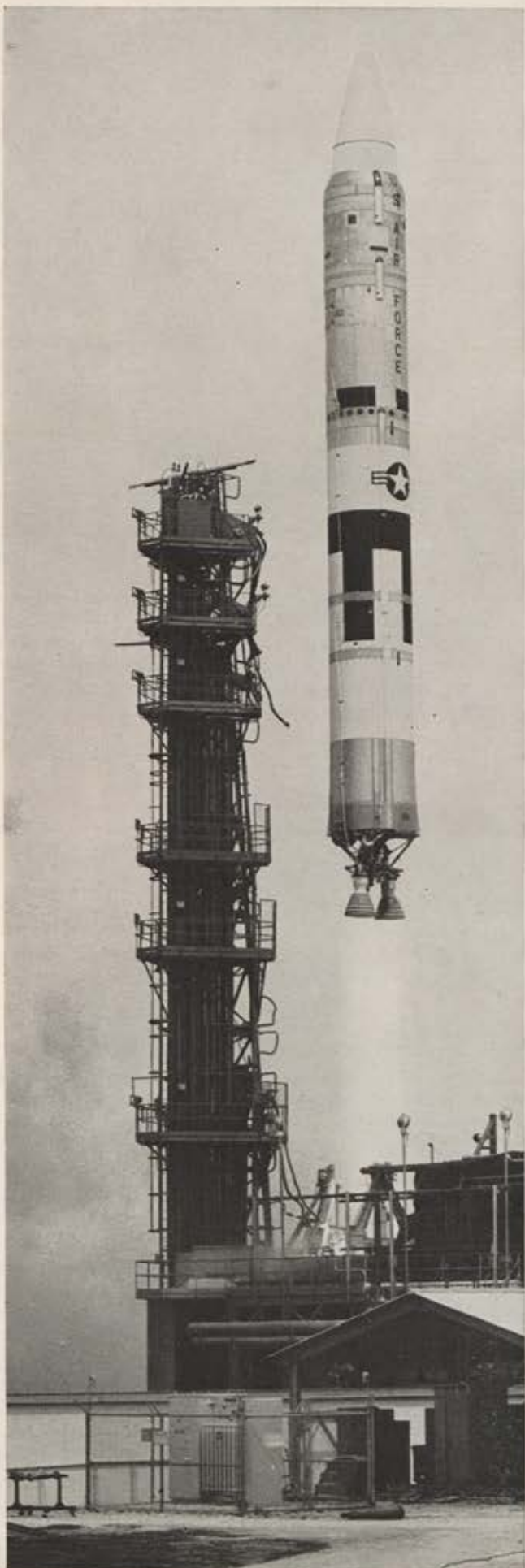
IT'S A space-age irony that the US Air Force's enormous contributions to the nation's on-going nonmilitary space programs being carried forward under the banner of the National Aeronautics and Space Administration will never be recorded with the exactitude such a chronicle deserves.

The politics of roles and missions, the semantics of "military" vs. "civilian" technology, and the simple fact that the "blue suiters" who are providing the needed support to the civil agency are so busy in their "interface" billets that they don't have the time to stop and add up the score have obscured the story.

It's ironic, too, that a sizable segment of Air Force people not involved with space technology really don't know the extent to which the Air Force, following high-level instruction to support the NASA effort vigorously, has bolstered the civil agency's program.

ITEM: NASA's Project Mercury program, which has placed three and will soon place a fourth American into orbit, is the lineal descendant of the Air Force's pre-NASA MISS (Man-in-Space-Soonest) program. MISS, developed in cooperation with the old National Advisory Committee for Aeronautics (see "Blueprint for Tomorrow's Spacecrews," AIR FORCE/SPACE DIGEST, May 1958), was turned over virtually in its entirety to the new civil space agency in late 1958—

(Continued on following page)



in accordance with national policy to focus manned spaceflight activity in NASA.

ITEM: The vast experience of the US Air Force in booster research, development, and testing—gained in the Air Force-industry team operation developed for the Air Force ballistic missile programs of the mid- and late-1950s—has been, since the inception of NASA, at the service of the civil agency. Air Force-developed Thors and Atlases have carried the lion's share of America's payloads into orbit and into space. In the case of Project Mercury, the Air Force procured and man-rated the Atlases earmarked for the manned flights. The same process will occur in the Gemini program, successor to Mercury, in which two Astronauts will attempt to prove out orbital rendezvous and gain longer-term orbital experience. The Air Force will procure and man-rate the Titan II booster and the Agena-stage package that will be used in the rendezvous attempts. Also, Air Force personnel are expected to fly Gemini missions in later flights of the program. The Titan III booster being developed currently by the Air Force also may well find its way into NASA programs. In both Mercury and Gemini programs, as well as in such scientific experimentation programs as NASA's Ranger moon study and Mariner Venus study program, there are Air Force officers specifically assigned to provide required support to NASA.

ITEM: Since the establishment of NASA, the civil agency's limited force of aerospace-medical personnel—vitally needed to implement manned spaceflight programs—has been bolstered by Air Force specialists, assigned directly to duty with NASA or on temporary loan. This aid, symbolized by such items as the fact that the Astronauts' flight surgeon was an Air Force officer, has been of such magnitude that it can fairly be said that NASA's space-medicine job has been mostly a "blue-suit" achievement. (When it hasn't been Air Force blue, it's been Navy blue; the seagoing service has also contributed heavily.) Indeed, the chief of aerospace medicine at NASA is himself an Air Force officer. And, of course, three of the original and three of the newest batch of NASA Astronauts are Air Force officers. Even NASA's space monkeys have practically all been trained by USAF specialists.

ITEM: In addition to the hundreds of US Air Force personnel on duty directly with or indirectly contributing to the NASA programs—providing services ranging from launch to air rescue (see "USAF's Space-Age Veterans," page 76)—the Air Force Systems Command has a full staff of top officers. Headed by Maj. Gen. Osmond J. Ritland, former commander of the Air Force Space Systems Division, they are working with NASA with the assigned mission of supporting NASA manned spaceflight operations.

ITEM: Air Force Assistant Secretary for Research and Development, Dr. Brockway McMillan, and the Commander of the Air Force Systems Command, Gen.

(Continued on page 72)

Soon to enter service as booster for NASA's two-man Gemini orbital rendezvous program, successor to Project Mercury and prelude to NASA Project Apollo moon-landing program, is the Air Force-developed Titan II, shown here lifting off.

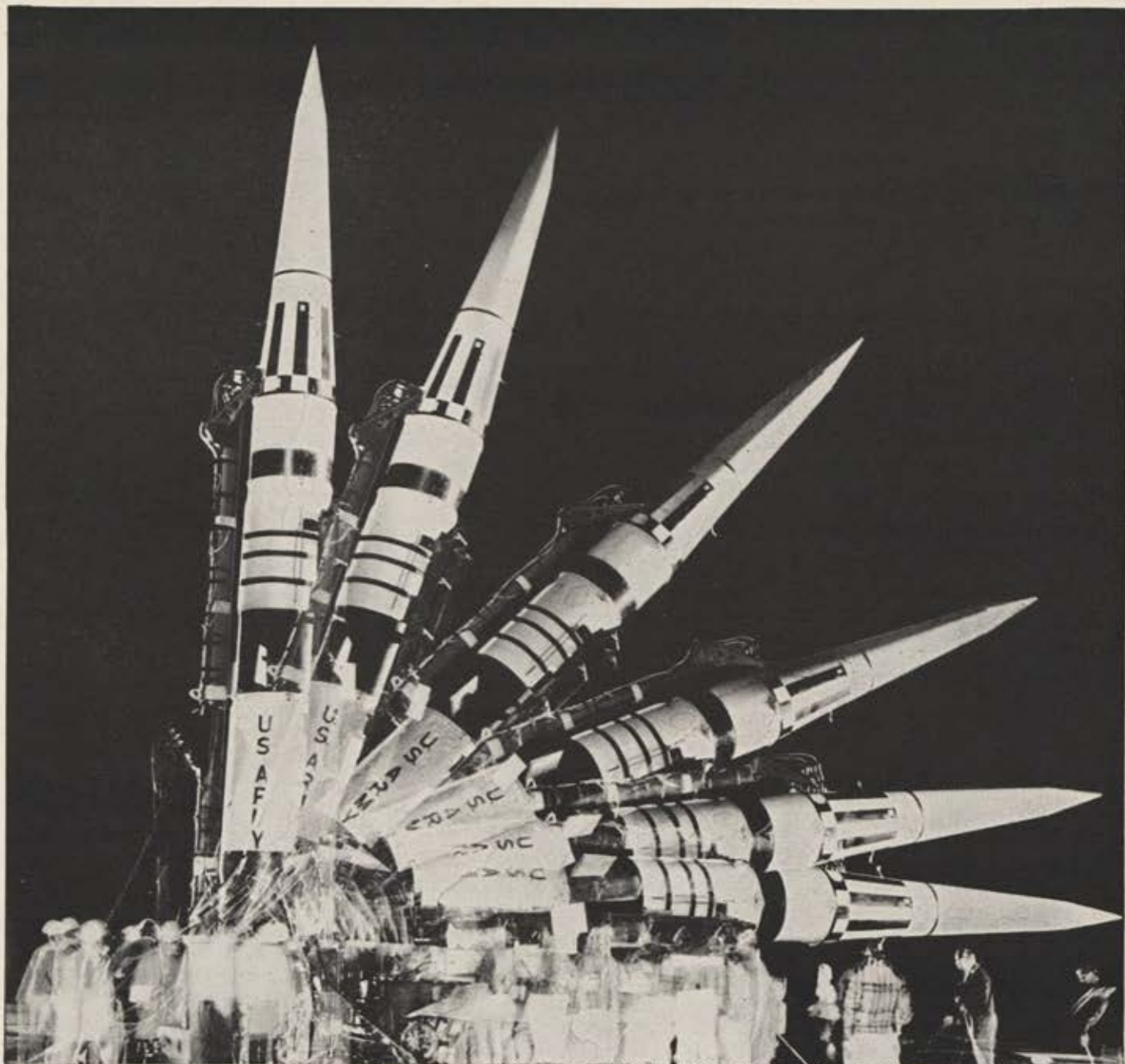


PHOTO COURTESY MARTIN-MARIETTA CORP., PERSHING MISSILE SYSTEM PRIME CONTRACTOR.

Hold...erect...fire!

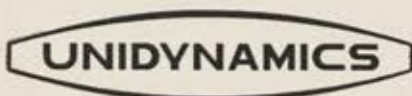
Within minutes, this highly maneuverable erector-launcher can place a Pershing Missile in its flight path.

ELGMT (Erector-Launcher, Guided Missile, Transportable) is produced for the Army by Unidynamics, a division of Universal Match Corporation. The erector-launcher serves as loading and assembly platform. It stows and supports the missile during transit. ELGMT also aligns

Pershing with the target azimuth and provides accurate support during check-out and launch.

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RIER, and recently designed, developed and produced a unique launching system for the ASROC. In addition, the Division has designed and built a variety of ship-board weapon handling equipments. Full information is available on Unidynamics' comprehensive experience and capabilities. Write Dept. AF-1 for a copy of the special brochure, "Weapon Launchers and Handling Equipment".



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Bernard A. Schriever, are members of the newly established top-level Gemini Program Planning Board (see also "Speaking of Space," March '63 issue), which was established in January by agreement of Defense Secretary Robert S. McNamara and NASA Administrator James E. Webb to monitor manned spaceflight projects in near-earth orbits.

Much water has fallen over the dam since the dimly recalled early post-World War II days when Air Force-sponsored RAND Corp. thinkers were passing around proposals for US space satellite programs. Now, seventeen years later, the country is embarked on a vastly expensive race for the moon, bossed by NASA, an agency that did not even exist in its present high-



USAF aerospace medical skills have backed up NASA manned spaceflight effort since its inception. Here Air Force Surgeon General, Maj. Gen. Oliver K. Niess, views chimpanzee being trained at Holloman AFB, N. M., for orbital experiments such as the famous flight of Air Force's Enos.

powered and competent form a mere six years ago. NASA, child of the old and respected National Advisory Committee for Aeronautics, but a descendant as different from its ancestor as man is from the creatures that preceded him on the evolutionary scale, officially came into existence—implemented by the Space Act of 1958—in October 1958, by proclamation of T. Keith Glennan of the Case Institute of Technology, NASA's first Administrator. The last of the NACA budgets amounted to some \$100 million. The fiscal 1964 NASA budget request, now before Congress, is for some \$5.7 billion—more than fifty times the last of the NACA budgets—an interesting measure of the financial investment the country is making in space technology.

The rationale for the foundation of NASA as a civilian agency devoted to the research, development, and operation of astronautics for peaceful purposes that would benefit mankind lay in the Eisenhower Administration's conviction that (1) the world image of the United States required a purely-for-peace aspect for its space activities and (2) space technology had little if any military significance.

In writing the Space Act of 1958, Congress generally went along with this Administration view, and it is a little-known piece of history that the Space Act nearly got passed with no mention at all of the possible defense significance of space developments. It took some rather fancy footwork by people in important congressional staff positions to insert the phrase in the Space Act that reserves Department of Defense jurisdiction over space developments having to do with the defense of the United States. Of such stuff is history made.

Having gone into business by act of Congress, NASA, even with its highly competent core of technical people, most of whom looked back to pleasant memories of successful cooperation in research and development with the military services and the aeronautical industry, found itself in a not-surprising position for an agency with the fantastic assignment of exploring the cosmos. Beyond the barest of minimums, it had neither the people, the in-house facilities, nor the expertise to do the job—even at the relaxed pace the Eisenhower Administration was willing to accept. This shortcoming naturally resulted in an expansion in all these fields, an expansion that is still going on, and one which has made NASA the fastest-growing government agency in the country, and, ironically enough, an agency with far more respect for the potential military significance of space than the Department of Defense.

But while this NASA expansion was under way and while it proceeds now, astronautical jobs had to and still have to be done. Gaps in in-house NASA know-how, personnel, and facilities had to be filled.

The gap-filling has been done by the military, from all three services and notably from the US Air Force which, long before NASA was born, was already deeply involved in two of the key activities associated with space technology: the rocket-booster developments and aviation (now renamed aerospace) medicine. The first basic capability was based on the huge backlog of Air Force expertise which had been accumulated during the Air Force ballistic missile program of the mid- to late-'50s that produced the Thor and Atlas and later, the Titan and Minuteman weapon systems. The second was available thanks to the long pioneering Air Force research effort into the medical aspects of flight, dating as far back as 1918 when the Air Force, then an infant element of the US Army, opened its first aeromedical research facility at Mineola, L. I., N. Y.—progenitor of today's vast USAF aeromedical complex at Brooks AFB, Tex.

On the aerospace-medical side, the Air Force contributions have included basic medical concepts for manned spaceflight, early space-capsule designs and experiments, weightlessness flights using animals and later humans dating back to the early 1950s, pioneering G-stress tests (such as the monumental work of Air Force Col. John P. Stapp). All this work has been fed into NASA programs and has served as a firm base on which to project present and future NASA manned spaceflight efforts.

(Continued on page 74)



AN/ALQ-T4 IS THE FIRST COMPLETE ECM SIMULATOR DELIVERED TO USAF. PURPOSE IS TO TRAIN B-52 ELECTRONIC WARFARE OFFICERS.

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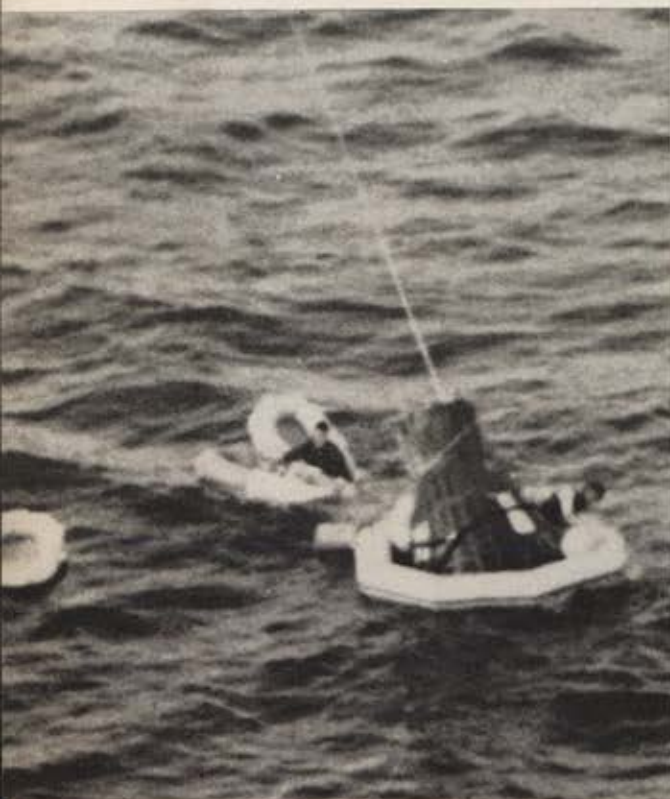
Reflectone offers an unusual capability in tactical and strategic training systems. T-4 is the most recent example. Others include a complete Defense Systems simulator for the B-58, and a POLARIS SUBMARINE navigational system.

Full information is available on Reflectone's engineering and manufacturing capabilities. Write Dept. AF-2 for a copy of "New Dimensions in Aircrew Training".



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Launch to rescue are among USAF services provided NASA. Pararescue capability came in handy for Astronaut Lt. Cmdr. M. Scott Carpenter, in May 1962, when contact was lost during reentry. Air Rescue spotted Astronaut, jumped to his side.



Air Force technicians contribute heavily to the civil space agency's tracking network during manned orbital flights. This was the tense scene at the console at Eglin AFB, Fla., at Tracking Station 17, during the Project Mercury flight of Astronaut Cmdr. Walter M. Schirra, Jr., who successfully completed six earth orbits, October 3, 1962.

On the hardware side, the Air Force heavily supports NASA. How heavily is illustrated by the following quotation from an unofficial and unclassified memo on the subject:

"As in the past, the Air Force remains prepared to provide three main types of support for NASA launch projects.

"A. Complete program planning and execution, to include payload development, flight planning, booster procurement, launch services, on-orbit tracking command and control, and recovery. . . .

"B. Launch services through injection into a prescribed orbit or a deep-space trajectory as determined by NASA. In this instance, the Air Force handles the technical work required to place a NASA payload into its experimental environment; thereafter NASA handles the experiment.

"The Mercury program is a good example of this type of support. There have been others in the past, and there are others planned where Air Force support will take this form.

"C. Development and procurement of standard booster vehicles and stages. Here the Air Force delivers to NASA a suitable propulsion vehicle, with Air Force responsibility extending generally to delivery at Cape Canaveral and a continuing availability of technicians for advice. Standard support by Air Force units at Cape Canaveral includes: . . . receipt-assembly and checkout of test vehicles, range instrumentation . . . tracking . . . command and control . . . timing . . .

photography and communications . . . safety . . . security . . . weather services. . . ."

It is difficult to chart exactly the full extent of Air Force funding in support of NASA. The ground rules for cooperation and support have been different in different projects. But some significant figures are available from informal surveys. For example, through June 1961, identifiable reimbursed USAF support of NASA amounted to at least \$263 million. Added to that was some \$49 million which was not reimbursed. Air Force manpower contributions to NASA just through fiscal 1961 amounted to more than 2,000 man-years, the cost of which was mostly absorbed by the Air Force—and Air Force contractors expended some 2,400 man-years in work for the Air Force support of NASA efforts. It is interesting to note, too, that NASA has for the most part adopted the government-industry developmental philosophy advanced by the Air Force when, in its early days, in-house capabilities were extremely limited.

Figures are impersonal, of course, but the proud story they tell is that the Air Force-industry team, which achieved so much in the USAF ballistic missile program, has been pretty busy lately in the nonmilitary spaceflight business. And the future looks even busier.

In view of the disdain with which the Department of Defense views specifically military-oriented space programs, it may be the only—though unnecessarily indirect—Air Force path to needed space capabilities.—END

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Air Force men and Air Force boosters have propelled the Mercury Astronauts into orbit, sent Mariner II off to Venus, and Ranger IV to the moon. Building on experience gained in thirteen years at the Air Force Missile Test Center, the Air Force is preparing for its military role in space . . .



Once scrubland, sand dunes, and swamp, these 15,000 acres jutting into the Atlantic on Florida's east coast have become the free world's most elaborate launch facility. First US missile shot occurred in 1950 at area marked 5 above. Astronaut John Glenn began his orbital flight at 4. New Titan III pads are being built above 3. NASA's new Merritt Island moon base lies to the north and slightly west.

CAPE CANAVERAL, FLA.
A UNION representing machinists employed at Cape Canaveral launched a modest demonstration here late in February, charging that the Air Force was adding men to its launch operations, thus depriving civilian machinists of jobs.

This incident might have gone unnoticed, had it not struck a tender nerve among Air Force personnel who have operated the nation's primary spaceport here continuously for almost thirteen years.

To many Americans who first heard of Cape Canaveral when the high drama of manned spaceflight flashed across their television screens, the Cape is synonymous with NASA. This mistaken impression understandably rankles in proud Air Force chests—particularly now, when Air Force leaders are calling for more national emphasis on military space operations.

In violation of Newton's law, then, the machinists' action triggered an opposite but decidedly unequal reaction.

Maj. Gen. Leighton I. Davis, who commands the Air Force Missile Test Center of which the Cape is a part, is normally a restrained, patient man. In this instance, his response was prompt and forceful.

"It is clear," he said, "that the Air Force stands accused of increasing the defense readiness of its forces."

He pointed out that the Air Force has always followed the policy of training its officers and men on its weapon systems.

"The nation is purchasing and installing thousands of missiles within the continental limits of the United



Close-up view of gantry tower used to prepare Atlas-Agena A for launch with Midas 2 payload. Platforms permit technicians to work on various parts of booster simultaneously. Midas 2 was successfully orbited in May 1960. These military satellites are now classified by DoD.

By Allan R. Scholin

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

States," he declared. "Unlike airplanes, whose crews continue to fly missions to test and upgrade the readiness of weapon systems, crews on missile bases will seldom have an opportunity to ready and launch a missile. Here at Cape Canaveral, and at Vandenberg AFB, Calif., the opportunity exists; and under existing Air Force policy every opportunity to increase defense readiness will be used.

"We have, therefore, stepped up military jobs on the active missile pads at Cape Canaveral, and we expect further expansion of military participation in the entire test program."

This reasoning is in line with other measures General Davis advocates to gain for the Air Force all possible experience in space weaponry within the ground rules laid down by the Administration and the Department of Defense.

General Davis has spent almost his entire career in Air Force research and development. Born in Sparta, Wis., fifty-three years ago, he was graduated from West Point in 1935, went immediately into pilot training, and after three years with a squadron in Hawaii returned to the Military Academy as an instructor in mechanics. He spent a year at MIT to acquire a master's degree in aeronautical engineering, and, in 1943, after suggesting a design for an improved fighter gunsight, he was assigned to the Armament Laboratory at Wright Field. He has been in R&D work ever since.

In his present assignment he supervises a 25,000-man work force serving the three elements he com-

(Continued on following page)



Maj. Gen. Leighton I. Davis, with twenty years' experience in Air Force R&D, commands the AF Missile Test Center.



Vice Commander of AFMTC is Brig. Gen. Harry J. Sands, Jr., of Columbus, Ohio; he led missile wing in Europe.



Dr. Kurt Debus, veteran of Germany's Peenemünde center, now heads NASA's launch operations directorate at Cape Canaveral, Florida.



Col. Harold G. Russell commands the 6555th Test Wing which has launched many missile and space shots, will test Dyna-Soar vehicle.

mands—the Missile Test Center at Patrick AFB, the Cape Canaveral “annex,” and the Atlantic Missile Range, which extends from Canaveral almost 10,000 miles diagonally across the Atlantic and beyond the southern tip of Africa into the Indian Ocean. Each of the downrange stations is commanded by an Air Force officer.

Much of the technical and housekeeping work of operating Cape Canaveral and AMR is handled under Air Force contract by Pan American Airways and its major subcontractor, the Radio Corporation of America. Pan Am and RCA handle such complex and diversified tasks as planning and supervising construction of missile-pad facilities, designing and operating range instrumentation systems, collecting and reducing test data into a composite report, storing and handling missile fuels, running the Cape’s police and fire departments and cafeteria, and providing technicians and support services for the network of downrange stations.

Also under subcontract to Pan Am are the Suwanee Steamship Company, which operates a fleet of nine ships equipped for missile tracking and telemetry, filling in the vast ocean reaches of the AMR south of the Caribbean, and an extraordinary firm called Underwater Services, Inc., whose divers comb the ocean floor off the Cape for missile fragments to help in determining the cause of not-infrequent failures.

Pan Am and RCA employees account for about forty percent of General Davis’ work force. Military personnel total about 4,700—two-thirds of them Air Force, the rest Army and Navy men who test their missiles at the Cape. There are about 3,000 civil service personnel, some 6,000 employees of missile contractors, and about 2,000 others working on construction, local subcontracts, and the like. An industrial directory published last October at General Davis’ headquarters listed fifty-seven firms associated with the missile industry with offices in the Canaveral area.

Two of the Cape’s principal “customers” are NASA’s Launch Operations Directorate, headed by Dr. Kurt Debus, a fifty-four-year-old alumnus of Germany’s Peenemünde rocket center, and USAF’s 6555th Missile Test Wing, commanded by Col. Harold G. Russell of Eau Claire, Wis.

Dr. Debus, who has become a US citizen since the Army brought him here after the war, has been assigned to the Cape since 1952. His directorate is part of the George C. Marshall Space Flight Center at Huntsville, Ala., headed by Dr. Wernher von Braun. Dr. Debus’ responsibilities now include developing NASA’s huge new moon base on Merritt Island, immediately to the north and west of Cape Canaveral, with five times Canaveral’s acreage.

Colonel Russell’s wing is part of the Air Force Systems Command, as is AFMTC, but his immediate superior is Maj. Gen. Waymond A. Davis, commander of AFSC’s Ballistic Systems Division, at Norton AFB, Calif. Under Colonel Russell are two deputy wing commanders—one responsible for test and evaluation of ballistic missiles, the other handling space systems tests for AFSC’s Space Systems Division at Los

Angeles, Calif., commanded by Maj. Gen. Ben Funk. The wing also performs tests for AFSC’s Aeronautical Systems Division, headed by Maj. Gen. Robert G. Ruegg at Wright-Patterson AFB, Ohio. Among ASD’s newer projects which the wing will handle are Dyna-Soar and its preliminary research series, ASSET, to study effects of reentry heat on space vehicle structures.

It is Colonel Russell’s wing which incited the machinists’ demonstration, for wing personnel perform all purely military launchings on the Cape, as well as assisting in NASA and military space shots. By this summer the wing will reach a strength of about 750. The wing also accommodates a varying number of SAC personnel on temporary duty at the Cape to be checked out on Minuteman and Titan II launchings.

Since the Air Force established Cape Canaveral and the AMR thirteen years ago, it has directed some 1,600 launchings, including missile tests, manned and unmanned orbital and suborbital shots, and probes into deep space. Testifying to the effectiveness of Air Force range safety procedures, not a single fatality has marred these launchings.

The launch is only the beginning of the flight test operation. The vital element is gathering information on how the missile works in flight. Missilemen gain data through tracking and by telemetry. They collect tracking information from external sources—ground, ship, and air, both in the Cape area and in downrange stations. Telemetry emanates from within the missile and is transmitted to surface and air observing stations. The raw data from these observations then goes to Patrick where it’s processed in computers in AFMTC’s technical laboratory.

When the range is fired up for a major test, there are more than a million vacuum tubes at work, even though many elements of range equipment have been transistorized. The final test report for the first Saturn launch was eight inches thick, and weighed thirty-two pounds.

Military missiles have provided the boosters for all of NASA’s dramatic Astronaut and space-probe shots, and except for a few early shots—notably the first two suborbital Mercury flights of Shepard and Grissom, which used Redstone boosters—the Air Force has been primarily responsible for launching them and achieving orbit.

“We are now under way with the construction that will eventually place a Titan III on its pad as America’s prime booster for its time period,” General Davis said recently in ceremonies initiating the new Titan III pad facility. “[It] becomes another in the line of boosters which the Defense Department has contributed as prime workhorses of the US space program. Ultimately these systems will boost the nation into its proper space role . . . the role of predominant leadership. . . .”

In working with NASA on its spaceflights, the Air Force is gathering experience that will be invaluable when USAF moves into military operations in space.

This doesn’t mean that General Davis and his colleagues buy the “building-block” philosophy—which

(Continued on page 81)

We are heavily involved in exotic instrumentation.



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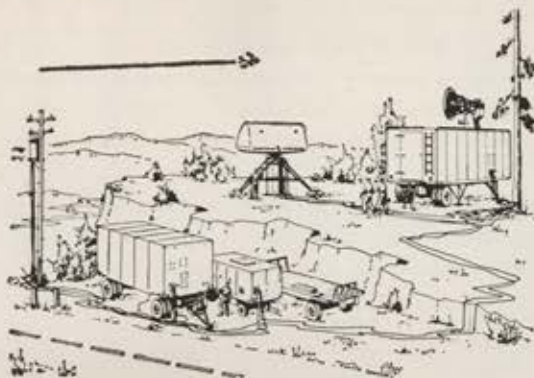


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presumes that a military space capability can be developed as a by-product of NASA's peaceful space projects.

"There are a couple of hookers in that philosophy," he says. "First, scientific projects have different characteristics than those needed in the military. For example, we must have a quick scramble capability—reducing pad time to the minimum. Second, the Air Force needs experience in operating space vehicles. We can't define clearly now the characteristics we will need in space. We need 'stick time'—in the Dyna-Soar, the Gemini, or whatever—to find out what can be done and to improve our vehicles accordingly."

General Davis draws an optimistic picture of spaceflight. In contrast to flying in the atmosphere, where higher speeds and altitudes magnify problems, spaceflight will be comparatively simple.

"As we move into space," he says, "density approaches zero and drag becomes infinitesimal. Guidance and control are simplified. There are no disturbing gusts, no trim changes due to lift or drag. Weather ceases to be a problem since there are no storms, fog, or rain. The stars furnish point references for highly accurate navigation."

Meteorites and high-energy particles may be a hazard, he admits, but the probability of encountering one is about equivalent to meeting with a serious accident on the turnpike. Shielding is necessary to avoid the dangers of radiation, much as we avoid sunburn on the beach.

"I like to think that our transition into space will be like going through a door into an unfamiliar room," he explains. "When we get there we'll like it so well that we'll wonder why we didn't open the door sooner."

For the present, though, General Davis is satisfied to have NASA open the door.

He points out that the Air Force could not realistically have expected to get an additional \$5 billion or so a year in its budget to handle the moon program. In fact, had the Air Force been assigned that project, he suggests, it would have been necessary to create a separate agency, like NASA, to perform the necessary research and development. For the present he is



Astronaut John Glenn leaves Pad 14 at Cape Canaveral on first US manned orbital flight February 20, 1962. All orbital Mercury flights employed Atlas-Agena booster launched by USAF's 6555th Missile Test Wing. Astronaut Gordon Cooper will use the same combination in 18-orbit flight.



President Kennedy visited Cape Canaveral upon Glenn's return to voice a nation's gratitude and present NASA medal. Also on stage are Vice President Lyndon Johnson, NASA Administrator James Webb, and other Astronauts.

content to work as closely as possible with Dr. Debus and NASA personnel at the Cape.

Some skeptics point out that the Air Force has been able to work closely with NASA so far because the Air Force runs the Cape. When NASA completes its huge Saturn-Nova complex on Merritt Island, they say, the Air Force will be outside looking in.

But General Davis is confident the close partnership he enjoys today with Dr. Debus will continue. Certain fundamental range functions will continue to be General Davis' responsibility in both areas—including scheduling, flight safety, traffic coordination and surveillance, and downrange station operations.

(Continued on following page)



USAF airmen handle vital launch preparation tasks. Men with needed aptitudes may be assigned directly from basic training to work under skilled technicians of USAF's 6555th Missile Test Wing. SAC also assigns missile crewmen to the Cape to be checked out on live launch procedures.

For another, more ominous, reason, too, General Davis believes the Air Force will have its own assignments in space before NASA launches its moon attempt.

"The moon vehicle is a greyhound," he says, "finely trained to run a specific course. It will have no extra power or maneuverability to overcome unexpected obstacles. In the time phase we're talking about, it would be comparatively easy for the Soviets to block the shot if they choose to. Surely the US won't risk that possibility."

It may be such a prospect that prompted Secretary of Defense McNamara last month to ask designers of both Dyna-Soar and Gemini to recommend how each craft, or a combination of the two, might be adapted to effect rendezvous in space with another vehicle and, if necessary, to destroy it.

Another useful fund of experience in support of space operations accrues to the Air Force at the Cape through General Davis' role as Department of Defense representative for Mercury operations. Under this authority, General Davis exercises global command over the resources of all services allocated to Mercury support. He and his staff have conducted frequent dry-run exercises simulating Astronaut recovery in unlikely places—high in the Andes, in the jungles of Africa, or in remote reaches of the ocean. In the eighteen-orbit flight planned for Astronaut Gordon Cooper next month, it would be theoretically possible for him to come down at almost any point on the earth's surface within thirty degrees north and south of the Equator. Experience in coping with these problems will be very helpful now and in devising techniques for recovery of military Astronauts in the future.

Costs of operating AFMTC and the AMR are, to say the least, substantial. The first pad at the Cape—used for the launching of a V-2 with a WAC Corporal second stage in July 1950—cost \$275,000. The first Saturn pad, completed in 1961, cost \$14 million. USAF now has more than a billion dollars invested in the AFMTC

and AMR, and operating costs will run \$230 million this year.

NASA's new Merritt Island facility will total another billion dollars.

With expenditures of this magnitude, it might seem hopeless to strive for economies, but General Davis is tireless in seeking ways to reduce costs.

"Even though we have everything at the Cape or downrange that anyone could need to test the missiles and space vehicles now in development, we are continually confronted with contractor proposals calling for new support equipment to serve a new missile or booster," he says. "They would save time and money if they'd concentrate on the missile itself, and leave it to us to adapt existing facilities for support."

A report to the House Committee on Science and Astronautics last year commended General Davis' control of resources.

The report expressed approval of the "extraordinary effectiveness of the system which has been evolved at the Air Force Missile Test Center to provide the integrated land-sea-air facilities and services necessary to assure maximum responsiveness to users of the Atlantic Missile Range...."

"General Davis has complete and centralized control over all of the integrated military, civil service, and range contractor activities engaged in the development, operation, maintenance, management, and logistical support of the AMR," the report noted. "This single center commander managership over all of the land, sea, and air elements which go to make up the over-all AMR operation is crucial to the timely and successful accomplishments of this nation's missile and space programs."

But, notwithstanding these laudatory comments, is there a future for the Air Force at the Cape? General Davis replies with a confident yes. Immediately ahead, he says, are projects to refine and improve the Minuteman, the Navy's Polaris, the Army's Pershing. The Mobile Medium Range Ballistic Missile is coming, and Titan III is already in development. Thousands of SAC missile crewmen should be given an opportunity to prepare and launch a missile. Later, General Davis says, will come Air Force military operations in space.

Work at improving the Cape never stops. Right now the list of projects under way and planned totals more than sixty. Among them are improvements in instrumentation, tracking, communications, flight control, meteorology, an improved missile impact location system, and planning for a global range comprised of all the national ranges—Atlantic, Pacific, and White Sands—with compatible instrumentation, integrated communications, and unified operations. There are more—many more.

As the Cape reviews its history and looks ahead, its leadership seems entirely worthy of the man for whom its headquarters was named—the first Chief of the Army Air Service, Maj. Gen. Mason Mathews Patrick. It was said of him that he had the vision to plan for the future of his service, and the courage to fight for that vision. Air Force men at the Cape, too, are men of vision—and they are fighters.—END

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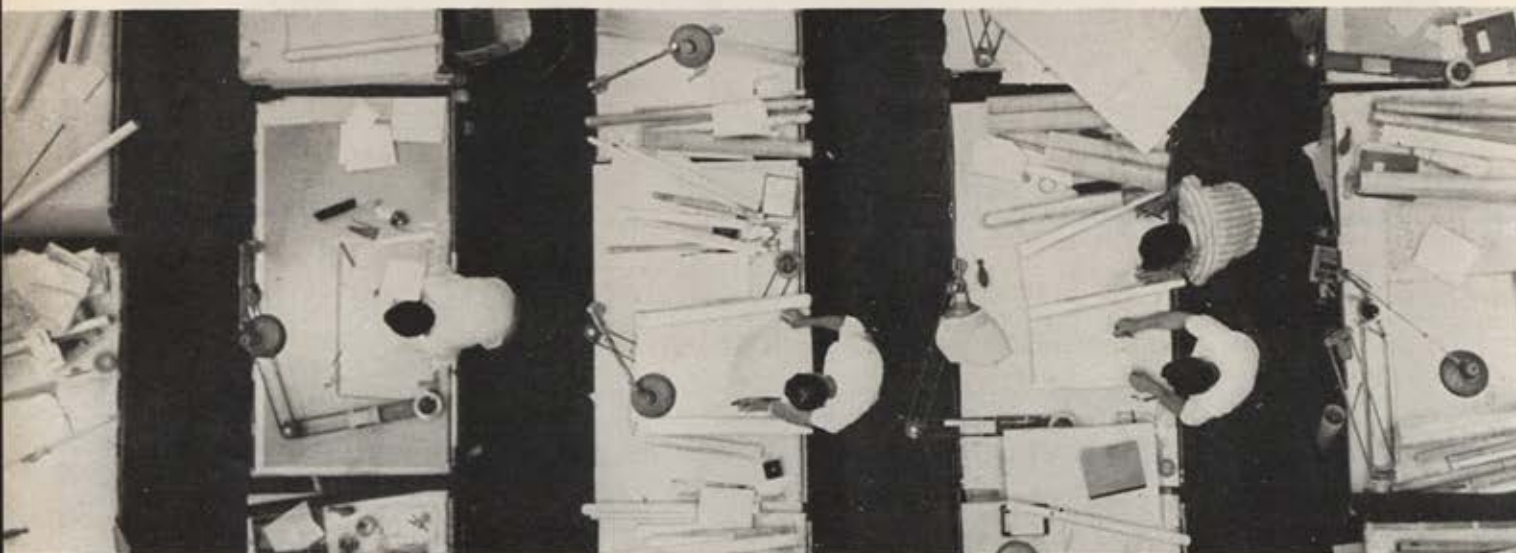
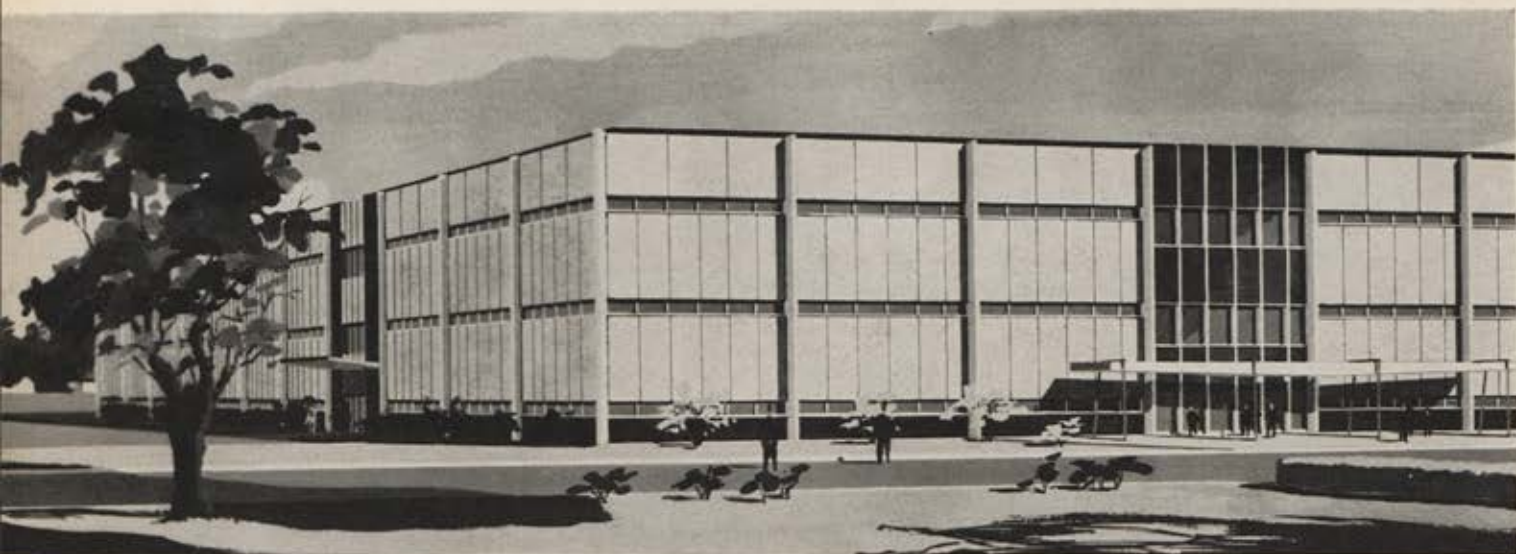
Since 1960, many basic component demonstrations for large segmented motors—such as joint tests, TVC, transportation studies, ignition tests and others have been conducted at the plant near Brigham City, Utah. The nearby Wasatch Pocatello, Idaho, plant is fully equipped, sized and available for handling inert components, preparations

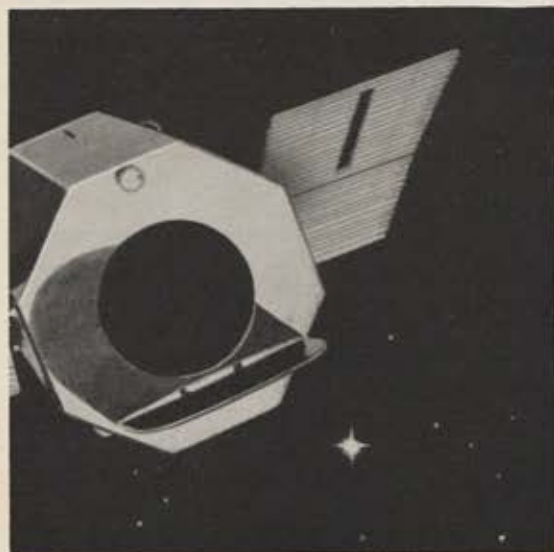
and other supporting functions.

From R&D through production, segmented motors' facilities and experience are established at Thiokol.

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Latest step in Grumman's long-range aerospace programming is construction of a new \$5 million Aerospace Engineering Center, shown here in an architect's drawing. Along with the recently completed Electronics Systems Center and in-progress Research Center, this new complex of aerospace facilities will give Grumman the physical capabilities and resources to undertake major space system assignments.

EXPERIENCE

In the early 1950's, Grumman instituted a comprehensive, long-range program of space studies. Significant areas were hypersonics, reentry, capsule retrieval, orbital transfer and lunar vehicles. Major accomplishment to date is acquisition of the OAO (Orbiting Astronomical Observatory) contract for Goddard Space Flight Center (NASA), the Echo II canister assembly, and the Lunar Excursion Module (LEM) in connection with Project Apollo. More recent study contracts include the performance study for Lunar Logistics Systems and a new contract study in Lunar Astro dynamics. Against the background of 33 years' experience in solving the man-machine equation in aircraft and weapons systems, Grumman now offers a fully integrated space capability.

AND ESPECIALLY

PEOPLE

Grumman's most valuable asset is people: scientists, engineers, technicians and craftsmen. This work force provides an unbroken network of interlacing aerospace experience and skills. Over all is a management team with the uncommon knack of fitting man and machine together . . . of correlating large-scale programs simultaneously . . . of ensuring "total company" effort . . . of transforming advanced ideas into reality. The Grumman work force is by far the most stable in the industry.

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The standing congressional space committees, hobbled since Sputnik by Administration concentration on the civilian space effort, have made only limited and ineffective forays into the military space arena. But the impact of Soviet successes, with their doleful implications, is spurring congressional leadership to chart new panels—separate from the standing committees—where military space may soon “find a home” . . .

CONGRESS TAKES A SECOND LOOK AT SPACE AND NATIONAL DEFENSE

By Claude Witze

SENIOR EDITOR, AIR FORCE/SPACE DIGEST

THERE is strong evidence this year that Congress, fast accumulating sophistication in military technology—more alarmed by signs of unabated Russian progress in space, and less confident about Pentagon management—is sharpening its scrutiny of the hesitant military space program.

Literally staggering under the impact of the budgetary and administrative monster created by the civilian space effort, committees of both the House and Senate have been slow to grasp the urgency of the military requirement. This characteristic, it must be added quickly, is not entirely the fault of the legislators. The pattern has been set, from the outset in the Eisenhower Administration, by the Executive Branch of the government. In January President Kennedy sent an annual report to Congress on the nation's aeronautics and space activities in 1962. The report was 105 pages long. Fifteen of those pages were devoted to the Defense Department effort.

The Kennedy report on 1962 spoke again of “clear, identifiable military needs and requirements” and gave the usual examples of jobs to be done in communications, navigation, and early warning. Titan III was named as a promising launch vehicle. There was a bow to Dyna-Soar—the now-tottering X-20—as a vehicle that will let a pilot try to maneuver in space and come back to a landing. The report contains no mention of the USAF requirement for operational experience in space. It is part of the known history of aerospace power that the prevailing force in any conflict not only needs good equipment, but also that both the vehicles and the pilots need logbooks with recorded time.

Congress did get the word on this, in the testimony



of Lt. Gen. James Ferguson, USAF, Deputy Chief of Staff for Research and Development, before the House Committee on Science and Astronautics (see page 46). The Air Force, General Ferguson said, proposes to develop a “military patrol capability” to protect America's interests in space. He emphasized that firsthand experience is essential to perform the mission. Said the general:

“Just consider, if you will, how well we could conduct the air defense of this country if we were suddenly called upon with no real experience in that field. Only with experience can we have assurance that we can handle the tasks which national security requires.”

This comparison was well designed to attract congressional attention. Air defense is a mission with obvious virtue, and it is easy to understand why ADC pilots and their equipment need exercise in the environment in which they will fight. Most congressmen have seen a “scramble,” at least from the grandstand at a firepower demonstration. They know its significance, and it is not difficult to project the air defense requirements into the space defense mission. Logbooks, for men and machines, are needed for proficiency in any and all environments.

If there was anything unfortunate about General Ferguson's presentation, it is the simple fact that the way Congress is organized to deal with the space effort brought this space patrol proposal to the attention of the wrong committee. Prime interest of the House Committee on Science and Astronautics is the program of the National Aeronautics and Space Administration. This is equally true on the Senate side, where the Committee on Aeronautical and Space

House Armed Services' R&D Panel: New Military Space Watchdog?



Melvin Price, Democrat of Illinois, is Chairman of the new Subcommittee on Research and Development of the House Armed Services Committee. He also is Chairman of the parallel subcommittee of the Joint Committee on Atomic Energy. He is probably the only man in Congress who predicted Sputnik. Also, he is known as a supporter of the nuclear propulsion program for both airplanes and submarines, the ICBM effort, and DEW Line system. Wearing an Army uniform when first elected to Congress in 1944, he has monitored our national defense capabilities steadily ever since that time.



Jeffery Cohelan, Democrat of California, comes from Berkeley, home of the University of California, which is distinguished by the high competence of its scientific faculty. The congressman, who was first elected in 1958, is a graduate of the University of California, where he studied economics before becoming a Fulbright scholar.



Otis G. Pike, Democrat of New York, flew 120 missions as a Marine pilot in World War II. He comes from Riverhead, on Long Island, and practiced law there after winning his degree at Columbia University. He also is a *magna cum laude* graduate of Princeton. He was elected to Congress in 1960 after being defeated in his first try.



Samuel S. Stratton, Democrat of New York, comes from the city of Schenectady. He has degrees from the University of Rochester, Haverford, and Harvard. He is a captain in the naval Reserve. In Congress, he has been outspoken in defense of retired military officers when they were under fire for joining the staffs of defense industries.



Frank J. Becker, Republican of New York, comes from Nassau County, on Long Island. He has been in Congress since 1952 and before that served four terms in the New York State Assembly. In New York he is credited with authorship of the Military Law of the State and the Civil Defense laws which were adopted prior to Korean War.



Durward G. Hall, Republican of Missouri, is a physician and graduate of the University of Chicago. A practicing surgeon until his election to Congress in 1960, he served seven years in the Army, where he once was personnel chief in the Office of the Surgeon General. In Missouri, he has been active in Chamber of Commerce affairs.



Robert T. Stafford, Republican of Vermont, is an attorney who served in the Navy in World War II and Korea. He is a Commander in the naval Reserve. He was governor of Vermont, 1959-1961, before coming to Congress. He also has been Deputy Attorney General, Attorney General, and Lieutenant Governor of his home state.

Sciences—less active and aggressive than its House counterpart—gives second priority to the military mission, following the pattern set down by the Executive Branch of the government.

A few days before General Ferguson talked about the space patrol requirement he delivered another paper before the House Armed Services Committee. Working on the military budget for fiscal 1964, this group for the first time is required by law to give authorization for funding of research-and-development projects. There is no money requested for even the first steps toward a space-patrol proficiency—the Defense Department's executive offices deny there is

such a requirement—and the Armed Services Committee has naturally paid a minimum of attention to the potential. General Ferguson did not mention the space patrol to this group.

It is increasingly clear that Rep. Carl Vinson, Armed Services Chairman, is preparing to grind the space requirement into his deliberations on military posture. As a first step, he has appointed a new subcommittee to deal in a specialized way with the military research-and-development requirement. It is expected that this will be a permanent subcommittee of armed services. The new group is headed by conscientious Rep.

(Continued on following page)

Melvin Price, Democrat of Illinois, and Robert Smart, the capable counsel for the Armed Services Committee, will serve in the same capacity for the subcommittee on research and development.

At this writing the new group (*see page 87*) is preparing for its first meeting. Mr. Smart is drafting an exact definition of the subcommittee's mission, a document that will include specific reference to the military's need for space capability. At this writing, also, the Defense Department is reevaluating the Air Force's Dyna-Soar program, and while USAF has no official indication that the project will be curtailed, it is widely assumed that there will be a cutback. Defense Secretary Robert McNamara, in testimony before the Armed Services Committee, already has said "the program is in doubt" and that he can see "no clear military requirement" (*see page 56*).

Congressman Price says the Dyna-Soar program probably will be the first item on his committee's agenda. This indicates an inquiry into its utility as a basic vehicle in USAF's approach to space operations. Mr. Price says the military application of research-and-development projects is the prime item of interest to his new subcommittee, an approach that has not been used in the studies by the science and astronautics group.

This difference in emphasis between the latter committee, commonly called the House Space Committee, and Mr. Vinson's Armed Services Committee has been more than four years in the making. First chairman of the Space Committee, in 1959, was Rep. John McCormack, now Speaker of the House, who provided leadership for the early effort as the US re-

(Continued on page 91)

The Space Committee Chairmen . . . On Both Sides Of the Hill



Senator Anderson



Representative Miller

The Senate Aeronautical and Space Sciences Committee, commonly called the Space Committee, is headed, for the 88th Congress, by Senator Clinton P. Anderson, Democrat of New Mexico. His immediate predecessor was Oklahoma's Robert S. Kerr, now deceased, who replaced Lyndon Johnson of Texas when the latter became Vice President. Mr. Anderson also serves on the Interior and Finance Committees and the Joint Committee on Atomic Energy. He exchanged his chairmanship of the Interior Committee for the new responsibility over space after helping to win major federal reclamation projects for his home state. He is reported to favor strongly the use of New Mexico as the site for NASA and Air Force aerospace landings and recoveries.

Other Democrats on the Senate Space Committee:

RICHARD B. RUSSELL, Ga.; WARREN G. MAGNUSON, Wash.; STUART SYMINGTON, Mo.; JOHN STENNIS, Miss.; STEPHEN M. YOUNG, Ohio; THOMAS J. DODD, Conn.; HOWARD W. CANNON, Nev.; SPESSARD L. HOLLAND, Fla.; J. HOWARD EDMONDSON, Okla.

There are five Republican members. They are:

MARGARET CHASE SMITH, Me.; CLIFFORD P. CASE, N. J.; BOURKE B. HICKENLOOPER, Iowa; CARL T. CURTIS, Neb.; KENNETH B. KEATING, N. Y.

The House Committee on Science and Astronautics, commonly called the House Space Committee, has been chaired by Democrat George P. Miller of California since

the death of Overton Brooks of Louisiana in late 1961. Before Mr. Brooks, the chairman was John W. McCormack of Massachusetts, now Speaker of the House. In 1961 Mr. Miller was one of the small minority who, in debate on the NASA authorization bill, complained that the agency had not justified additional funds added to the request for fiscal 1962. Mr. Miller was an artillery officer in the Army in the first World War. He has served two terms in the California State Assembly, then was executive secretary of the California Division of Fish and Game before first being elected to Congress in 1944.

Other Democrats on the House Space Committee are:

OLIN E. TEAGUE, Tex.; JOSEPH E. KARTH, Minn.; KEN HECHLER, W. Va.; EMILIO Q. DADDARIO, Conn.; J. EDWARD ROUSH, Ind.; THOMAS G. MORRIS, N. M.; BOB CASEY, Tex.; WILLIAM J. RANDALL, Mo.; JOHN W. DAVIS, Ga.; WILLIAM FITTS RYAN, N. Y.; THOMAS N. DOWNING, Va.; JOE D. WAGGONER, Jr., La.; EDWARD J. PATTEN, Jr., N. J.; RICHARD FULTON, Tenn.; DON FUQUA, Fla.; NEIL STAEBLER, Mich.; CARL ALBERT, Okla.

The Republican members follow:

JOSEPH W. MARTIN, Jr., Mass.; JAMES G. FULTON, Pa.; J. EDGAR CHENOWETH, Colo.; WILLIAM K. VAN PELT, Wis.; R. WALTER RIEHLMAN, N. Y.; CHARLES A. MOSHER, Ohio; RICHARD L. ROUDEBUSH, Ind.; ALPHONZO BELL, Calif.; THOMAS M. PELLY, Wash.; DONALD RUMSFELD, Ill.; JAMES D. WEAVER, Pa.; EDWARD J. GURNEY, Fla.; JOHN W. WYDLER, N. Y.

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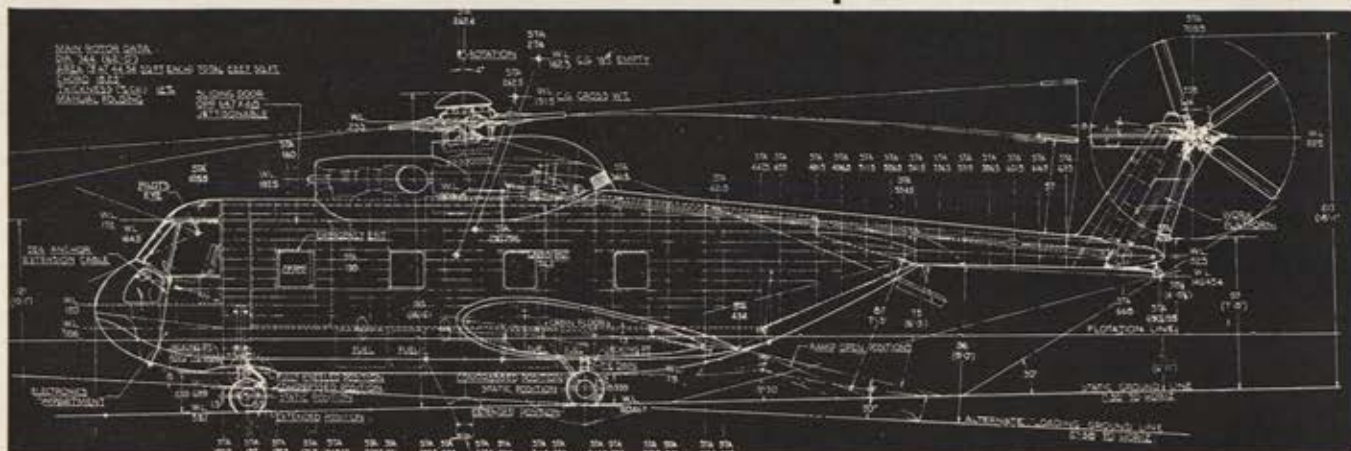
The delivery by Hitco of the first 120-in. structural plastic nozzle to United Technology Center in mid-1963 will climax over four years of research and development in large nozzle fabrication. The problems of building the nation's largest and most reliable nozzles for the Air Force Titan III-C first-stage solid-propellant motors have been overcome. □ Principal contribution to the solution of these problems was the installation of a 132-in. diameter hydroclave-autoclave combination at Hitco's extensive aerospace plastics facility. This giant pressure vessel greatly increases structural reliability of the nozzle by distributing 1000 psi pressure uniformly over the nozzle surface. □ Determined to keep pace with the development of larger solid boosters, Hitco now is studying other approaches to the fabrication of nozzles up to 260-in. diameter. □ Hitco invites your interest in its large structural plastics facility which, in addition to the nation's largest hydroclave-autoclave, includes winding and machining equipment, presses up to 2400 tons, large filament winding equipment, and assembly facilities and capabilities for smaller ablative and insulation parts. Please write or call.



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The twin-turbine CH-3C can fly 25 troops or 5,000 pounds of cargo 238 miles at 150 mph—or 2,400 pounds 810 miles. It can operate in 57 mph winds, day or night, to support Texas Towers or missile sites. And it can fly drone retrieval or geodetic survey missions. Operating costs: the lowest in the medium-transport class.

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*Sikorsky's SH-3A currently holds five world speed records.

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luctantly moved into the space age under the conservative Eisenhower leadership. Next chairman was the late Overton Brooks of Louisiana, under whom the group wandered at times far from its basic job of monitoring the civilian effort. Under Mr. Brooks there was a busy but ineffective effort to cover large segments of the military problem, but the emphasis remained on NASA.

Present chairman of the Committee is George P. Miller of California. At the last session there was a noticeable retreat from any attention to military matters, and the outlook at present is that the Committee has its hands full monitoring the now elephantine civil program. Mr. Miller's attitude on military space was made clear late last summer when he took the floor of the House (September 6, 1962) to defend Administration policies against Senate critics.

Even at that time, the congressman raised the question of Dyna-Soar's role and the timing of its contribution vis-à-vis NASA's Gemini schedule. Since that speech there has been little doubt that the military program holds low priority in Mr. Miller's committee. It also is true that under his leadership the space group has given increasing attention to the side of government interest in pure science, with increasing emphasis on such items as oceanography and the National Science Foundation.

There have been some exceptions to the coolness shown in the House group.

Rep. Emilio Q. Daddario, Democrat of Connecticut, considered the leading congressional expert on bioastronautics, has waged a hard fight, against extremely difficult odds, for utilization of the extensive and primarily Air Force aerospace medical capability by NASA as well as the military, and has opposed efforts to build parallel facilities and organizations that would splinter the rather small total number of experts in bioastronautics available in this country and weaken our defense technology base. Mr. Daddario has also warned vocally that the military significance in space must not be ignored. Texas Democrat Olin E. Teague, chairman of the Manned Spaceflight Subcommittee of the House space panel, has uttered similar warnings. And lately, Rep. James J. Fulton, Republican of Pennsylvania, has made charges of poor planning and waste against the civil space agency.

However Congress handles space budgets in the future, this is a good year for Mr. Vinson, through Mr. Price, to start altering the pattern. Capitol Hill is considering, for fiscal 1964, a NASA budget of about \$5.7 billion and a military space budget of \$1.6 billion. What talk there is centers around the idea that NASA may be pared down and that the military request should be increased.

Until the Price subcommittee was set up it appeared that the Senate had the more outspoken advocates of military space ambitions. Mr. Miller's speech, mentioned above, was a reply to addresses on the other side of the Hill by Senators Howard W. Cannon, Thomas J. Dodd, and Barry Goldwater. In the Senate, Mr. Cannon is a member of the Space and Armed Services Committees, Mr. Dodd of the Space Committee,

and Mr. Goldwater of the Armed Services Committee.

Neither of these committees has distinguished itself for interest in the military space program. The Space Committee, in fact, has become almost notorious for its dormancy under leadership of the late Senator Robert S. Kerr, whose place has been taken by Clinton P. Anderson, a New Mexico Democrat who has been quoted as saying his big objective is to persuade NASA to increase its use of military facilities in his state. These include the White Sands Missile Range and Holloman Air Force Base.

Senator Cannon, who was first to provoke a floor discussion on the military space requirement after the Russian flight of Vostoks III and IV, had pointed out that Dyna-Soar was "critically important to the attainment of effective manned military capabilities in space." The fact that the two Soviet capsules came close to a rendezvous in space had, in the opinion of many experts, lent urgency to the Dyna-Soar concept.

Senator Dodd had pointed out that the real point of the Soviet accomplishment had been missed by NASA spokesmen. He said that the Soviet space effort has been concentrated on the development of manned and maneuverable vehicles. Their aim, he believed, was obvious: military control of space.

Senator Goldwater has been a steady and outspoken opponent of the emphasis on NASA. Others who have shown alarm include Senators Margaret Chase Smith, John Stennis, Strom Thurmond, and Richard B. Russell, who is Chairman of the Armed Services Committee, senior Democratic member of the committee on space sciences, and chairman of the powerful defense appropriations subcommittee. Mr. Russell, all jobs and seniority considered, probably will be the most important man in the Senate if the military space effort becomes a real issue. At least, if he were to take leadership in a demand for reevaluation of the national effort, he is in a position to wield real power.

Senator Anderson, who heads the Aeronautical and Space Sciences Committee, has strong convictions that space travel is fully dependent on the development of nuclear propulsion. He is known to favor strong civilian control of the program and tends to downgrade the military contribution. Mr. Anderson supports public power and other growing in-house federal capabilities and cannot be expected to lay stress on the contributions of private industry.

It is not evident on the surface, but here again there is an area of vital importance to the space program, in which Congress and the military services have intense interest and in which the House side has displayed intelligent aggressiveness. With research and development taking an ever-larger share of the entire federal budget and bureaucracy unabated in its mushroom growth, the whole issue of how Uncle Sam buys his research is getting a severe review.

Rep. Chet Holifield of California, Chairman of the Military Operations Subcommittee of the Committee on Government Operations, held a restrained hearing last summer on the subject of "Systems Development and Management." The inquiry was an effort to ex-

(Continued on following page)

plore some of the recommendations made by the Bureau of the Budget in the report on "Government Contracting for Research and Development" prepared for the White House. This was commonly known as the Bell Report, named for its main author, David B. Bell, then Director of the Bureau of the Budget.

The Bell Report recommended a larger in-house capability for government-owned laboratories. It also urged improved government techniques for supervision of private contracts, emphasis on fixed-price contracts for research and development, and controls over the salaries paid by private contractors. The Holifield Committee, which has been monitoring this general subject for many years and is credited with sponsoring improvements in government management of both research and systems engineering services, heard a long list of witnesses from industry, nonprofit corporations, universities, labor unions, the military services, the Executive Branch, and Congress.

No report has been issued by the Holifield Committee and more hearings are expected this spring before any conclusions are drafted. It was evident from the path taken last year, however, that the chairman is concerned about the bottlenecks in government operations that delay technological progress, the shortage of professional competence in the technological fields, and the general inefficiency of the national research-and-development effort.

It was natural, in discussing these subjects, for the witnesses—including some of the most prominent military and scientific experts—to express opinions about the nature of our space effort. The Holifield Committee thus provided a platform for competent observers to support the military requirement in an atmosphere not available before other committees of the House.

Typical witness was Dr. Ivan A. Getting, President of the Aerospace Corporation, who—under questioning—pointed to the fact that our weather satellite project was assigned to NASA. He added, quickly, that "one could show that the military have a bigger requirement for knowing worldwide weather than does the Weather Bureau." He said that, historically, the Navy makes charts of the world as a whole but that, for some unexplained reason, map making from space is a civilian operation. Dr. Getting listed some clear reasons why the military services need their own communications systems in space, distinct from those serving civil purposes.

There were others before the Holifield Committee, including Gen. Bernard A. Schriever, Commander of USAF's Systems Command, who lent credence to the plea for more balance in the space program. It is not necessary to quote all of them but only to note that there is cross-fertilization between Mr. Holifield's committee and Armed Services. Representatives Joe M. Kilgore and Richard E. Lankford are members of both groups. Both also are Democrats. While there is no outside evidence that the more scholarly and professional views that have been brought out by Mr. Holifield have an impact in the other committee—which now has authorization power over research money—

there is little doubt that the words have been heard.

The immediate outlook is not for any sudden reversal in the pattern laid down and espoused so vocally by the Executive Department. Dr. Harold Brown, Director of Defense Research and Engineering, has been cool to the military possibility for operations in space. Certainly he has been supported to the hilt in this by Secretary McNamara.

On the other hand there is snowballing evidence on both sides of Capitol Hill of a growing impatience with present Pentagon approaches. As usual, the House of Representatives is most promising as a source of practical efforts to spark some change in emphasis for the space program.

In addition to General Ferguson's plea for "military patrol capability," there have been statements in recent weeks by USAF Secretary Eugene M. Zuckert and the Chief of Staff, Gen. Curtis E. LeMay (see pages 35 and 40). Both have argued for the start of an effort to get operational capability for military systems in space beyond the more passive missions of communication, navigation, meteorology, etc.

It may be that the news of the day, from day to day, will have more impact on Congress than the expert opinions, often diluted by dispute, that come out on the witness stands. Take, for example, the recent disclosure that long-range Russian reconnaissance aircraft, flying out of home bases over a polar route, have overflown American naval vessels in the Atlantic. There is nothing illegal about this, and the alarming part of it is not that US sailors and airmen were within easy shooting distance of Soviet military aircraft.

The significant part of this exercise is that the Russian pilots did not have to search for the USS *Enterprise*. They knew where it was and flew a direct path from Russia to the spot in the Atlantic where the carrier force was located. Their information on the exact location of the fleet could have come from spies. It could have been provided from calculations worked out by listening to fleet-generated radio signals. The US vessels may have been tracked by Russian submarines, which relayed the information to a home base.

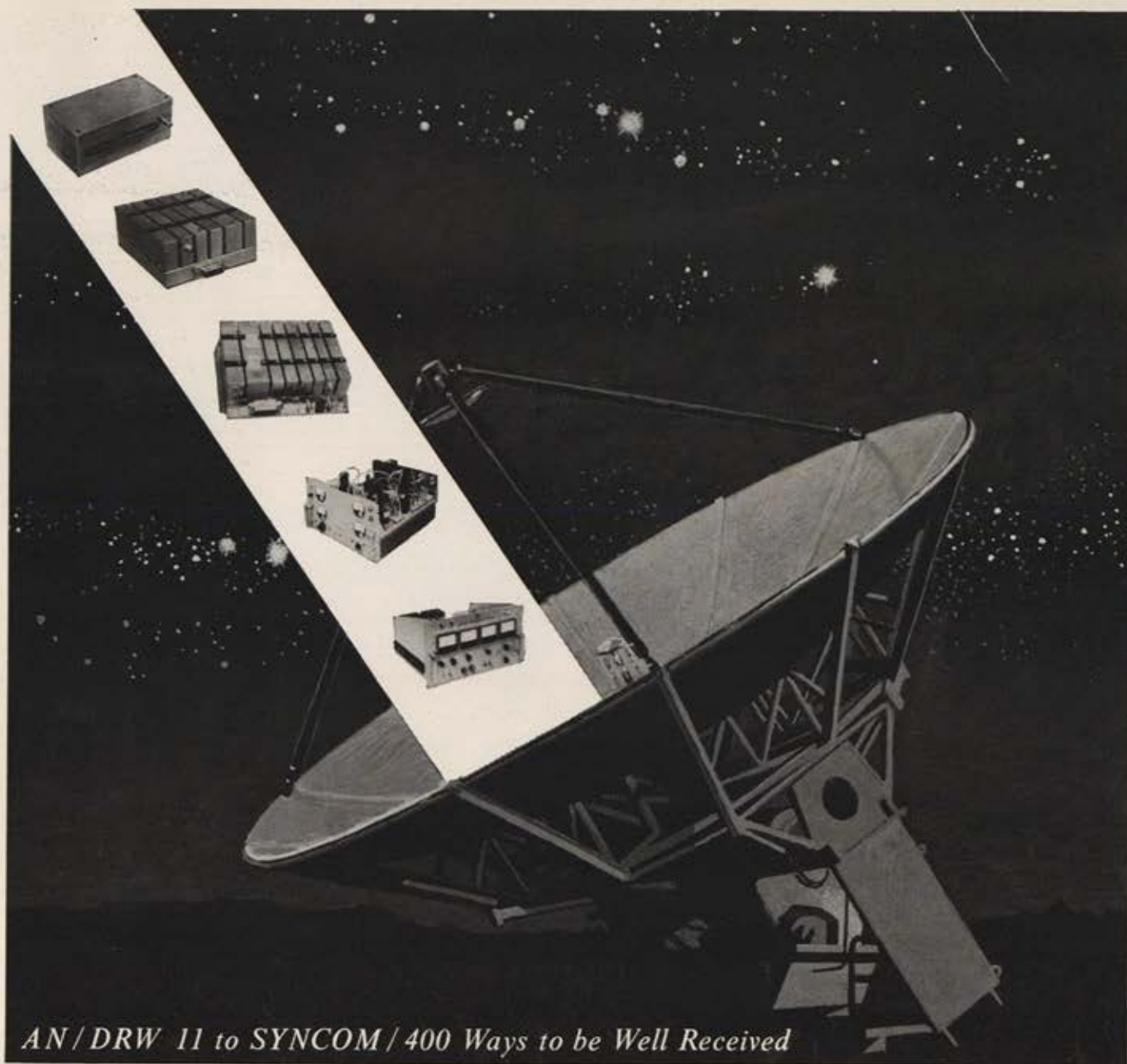
There is one other possibility. The Russians today may be tracking our military movements at sea with a reconnaissance satellite system high in space. We simply don't know, and if we did we would have less reason to protest than Moscow had when it created an international storm over the flight of Francis Gary Powers across Russia in his U-2. At the same time, the simple fact that a potential aggressor can easily obtain this capability of monitoring military movements from space lends urgency to the US military requirement.

The Russian overflights lend credency and urgency to General Ferguson's case for space patrol capability. In a hot war there will be shooting in the atmosphere and in the space above it. The nation without proficiency in both these environments will lose. Congress is authorized and directed by the Constitution to ensure this capability.—END



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The cost of war in human casualties and deaths has steadily and horrifyingly risen since man first fought his fellow man hundreds of centuries ago. Now we are approaching tolls that suggest Armageddon. In the last analysis, the only real way to prevent the world's funeral is to make aggression and the consequent touching off of holocaust unthinkable—through credible deterrence . . .

HALTING THE INFLATIONARY SPIRAL OF DEATH

By Dr. Ivan A. Getting

PRESIDENT, THE AEROSPACE CORPORATION

IT WAS Leon Trotsky—appropriately enough—who once remarked that, if we are looking for peace and quiet, we picked the wrong century to be born in.

When Trotsky made that remark, he could hardly have known that the Nuclear Age and the Space Age would arrive among us practically at the same time. Yet what has happened in the twenty years since the first nuclear chain reaction was achieved in Chicago and in the four years since intercontinental ballistic missiles have been operational has served to confirm the observation of that old-line Bolshevik.

But technology, while it has added new dimensions to warfare, is not of itself responsible for human conflict. Man has been killing his brothers in an organized fashion for hundreds of centuries. It is interesting to trace the history of war in purely statistical terms. In so doing we are able to illustrate graphically one of the key problems of our age, the problem of large-scale violence. Taking Europe as our example, the number of casualties per decade attributable to war has climbed upward with relentless steadiness. The only exception to the upward trend is in the eighteenth and nineteenth centuries (*see chart at right*). In this time period the casualty curve flattens out and even dips a little. A determination of the causes for this relative and temporary decline in violence is something for

(Continued on following page)



Prelude to Armageddon? On July 16, 1945, on New Mexican desert wastes, US achieved first test nuclear explosion.

FEVER CHART OF WARFARE—1000-1950 A.D.

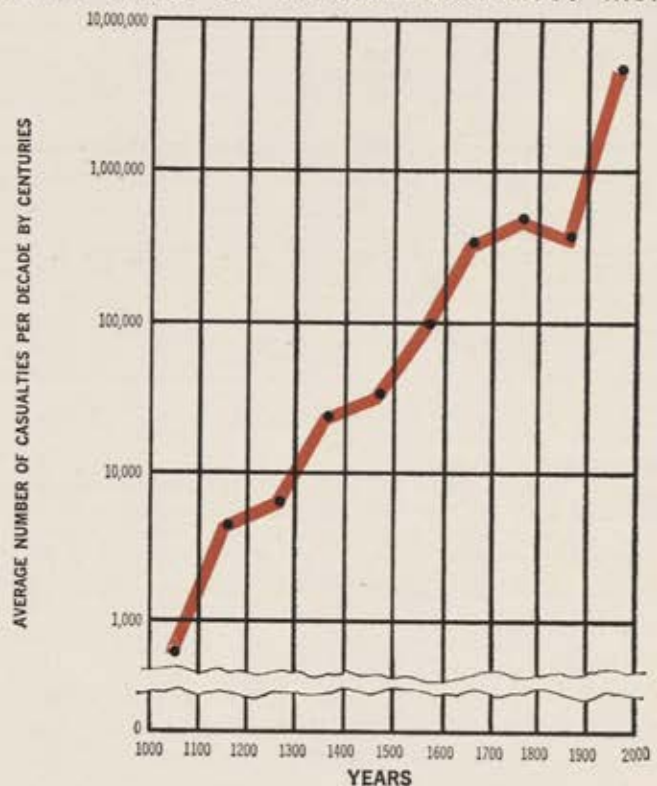


Chart shows the number of European war casualties (including dead), averaged for ten-year periods, by centuries since the year 1000 A.D. During the period 1000-1100 (and including the Battle of Hastings in 1066, for example), casualties averaged nearly 1,000 for each ten-year period. In our own time, the figure is up to nearly 10,000,000 per decade—approaching the appalling rate of 100,000,000 casualties for the century. The only period of stabilization and even some decline came in the eighteenth and nineteenth centuries, probably as a reaction to the excesses of the Thirty Years' War and the Napoleonic era. But the rate goes up sharply again in the twentieth century.

THE INFLATIONARY SPIRAL OF WAR: IN THE NEXT CENTURY, ARMAGEDDON?

SIZE OF WAR IN TERMS OF CASUALTIES	TIME PERIOD	PROJECTIONS				
		1820 to 1859	1860 to 1899	1900 to 1949	1950 to 1999	2000 to 2050
	500 - 5,000 CASUALTIES PER WAR	100,000 killed in 63 wars	100,000 killed in 75 wars	100,000 killed in 71 wars	100,000 killed in 64 wars	100,000 killed in 57 wars
	5,000 - 50,000 CASUALTIES PER WAR	300,000 killed in 25 wars	200,000 killed in 21 wars	300,000 killed in 25 wars	300,000 killed in 25 wars	300,000 killed in 25 wars
	50,000 - 500,000 CASUALTIES PER WAR	400,000 killed in 4 wars	700,000 killed in 7 wars	1,500,000 killed in 15 wars	2,200,000 killed in 22 wars	2,500,000 killed in 25 wars
	500,000 - 5,000,000 CASUALTIES PER WAR	0	3,600,000 killed in 3 wars	4,600,000 killed in 4 wars	5,000,000 killed in 5 wars	6,000,000 killed in 6 wars
	5,000,000 - 50,000,000 CASUALTIES PER WAR	0	0	36,000,000 killed in 2 wars	38,000,000 killed in 3 wars	40,000,000 killed in 4 wars
	50,000,000 - 500,000,000 CASUALTIES PER WAR	0	0	0	360,000,000 killed in 1 war	400,000,000 killed in 2 wars
	500,000,000 5,000,000,000 CASUALTIES PER WAR	0	0	0	0	3,600,000,000 killed in 1 war
	TOTAL NUMBER KILLED IN TOTAL NUMBER OF WARS	800,000 killed in 92 wars	4,600,000 killed in 106 wars	42,500,000 killed in 117 wars	405,600,000 killed in 120 wars	4,048,900,000 killed in 120 wars
WORLD POPULATION		1.0 billion	1.3 billion	2.0 billion	4.0 billion	10.0 billion
PERCENTAGE OF WORLD POPULATION KILLED		0.1%	0.4%	2.1%	10.1%	40.5%
PROJECTIONS						

The first three columns of the chart above summarize war casualties from 1820 to mid-twentieth century. In each column a bigger war appears than had occurred in the earlier era. If trend is projected (*tinted area*) up to the year 2050, statistics indicate that mankind may expect a

cataclysmic engagement approaching Armageddon—a single war costing 3.6 billion lives. This, combined with the projected 119 other wars that, statistically, would take place during this fifty-year period, would claim the lives of 40% of the earth's estimated 10 billion population.

the historians to worry about, but one theory comes readily to mind.

During the eighteenth century, the European powers, appalled by the excesses of the Thirty Years' War, seemingly agreed—if only tacitly—to risk only token forces in future conflicts. Such wars as did occur, therefore, were less disastrous in terms of loss of life.

In the nineteenth century, following in the wake of Napoleon, Europe turned to the explicit concept of the balance of power in an attempt to prevent the outbreak of conflicts. And, indeed, Europe by and large was peaceful during most of that century, certainly once the balance-of-power concept had been accepted.

The fact that the casualty curve has been going up in absolute terms is interesting per se. But what

about the ratio between total casualties and total population? After all, the population of Europe has been rising for the last thousand years.

There is likewise little cheer in this approach. An examination of the ratio of casualties to population (*see the chart above*) indicates clearly that wars are increasing in intensity as well as in magnitude as shown by the increasing percentage of the world population killed in wars. And the trend is up, with the casualty rate growing at a faster pace than that of the population—explosion and all.

A disconcerting over-all pattern begins to emerge. Every forty to fifty years the size of the largest conflicts in that time period goes up by a factor of ten.

(Continued on page 99)

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War doesn't need to be nuclear to be hellish, as witness the carnage of (left) World War I trench conflict or the blood that flows in today's "little wars" such as the struggle against Red guerrillas in Vietnam. The photograph above shows government troops in pursuit of Viet Cong rebels.

Every two generations or so, the biggest wars are ten times worse than before. When one extrapolates these data into the future, we get into Armageddon-scale figures—and in less than a hundred years.

At the same time, smaller conflicts—and "smaller" means only comparatively—have increased in number. In the next hundred years extrapolation of the past data leads us to expect some seven conflicts comparable to either of the past two World Wars. Meanwhile the total *number* of conflicts increases only slightly.

It is worth noting that the larger the conflicts, the fewer of them there tend to be. It may be that, as the ability to do large-scale violence becomes greater, nations become more reluctant to resort to the highest order of violence to settle their differences.

During the first half of the present century, then, mankind managed to kill off 42,500,000 people, or 2.1 percent of the world total. The carnage was surely terrible, but civilization has withstood it.

But both the intensity and magnitude of conflicts are rising. Thus we might be led to predict that by the first half of the next century mankind, if the precedent of past years is followed, would experience one war that would account for some 3,600,000,000 deaths.

Total war deaths from all conflicts would add up to nearly 4,500,000,000, and the world would lose 40.5 percent of its population.

Now what does all this mean? Simply that, if we can possibly do so, we must stop having wars. Most especially we must stop having big wars.

But how are we to postpone indefinitely such catastrophes, when indeed we have the capabilities in an era of nuclear weapons and effective delivery systems? How are we to confound the iron law suggested by these statistics?

Mankind thus far has been able to think of only two basic ways of making war unlikely. One is to make sure that the means to start and wage a major war are not available. In modern terms, this means disarmament or stringent arms control.

But almost everyone agrees that any kind of effective disarmament or arms-control agreement must include all nations that possess weapons of large-scale violence, that the disarmament process must at some fairly early stage be reciprocal, and that there must be adequate enforcement provisions and machinery.

I leave it to the reader's judgment as to when or if we are likely to get such an agreement with the Soviet Union, or in the future with Communist China. The disarmament road to avoidance of war seems more attractive than it is likely.

The alternative method of trying to avoid war has the advantage that it can be undertaken unilaterally. It is to increase the price a potential aggressor must expect to pay for breaking an armed peace. If this price can be made high enough and sure enough, the only rational course for an aggressor is to keep his ambitions in abeyance. This method we call deterrence, and it is the theory to which our country has been strongly committed.

We have raised the stakes so high that an aggressive nation must face destruction or contain its ambitions, one or the other.

Our deterrent force, which is deployed more to prevent a war from taking place than it is to wage one successfully if need be, depends greatly on the ballistic missile. We have accomplished an amazing technical feat in developing operational ballistic missile systems so rapidly. We have designed these weapons to be accurate at long ranges; we have put them in concrete silos and aboard submarines so that they will be as nearly invulnerable as it is now possible to make them. Now we can be sure that we can strike back crushingly against anyone who attacks our vital interests.

Or can we? How do we know?

Those are two very important questions, and it is important that we be able to answer the first affirmatively and the second convincingly. Only then
(Continued on following page)



World War II conventional strategic bombing (left) caused heavy casualties on the ground, but its destructiveness was dwarfed by the monumental explosive power achieved with the atomic bomb dropped on Hiroshima (above) during the last days of the war, killing most of the city's inhabitants and wiping out most of its buildings in a single fearful stroke.

do we have the credible deterrence essential to the maintenance of peace.

Many observers today are fond of remarking that ours is an unprecedented age and that our problems are accordingly unprecedented. One of the more acute of our problems arises because we have placed critical reliance on weapon systems that have never been tested in actual combat.

How do we dare stake so much on them? This is the key question.

Without flight testing, we would be in a poor position to know whether our impressive strategic systems are in fact workable, and therefore credible.

"Credible" has become an increasingly important word in recent years, and concern over "credibility" much occupies our leading political and strategic thinkers. At no other time in history has such been true to as great an extent.

In simpler days, say up to World War II, a nation demonstrated its military capabilities on the battlefields. Everyone knew, for example, that Prussia was a great military power because from time to time it had put that power into the field. The ways to military power were not critically dependent on radically new technologies but on means that were understood by tradition, tried in practice, and evolutionary in nature.

Looking back over the last 300 years, we see that even the loser in a major battle of the past might suffer defeat but never total destruction. Boundaries might be rearranged, governments might fall, but mankind and his civilization continued to exist.

The unprecedented successes of technology of the twentieth century—and the applications of those successes to produce military capabilities—have surely changed all that. The battlefields of a real, all-out

conflict today are liable to be continents; the stakes, life or death for an entire society. Yet, if the world situation deteriorates to the point where recourse to arms is imminent, doubt—by either side—of the other's capabilities might trigger the holocaust.

Therefore, if you ask: Where are the front lines today in the contest for national security? My answer is: They are our missile and space testing grounds.

They are at Cape Canaveral—at Vandenberg—at the national missile ranges where we test out the capabilities of our missile and space systems.

Some observers have pointed out that certain trends within the Soviet Union seem to indicate that they are trying to build a relatively invulnerable second-strike force, roughly on our lines. If this is, indeed, what they are up to, these sources ask, will this not result in a kind of stalemate, in which case it is pointless to pursue further development? The answer is no.

Dr. Harold Brown, Director, Defense Research and Engineering, spoke at the March 2 dedication of Aerospace Corporation's new San Bernardino buildings. He drew an analogy to a mathematical equation in which the first-order terms cancel out, making the second-order terms determinant. The first-order terms, in this case, are clearly our intercontinental strategic capabilities; the second-order terms are forces for more limited engagements. Dr. Brown pointed out:

"Why, then, do we continue work on strategic weapons? The answer is that it remains of the very greatest importance that the first-order balance not go against us. We cannot afford to abandon or minimize our efforts in the development and deployment of our strategic systems. Even though it is technically feasible for the Soviets to have a secure second-strike force, and even though at least some of their tendencies seem

(Continued on page 105)

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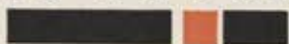
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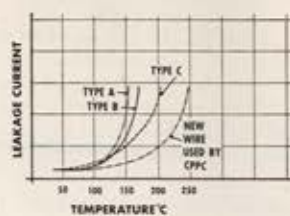
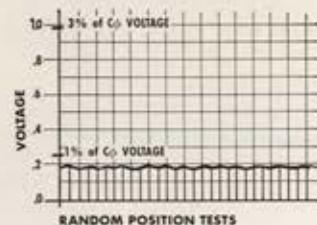
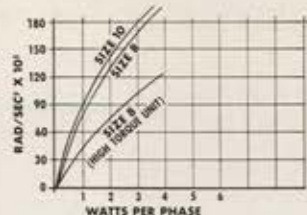
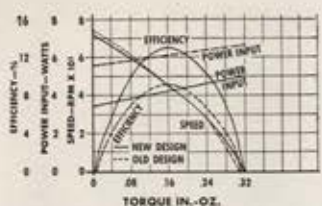
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to be in that direction, they can make mistakes in their strategic force development and deployment. Furthermore, even if our deterrent capability is such that the only rational Soviet course is not to launch a thermonuclear attack, it is possible in one way or another for smaller wars to escalate or for the Soviets to make miscalculations. . . .

"Furthermore," he continued, "deterrence could be unbalanced by further technological advance. Though I do not consider this likely, to the extent that it is possible at all, we must not allow future technological advances to catch us unaware and deprive us of the all-important capability to destroy any potential aggressor completely as a nation no matter what he may do in a first strike against our strategic forces."

I do not mean to infer that the maintenance of our strategic and tactical forces is the only important project assigned to spaceflight testing. Our national scientific and exploratory space programs are also vital to us, and, indeed, the two are inseparable within space technology as a whole.

All space projects contribute toward our national security. I think we frequently make needless trouble for ourselves when we try to separate into two hampers the so-called military space projects and the so-called peaceful space projects.

It is important to have a wide range of national capabilities in space in order to be ready to capitalize on whatever trend of events takes shape there.

Our government recognizes that hard and fast distinctions as to the character of a project are often difficult and pointless. Accordingly, one can list many examples of interagency cooperation—the Department

SAC flight lines—and missile pads, too—are in-being deterrent insurance against aggression, nuclear holocaust. Keeping the deterrent credible is our first security task.

of Defense and NASA share in the Atlantic Missile Range, in the X-15 program, and in the National Launch Vehicle Program. And last January they concluded a similar agreement on Project Gemini.

Further, all of our space exploits, whether conducted by the military or by civilians, have an equal share in enhancing national prestige, which has come to depend heavily on demonstrated scientific prowess. I cannot think of any other time in history in which scientific and technical accomplishments have been so widely interpreted in a political context. A staff report to the US Senate Committee on Aeronautical and Space Sciences had this to say:

"Achievements in science and technology are taken as documented proof of national strength, vigor, and capacity for progress. It is tangible evidence of national capabilities that can be translated into components of military power. In the popular mind, space activities, by nature imaginative and spectacular, seem to have come to epitomize over-all national progress."
—END

Dr. Getting is President of the Aerospace Corporation, Inglewood, Calif., and one of the nation's foremost defense scientists. A physicist, he pioneered in radar development. A one-time professor at Massachusetts Institute of Technology, Dr. Getting is also a former Vice President of the Raytheon Co. He has served on a number of high government defense panels, including the Air Force Scientific Advisory Board and as an adviser to the Joint Congressional Committee on Atomic Energy. The foregoing article is based on remarks by Dr. Getting at the AIAA Space Flight Testing Conference at Cocoa Beach, Fla., on March 19, 1963.

In its enthusiasm for finding a "rational" basis of agreement with the Communists on questions on conflict control, is the Administration missing some crucial points?—

- That recognizing the Communists as human beings with an interest in survival does not necessarily prove that the Communist definition of rationality is the same as ours.

- That Communist rationality, geared to world domination, probably means working toward technological-military end runs—even after both sides solemnly agree to legislate the strategic competition out of existence through stalemate pacts.

- That since technology in the nuclear/space age is dynamic and exponential, the free world must use it dramatically and openly, wherever advantageous, in the control of conflict and, hopefully, in the final erosion of messianic totalitarianism . . .

SPACE TECHNOLOGY: TODAY'S TOOL FOR CONTROLLED

WHEN the history of our era is written, our successors may well read that the application of space technology to the control of conflict on earth was far more significant to mankind's well-being than such monumental achievements as the landing of manned expeditions on the moon and planets with all their highly touted "spin-offs" to the civilian economy. Whether or not such a chapter in future history is written will depend in large part on the imagination and daring of American leadership today and tomorrow.

Yet it is a major irony that in our cold-war-weary world the high potential of space technology as a tool for the maintenance of *controlled peace* with safety not only for the free world but also for our opponents—who live in the same nuclear shadow—receives so little of the attention it deserves. We hear only that space must be preserved for peaceful purposes and that the arms race on earth must be slowed, or better still, stopped.

Indeed, almost overnight there has grown up a vast literature of arms control and disarmament, with the great weight of the talk and writing on the western side of the Iron Curtain. The burden of this vast and

important discussion is that something must be done about the arms race, and that if something isn't done, an accident or other military-political event will inevitably set off a world-destructive nuclear holocaust in which there can, we are told, be no victor. War is obsolescent, we are warned, and Clausewitz's famous definition of war as a continuation of politics by other means is defined as an anachronism in the latter half of the twentieth century.

In this context, great efforts are under way, political and military, to create a "safer" world environment. On the political side, reported daily and excitedly in the public prints, there is a vigorous effort to reach an agreement with the Soviet Union on the cessation of nuclear testing. On the military side, our top civilian defense planners are rushing headlong toward a stable-deterrence situation, an era of strategic nuclear parity, the rationale of which seems to be the firm Administration conviction that within a few years both we and the Soviet Union will have mutual retaliatory strength sufficient to destroy each other and that the deadly logic of this situation will prevent nuclear attack by either side on the other.

Of course, the main criticism of this approach—as

By William Leavitt

ASSOCIATE EDITOR, AIR FORCE/SPACE DIGEST

PEACE

rational as it may seem on the surface—is the question: Will the Soviets agree with the Administration's view that for all practical purposes military technology ought to be "frozen" at approximately its present level? The Administration apparently believes strongly that the Soviets *can* be convinced, and that once they are, both sides can press on toward other agreements based on a "mutual interest" in the avoidance of world destruction. Yet history militates against such Administration confidence. The Soviet Union, whether under Stalin or his successors, has given no indication of abandoning its messianic desire to communize the world. To be sure, there have been important changes in the Communist world—in Russia a lessening of terror as a domestic political tool—and in the larger Communist world a public and violent argument between Russia and Communist China over the best means to achieve world domination. It is true, too, that Nikita Khrushchev is far more understanding of the nuclear age which was well under way when he seized power than was his predecessor Stalin. He is doubtless appreciative of the "nuclear teeth," as he puts it, of the United States. Indeed, some argue that it is this very appreciation of the nuclear facts of life

that will induce the Soviets to go along with nuclear test bans and successor arms-control plans, since Khrushchev must see that to press forward with new military technology will only encourage the US to do the same and exacerbate an already tense arms race.

No matter how it is expressed, this philosophy has its roots in the conviction that technology, itself, particularly nuclear technology, has run amok, that it has come to threaten the very survival of the human race, and that therefore its march must be slowed or even ended by mutual agreement of its two foremost practitioners—the US and the Soviet Union. Once nuclear technology is legislated against, according to this credo, other kinds of technology, notably space, and rocket technology—which provides the delivery means for nuclear warheads—can be regulated too. The particular and understandable nightmare of many strategic thinkers is the extension of rocketborne nuclear weaponry into orbital space itself, *i. e.*, the orbital bombing system, which is often pooh-poohed as an expensive way to do something that can be done cheaper with conventional intercontinental missiles, yet continues to be recognized as worth worrying

(Continued on page 109)



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about by recognized strategic experts. As Donald J. Brennan, a leading defense scientist and arms-control expert who now heads the Hudson Institute at Harmon-on-Hudson, N. Y., has written:

"The potential characteristics and utilizations of orbital weapons cover a considerable range of possibilities. They could be used as a purely retaliatory system aimed chiefly or entirely at cities, in which case they could have relatively modest yields (in the region of one megaton). The problems of effecting reentry of these devices from orbit with sufficient accuracy for this purpose can probably be solved without the necessity for some form of terminal guidance.

"Another possibility of a purely countervalue [use against populations rather than military targets per se] system that has been discussed, and which appears much more disturbing, would involve placing in orbit a limited number of devices of very large yield (a few hundred megatons or more) which would be detonated at orbital altitudes (say 150 miles) rather than [being] brought down to earth before detonation. The thermal effects from such a high-yield device could set fire to a large fraction of a continent, the extent of which would probably be limited only to that which could be 'seen' from the point at which the device was detonated, except that areas protected by cloud cover at the time of detonation probably would not be ignited.

"In addition to purely countervalue possibilities, it may prove possible to deploy orbital-bomb systems that are effective for attacking the strategic forces on an opponent. This would probably require devices of moderately large yield that could be brought down out of orbit with considerable precision, possibly using some form of active guidance (such as television) in the terminal phase of delivering the weapon to its target. Systems of this type would probably need to incorporate, or be supplemented by, reconnaissance systems for gathering suitable target information. Also, if a system of this type were to be used for

initiating a coordinated surprise attack, it would probably be necessary to 'bunch' the weapons in orbit in order to effect the delivery on their targets within a relatively brief interval of time. Retaliatory weapons, on the other hand, could be spread out in separated orbits since it would not be necessary to deliver them all at the same time."

As if to add to the horror, Dr. Brennan adds in a later passage in his essay, which appears in *Outer Space, Projects for Man and Society*, a Prentice-Hall Spectrum Book, published in 1962 by the American Assembly, Columbia University: "The further development of booster-rocket technology by the major powers may make possible the deployment of relatively invulnerable orbital weapon systems by some of the secondary industrial powers." Shall we be faced, Dr. Brennan asks, implicitly, with an Nth-country-in-space problem? Will some future General de Gaulle insist that France must have the means of defending herself from space with a spaceborne deterrent, a *force de frappe en l'espace*?

Bombs in orbit, as Dr. Brennan and many other specialists in strategy and arms control suggest, obviously offer little toward solution of the arms dilemma. They can scarcely be identified as space-oriented contributions to conflict control. They are mentioned here primarily to make two basic points:

- That no matter how hopefully we approach negotiations on arms control on earth or in space with the Soviets and no matter how logically we may expect the Soviets to act in the face of what we expect to be a stalemated strategic situation, we must take into account the Soviet temptation to make technological end runs. Orbital weapon systems are but one of a series of possibilities. They range from calculated disruption of our command-and-control facilities to the covert destruction, one by one, of our Polaris submarines.

- That, unfortunately, most of the discussion of arms

(Continued on following page)

control, whether in terms of conventionally delivered nuclear weaponry as represented by intercontinental missiles, or of spaceborne weaponry, has been in terms of finding rationales on which to base reduction or outlawing agreements that will be acceptable to us and to the Soviets at the same time. This approach hangs tenuously on the hope that we can persuade the Soviets to be logical in our terms, a process that leads only to interminable hair-splitting negotiations.

Instead of emphasizing the unlikely abolition of technology by mutual agreement, what ought to be stressed positively is the use of technology, particularly space technology—married to the observation and computing arts of today—as a really viable instrument for conflict control, an instrument that ideally might eventually be used by an international authority, but that in any case ought to be used publicly and unilaterally now by the US as a peace-preserving technique.

For a time, there was such an effort—albeit timid—under way. The US openly discussed its Air Force Samos-Midas spaceborne-observation and missile-warning satellite programs and even sent up trial balloons on the possibility of turning over surveillance data to the United Nations. Then suddenly and absurdly in the early days of the current Administration almost a total clamp was put on any information about such surveillance programs, except for recent official announcements that the Midas program suffered from serious technical problems. As to Samos, it is not only a dirty word in Moscow, where the Communists periodically howl about American spying from space, but it is also unmentionable in Washington, where the Administration view is that to discuss it is to admit its existence, suggest its efficacy, and to acknowledge Soviet charges of provocation. This policy is not only inconsistent with the fact that everyone knows Samos exists, but it also makes no sense when measured against the fact that during the Cuban crisis last year, the one item that really had impact at the United Nations was the display at the UN, to all who would look, of the photos of Soviet missile sites in Cuba. Somehow this point has been lost on the Administration, yet it is crucially important to demonstrate that technology can crack the traditional Soviet secrecy screen. This fact should be used as a vital political conflict-control tool by the US.

One of the most succinct statements in this connection is contained in a recent article, "Information and Arms Control," in the *Journal of Arms Control*, January 1963, by John B. Phelps of the Institute of Defense Analyses. Dr. Phelps writes:

"... A further prospect, resulting from technology, is that observation satellites will make it either impossible or extremely difficult to maintain certain kinds of secrecy in the 1960s. The development of these satellites seems inevitable. ... The point to be emphasized is that, in several ways, the weapons and space technology of the 1960s hold the promise of both lessening the need for military secrecy and making certain kinds of secrecy impractical anyway. Our task is to align our arms-control thinking to take advantage of this state of affairs."

Dr. Phelps adds later in his article:

"... It seems likely that as yet we do not fully understand the implications of these satellites for arms control or for a number of peaceful purposes. As before, it seems doubtful that either side will forego their use; they are in the technological cards. We may be able to move further toward acceptance of the principle that observation from space is a normal and not particularly threatening activity, more or less equivalent legally to observation from the high seas. Perhaps, eventually, satellite observation can be conducted on an international basis or made part of an arms-control agreement. As an agreed inspection technique, it could be notably free of irritation hazards. But as unagreed unilateral instruments, observation satellites can probably still contribute substantially to the totality of information on which a nation bases its arms-control possibilities. One is intrigued by the possibility that, if the Soviets can be gotten used to the idea of being looked at from above, over the years some fundamental and highly desirable changes in the present information asymmetry, and indeed in the whole politico-military climate, might be brought about."

Dr. Phelps's latter suggestion that the Soviets might get used to and accept observation from space is probably too much to hope for. But his main argument is cogent—that observation satellite systems are essentially positive contributions to the problem of conflict control in a cold-war world. This is true even with some political and technical caveats.

From a political point of view, American unilateral and open use of spaceborne observation will, of course, carry risks, not only of loud Soviet protests about spying, but even of Soviet appeals to "international law." But all this has already happened. The shouts of "spy" are legion, and the Soviet Union has already complained at the UN that "no analogy exists [in terms of observation satellites] with principles applying to the open seas. Such [US] gathering of [reconnaissance] intelligence data through the use of space vehicles is in violation of the sovereign rights of states, and if outer space is to be used in peaceful cooperation, such operations cannot be regarded as legal or in conformity with international law." The US should welcome the chance to debate this point in the UN because of the opportunity to hammer away at the obsession with secrecy of the Soviet Union and its consequent untoward influence on the arms competition.

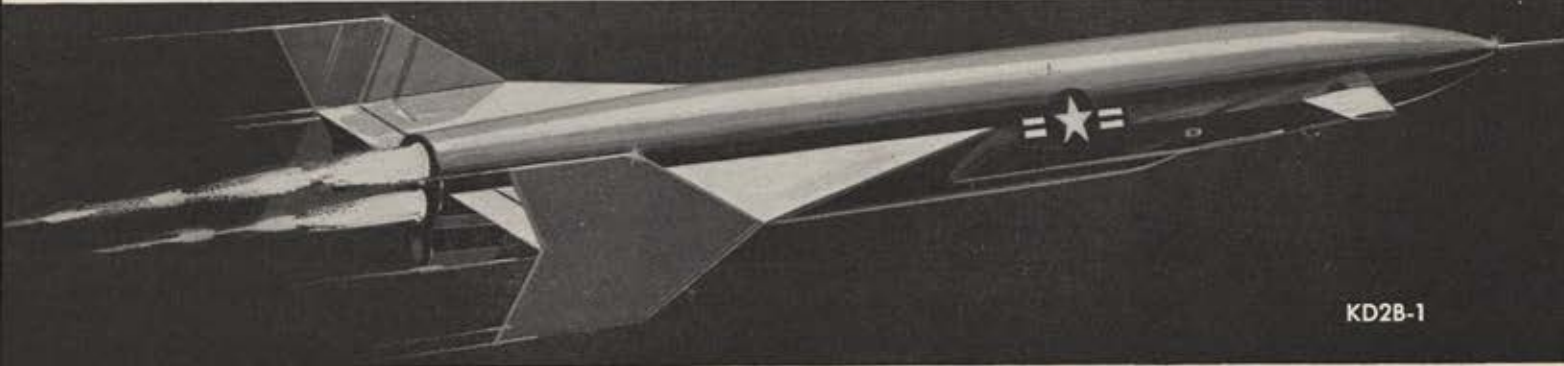
As to technical problems of observation satellites, they are numerous and range from the problems of penetrating cloud cover and camouflage to methods of data retrieval, and include vulnerability and the ever-present questions of cost effectiveness—which is to say, observation satellites are by no means a conflict-control panacea. (The interested reader will find what is virtually a "bible" on the problems and potential of observation satellites by following the work of the RAND Corporation's Amrom Katz, who has written clearly and provocatively on the subject for this and many other publications.) Yet spaceborne observation

(Continued on page 113)

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is bound to be an important technological means toward the end of conflict control, a distinctively positive means.

The argument has been made that the primary purpose of observation satellites is really target selection, making such satellites offensive and aggressive. But in the US context the purpose of such satellites has undoubtedly been to ascertain Soviet military capabilities so as to have solid data on which to base our own military planning. The arms-control enthusiast should logically accept such satellites as a vital contribution to nonformalized arms control, since the better the data the US has on the true ratio of reality to bluff in Soviet weapon claims, the less the need for the US to invest in *unnneeded* weapon systems.

Ironically, instead of recognizing this positive present and future beneficial arms-control influence of unilateral US spaceborne observation, too many arms-control thinkers tend to concentrate their energies on the "mutual interest" concept and worry about how the US and Soviet Russia can find ways to agree on what not to test and what not to build. This obsession leads to projection of US attitudes over to the Soviets, on the ground that they, too, are human and interested in survival. What is too often forgotten is that to recognize that the Soviets think differently from us is not to deny their humanness. It is rather to recognize that they will abandon their world-domination intent only when it is finally demonstrated as unworkable.

Robert S. Rochin of the General Electric Company, in his monograph, "Observation Satellites for Arms Control Inspection," GE General Engineering Laboratory Report 62GL78, sums up the case for observation satellites in the arms-control context this way:

"In a relatively short period of time, a satellite can survey the entire area of any country, or even the entire surface of the earth, in order to locate suspicious areas or activities. Such areas can then be examined more closely by higher resolution observation from a satellite or an aircraft, or by sending ground-based inspectors to inspect the area. Among the facilities which may be detected and identified from high-altitude rapid-scan observation are missile-launching pads, major airfields, factories which could be used for producing large weapons or weapon-delivery vehicles, such as missiles or airplanes, and storage facilities for such delivery vehicles. It is also possible to locate roads, shipyards, large roving ships at sea (due to their conspicuous wakes), and major logistic activities, particularly in areas where there had previously been no comparable activity.

"Satellites can also be used to photograph, with a higher resolution, specific areas which are pinpointed by the surveillance techniques described above. It is possible with these higher-resolution systems to identify weapon systems and weapon production facilities for the larger types of weapons. Airfields can be analyzed to distinguish civilian from military fields. It should be possible to inspect ground force installations to analyze troop and weapon dispositions, vehicles, storage of munitions, etc.; to study seaports and their facilities to identify naval ships; and to determine the

deployment of warships, naval airplane carriers, surfaced submarines, etc."

In short, with enough vehicles, enough film, enough time, enough patience, spaceborne observation can shatter the secrecy that envelops the most notably closed society in history, the Soviet Union. Such an attainment, unilaterally achieved by the US and announced to the world and to the citizens of the Soviet Union and Communist bloc, could have an enormous and salutary effect on the cold war, a far more important effect than will be obtained by interminable musings on how to reach agreements with the Soviets on banning weapons on the ground or in space.

Another significant potential capability of spaceborne observation is in the field of limited war, which has attained so much significance in Mr. Khrushchev's era of "wars of liberation." As the Raytheon Company's Clark C. Abt (see "Space Denial: Costs and Consequences," *SPACE DIGEST*, March '63) has suggested in his article "The Problems and Possibilities of Space Arms Control," in the *Journal of Arms Control*, January 1963:

"The effect of such a capability on limited-war operations would be a substantial aid to defending powers against Communist ambiguous threats and limited aggressions. Since the Western democracies have a sufficiently open society so that major moves of weapons and forces can be concealed only for a short period of time and with the greatest difficulty, while the relatively rigid internal security of the Soviet Union and Communist China make the concealment of such movements comparatively easier, the global surveillance systems would upset this advantage of an aggressor. Furthermore, the very availability of continuous global surveillance, presumably with the at least threatened intention of the United States to make public any indication of Communist buildup for aggression, might in itself help to deter such buildups of forces for peripheral aggression."

Mr. Abt's thesis makes good sense. The West's problem in dealing with the Communist bloc is essentially the problem of making impractical those aggressions, overt and covert, which feed Communist messianism. The West, led by the US, must take a world view based on its own image of what constitutes a peaceful planet, and it can take great steps in that direction by openly using the new tools of space technology. Global surveillance is but one of those tools. A US antibomb-in-orbit capability—announced to the world and especially to the Communists—is another and probably the best and cheapest way in the long run to convince the Soviets that whatever they put up we can knock down if it is considered dangerous. To base our hopes on tacit or even formalized agreements with them is an idle wish in an era of exponential technological development.

In the nuclear/space age, marred by a cold war we didn't start and have bent over backward for nearly two decades to try to end, there is more danger to us if we fear technology itself than if we intelligently plan to use it to our own and the world's advantage. —END

The first chief of the US Atomic Energy Commission writes pointedly that disarmament negotiations now—at the wrong time and under the wrong circumstances—actually can and do increase the very tensions they are designed to diminish. Getting rid of weapons in a dangerous world is no panacea for peace. It is a myth we ought to eschew. In a world of expanding technology, with great promise for mankind, we should instead search for peace through an attack on the causes of conflict rather than attempting to treat the symptoms. We must face up to the fact of the . . .

UNREALITY AT GENEVA

By David Lilienthal

FORMER CHAIRMAN, US ATOMIC ENERGY COMMISSION

EVERYONE recognizes what terrible disaster the use of nuclear weapons can bring to the whole world. Here there are no important differences of opinion. The area of difference of opinion lies in answers to the question: What can be done about this threat of disaster, and how?

There are at least three different points of view:

First: There are those who find that the answer lies in the question itself: First get rid of the weapons. Universal disarmament, not unilaterally, but by the process of negotiated treaty with the Soviet Union, is a life-and-death imperative. Press the negotiations at Geneva as a primary and urgent and overriding objective. We are told on high authority that disarmament is "the most seriously pressed proposal for the achievement of peace"; our President has admonished the world that, "The weapons of war must be abolished before they abolish us."

With the concept of absolutes in human affairs—"either-or"—I profoundly disagree.

Second: The second course to avoid nuclear disaster embraced by many can be summarized in this way: Give the negotiation of a disarmament agreement the top priority, even while recognizing that the prospects of complete agreement immediately are not bright. But concurrently seek other ways as well by which tensions and animosities between the great powers can be reduced and relieved.

This is far from an unreasonable view, but it is not one I can share.

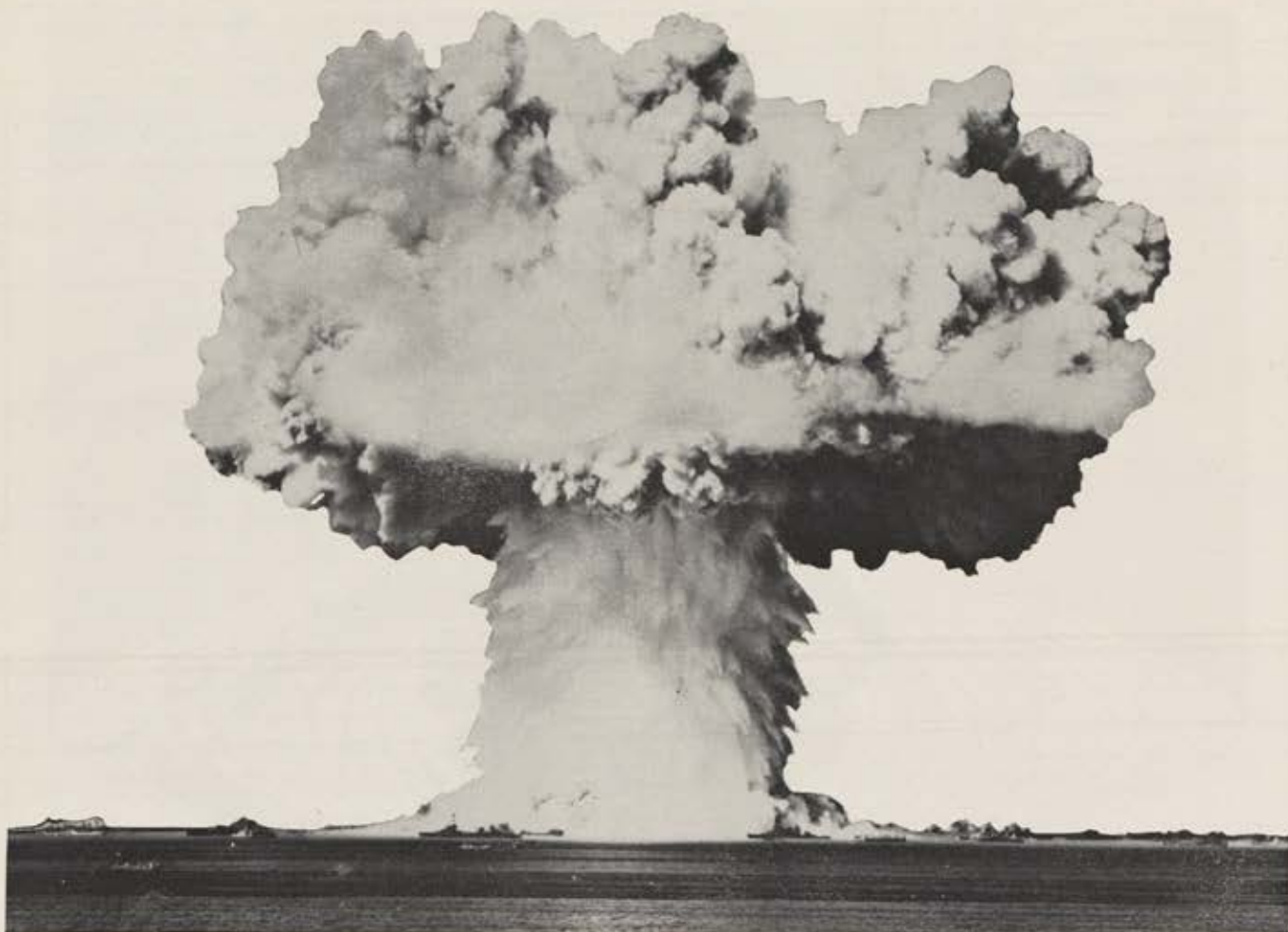
I ask you to consider still another concept, one that represents my own conviction, reached after a painful reassessment of my earlier views of the road to peace in an age of nuclear weapons.

First Attack the Causes

My view of the best course is founded on my belief that in human affairs the only thing that is inevitable is change: That there is no single great dramatic step, neither disarmament nor sole and increased reliance on weapons, that will or can solve the problem of nuclear weapons. I find the great hope for peace to lie not in a single panacea but in diversity, in [the pursuit of] the ends of peace in thousands of areas of human life.

Consider the hazards to the very peace we seek that lie in the disarmament negotiating process under present conditions.

I believe it to be fundamental that it is the causes of war that must first be ameliorated before we can safely make progress toward eliminating or even limiting substantially these terrible weapons of war. The reason nuclear weapons are a threat to the world lies not primarily in the inanimate weapons themselves, but in the animosities, the suspicions, the conflicting



drives and ambitions and ideologies of the nations who possess the weapons. While the very existence of such awesome weapons increases tensions, it is more than futile, I believe it is courting disaster, to negotiate for general disarmament in the present atmosphere of distrust and hatred.

The road to eliminating war using nuclear weapons is said to be disarmament. I say "said to be," because this is the official verbal position of the great powers, and the great tranquilizer for the anxious lay citizen, on our side and perhaps both sides of the curtain of iron. Draft treaties by the United States and the USSR calling for such general disarmament lie before the negotiators at Geneva; in this country dozens of technical studies to support our proposal are under way.

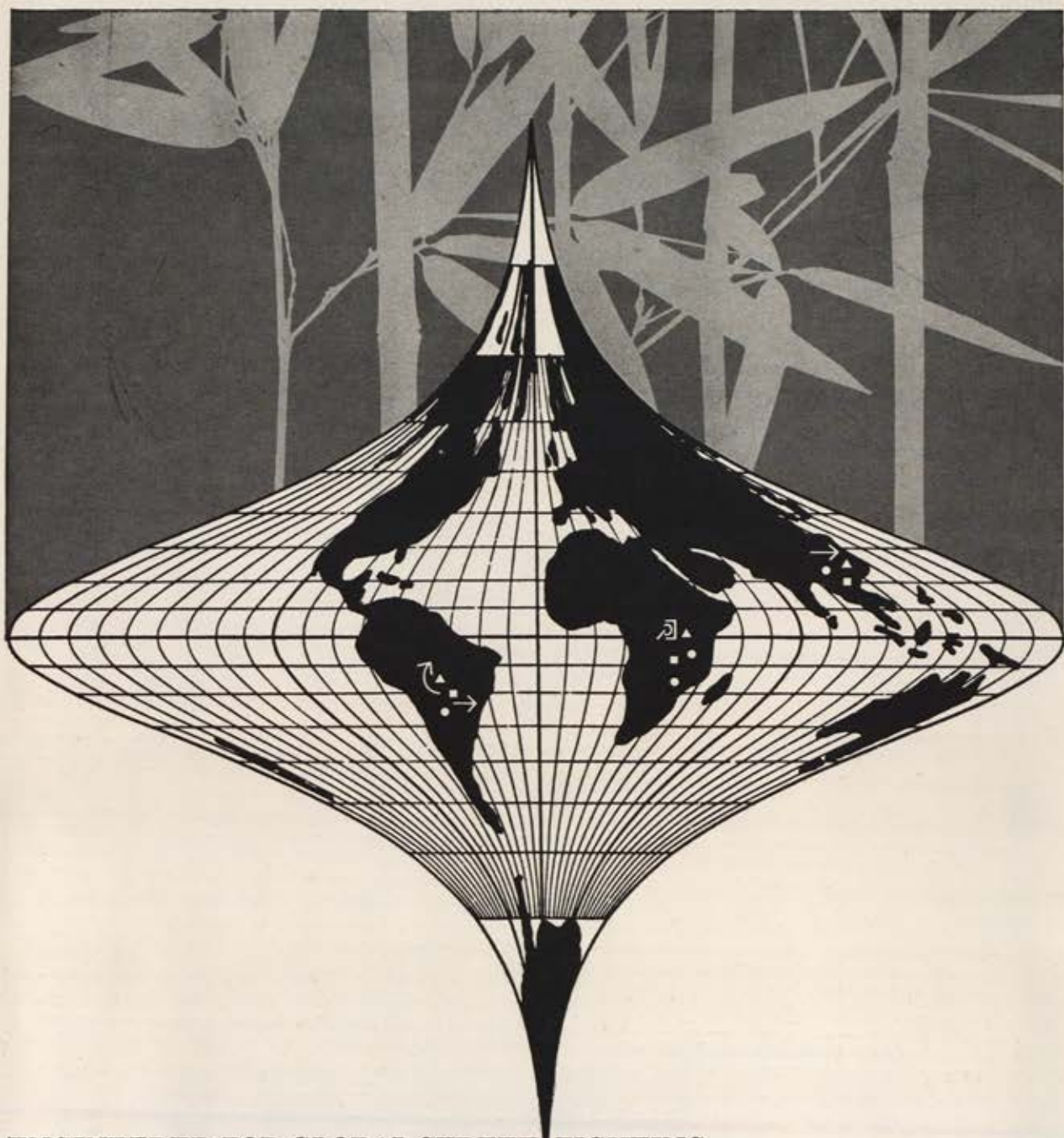
The Russians for years have lost no opportunity to propose in general terms the goal of general disarmament, as years ago they initiated the transparently unacceptable ban-the-bomb cure for world tensions. The United States, following this lead, has also put forward a proposal for step-by-step general disarmament. A special agency in our government on disarmament is in existence. For several years the Russians and ourselves (as chief parties) have been at the conference table at Geneva on what is described as a first step in disarmament, that is, an attempt to agree not to test nuclear weapons.

I suggest that the discussions themselves have increased, and are likely to continue to increase rather than diminish, ill-will and distrust. Our willingness to negotiate (and to make one concession after another, as we have) has not increased the Russians' confidence in us. It has certainly not increased our confidence in their intentions. Our representatives have been forced openly and explicitly to say that the Russians are using disarmament talks to gain time for military advantage, and we say much the same thing about their good faith and aggressive intentions.

Talk and Actions Differ

From time to time—as in the past—Chairman Khrushchev will make some dramatic disarmament move, couched in conciliatory terms. This will, if the past is any measure, encourage a belief among many people that disarmament is in truth a real hope. As a consequence, there will once more be a diminution of vigor and faith and public interest in those more prosaic measures for peace that lie outside the area of weapons. The Russians have done this more than once before, Chairman Khrushchev coming to the United States at one time for that purpose. It is bound to happen again in a somewhat different form, perhaps at Geneva and possibly soon.

(Continued on page 117)



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Test-ban negotiations have become a hardy international perennial, often raising false hopes in a conflict-weary world. This is one of the sessions of the 1958 meeting at Geneva of technical experts from East and West convened to discuss test-detection feasibility. The talks were futile.



Two years later, in 1960, more delegates from more nations, ten this time, sat down once more at Geneva to confer on disarmament. Agreement eluded this group, just as it has eluded its predecessors. This year, East and West unsuccessfully negotiated on the nuclear test ban once again.

But such proffers, while they will stir hopes in an anxious world, will prove to be another source of disillusion, another diversion and dilution of the priority that should go to other means of bringing peace, and a cause of added frustration and anger. The underlying animosities will not be diminished thereby. On the contrary, the negotiations at Geneva, although conducted by able and patient men, have not improved the prospects for avoiding nuclear disaster, but have subtracted from the prospects of peace.

Why should we continue the official rhetoric that the USSR or the United States seriously expects major disarmament in the near future? The acts of rearmament of both our governments look the other way. We were never farther from a peaceful mood than in the midst of this disarmament rhetoric, on both sides. This is not necessarily for lack of sincerity as to goals. Certainly neither the United States nor the USSR wants war or wants to go on spending vast sums on armament. But in any case the formal position of both governments places serious steps in disarmament highest on their officially stated priorities, so we must consider it a major premise.

But there are other reasons why we must consider the current negotiations for disarmament with the utmost seriousness, and question them if we feel that they should be challenged. For whether the negotiators believe there will be consequential affirmative results of their efforts or not, they are necessarily prisoners of a commitment, an emotional commitment to their premise which I regard as a mirage, a myth, the myth that hope for eliminating war lies chiefly or solely in eliminating weapons of war.

The crucial question is not whether we are "for" or "against" disarmament, "for" or "against" peace. What we must ask ourselves carefully and critically is whether negotiation about disarmament at this time is for or against the interests of peace, for or against the ultimate prospects of true disarmament.

There are four chief concerns I have about continua-

tion or resumption of general or nuclear disarmament negotiations at this time with the Soviet Union; they can be summarized in this way:

First: High priority given to negotiations for disarmament treaties at this time adds to the risks of disaster. For they provide the tinder for an increase rather than a decrease in acute animosities, distrust, tensions, and confrontations, at almost the worst possible time, with no likelihood of an offsetting gain for peace to balance against the taking of such added risks.

Second: A disarmament treaty, now, between the Soviet Union and the United States and the West would leave the warlike Chinese in a position of power dangerous to world peace; even a serious prospect that both the great powers might disarm could be disturbing to peace-loving peoples in Asia, under the shadow of China.

An Escape from Reality?

Third: If negotiations for disarmament are undertaken seriously under current conditions, they are unrealistic. Therefore, they have the infirmities and dangers of any escape from reality in a tough and changing world. And if they are not undertaken seriously, but as propaganda moves, they have the risk of any transparent maneuver: Little hope of gain for peace, and real danger of moral injury.

Fourth: Disarmament negotiations, that is, a preoccupation with weapons, distract and dilute our energies and attention from those multiple diverse ways and means of strengthening bit by bit the sense of community and commonality of interest in the world in which lies the real hope of making weapons less relevant.

A few comments on my first stated concern: That negotiations now, at the wrong time and under the wrong circumstances, can and do increase the very

(Continued on following page)

anxieties, tensions, and animosities they are designed to diminish.

No need to get into the technicalities of the months and years of the negotiations. Take one instance only. Ironically, this instance arises out of the sole issue of principle on which the United States and the USSR have reached verbal agreement.

In September 1961, Ambassadors McCloy and Zorin agreed for their governments—and I quote a portion of the central clause—that “all measures of general and complete disarmament should be balanced so that at no stage of the implementation of the treaty could any state or group of states gain military advantage” as a consequence of disarmament measures.

How can these bitter antagonists discuss a “balance” of military force as between them, so that the discussion will make any sense at all, without disclosing to the other what is the state of their arms at the time of the balancing process?

And information, in sufficiently revealing detail to mean anything, about the state of their arms inevitably discloses to knowledgeable men their war plans and military policies. War policies and plans are a nation's most sensitive area, making the controversial “on-site” inspection of underground tests seem innocuous indeed by comparison. And how can discussion of “balance” make any sense unless the disclosures and representations of the two parties of their present arms are subjected to verification by the other side? The incentive for lying, or saber-rattling to impress the other side, would be brought to a new high point if such a discussion got very far.

There are more than a few instances growing out of the negotiations of disarmament and of the test ban that have led to and will continue to lead to provocative and dangerous charges of bad faith, on both sides. These are directed not just against the negotiators, but inevitably challenge the honor and intentions of the heads of state and their chief civilian and military officers. Repeatedly calling into question the honesty and intentions of a great power, in the ugly temper of the present, inflicts wounds that fester.

When the dispute in negotiation is fishery rights, say, that is one thing. But where the questions are those of life and death that are involved in disarmament discussions, that is quite another matter, for, while these talks go on, the very subjects of discussion—their nuclear missiles, and ours—are pointed toward each other night and day. Under these conditions an accusation that impugns an antagonist's basic intentions about those very weapons increases the risk that the trigger will be pulled by design or in panic, since such an accusation may well be construed as the signal for attack, forcing what a military man might readily justify as “anticipatory retaliation.”

Turning to a discussion of my second stated concern, which is the absence of China from the conference table:

The discussions about disarmament have assumed two antagonists. A commitment, therefore, on the part of the Soviet Union for disarmament is presumed, under this doctrine, to encompass wholly one side of

the balance of power, and the same is to be said of the West. But the fluidity of the world is such that the Soviet Union may not even now be able to speak for the countries that are or may be major threats to peace. It is almost certain today that the Soviet Union would be unable to commit China to disarmament. With the West and the Soviet disarmed the Chinese could make a mockery of the very objective of disarmament: peace in the world. If the Soviet Union did in fact disarm, and China did not, would the peace-loving Indians regard this as a step toward peace? Of course not.

How About China, France?

If any further evidence of the unreality of Geneva were needed, the absence of China would supply it. Can one conceive of the USSR disarming, except as a token, without China included? Can anyone expect us to do that, either? Of course not. Would any person now want the United States and USSR to disarm, with the warlike Chinese on the move?

On the other side (but to a lesser degree) it is far from clear that the United States could now speak for France on a disarmament program, perhaps even on a test ban, certainly not until France fully establishes herself as a nuclear power.

Disarmament now, as a principal reliance for peace, has this inherent defect: That unless it is well-nigh universal it increases the power for mischief of those who are unwilling to disarm.

If the pieces on the armament chessboard are moving with such unpredictable rapidity, is this not a dangerous time to engage in serious negotiations with the Soviet Union about complete and total disarmament; is this a time when anything but continued futility, frustration, and increased hostility can come out of such negotiations?

My third concern is that negotiation is unrealistic if it is founded on the belief, on either side, that general and total disarmament, or even major reductions in arms, can come out of negotiations at this time.

Suppose it is clearly futile. What harm does it do, one is asked, to negotiate with the Soviets on their offer of peaceful coexistence and their offer to negotiate for an immediate general and total disarmament?

The chief harm is that this preoccupation with getting rid of weapons is a basically wrong premise. But there is the harm that inheres in the fact that disarmament now is not realistic.

We have been through just such periods of unreality and wishful thinking in recent years—the spirit of Geneva, the spirit of Camp David, the illusions of the summit meeting formula for peace.

I find that there are not a few thoughtful people who say, to justify futile and ill-timed negotiations: “While you are talking you're not shooting.”

I wonder. I recall that the Japanese emissaries were still talking to Secretary Hull while their bombardiers were blasting our fleet at Pearl Harbor.

Talking is not always synonymous with not shooting.

(Continued on page 121)

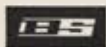


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'The Winds of Change'

My fourth category concerns change and hope. In what direction do I think hope lies? My view is that hope lies in "the winds of change," to use the phrase recently used by President Kennedy, changes outside the area of weapons.

These currents of change run for the most part in deep tidal currents far below the surface, where even the most perceptive eye cannot detect their beginnings. They are not predictable and in their embryo state not even detectable; all we know is that changes are under way. Therefore, to cite cases of the kind of change I have in mind in a way obscures the essential point of their unpredictability and wide diversity. Nevertheless, a few references to changes that serve the cause of peace may help us to be sensitive to, to recognize, and to encourage the beginnings of changes that, in my view, bear mightily on the central problem of maintaining peace in the world and ultimately bringing to an end the nightmare of overhanging nuclear war.

Seven areas come to mind:

1. **International trade and commerce.** From the earliest days of Marco Polo and the caravans that crossed the Asian wastes until today, trade has been one of the many forces drawing men together. It has also induced conflict, but, on balance, trade and commerce have had a profound effect on the reality of mutual human dependence, our need for each other.

2. **Transportation and communication.** Changes in these areas, in hundreds of ways, have come faster in our time than perhaps at any other period of history. The effects of internationalization of the fast ship, the airplane, the telephone, of radio and television are well known to us all.

3. **Economic development of the poorer countries.** The full effect of the international helping hand cannot be judged now, but its influence on internationalization, on the cross-fertilization of ideas and cultures, is one of the changes from which real hope can be derived.

4. **Food.** In our time there has been launched a great international movement in the United Nations and elsewhere dealing with man's most ancient problem: feeding himself from the fruits of the earth. The techniques of one people become available to other people, at a rapid rate. The lessons of irrigation practices, or seeds, or fertilizers, learned in countries A and B are carried to countries C and D—and so on. And this is one of the greatest forces, though often little noticed, toward mutual respect and awareness of interdependence.

5. **Health.** The work of the World Health Organization and of many other health agencies that move across national borders directly to peoples of another country—here is a change that has at least as great potentialities in building the foundations and perspectives of peace as any of the measures for, let us say, adjudicating international disputes. And it has the virtue of dealing with the everyday life of people, and so is readily understood.

6. **Science and technology.**

7. **Education.**

These seven fronts in the war for peace are but a few of many. But they suffice to make this point clear: Operating on the international scene, these are among the multiple forces of change that from time immemorial have wrought individuals into communities, have transformed communities into a nation such as ours. It is my faith that the same forces for living together that trade, transport, communication, food, health, science, and education have exerted over the centuries are playing a similar role in the building of the world community.

The World Wars in this century have grown out of the bitter antagonism between Germany and France. Today, as part of the economic rather than diplomatic effort only a decade old, Western Europe is closer to economic unity than at any other time in the history of this center of modern civilization. The most relevant aspect of this major event in world history is that the bitter enemies, France and Germany, have effectively disarmed themselves.

'Man Will Not Perish'

France is not literally disarmed vis-à-vis Germany in the sense that it does not have weapons: West Germany is not disarmed in the sense that it has signed a treaty of disarmament with France. These countries are disarmed in an even deeper sense. They are disarmed because they have found that they have interests in common in leading the development of the community of Europe that make any question of a disarmament treaty between traditional enemies almost irrelevant.

If I am right that this is a form of true disarmament, then this point is worth reiterating: that disarmament between violently antagonistic countries, Germany and France, came about not through a preoccupation with armament but in a different area, the area of trade and commerce, of economic cooperation.

Let me conclude these discussions on nuclear hazards on a personal note of my own faith about the future. I believe in man and believe he will not perish. Nor will the works of his spirit and imagination vanish from the earth. I believe civilization will ride through this storm.

I do not believe that God created man and endowed him with the capacity to unlock the energy within the very heart of matter in order that man should use that knowledge to destroy this beautiful world, which is the handiwork not of man, but of God.—END

David Lilienthal is a veteran public servant who was the first chairman of the Atomic Energy Commission and served in that post, under appointment by President Truman, from 1946 to 1950. Prior to his AEC service, he was director of the Tennessee Valley Authority public power agency, about which he wrote a book, TVA, Democracy on the March. He is now Board Chairman of Development Resources Corporation. The above article is based on presentations delivered at Princeton University by Mr. Lilienthal as Henry Stafford Little lecturer for 1963.

SATELLITE SCOREBOARD

As of AIR FORCE/SPACE DIGEST's mid-March cutoff date for entries in this year's "Satellite Scoreboard," there were more space shots on the record than anyone could possibly have forecast just a few years ago, and we have attempted to set down all significant material on every shot that has been publicly announced. Unfortunately, our list this year is in some ways less complete than last year's because security regulations have shut off almost all data on military space shots beyond simple announcements that launches have been made. Barring changes in classification policies, this shortcoming will continue to obtain—creating an irony whereby as more hardware enters space, the less complete becomes the compendium. Information on Soviet shots, of course, is always minimal. Against this background, we have set down below and on the pages that follow the highlights of all data presently available on US and Soviet space achievements. We are including, this year for the first time, entries on a number of suborbital and space-probe shots. Much of this information is based on NASA Historical Report No. 8, issued by the Office of Educational Programs and Services, Hq. NASA, Washington, D. C., published in January 1963, and for which quarterly supplements will be available. Another valuable source is the *STL Space Log*, published quarterly by the Office of Scientific and Engineering Relations, Space Technology Laboratories, Inc., Redondo Beach, Calif. In the AIR FORCE/SPACE DIGEST listing which follows, these abbreviations have been used for launch locations: AMR for Atlantic Missile Range (Cape Canaveral); VAFB for Vandenberg Air Force Base, Calif.; PA for Point Arguello, Calif. (Pacific Missile Range); WS for the NASA facility at Wallops Station, Wallops Island, Va.; and USSR for any launches made from the Soviet Union.

—THE EDITORS

DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Oct. 4, 1957	Sputnik 1	USSR	USSR	First earth satellite; payload wt. 184 lb.; reentered Dec. 1, 1957.
Nov. 3, 1957	Sputnik 2	USSR	USSR	Payload wt. of 1,120 lb. incl. dog Laika; reentered Apr. 14, 1958.
Dec. 6, 1957	Vanguard	Navy	AMR	Failed to orbit.
Jan. 31, 1958	Explorer 1	Army	AMR	First US satellite; launched by Jupiter-C; discovered Van Allen radiation belt; still in orbit.
Feb. 5, 1958	Vanguard	Navy	AMR	Failed to orbit.
Mar. 5, 1958	Explorer 2	Army	AMR	Failed to orbit.
Mar. 17, 1958	Vanguard 1	Navy	AMR	Launched by Vanguard rocket; one transmitter still operating; estimated lifetime up to 1,000 years.
Mar. 26, 1958	Explorer 3	Army	AMR	Launched by Jupiter-C; reentered June 28, 1958.
Apr. 28, 1958	Vanguard	Navy	AMR	Failed to orbit.
May 15, 1958	Sputnik 3	USSR	USSR	Wt., incl. 2,925-lb. payload, estimated at 3½ tons; reentered Apr. 6, 1960.
May 27, 1958	Vanguard	Navy	AMR	Failed to orbit.
June 26, 1958	Vanguard	Navy	AMR	Failed to orbit.
July 26, 1958	Explorer 4	ARPA-Army	AMR	Launched by Jupiter-C; provided radiation and magnetic data; reentered Oct. 23, 1959.
Aug. 17, 1958	Pioneer	ARPA-USAF	AMR	Lunar probe; first-stage engine failure caused explosion after 77 seconds of flight.
Aug. 24, 1958	Explorer 5	ARPA-Army	AMR	Failed to orbit.
Sept. 26, 1958	Vanguard	Navy	AMR	Failed to orbit.
Oct. 11, 1958	Pioneer 1	NASA-USAF	AMR	Lunar probe; launched by Thor-Able; reached altitude of 70,700 mi.; reentered Oct. 12, 1958.
Oct. 23, 1958	Beacon 1	NASA	AMR	Inflatable sphere; failed to orbit.
Nov. 8, 1958	Pioneer 2	NASA-USAF	AMR	Lunar probe; launched by Thor-Able; reached altitude of 963 mi.; third stage failed.
Dec. 6, 1958	Pioneer 3	NASA-Army	AMR	Deep space probe; launched by Juno II; failed to reach escape velocity; reached altitude of 63,580 mi.; discovered second radiation belt; reentered Dec. 7, 1958.

DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Dec. 18, 1958	Score	ARPA-USAF	AMR	Atlas ICBM placed in orbit; relayed President Eisenhower's voice from space; reentered Jan. 21, 1959.
Jan. 2, 1959	Lunik 1	USSR	USSR	Lunar probe; in 450-day solar orbit; long lifetime expected.
Feb. 17, 1959	Vanguard 2	NASA	AMR	Launched by Vanguard rocket; excessive wobble prevented use of cloud-cover data; 10-100 year lifetime expected.
Feb. 28, 1959	Discoverer 1	ARPA-USAF	VAFB	Launched by Thor-Agena A; reentered Mar. 5, 1959.
Mar. 3, 1959	Pioneer 4	NASA-Army	AMR	Lunar probe; launched by Juno II; in 398-day solar orbit; long lifetime expected.
Apr. 13, 1959	Discoverer 2	ARPA-USAF	VAFB	Launched by Thor-Agena A; capsule ejected but not recovered; reentered Apr. 26, 1959.
Apr. 13, 1959	Vanguard	NASA	AMR	Failed to orbit.
May 28, 1959	Jupiter	NASA-Army	AMR	Monkeys Able and Baker recovered from nose cone after 1,700-mi. suborbital flight.
June 3, 1959	Discoverer 3	ARPA-USAF	VAFB	Failed to orbit.
June 22, 1959	Vanguard	NASA	AMR	Failed to orbit.
June 25, 1959	Discoverer 4	ARPA-USAF	VAFB	Failed to orbit.
July 16, 1959	Explorer	NASA	AMR	Failed to orbit.
Aug. 7, 1959	Explorer 6	NASA	AMR	Launched by Thor-Able; mapped Van Allen belt; relayed TV pictures of cloud cover; reentered before July 1961.
Aug. 13, 1959	Discoverer 5	ARPA-USAF	VAFB	Launched by Thor-Agena A; reentered Sept. 28, 1959; capsule ejected into separate orbit; reentered Feb. 11, 1961.
Aug. 14, 1959	Beacon 2	NASA	AMR	Failed to orbit.
Aug. 19, 1959	Discoverer 6	ARPA-USAF	VAFB	Launched by Thor-Agena A; capsule ejected but not recovered; reentered Oct. 20, 1959.
Aug. 21, 1959	Little Joe	NASA	WS	During preparation, malfunction caused Mercury escape rocket to fire; capsule lost in the ocean.
Sept. 9, 1959	Big Joe	NASA	AMR	Preliminary model of Mercury capsule sent 1,300 mi. downrange; recovered safely from the sea; Atlas booster.
Sept. 12, 1959	Lunik 2	USSR	USSR	Lunar probe; payload estimated at 858.4 lb.; hit moon Sept. 13, 1959, after 35-hr. flight.
Sept. 16, 1959	Jupiter	NASA	AMR	IRBM containing biological experiment destroyed by Range Safety shortly after launch.
Sept. 17, 1959	Transit 1A	Navy	AMR	Navigation satellite; failed to orbit.
Sept. 18, 1959	Vanguard 3	NASA	AMR	Launched by Vanguard rocket; surveyed magnetic field, radiation belt; 30-40 year lifetime expected.
Sept. 24, 1959	Pioneer	NASA-USAF	AMR	Atlas-Able vehicle, scheduled to launch lunar-orbit payload, exploded on launch pad while being static-tested.
Oct. 4, 1959	Lunik 3	USSR	USSR	Lunar probe; 614-lb. payload; photographed 70 percent of moon's far side; transmitted pictures to earth; satellite went into earth orbit; reentered Apr. 20, 1960.
Oct. 4, 1959	Little Joe 1	NASA	WS	First of series of 7 firings to test Mercury capsules in suborbital flights.
Oct. 13, 1959	Explorer 7	NASA	AMR	Launched by Juno II; provided data on radiation and magnetic storms; 20-30 year lifetime expected.
Oct. 28, 1959	Shotput 1	NASA	WS	Launched by augmented Sergeant; suborbital communications test; canister ejection successful; 100-ft. sphere inflation unsuccessful.
Nov. 4, 1959	Little Joe 2	NASA	WS	Suborbital test of Mercury capsule escape system.
Nov. 7, 1959	Discoverer 7	ARPA-USAF	VAFB	Launched by Thor-Agena A; malfunction prevented capsule ejection; reentered Nov. 26, 1959.
Nov. 20, 1959	Discoverer 8	USAF	VAFB	Launched by Thor-Agena A; capsule ejected but could not be located; reentered Mar. 8, 1960.
Nov. 26, 1959	Pioneer	NASA-USAF	AMR	Lunar probe; payload shroud fairing broke away after 45 sec.
Dec. 4, 1959	Little Joe 3	NASA	WS	Monkey Sam used in suborbital test of Mercury capsule escape system.
Jan. 16, 1960	Shotput 2	NASA	WS	Launched by augmented Sergeant; suborbital communications test; canister ejection successful; sphere inflation unsuccessful.
Jan. 21, 1960	Little Joe 4	NASA	WS	Monkey Miss Sam used in suborbital test of Mercury capsule escape system.
Feb. 4, 1960	Discoverer 9	USAF	VAFB	Failed to orbit.
Feb. 19, 1960	Discoverer 10	USAF	VAFB	Failed to orbit.
Feb. 26, 1960	Midas 1	USAF	AMR	Infrared missile alarm system; failed to orbit.
Feb. 27, 1960	Shotput 3	NASA	WS	Launched by augmented Sergeant; suborbital communications test; canister ejection successful; sphere inflation unsuccessful.
Mar. 11, 1960	Pioneer 5	NASA-USAF	AMR	Deep space probe; launched by Thor-Able; communicated data from 17.7 million mi., position signal from 22.5 million mi.; in 312-day solar orbit; long lifetime expected.
Mar. 23, 1960	Explorer	NASA	AMR	Failed to orbit.
Apr. 1, 1960	Shotput 4	NASA	WS	Launched by augmented Sergeant; voice message relayed in suborbital communications test.
Apr. 1, 1960	Tiros 1	NASA	AMR	Meteorological satellite; launched by Thor-Able; TV system relayed 22,000 pictures of cloud cover during 78-day useful lifetime; 50-100 year lifetime expected.
Apr. 13, 1960	Transit 1B	Navy	AMR	Navigation satellite; launched by Thor-Able Star; still in orbit.
Apr. 15, 1960	Discoverer 11	USAF	VAFB	Launched by Thor-Agena A; capsule ejected but not recovered; reentered Apr. 26, 1960.

(Continued on page 125)



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SATELLITE SCOREBOARD

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DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Apr. 18, 1960	Scout	NASA	WS	Launch vehicle development test; second and fourth stages were dummies; third stage did not ignite.
May 9, 1960	Mercury	NASA	WS	First production model of Mercury capsule tested in "pad abort."
May 13, 1960	Echo	NASA	AMR	Inflatable 100-ft. sphere; failed to orbit.
May 15, 1960	Sputnik 4	USSR	USSR	Placed dummy spaceman in orbit in test of life-support system; recovery failed when 10,000-lb. vehicle went into lopsided orbit; reentered Sept. 5, 1962.
May 24, 1960	Midas 2	USAF	AMR	Launched by Atlas-Agena A; still in orbit.
May 31, 1960	Shotput 5	NASA	WS	Launched by augmented Sergeant; inflation successful despite excess spin in sub-orbital communications test.
June 22, 1960	Transit 2A Greb 1	Navy	AMR	Launched by Thor-Able Star; first launching of twin satellites; Greb is Naval Research Lab solar-radiation satellite; both still in orbit with 50 year lifetime expected.
June 29, 1960	Discoverer 12	USAF	VAFB	Failed to orbit.
July 1, 1960	Scout	NASA	WS	Ground tracking failure led to erroneous destruction by Range Safety in launch vehicle development test.
July 29, 1960	Mercury	NASA	AMR	First test firing of Atlas-Mercury combination; booster exploded after 64 seconds of flight.
Aug. 10, 1960	Discoverer 13	USAF	VAFB	Launched by Thor-Agena A; capsule successfully recovered from ocean, Aug. 11, 1960; satellite reentered Nov. 14, 1960.
Aug. 12, 1960	Echo 1	NASA	AMR	Launched by Thor-Delta; first passive communications satellite; 100-ft. inflated sphere used for voice transmission from Goldstone, Calif., to Holmdel, N. J.; still in orbit.
Aug. 18, 1960	Discoverer 14	USAF	VAFB	Launched by Thor-Agena A; capsule recovered in air, Aug. 19, 1960; satellite reentered Sept. 16, 1960.
Aug. 18, 1960	Courier 1A	ARPA-Army	AMR	Military communications satellite; failed to orbit.
Aug. 19, 1960	Sputnik 5	USSR	USSR	Test of capsule and recovery system for manned spaceflight; payload wt. of 10,120 lb. included dogs, rats, mice, flies, plants; capsule recovered on land Aug. 20, 1960, on 18th orbit; carrier rocket reentered Sept. 23, 1960.
Sept. 13, 1960	Discoverer 15	USAF	VAFB	Launched by Thor-Agena A; capsule ejected but not recovered; satellite reentered Oct. 18, 1960.
Sept. 25, 1960	Pioneer	NASA-USAF	AMR	Lunar probe; launched by Atlas-Able; second-stage failure prevented escape velocity; destroyed on reentry.
Oct. 4, 1960	Courier 1B	Army	AMR	Military communications satellite; launched by Thor-Able Star; still in orbit.
Oct. 4, 1960	Scout	NASA	WS	Successful development test of Scout launch vehicle; AF Special Weapons Center payload included.
Oct. 10, 1960	Mars probe	USSR	USSR	Failed.
Oct. 11, 1960	Samos 1	USAF	PA	Surveillance satellite; failed to orbit.
Oct. 14, 1960	Mars probe	USSR	USSR	Failed.
Oct. 26, 1960	Discoverer 16	USAF	VAFB	Failed to orbit.
Nov. 3, 1960	Explorer 8	NASA	AMR	Launched by Juno II; provided ion, electron, micrometeoroid measurements; 10 year lifetime expected.
Nov. 8, 1960	Little Joe 5	NASA	WS	Escape rocket fired prematurely in test of Mercury escape-system qualification.
Nov. 12, 1960	Discoverer 17	USAF	VAFB	Launched by Thor-Agena B; capsule recovered in air, Nov. 14, 1960; satellite reentered Dec. 29, 1960.
Nov. 21, 1960	Mercury	NASA	AMR	First firing of Mercury-Redstone combination; booster engine cut off one inch off pad; capsule escape rocket fired normally; both capsule and booster reused Dec. 19, 1960.
Nov. 23, 1960	Tiros 2	NASA	AMR	Meteorological satellite; launched by Thor-Delta; combined infrared measurements with photography; 50-100 year lifetime expected.
Nov. 30, 1960	Transit 3A Greb 2	Navy	AMR	Destroyed by Range Safety.
Dec. 1, 1960	Sputnik 6	USSR	USSR	Test of equipment for manned spaceflight; payload included 2 dogs and other animal and plant life; capsule destroyed on reentry, Dec. 2, 1960.
Dec. 4, 1960	Explorer	NASA	WS	Combined test of Scout vehicle and Beacon inflatable sphere; failed to orbit.
Dec. 7, 1960	Discoverer 18	USAF	VAFB	Launched by Thor-Agena B; capsule recovered in air Dec. 10, 1960, after 48 orbits; satellite reentered Apr. 2, 1961.
Dec. 15, 1960	Pioneer	NASA-USAF	AMR	Lunar probe; Atlas-Able vehicle exploded at 40,000 ft. after 70 seconds of flight.
Dec. 19, 1960	Mercury	NASA	AMR	Mercury capsule launched in suborbital flight by Redstone in repeat of Nov. 21, 1960 attempt; capsule recovered 235 mi. downrange.
Dec. 20, 1960	Discoverer 19	USAF	VAFB	Launched by Thor-Agena B; no recovery attempt; satellite collected infrared data in support of Midas; reentered Jan. 23, 1961.
Jan. 31, 1961	Samos 2	USAF	PA	Surveillance satellite; launched by Atlas-Agena A; still in orbit.
Jan. 31, 1961	Mercury	NASA	AMR	Mercury-Redstone suborbital test; chimpanzee Ham recovered from sea after 16-minute flight 414 mi. downrange, 120 mi. farther than programmed.
Feb. 4, 1961	Sputnik 7	USSR	USSR	No recovery attempted for 7.1-ton vehicle; reentered Feb. 26, 1961.
Feb. 12, 1961	Sputnik 8 Venus probe	USSR	USSR	First satellite to launch another vehicle from orbit; "Automatic Interplanetary Station" launched from Sputnik Feb. 12, 1961, toward vicinity of Venus; probe still in 300-day solar orbit; Sputnik reentered Feb. 25, 1961.

(Continued on following page)

SATELLITE SCOREBOARD

CONTINUED

DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Feb. 16, 1961	Explorer 9	NASA	WS	Launched by Scout; first satellite launched by solid rocket and first successful orbit from Wallops Station; optical tracking of 12-ft. inflatable sphere provided atmospheric-density data.
Feb. 17, 1961	Discoverer 20	USAF	VAFB	Launched by Thor-Agena B; malfunction prevented release of capsule; reentered July 28, 1962.
Feb. 18, 1961	Discoverer 21	USAF	VAFB	Launched by Thor-Agena B; no recovery attempt; Agena engine successfully restarted in space; reentered Apr. 20, 1962.
Feb. 21, 1961	Mercury	NASA	AMR	Atlas-boosted Mercury capsule fired 1,425 mi., brought back at steep angle to test maximum heating in suborbital test.
Feb. 21, 1961	{ Transit 3B Lofti 1	Navy	AMR	Launched by Thor-Able Star; achieved highly elliptical orbit; Lofti (Low Frequency Trans-Ionospheric) vehicle failed to separate as planned; both reentered Mar. 30, 1961.
Feb. 24, 1961	Explorer	NASA	AMR	Second-stage malfunction of Juno II; failed to orbit.
Mar. 9, 1961	Sputnik 9	USSR	USSR	Five-ton spacecraft; recovered on land Mar. 9, 1961; contained dog Blackie.
Mar. 18, 1961	Little Joe 5A	NASA	WS	Premature escape-rocket firing in suborbital Mercury capsule test.
Mar. 24, 1961	Mercury	NASA	AMR	Mercury-Redstone booster development test.
Mar. 25, 1961	Sputnik 10	USSR	USSR	Five-ton spacecraft; recovered on land Mar. 25, 1961; contained dog Little Star.
Mar. 25, 1961	Explorer 10	NASA	AMR	Launched by Thor-Delta; magnetometer probe; highly eccentric orbit with 145,000-mi. apogee; still in orbit but position uncertain.
Mar. 30, 1961	Discoverer 22	USAF	VAFB	Failed to orbit.
Apr. 8, 1961	Discoverer 23	USAF	VAFB	Launched by Thor-Agena B; capsule ejected into separate orbit; capsule reentered May 23, 1962; satellite reentered Apr. 16, 1962.
Apr. 12, 1961	Vostok 1	USSR	USSR	First successful manned orbital flight; Maj. Yuri A. Gagarin recovered on land Apr. 12, 1961, after single orbit, 108-minute flight.
Apr. 25, 1961	Mercury	NASA	AMR	First-stage failure of Atlas booster in unmanned orbital attempt caused destruct by Range Safety after 40 seconds, at 16,400 ft.; capsule ejected and recovered from ocean.
Apr. 27, 1961	Explorer 11	NASA	AMR	Launched by Juno II; gamma ray experiment; still in orbit.
Apr. 28, 1961	Little Joe 5B	NASA	WS	One booster engine fired late in repeat of Mercury escape-system test.
May 5, 1961	Mercury	NASA	AMR	Launched by Mercury-Redstone; first successful US manned suborbital flight; USN Cmdr. Alan B. Shepard, Jr., recovered from capsule Freedom 7 302 mi. downrange after 15-minute flight.
May 24, 1961	Explorer	NASA	AMR	Juno II second-stage failure; failed to orbit.
June 8, 1961	Discoverer 24	USAF	VAFB	Failed to orbit.
June 16, 1961	Discoverer 25	USAF	VAFB	Launched by Thor-Agena B; capsule recovered from ocean, June 18, 1961; satellite reentered July 12, 1961.
June 29, 1961	{ Transit 4A Greb 3 Injun 1	Navy	AMR	Launched by Thor-Able Star; Transit navigation satellite still in orbit, still transmitting; Greb solar-radiation satellite and Injun cosmic-ray satellite failed to separate; both still in orbit.
June 30, 1961	Explorer	NASA	WS	Third-stage failure of Scout vehicle; failed to orbit.
July 7, 1961	Discoverer 26	USAF	VAFB	Launched by Thor-Agena B; capsule recovered in air, July 9, 1961; satellite reentered Dec. 5, 1961.
July 12, 1961	Tiros 3	NASA	AMR	Meteorological satellite, launched by Thor-Delta; transmitted useful photos of earth's cloud cover; still in orbit.
July 12, 1961	Midas 3	USAF	PA	Launched by Atlas-Agena B; missile-alarm system; still in orbit.
July 21, 1961	Mercury	NASA	AMR	Launched by Mercury-Redstone; successful manned suborbital flight; USAF Capt. Virgil I. Grissom recovered from capsule Liberty Bell 7 303 mi. downrange after 16-minute flight; capsule lost at sea.
July 21, 1961	Discoverer 27	USAF	VAFB	Failed to orbit.
Aug. 3, 1961	Discoverer 28	USAF	VAFB	Failed to orbit.
Aug. 6, 1961	Vostok 2	USSR	USSR	First successful manned multiorbital flight; Maj. Gherman S. Titov recovered on land Aug. 7, 1961, after 17-orbit flight lasting 25 hours, 18 minutes.
Aug. 16, 1961	Explorer 12	NASA	AMR	Launched by Thor-Delta; provided data on solar winds, magnetic fields, high-energy particles; still in orbit but position uncertain.
Aug. 23, 1961	Ranger 1	NASA	AMR	Lunar probe; launched by Atlas-Agena B; remained in parking orbit when Agena failed to restart; reentered Aug. 30, 1961.
Aug. 25, 1961	Explorer 13	NASA	WS	Launched by Scout; designed to investigate micrometeoroids; reentered Aug. 28, 1961.
Aug. 30, 1961	Discoverer 29	USAF	VAFB	Launched by Thor-Agena B; capsule recovered from ocean, Sept. 4, 1961; satellite reentered Sept. 10, 1961.
Sept. 9, 1961	Samos 3	USAF	PA	Failed to orbit.
Sept. 12, 1961	Discoverer 30	USAF	VAFB	Launched by Thor-Agena B; capsule recovered in air, Sept. 14, 1961; satellite reentered Dec. 11, 1961.
Sept. 13, 1961	Mercury	NASA	AMR	Launched by Mercury-Atlas; achieved one orbit, reentry, and recovery from ocean of capsule containing crewman simulator.
Sept. 17, 1961	Discoverer 31	USAF	VAFB	Launched by Thor-Agena B; malfunction prevented capsule ejection; reentered Oct. 26, 1961.
Oct. 13, 1961	Discoverer 32	USAF	VAFB	Launched by Thor-Agena B; capsule containing radiation experiments recovered in air, Oct. 14, 1961; satellite reentered Nov. 13, 1961.

(Continued on page 129)

nk Times.

THE WEATHER

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Build in growth potential.

Make it operational with the Air Force in 1963.

SOLUTION: TITAN II

At Martin, systems management means the best possible product
in the shortest possible time at the lowest possible cost.

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SATELLITE SCOREBOARD

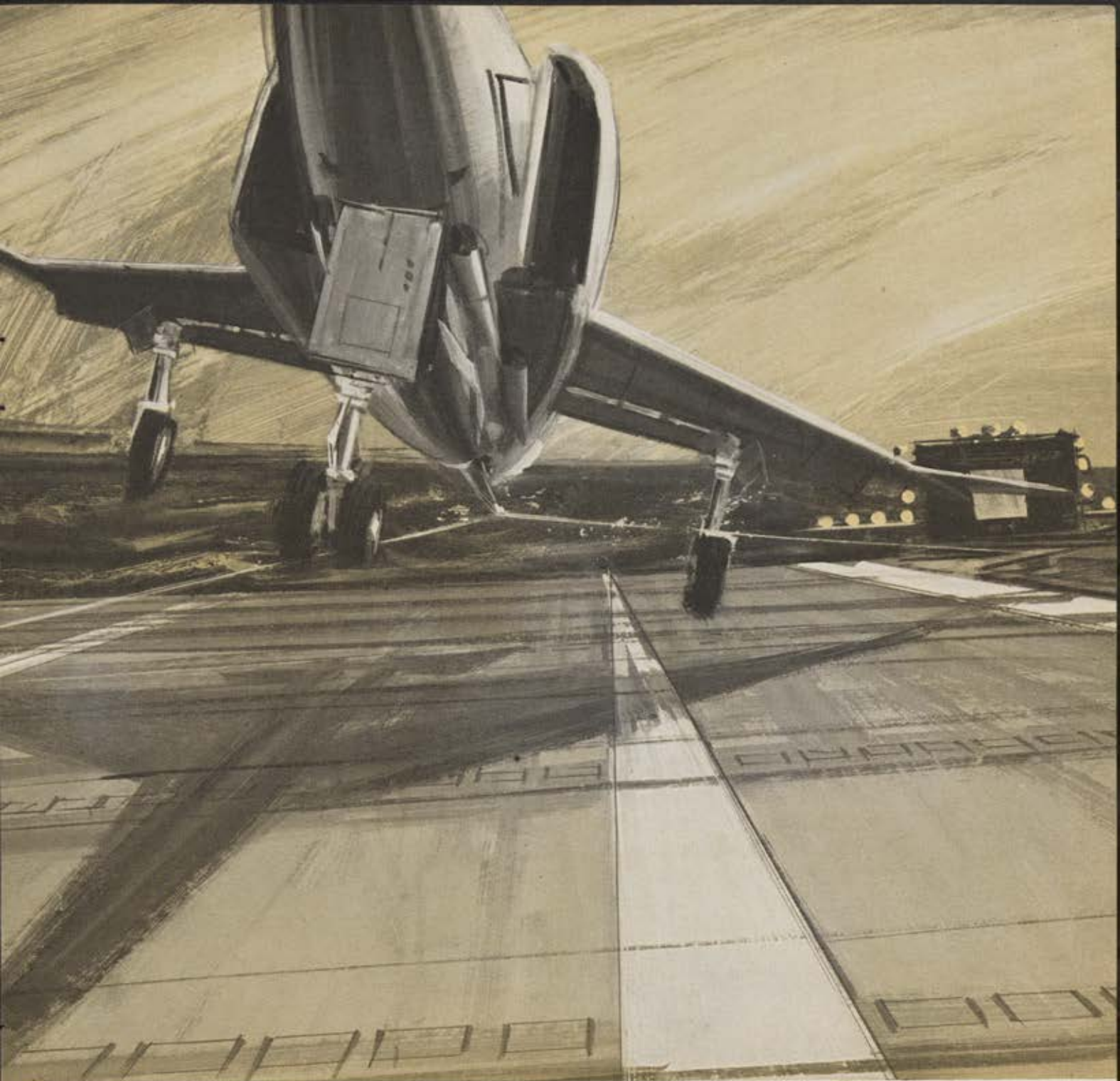
CONTINUED

DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Oct. 19, 1961	Scout probe	NASA	WS	Scientific geoprobe; launched by Scout; reached 4,261 mi.; electron density measurement.
Oct. 21, 1961	Midas 4	USAF	PA	Launched by Atlas-Agena B; carried and ejected package of Project Westford copper-wire dipoles which failed to scatter; Midas still in orbit.
Oct. 23, 1961	Discoverer 33	USAF	VAFB	Failed to orbit.
Oct. 27, 1961	Saturn	NASA	AMR	Successful launch of first stage only in development test.
Nov. 1, 1961	Mercury	NASA	AMR	Launched by Scout; attempt to orbit satellite to test Mercury tracking network; destroyed by Range Safety after 30 seconds of flight.
Nov. 5, 1961	Discoverer 34	USAF	VAFB	Launched by Thor-Agena B; malfunction prevented capsule ejection; satellite reentered Dec. 7, 1962.
Nov. 15, 1961	Discoverer 35	USAF	VAFB	Launched by Thor-Agena B; capsule recovered in air, Nov. 16, 1961; satellite reentered Dec. 3, 1961.
Nov. 15, 1961	Transit 4B Traac 1	Navy	AMR	Launched by Thor-Able Star; Transit navigation satellite still in orbit; Traac (for Transit Research and Attitude Control) still in orbit.
Nov. 18, 1961	Ranger 2	NASA	AMR	Lunar probe; launched by Atlas-Agena B; remained in parking orbit when Agena failed to restart; reentered Nov. 18, 1961.
Nov. 22, 1961	Atlas-Agena B	USAF	PA	"Successfully launched"; no other data released.
Nov. 29, 1961	Mercury	NASA	AMR	Launched by Mercury-Atlas; achieved two orbits, reentry, and recovery from ocean of capsule containing chimpanzee Enos.
Dec. 12, 1961	Discoverer 36 Oscar 1	USAF	VAFB	Launched by Thor-Agena B; capsule containing nuclear-explosion detection device and biopack to study radiation recovered from ocean, Dec. 16, 1961; satellite reentered Mar. 8, 1962; Oscar small radio satellite to broadcast to ham operators reentered Jan. 31, 1962.
Dec. 22, 1961	Atlas-Agena B	USAF	PA	"Successfully launched"; no other data released; believed to have reentered Aug. 14, 1962.
Jan. 13, 1962	Discoverer 37	USAF	VAFB	Failed to orbit.
Jan. 15, 1962	Echo	NASA	AMR	Suborbital communications test; launched by Thor; canister opened but 135-ft. sphere ruptured.
Jan. 24, 1962	Composite 1 Greb 4 Lofti 2 Injun 2 Surcal 1 Secor	Navy	AMR	Five-satellite package; launched by Thor-Able Star; second-stage malfunction at 50-mi. altitude; failed to orbit.
Jan. 26, 1962	Ranger 3	NASA	AMR	Lunar probe; launched by Atlas-Agena B into parking orbit; restarted Agena boosted Ranger vehicle but too great velocity caused spacecraft to miss moon by 22,862 mi. despite midcourse correction; now in 406.4-day solar orbit.
Feb. 8, 1962	Tiros 4	NASA	AMR	Launched by Thor-Delta; meteorological satellite; transmitted excellent cloud-formation pictures; still in orbit; still transmitting.
Feb. 20, 1962	Mercury	NASA	AMR	First US manned orbital flight; launched by Mercury-Atlas; USMC Lt. Col. John H. Glenn, Jr., recovered from capsule Friendship 7 after 3 orbits in 4-hour 56-minute flight.
Feb. 21, 1962	Thor-Agena B	USAF	VAFB	"Successfully launched"; no other data released; believed to have reentered Mar. 4, 1962.
Feb. 27, 1962	Discoverer 38	USAF	VAFB	Launched by Thor-Agena B; capsule recovered in air, Mar. 3, 1962; satellite reentered Mar. 21, 1962.
Mar. 1, 1962	Scout	NASA	WS	Reentry test; launched by Scout; reentry speed lower than planned 28,000 ft/sec.
Mar. 7, 1962	OSO 1	NASA	AMR	Orbiting Solar Observatory launched by Thor-Delta; 458-lb. laboratory transmitted data on solar flares; still in orbit; still transmitting.
Mar. 7, 1962	Atlas-Agena B	USAF	PA	"Successfully launched"; no other data released; believed still in orbit.
Mar. 16, 1962	Cosmos 1	USSR	USSR	Designed to study radiation belt, cosmic rays, solar emissions, and distribution and formation of cloud systems; reentered May 25, 1962.
Mar. 29, 1962	Scout probe	NASA	WS	Scientific geoprobe; launched by Scout; reached 3,910 mi.
Apr. 6, 1962	Cosmos 2	USSR	USSR	Designed to investigate ionosphere, cosmic rays, meteoritic dust particles, magnetic field, cloud formation and distribution, and solar radiation; still in orbit.
Apr. 9, 1962	Atlas-Agena B	USAF	PA	"Launched"; no other data released; believed still in orbit.
Apr. 17, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered May 28, 1962.
Apr. 23, 1962	Ranger 4	NASA	AMR	Lunar probe; launched by Atlas-Agena B; timer failure caused loss of control over spacecraft; no midcourse correction, no TV, no lunar-capsule separation; vehicle crashed onto moon Apr. 26, 1962, after 64-hour flight.
Apr. 24, 1962	Cosmos 3	USSR	USSR	Designed to investigate ionosphere, cosmic rays, meteoritic dust particles, magnetic field, cloud formation and distribution, and solar radiation; reentered Oct. 17, 1962.
Apr. 25, 1962	Saturn	NASA	AMR	Successful test of first stage only with dummy upper stages.
Apr. 26, 1962	Cosmos 4	USSR	USSR	Designed to investigate earth's radiation belts, study meteoritic particles, weather phenomena, and factors affecting communications; recovered "at predetermined point" in USSR, Apr. 29, 1962.
Apr. 26, 1962	Ariel 1	NASA-UK	AMR	First international satellite; launched by Thor-Delta; contained 6 British experiments; designed to investigate ionosphere; still in orbit; still transmitting.
Apr. 26, 1962	Atlas-Agena B	USAF	PA	"Launched"; no other data released; believed to have reentered Apr. 28, 1962.

(Continued on following page)

DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Apr. 26, 1962	Blue Scout	USAF	PA	"Launched"; no other data released.
Apr. 28, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered May 26, 1962.
May 8, 1962	Centaur	NASA	AMR	Launch vehicle development test; Centaur exploded before separation.
May 10, 1962	Anna 1A	Navy	AMR	Failed to orbit; Anna is acronym for Army, Navy, NASA, and Air Force; program designed to provide a triangulation point in space for precise determination of distances and positions on earth.
May 15, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed still in orbit.
May 23, 1962	Blue Scout	USAF	PA	"Launched"; no other data released.
May 24, 1962	Mercury	NASA	AMR	Launched by Mercury-Atlas; USN Lt. Cmdr. M. Scott Carpenter recovered from capsule Aurora 7 after 3 orbits in 4-hour 56-minute flight.
May 28, 1962	Cosmos 5	USSR	USSR	Designed to continue Cosmos program; still in orbit.
May 29, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered June 11, 1962.
May 31, 1962	Blue Scout	USAF	PA	Probe; no other data released.
June 1, 1962	Thor-Agena B Oscar 2	USAF	VAFB	"Launched"; no other data released; Agena believed to have reentered June 28, 1962; Oscar small radio satellite to broadcast to ham operators reentered June 21, 1962.
June 17, 1962	Atlas-Agena B	USAF	PA	"Launched"; no other data released; believed to have reentered June 18, 1962.
June 18, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed still in orbit.
June 19, 1962	Tiros 5	NASA	AMR	Launched by Thor-Delta; meteorological satellite; orbit more elliptical than planned; cameras transmitted excellent weather photos; still in orbit; still transmitting.
June 22, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered July 7, 1962.
June 27, 1962	Thor-Agena D	USAF	VAFB	"Launched"; no other data released; first of "D" series of Agena; believed to have reentered Sept. 14, 1962.
June 30, 1962	Cosmos 6	USSR	USSR	Continuation of Cosmos program; reentered Aug. 8, 1962.
July 10, 1962	Telstar 1	NASA-AT&T	AMR	First active communications satellite; world's first commercial satellite; built by AT&T's Bell Telephone Laboratories; launched by Thor-Delta; used successfully in communications tests, including transmission of transatlantic TV; still in orbit; still active.
July 18, 1962	Atlas-Agena B	USAF	PA	"Launched"; no other data released; believed to have reentered July 25, 1962.
July 18, 1962	Echo	NASA	AMR	Launched by Thor; suborbital communications test; inflation of Echo sphere successful though surface not as smooth as planned.
July 20, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered Aug. 14, 1962.
July 22, 1962	Mariner 1	NASA	AMR	Venus probe; launched by Atlas-Agena B; booster deviated from course; destroyed by Range Safety.
July 24, 1962	Blue Scout	USAF	PA	"Launched"; no other data released.
July 27, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered Aug. 24, 1962.
July 28, 1962	Cosmos 7	USSR	USSR	Designed to investigate charged particles in the ionosphere, corpuscular streams and low-energy particles, earth's magnetic field and radiation belts, cloud formations, and cosmic rays; reentered Aug. 1, 1962.
Aug. 1, 1962	Thor-Agena D	USAF	VAFB	"Launched"; no other data released; believed to have reentered Aug. 26, 1962.
Aug. 5, 1962	Atlas-Agena B	USAF	PA	"Launched"; no other data released; believed to have reentered Aug. 6, 1962.
Aug. 11, 1962	Vostok 3	USSR	USSR	Launched from near Karsakpay, in Kazakhstan (Baikonor launch complex); completed 64 orbits; joined on 17th orbit by Vostok 4 (see below), as little as 4 mi. away; after 94 hours 27 minutes spacecraft reentered and Maj. Andrian G. Nikolayev ejected from capsule at low altitude and parachuted; 1,633,000-mi. flight; Cosmonaut floated free in capsule 3½ hours during flight; recovered Aug. 15, 1962.
Aug. 12, 1962	Vostok 4	USSR	USSR	Companion vehicle to Vostok 3 (see above); completed 48 orbits; conducted near-rendezvous with Vostok 3; after 70 hours 22 minutes spacecraft reentered and Lt. Col. Pavel Popovich ejected from capsule at low altitude and parachuted; 1,247,000-mi. flight; Cosmonaut floated free 3 hours; recovered Aug. 15, 1962.
Aug. 18, 1962	Cosmos 8	USSR	USSR	Designed to continue the Cosmos program; still in orbit.
Aug. 23, 1962	Blue Scout	USAF	PA	"Launched"; no other data released; believed still in orbit.
Aug. 25, 1962	Venus probe	USSR	USSR	Reentered Aug. 28, 1962; launch from orbit believed to have failed.
Aug. 27, 1962	Mariner 2	NASA	AMR	Venus probe; launched by Atlas-Agena B; first satellite to scan another planet; passed 21,100 mi. from Venus on Dec. 14, 1962; set space communications record of 54,700,000 mi.; now in 348-day solar orbit.
Aug. 28, 1962	Thor-Agena D	USAF	VAFB	"Launched"; no other data released; believed to have reentered Sept. 10, 1962.
Aug. 31, 1962	Scout	NASA	WS	Reentry test; launched by Scout; tardy third-stage ignition resulted in less than 28,000 ft/sec desired speed.
Sept. 1, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed still in orbit.
Sept. 1, 1962	Venus probe	USSR	USSR	Launch from orbit apparently failed.
Sept. 12, 1962	"Mystery"	—	—	The British magazine <i>Flight</i> claimed that a "mystery satellite" was launched Sept. 12, 1962, that it orbited at 113-mi. altitude, and reentered 12 days later. Neither the US nor the USSR would admit ownership.
Sept. 17, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered Nov. 16, 1962.
Sept. 18, 1962	Tiros 6	NASA	AMR	Launched by Thor-Delta; meteorological satellite; transmitted cloud-cover photographs; still in orbit; still transmitting.
Sept. 27, 1962	Cosmos 9	USSR	USSR	Designed to continue the Cosmos program; status indefinite.

(Continued on page 133)



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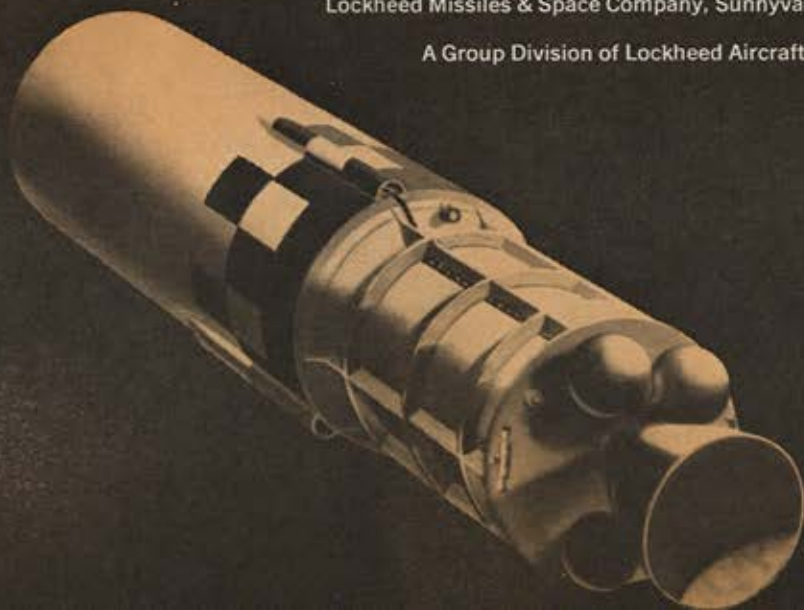


Mariner's silent partner on the Venus flyby

On the morning of December 14, Mariner II radioed back across 36 million miles of space its report on mysterious, cloud-shrouded Venus. The success of this great venture was made possible on the August morning a Lockheed-built Air Force Agena — after separating from its Atlas booster — put Mariner on the right course at the precise speed that allowed it to escape the earth's orbit and fall inward toward the sun and, with a planned mid-course correction, intercept Venus. So complete was the data Mariner sent home to its makers — Cal Tech's Jet Propulsion Laboratory — that the National Aeronautics and Space Administration has cancelled plans for two additional Venus missions. Next stop: Mars. **Lockheed**

Lockheed Missiles & Space Company, Sunnyvale, California

A Group Division of Lockheed Aircraft Corporation



SATELLITE SCOREBOARD

CONTINUED

DATE	PROGRAM	LAUNCHED BY	FROM	REMARKS
Sept. 28, 1962	Alouette 1	NASA-Canada	VAFB	Launched by Thor-Agena B; Canadian-designed and -built satellite; first NASA launch from Pacific Missile Range; designed to study ionosphere's free electron distribution, measure galactic noise, and observe cosmic rays; still in orbit; still transmitting.
Sept. 29, 1962	Thor-Agena D	USAF	VAFB	"Launched"; no other data released; believed to have reentered Oct. 14, 1962.
Oct. 2, 1962	Explorer 14	NASA	AMR	Launched by Thor-Delta; achieved highly eccentric orbit; energetic particles satellite; still in orbit; still transmitting.
Oct. 3, 1962	Mercury	NASA	AMR	Launched by Mercury-Atlas; USN Cmdr. Walter M. Schirra, Jr., recovered from capsule Sigma 7 after 6 orbits in 9-hour 13-minute flight; first Mercury Astronaut recovery in the Pacific.
Oct. 9, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered Nov. 16, 1962.
Oct. 17, 1962	Cosmos 10	USSR	USSR	Designed to continue the Cosmos program; status indefinite.
Oct. 18, 1962	Ranger 5	NASA	AMR	Launched by Atlas-Agena B; lunar probe; injected from parking orbit into lunar trajectory; payload, including midcourse guidance, did not function because spacecraft failed to get power from solar cells; passed within 450 mi. of the moon; now in 370-day solar orbit.
Oct. 20, 1962	Cosmos 11	USSR	USSR	Designed to continue the Cosmos program; status indefinite.
Oct. 20-26, 1962	Mars probe (?)	USSR	USSR	Believed to have been Soviet Mars probe that failed to leave parking orbit.
Oct. 26, 1962	Thor-Agena D (TRS 1 ?)	USAF	VAFB	"Launched"; no other data released; believed still in orbit; may include as payloads TRS 1 (Tetrahedral Research Satellite), which a Nov. 13, 1962, announcement said had been launched from Vandenberg AFB aboard a USAF R&D satellite "sometime in the last 60 days"; satellite believed still in orbit; TRS, at 1½ pounds the smallest and lightest satellite yet orbited, was developed by Space Technology Laboratories as an independent research project to provide data on changes in the earth's radiation belt as a result of the high-altitude nuclear test detonation over Johnston Island, July 9, 1962.
Oct. 27, 1962	Explorer 15	NASA	AMR	Launched by Thor-Delta; designed to study artificial radiation belt around the earth; achieved high spin rate, making it difficult to analyze data from 2 of 7 experiments; still in orbit.
Oct. 31, 1962	Anna 1B	Navy	AMR	Launched by Thor-Able Star; geodetic satellite to provide triangulation point in space; flash tube system indicated successful operation in conjunction with stellar camera ground stations; still in orbit; still transmitting.
Nov. 1, 1962	Mars 1	USSR	USSR	Mars probe; 1,965-lb. "Automatic Interplanetary Station"; injected from parking orbit to Mars flyby trajectory; programed to reach vicinity of Mars about June 1, 1963, when Mars is about 150,000,000 mi. from earth.
Nov. 5, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered Dec. 3, 1962.
Nov. 11, 1962	Atlas-Agena B	USAF	PA	"Launched"; no other data released; believed to have reentered Nov. 12, 1962.
Nov. 16, 1962	Saturn	NASA	AMR	First stage only in launch vehicle development test; Project Highwater used dummy upper stages.
Nov. 21, 1962	Blue Scout	USAF	PA	Probe; no other data released.
Nov. 24, 1962	Thor-Agena B	USAF	VAFB	"Launched"; no other data released; believed to have reentered Dec. 8, 1962.
Dec. 4, 1962	Thor-Agena	USAF	VAFB	"Launched"; no other data released; believed to have reentered Dec. 8, 1962.
Dec. 12, 1962	Thor-Agena Injun 3	USAF	VAFB	"Launched"; no other data released; 3 or 4 otherwise specified piggyback satellites may also have been included; all objects believed still in orbit.
Dec. 13, 1962	Relay 1	NASA-RCA	AMR	Launched by Thor-Delta; first launch with uprated Delta; RCA-built communications satellite; power supply voltage originally too low for communications experiments; voltage built up and early in Jan. 1963 transatlantic TV transmission began; still in orbit; still transmitting.
Dec. 14, 1962	Thor-Agena	USAF	VAFB	"Launched"; no other data released; believed to have reentered Jan. 8, 1963.
Dec. 16, 1962	Explorer 16	NASA	WS	Launched by Scout; micrometeoroid satellite; still in orbit; still transmitting.
Dec. 17, 1962	Atlas-Agena	USAF	PA	Failed to orbit.
Dec. 18, 1962	Blue Scout	USAF	PA	"Launched"; no other data released; believed to have been suborbital flight, containing first US ion engine; malfunction reportedly caused destruction shortly after launch.
Dec. 19, 1962	Transit 5A	Navy	PA	Launched by Scout; navigational satellite; still in orbit; still transmitting.
Dec. 22, 1962	Cosmos 12	USSR	USSR	Believed to be continuation of Cosmos program; believed still in orbit; still transmitting.
Jan. 7, 1963	Thor-Agena	USAF	VAFB	"Launched"; no other data released.
Jan. 16, 1963	Thor-Agena	USAF	VAFB	"Launched"; no other data released.
Feb. 1, 1963	Blue Scout	USAF	PA	"Launched"; no other data released; believed to have been a probe.
Feb. 14, 1963	Syncom 1	NASA	AMR	Launched by Thor-Delta; communications satellite; programed to reach 22,300-mi. altitude so its orbit would coincide with earth's rotation, keeping it stationary over the equatorial Atlantic; radio contact lost shortly after reaching final orbit; satellite believed tumbling and drifting out of position; by Mar. 15, 1963, attempts to communicate with Syncom were unsuccessful.
Feb. 19, 1963	Blue Scout	USAF	VAFB	"Launched"; no other data released.
Feb. 28, 1963	Thor	USAF	VAFB	Failed to orbit; destroyed by Range Safety when booster veered off course; according to USAF, the missile used "an improved Thor booster combination of liquid and solid propellants," for what was believed the first time; thrust believed increased from 170,000 lb. to about 330,000; reportedly carrying a "secret" satellite.
Mar. 13, 1963	Blue Scout	USAF	VAFB	"Launched"; no other data released.



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Readiness in the Nation's Defense

How the Bell System geared up for the October, 1962, Cuban crisis:

Communications are the lifelines of our defense systems. And when the October, 1962, Cuban crisis erupted, the Bell System was immediately put on alert.

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Yet, these lines weren't enough. So hundreds of additional channels were added by building and equipping a new microwave radio relay system over an alternate route. While this was going on, 21 switchboards were flown from Miami to the Keys and put into operation.

At strategic military locations, thousands of orders for private lines and other services were met. Hundreds of telephones and teletypewriters were installed. Dial systems were set up. To get all of this done, engineers produced designs and specifications on the spot. Western

Electric, manufacturing and supply unit of the Bell System, chartered nine planes to speed tons of equipment from 20 factory and warehouse locations.

Trucks rolled day and night. Construction crews worked round the clock placing and splicing miles of cable.

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Fortunately, the crisis was resolved peacefully. But the drama of those anxious times emphasized two facts vital to our nation's defense.

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Gallery of Missiles and Space Weapons

UNITED STATES AIR FORCE



ATLAS



MINUTEMAN

ATLAS

Type—SAC intercontinental ballistic missile; also, booster for US Mercury manned orbital flights and numerous other space efforts; **prime contractor**—General Dynamics/Astronautics; **maximum speed**—over 17,000 mph; **range**—to 9,000 mi.; **length**—82 ft.; **diameter**—10 ft.; **launch weight**—260,000 lb.; **power system**—1½-stage liquid-rocket engine developing 389,000-lb. thrust; **guidance**—radio-inertial on "D" model; all-inertial on "E" and "F"; **warhead**—nuclear; **status**—a total of 129 missiles are operational in 13 squadrons on 11 bases; Atlas missile site program is completed; launch record as of March 19, 1963—119 successful out of 168 launches, 29 partially successful, 20 failures; **other contractors**—technical assistance, Space Technology Labs, Aerospace; powerplant, North American Rocket-dyne; guidance, "D" model, General Electric-Burroughs; "E" and "F" model, Arma; reentry vehicle, "D" model, General Electric; "E" and "F," Avco.

MINUTEMAN

Type—SAC solid-propellant ICBM; principal US deterrent

missile weapon; **prime contractor**—Boeing Co.; **maximum speed**—over 15,000 mph; **range**—over 6,500 mi.; **length**—54 ft.; **diameter**—71 in.; **launch weight**—69,000 lb.; **power system**—3-stage solid-propellant rocket engines; first stage, 170,000-lb. thrust, second stage 65,000 lb., third stage 35,000 lb.; **guidance**—all inertial; **warhead**—nuclear; **status**—60 missiles operational as of March 13, 1963, at Malmstrom AFB, Mont., others being added at rate of almost one a day through 1963; location of six wings announced as Malmstrom, Minot AFB, and Grand Forks AFB, N. D., Ellsworth AFB, S. D., Whiteman AFB, Mo., and Warren AFB, Wyo. Warren will have 200 missiles, others 150 each, for total of 950 operational Minuteman missiles; **launch record**—as of March 19, 1963, 31 tests of which 20 were successful, 5 partially successful, 6 unsuccessful; **other contractors**—systems engineering and technical direction, Space Technology Labs; administrative and technical support, Aerospace; propulsion, first stage, Thiokol, second stage, Aerojet-General, third stage, Hercules; guidance, North American/Autonetics; reentry vehicle, Avco.

(Continued on following page)



THOR



TITAN II



TITAN III

THOR

Type—intermediate-range ballistic missile; however, with return of 60 Thor missiles from Great Britain, Thor is no longer in use as a weapon system but continues in service as a scientific space booster, alone or in combination with, various second-stage vehicles; **prime contractor**—Douglas Aircraft Co.; **maximum speed**—Mach 10 to 15; **range**—beyond 1,750 mi.; **length**—65 ft.; **diameter**—8 ft.; **launch weight**—over 100,000 lb.; **power system**—single-stage liquid rocket producing 170,000-lb. thrust; **guidance**—all-inertial; **warhead**—nuclear; **status**—employed for scientific and military space exploration; **launch record**—188 launches, of which 106 were scientific, 82 IRBM; of scientific launches, 98 were successful, eight unsuccessful; of IRBM launches, 56 were successful, 14 partially successful, 12 failures; **other contractors**—technical assistance, Space Technology Labs; powerplant, North American Rocketdyne; guidance, AC Spark Plug Div., GMC.

TITAN I, II

Type—SAC 2-stage liquid-propellant ICBM; **prime contractor**—Martin/Denver; **speed**—over 17,000 mph; **range**—I, over 6,300 mi., II, over 9,000 mi.; **length**—I, 98 ft., II, 103 ft.; **diameter**, 10 ft.; **launch weight**—I, 220,000 lb., II, 330,000 lb.; **power system**—I, first stage 300,000-lb. thrust, second stage, 80,000 lb.; II, first stage 430,000 lb., second stage, 100,000 lb.; **guidance**—I, radio-inertial, II, all-inertial; **warhead**—nuclear; **status**—Titan I operational, with all 54 programmed missiles on site in six squadrons; they must be raised from silos before being launched; Titan II, 54 missiles to be emplaced in silos this year, completing Titan ICBM program;

launch record of March 19, 1963—I, 55 missiles launched, 40 were successful, 11 partially successful, 4 failures; II, 12 missiles launched, 7 successful, 5 partially, no failures; **other contractors**—technical direction, Space Technology Labs, Aerospace; propulsion system, Aerojet-General; guidance, Bell Telephone Labs, Sperry-Rand, AC Spark Plug Div., GMC, Western Electric, General Motors; reentry vehicle, I, Avco; II, General Electric.

TITAN III

Type—standardized space-launch system capable of performing a variety of manned and unmanned booster missions in this decade; **prime contractor**—Martin/Denver. Titan III is designed for use in one of two configurations—the core, consisting of a modified Titan II with a new upper stage and control module mounted on top, or the Titan III core with two five-segment strap-on solid motors attached to comprise the first boosting stage; **propulsion**—maximum thrust available in the Titan III will be in 3 parts: 2,430,000 pounds produced by the Titan II first stage together with a million pounds of thrust in each of the two strap-on motors, the 100,000-lb. second stage of the Titan II, plus the 16,000-lb. thrust of the new third stage, designed to provide a multiple restart capability in space. Titan III will employ an integrated-transfer-launch (ITL) complex permitting the booster to be completely assembled and checked out in the assembly area, then moved intact to a simplified launch pad, thus reducing the time on pad and the number of pads required; **other contractors**—technical assistance, Space Technology Labs; strap-on engines, United Technology; upper-stage engine, Aerojet-General.

(Continued on page 139)



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Hytrol Mark II is standard equipment on Boeing's 707-320B, Douglas' DC-8F, Convair's 990, Boeing's 727, 707-320C and the USAF F4C.

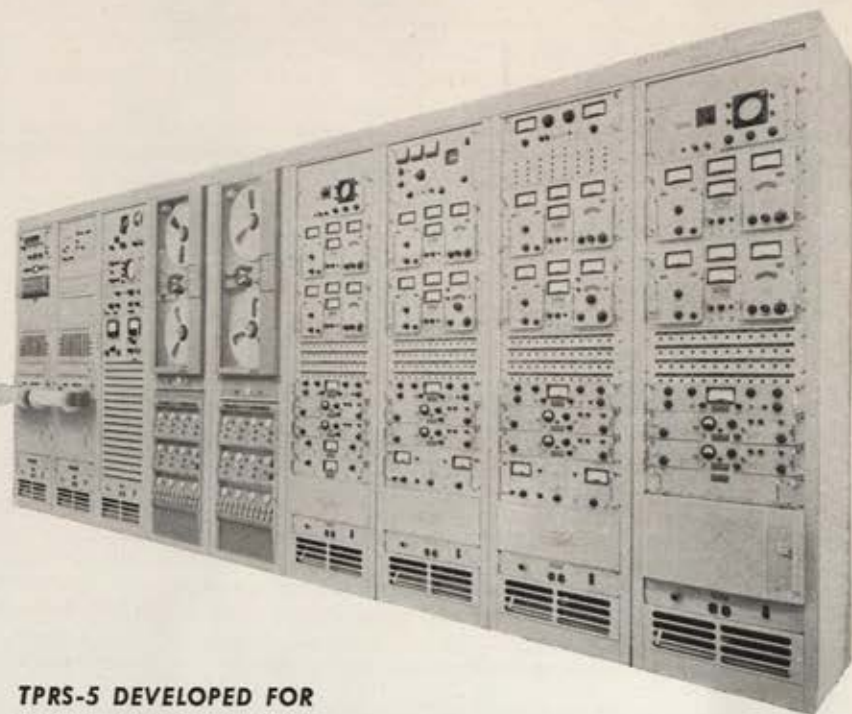
Universal Predetection Telemetry Systems by DEFENSE ELECTRONICS, INC.

Under contract to USAF, Defense Electronics developed the art of TM predetection recording to a position of prominence within the industry. Unique single sideband frequency translation technique, developed by DEI, effectively utilizes maximum recorder bandwidths.

The TPRS-5 is capable of being used as a completely self-sufficient ground station facility for TM data acquisition, recording, and display. The system is capable of receiving four RF links with dual diversity and making both predetection and post-detection recordings simultaneously. It contains provisions for playback, demodulation, and limited data separation for quick-look purposes. The system is capable of recording, without adjustment, FM/FM, PAM/FM, PDM/FM, PCM/FM, AM or PM telemetry signals.

It features extreme flexibility in both the acquisition and the playback modes with selectable bandwidths, demodulators, and RF tuning heads.

- Handles all IRIG formats
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JUPITER



MACE A



BOMARC

MACE A and B

Type—tactical, air-breathing, surface-to-surface guided missile; improved version of the Matador which has been withdrawn from operational use; **prime contractor**—Martin Co.; **speed**—600 mph plus; **range**—A, over 700 mi., B, 1,200 mi.; **ceiling**—above 30,000 ft.; **length**—44 ft.; **span**—22 ft. 9 in.; **diameter**—44 ft. 6 in.; **launch weight**—A, 14,000 lb., B, 18,000 lb.; **power system**—J33 turbojet engine with 5,200-lb. thrust plus rocket booster of 100,000-lb. thrust for zero launch; **guidance**—A, ATRAN may-matching radar, B, inertial; **warhead**—conventional or nuclear; **status**—both models operational; deployed in Europe and Far East; **other contractors**—engine, Allison; booster, Thiokol; guidance system, AC Spark Plug Div., GMC.

JUPITER

Jupiter is to be withdrawn from operation in Italy and Turkey in favor of Polaris missiles. It is no longer included in the US inventory of operational missiles.

MMRBM

Type—mobile medium-range ballistic missile; **prime contractor** (program definition phase)—Hughes Aircraft Co.; **maximum speed**—hypersonic; **maximum range**—1,725 mi.; will cover distances from maximum range of Pershing to minimum feasible ranges of ICBMs; **length**—will be short enough to be truck-mounted and able to be driven over roads of Europe

and Far East; **power system**—2-stage solid-propellant motor; **guidance**—inertial; **warhead**—nuclear; **status**—in program definition phase; **other contractors**—propulsion, Thiokol; guidance, General Precision Labs; command and control, Hughes, Sylvania, Martin; reentry system, Ford, Sperry-Rand, Fairchild-Stratos; transporter-erector-launch vehicle, American Machine & Foundry, Goodyear.

BOMARC

Type—surface-to-air, area-defense missile; **prime contractor**—Boeing Co.; **maximum speed**—Bomarc B, 2,500 mph, A, 1,800 mph; **range**—B, 440 mi., A, 250 mi.; **ceiling**—B, 100,000 ft., A, 60,000 ft.; **length**—B, 45 ft., A, 47 ft.; **diameter**—35 in.; **span**—18 ft. 2 in.; **launch weight**—B, 16,000 lb., A, 15,000 lb.; **power system**—B, solid-propellant booster, A, liquid-propellant booster, each with two ramjets for cruise; **guidance**—radar command linked with SAGE air-defense system, switching to target-homing system as terminal guidance; **warhead**—nuclear or conventional; **status**—operational; A and B at McGuire AFB, N. J., Langley AFB, Va., Otis AFB, Mass.; A at Suffolk County AFB, N. Y., and Dow AFB, Me.; B at Kincheloe AFB, Mich., Duluth Municipal Airport, Minn., Niagara Falls Municipal Airport, N. Y., and at two stations in Canada; **other contractors**—liquid booster, Aerojet-General; solid booster, Thiokol; ramjet engines, Marquardt; homing radar, Westinghouse; fuze, Bendix.

(Continued on following page)



HOUND DOG AND B-52

QUAIL



FALCON GAR-2



SKYBOLT

FALCON

Type—air-to-air guided missile; Falcon family includes GAR-1D, -2, -2A, -3A, -4A, -11, and 11-A; prime contractor—Hughes Aircraft Co. for all Falcon missiles; speed—GAR-3 and -4, Mach 3; all others, Mach 2; range—5 mi.; length—GAR-1, -2, 6 ft. 6 in.; GAR-4, 6 ft. 9 in.; GAR-11, 7 ft.; GAR-3, 7 ft. 2 in.; diameter—GAR-11, 11 in.; all others, 6½ in.; launch weight—GAR-1, -2, 120 lb.; GAR-3, -4, 150 lb.; GAR-11, 200 lb.; power system—solid-propellant rocket; guidance—GAR-1, -3, -11, radar homing; GAR-2, -4, infrared homing; warhead—GAR-11, nuclear; all others conventional; status—operational; GAR-2A and -11 are being produced for Swedish Air Force by Saab; nuclear GAR-9, originally intended for use on dropped F-108 interceptor, remains in development stage; no details on size or performance have been released; other contractors—rocket motors, Thiokol; rocket engine case, Norris Thermador; fuze and arming, General Sintering, Philco.

SIDEWINDER

Air-to-air missile; see entry under Navy.

HOUND DOG

Type—air-to-ground air-breathing SAC standoff missile; prime contractor—North American Aviation Corp.; speed—1,200 mph; range—700 mi.; length—42 ft. 6 in.; diameter—28 in.; span—12 ft.; launch weight—9,600 lb.; power system—J52-P-3

turbojet, 7,500-lb. thrust; guidance—inertial; warhead—nuclear; status—operational on B-52 bombers; other contractors—propulsion, Pratt & Whitney; guidance, NAA/Autonetics; astro-tracker, Kollsman Instrument.

BULLPUP

Air-to-surface missile; see entry under Navy.

SKYBOLT

Development of the Skybolt, a ballistic missile designed to be air-launched from a B-52 bomber, was canceled in December 1962 by Secretary of Defense.

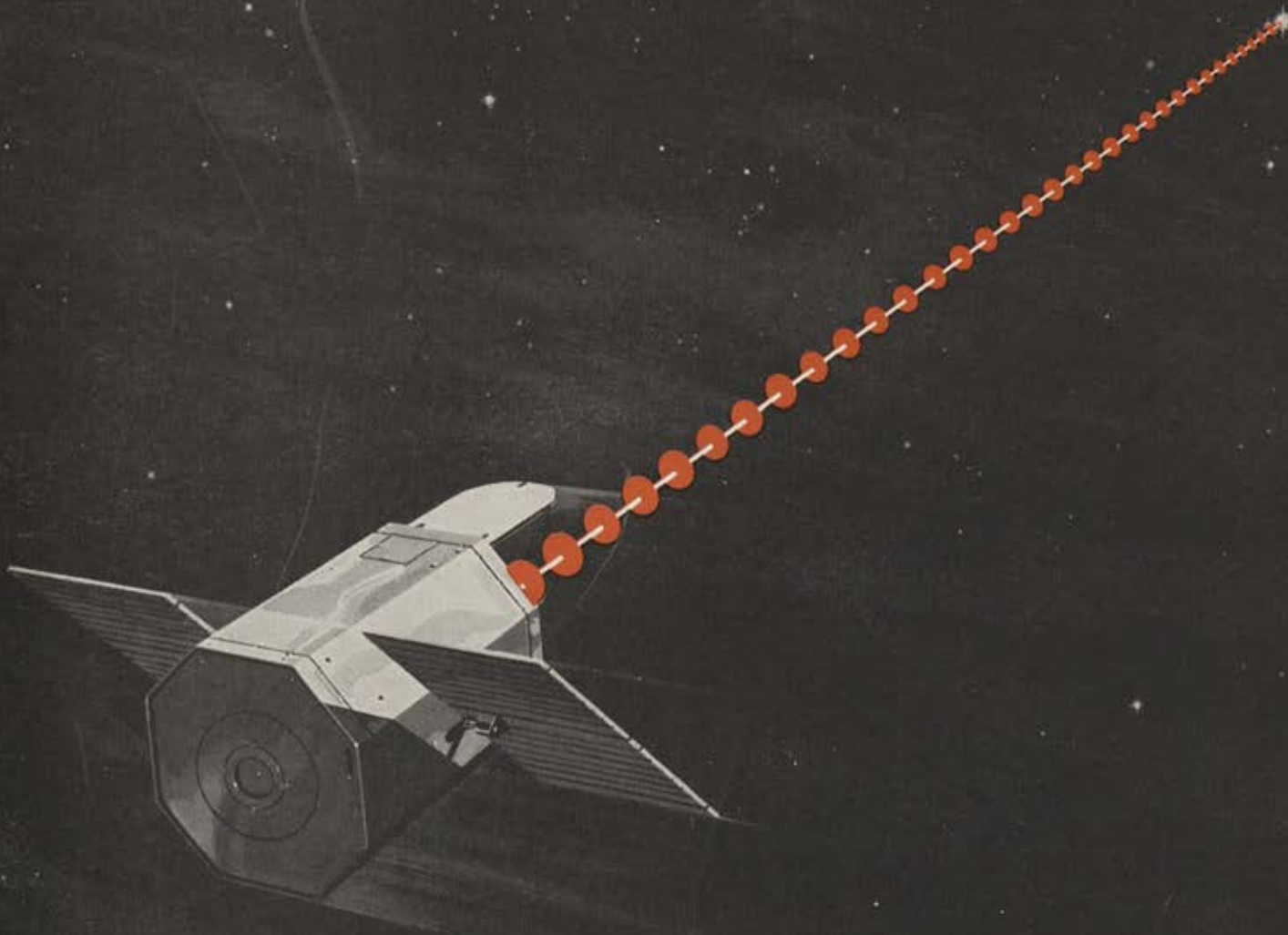
QUAIL

Type—air-launched, air-breathing bomber decoy missile; prime contractor—McDonnell Aircraft Corp.; speed—comparable to B-52 bomber, high subsonic; range—230 mi.; length—13 ft.; diameter—2 ft.; span—5 ft. 6 in.; launch weight—1,100 lb.; power system—J85 turbojet engine, with 2,450-lb. thrust; guidance—gyro autopilot; warhead—none; status—operational; each bomber can carry several missiles to confuse enemy radar; advanced version with longer range in development; other contractors—powerplant, General Electric; guidance, Summers Gyroscope; countermeasures gear, Thompson Ramo Wooldrige; aircraft modification, Boeing.

(Continued on page 143)

URGENT:

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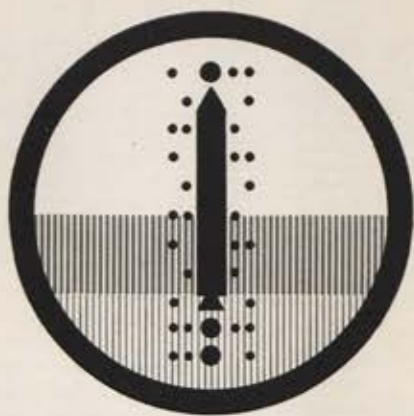
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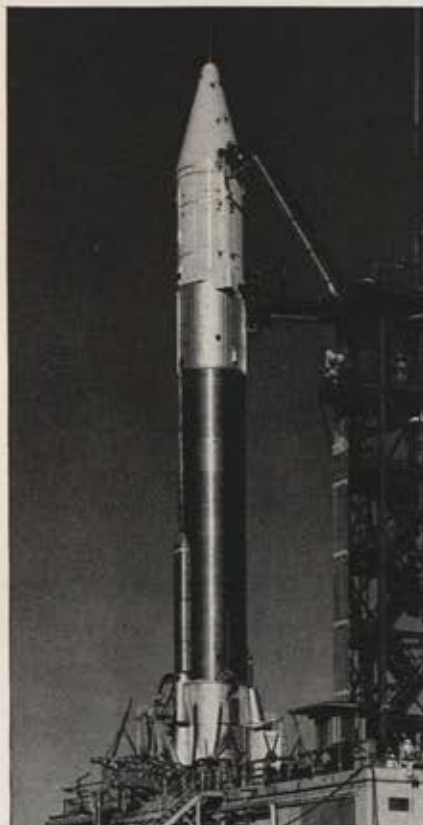
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UNITED STATES ARMY



LANCE



PERSHING



REDSTONE
WITH
MERCURY
CAPSULE



SERGEANT



CORPORAL

CORPORAL

Type—surface-to-surface, short-range ballistic missile; prime contractor—Firestone Tire & Rubber Co.; maximum speed—2,500 mph; range—85 mi.; length—45 ft.; diameter—30 in.; launch weight—11,000 lb.; power system—liquid propellant; guidance—preset and command; warhead—nuclear or conventional; status—operational since 1954; deployed in Europe, used by British; to be replaced by Sergeant; other contractors—ground equipment, Gilfillan; missile containers, Fruehauf; propellant valve, Silas-Mason.

SERGEANT

Type—short-range, surface-to-surface ballistic missile; prime contractor—Sperry Utah Engineering Lab.; maximum speed—2,500 mph; range—85 mi.; length—34 ft. 6 in.; diameter—31 in.; launch weight—10,000 lb.; power system—solid-propellant rocket; guidance—inertial; range control provided by drag brakes on reentry; warhead—nuclear or conventional; status—operational; being deployed to Europe to supplant Corporal; other contractors—powerplant, Thiokol; gyroscopes, Minneapolis-Honeywell; erector-launcher, American Machine & Foundry; trailers, Fruehauf.

REDSTONE

Type—surface-to-surface ballistic missile; prime contractor—Chrysler Corp.; maximum speed—over 3,000 mph; range—200 mi.; length—70 ft.; diameter—70 in.; fin span—12 ft.; launch weight—62,000 lbs.; power system—single-stage, liquid-propellant rocket, 78,000-lb. thrust; guidance—self-contained, all-inertial; warhead—nuclear; status—opera-

tional, deployed in Europe since 1958. In 1961 modified Redstone missiles were used in the two successful suborbital flights of Lt. Cmdr. Alan Shepard and Capt. Virgil Grissom; other contractors—frame, Reynolds Metals; powerplant, Rocketdyne; guidance, Sperry Farragut Div.; warhead adaptation kits, Picatinny Arsenal.

PERSHING

Type—2-stage, surface-to-surface, selective-range ballistic missile; prime contractor—Martin Co.; speed—more than 3,000 mph; range—100-450 mi.; length—34 ft.; diameter—3 ft. 4 in.; launch weight—30,000 lb.; power system—2-stage, solid-propellant rocket; guidance—inertial, with selective range; warhead—nuclear; status—in advanced development, scheduled for operational use in 1963; to replace Redstone. Will also be furnished to West Germany. Nicknamed "Scoot and Shoot" because it is fired from mobile launcher which serves as both transporter and erector; other contractors—frame, Martin; powerplant, Thiokol; guidance, Bendix; warhead fuzing and arming, Ford Instrument.

LANCE

Type—surface-to-surface, battlefield guided missile for division support; prime contractor—Ling-Temco-Vought; range—30 mi.; power system—prepackaged storable-liquid-propellant rocket; guidance—new concept developed by US Army Missile Command; warhead—interchangeable conventional or nuclear; Status—commencing development; is scheduled to replace Honest John, Little John, and Lacrosse.

(Continued on following page)

SHILLELAGH



LACROSSE



ENTAC



LITTLE JOHN



HONEST JOHN

**HONEST JOHN**

Type—surface-to-surface, unguided tactical rocket; prime contractor—Douglas Aircraft Co.; speed—about 1,200 mph; range—about 12 mi.; length—27 ft. 3 in.; diameter—2 ft. 6 in.; launch weight—5,900 lb.; power system—solid-propellant rocket; guidance—pre-aimed; warhead—nuclear or conventional; status—operational; deployed in Europe and Japan and supplied to NATO forces, to be replaced by Lance; advanced design is slightly shorter and lighter than the current Honest John with comparable range but greater accuracy; other contractors—frame, Douglas, American Machine & Foundry; powerplant, Hercules.

LITTLE JOHN

Type—surface-to-surface, unguided tactical rocket; system manager—US Army Missile Command; prime contractor—Emerson Electric Co.; speed—about 1,800 mph; range—10 mi.; length—14 ft. 6 in.; diameter—12½ in.; launch weight—800 lb.; power system—solid-propellant rocket; guidance—pre-aimed; warhead—nuclear or conventional; status—operational in STRAC forces and overseas; will be replaced by Lance; other contractors—frame, Emerson Electric; powerplant, Hercules; warhead arming and fuzing, General Electric, Consolidated Western Steel, Minneapolis-Honeywell.

LACROSSE

Type—surface-to-surface, all-weather, close-support guided missile; prime contractor—Martin Co.; maximum speed—transonic; range—20 mi.; length—19 ft.; diameter—20½ in.; launch weight—2,300 lb.; power system—solid propellant; guidance—command; forward observer handles guidance during terminal phase of flight; warhead—nuclear or conventional; status—

operational in eight missile battalions; deployed in Europe; other contractors—developed by Cornell Aeronautical Lab.; powerplant, Thiokol; motor parts, Parish Pressed Steel, Good-year Aircraft; target survey unit, Federal Telephone and Radio; gyroscope, Summers Gyroscope.

SHILLELAGH

Type—solid-propellant, close-support guided missile for use against armored vehicles, troops, fortifications; prime contractor—Ford Aeronutronic Co.; weight—about 40 lb.; diameter—6 in.; guidance—command; fired from tube, guided to target by microwave beam; warhead—conventional or nuclear; status—in development; expected to become operational in mid '60s; other contractors—powerplant, Picatinny Arsenal, Amoco Chemical.

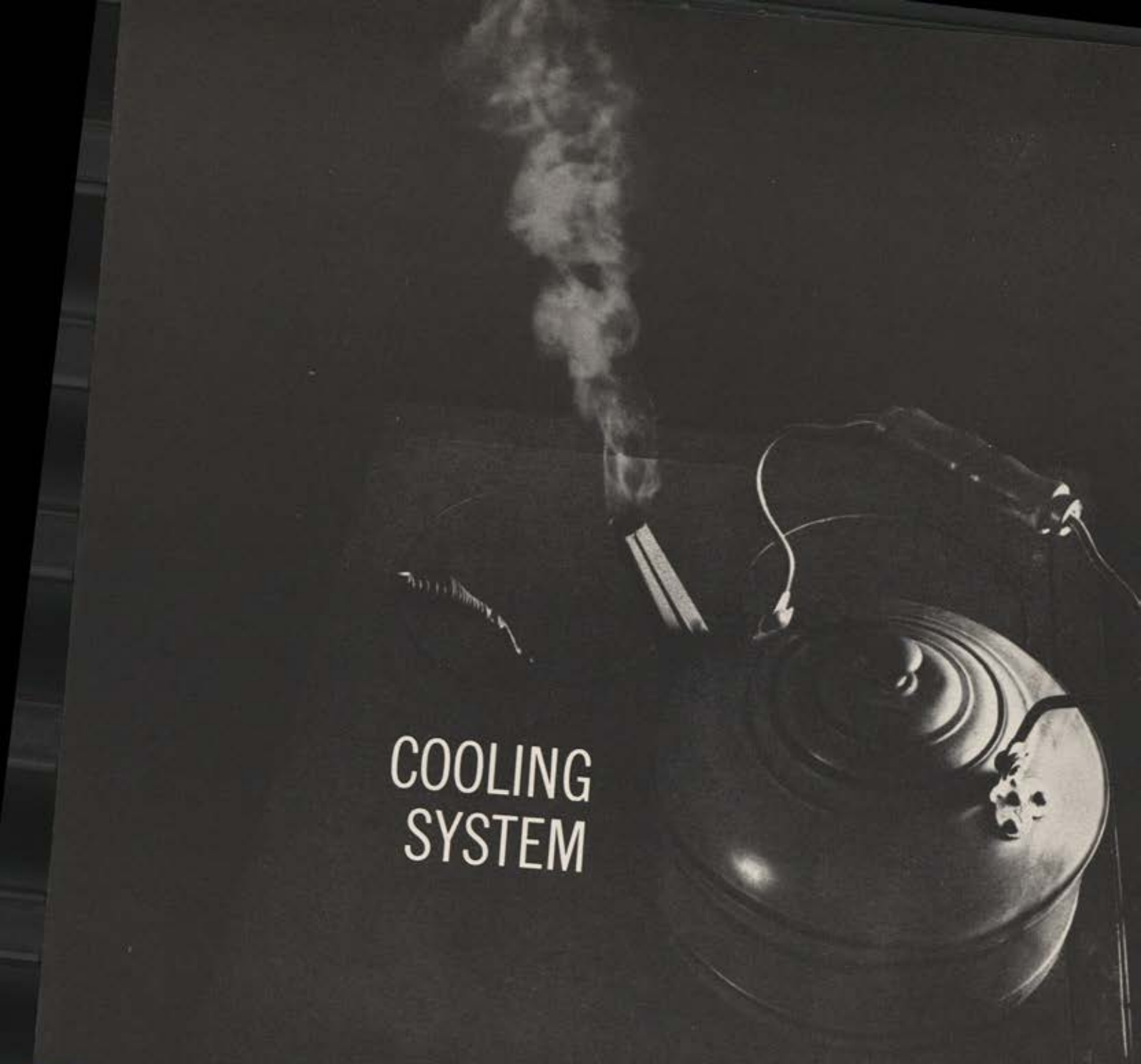
TOW

Type—antitank guided missile; TOW stands for Tube-launched, Optically-tracked, Wire-guided missile; intended for infantry use against armor or hard targets; prime contractor—Hughes Aircraft Co.; range—up to 2,000 meters; guidance—wire guided; warhead—high explosive, antitank; status—early development.

ENTAC

Type—wire-guided antitank missile; prime contractor—Nord Aviation (France); maximum speed—190 mph; range—6,500 ft.; length—33½ in.; diameter—5½ in.; launch weight—40 lb. in launch box; power system—solid-propellant rocket; guidance—wire; warhead—high-explosive shaped charge; status—operational; replacing SS-10.

(Continued on page 147)



COOLING SYSTEM

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LTV LEADERSHIP THROUGH VERSATILITY



REDEYE



SS-10



SS-11



MAULER



HAWK

SS-10

Type—wire-guided antitank missile; prime contractor—Nord Aviation (France); speed—180 mph; range—5,250 ft.; length—34 in.; diameter—6 in.; launch weight—33 lb.; power system—solid propellant; guidance—wire guided; warhead—conventional; status—operational; being replaced by Entac.

SS-11

Type—wire-guided antitank missile; prime contractor—Nord Aviation (France); maximum speed—425 mph; range—10,500 ft.; length—46 in.; diameter—6 in.; Launch weight—63 lb.; power system—solid propellant; guidance—wire guided; warhead—conventional; status—in production; other contractor—US licensee, General Electric.

HAWK

Type—surface-to-air missile for use against low-flying aircraft; prime contractor—Raytheon Co.; maximum speed—2,000 mph; range—20 mi.; ceiling—on deck to 38,000 ft.; length—16.8 ft.; diameter—14 in.; launch weight—1,275 lb.; power system—solid propellant; guidance—homing device; warhead—conventional; status—operational, deployed in Europe, Far East, and Panama; also used by US Marines; other contractors

—frame, Northrop; powerplant, Aerojet-General, Intercontinental Mfg. Co.; guidance, Raytheon.

REDEYE

Type—surface-to-air, shoulder-fired guided missile for use against low-flying aircraft; prime contractor—General Dynamics/Pomona; maximum speed—1,500 mph or more; length—44 in.; diameter—2.75 in.; launch weight—22 lb.; power system—dual-thrust solid propellant; guidance—infrared homing; warhead—high explosive; status—in development, with Marine Corps; limited numbers to be produced in 1963.

MAULER

Type—highly mobile all-weather guided missile designed to defend Army units against high-performance tactical aircraft, battlefield missiles, and rockets; prime contractor—General Dynamics/Pomona; maximum speed—3,000 mph; range—8 mi.; length—6 ft.; diameter—5 in.; launch weight—120 lb.; power system—single-stage solid-propellant; guidance—infrared homing; warhead—conventional; status—in development; Navy considering development of Sea Mauler; other contractor—infrared acquisition unit, DeHavilland.

(Continued on following page)



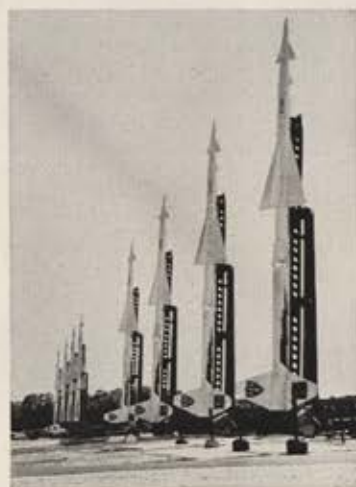
NIKE-ZEUS



NIKE-HERCULES



THE NIKE FAMILY



NIKE-AJAX

NIKE-AJAX

Type—surface-to-air guided missile; prime contractor—Western Electric Co.; maximum speed—1,900 mph; range—29 mi.; ceiling—60,000 ft.; length—31 ft. with booster; diameter—12 in.; launch weight—2,300 lb.; power system—solid-propellant booster, liquid-propellant sustainer; guidance—command; warhead—conventional; status—first operational supersonic anti-aircraft guided missile, now largely replaced by Nike-Hercules but still operational in some Army National Guard batteries.

NIKE-HERCULES

Type—surface-to-air guided missile; prime contractor—Western Electric Co.; maximum speed—2,500 mph; range—86 mi.; ceiling—above 150,000 ft.; length—39 ft. with booster; diameter—31½ in.; launch weight—10,000 lb.; power system—solid-propellant sustainer and booster; guidance—command; warhead—nuclear or conventional; status—operational since 1958; widely deployed in US and overseas; Army National Guard operates six batteries in Hawaii; other contractors—frame, Douglas; powerplant, Thiokol; jatos, Hercules; warhead, Aerojet-General, Iowa Ordnance Plant, Silas Mason; guidance, Bell Telephone Labs; acquisition radar, General Electric; ground support equipment, Pacific General Construction.

NIKE-ZEUS

Type—automated antimissile missile; prime contractor—

Western Electric Co.; maximum speed—8,000 mph; range—over 150 mi.; length—48 ft.; diameter—36 in. (sustainer); launch weight—22,800 lb.; power system—3-stage, solid propellant; guidance—command, employing fully automatic radar and computer sequence; warhead—nuclear; status—advanced development; launch record—three controlled test intercepts made in 1962 of Atlas missiles fired from Vandenberg AFB, Calif., intercepted by Nike-Zeus launched from Kwajalein, one in July, two in December; in most recent test, on December 22, 1962, Zeus reportedly differentiated between actual and decoy warheads; other contractors—frame, Douglas; propulsion, Thiokol; guidance, Bell Telephone Labs.

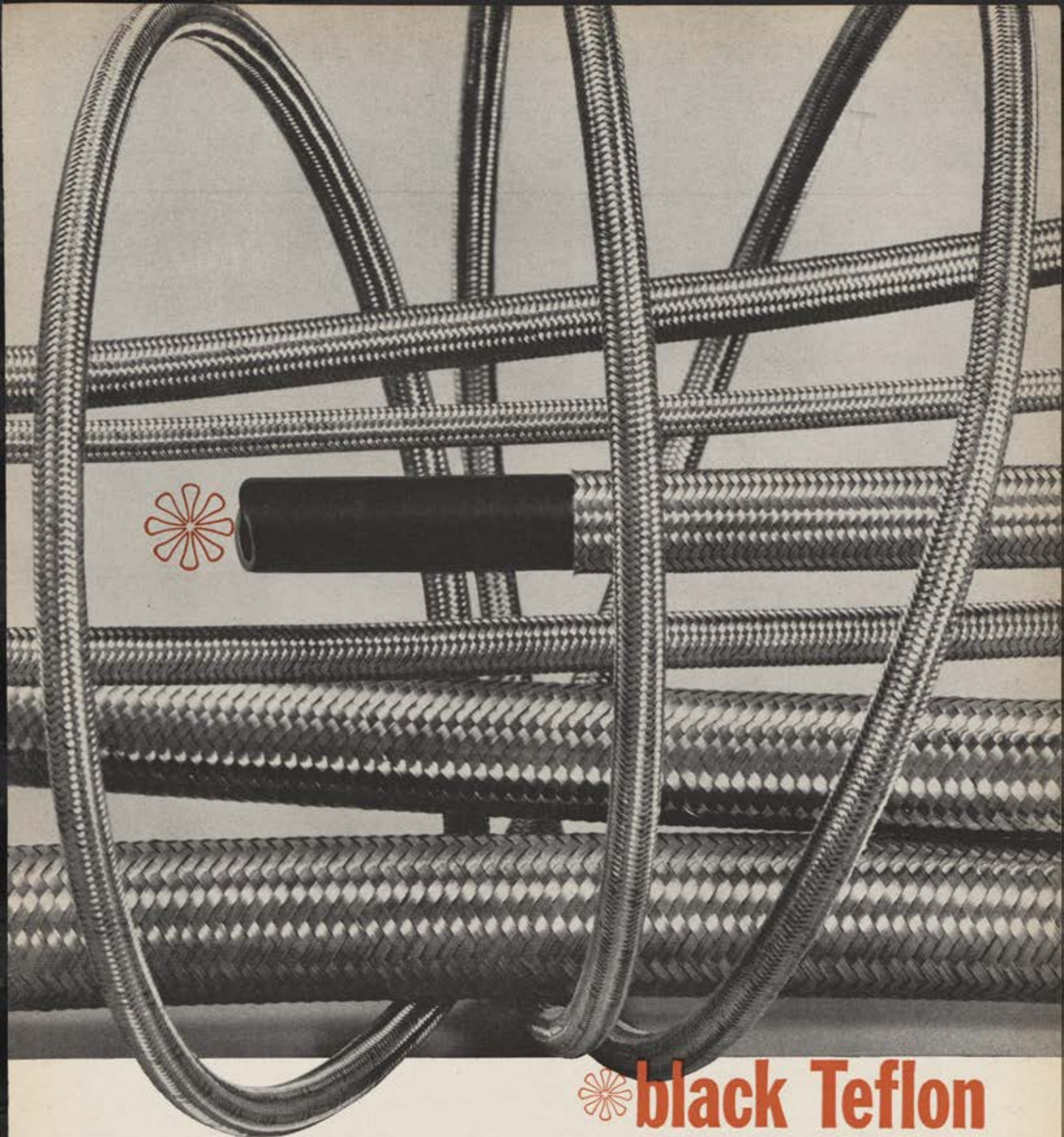
NIKE X

Type—advanced concept of antimissile defense, employing mixture of Nike-Zeus and Sprint missiles and multifunction array radar; prime contractor—Western Electric; status—in study phase; other contractors—guidance, Bell Telephone Labs; propulsion, Thiokol, Lockheed; frame, Douglas.

SPRINT

Type—high-speed antimissile concept for point defense of SAC bomber bases and ICBM sites; prime contractors—Western Electric; Bell Telephone Labs. Would be used in conjunction with Nike-Zeus in Nike X system; its characteristics of higher acceleration but shorter range than Zeus indicate it may be designed as backup for Nike-Zeus; status—in study phase.

(Continued on page 150)



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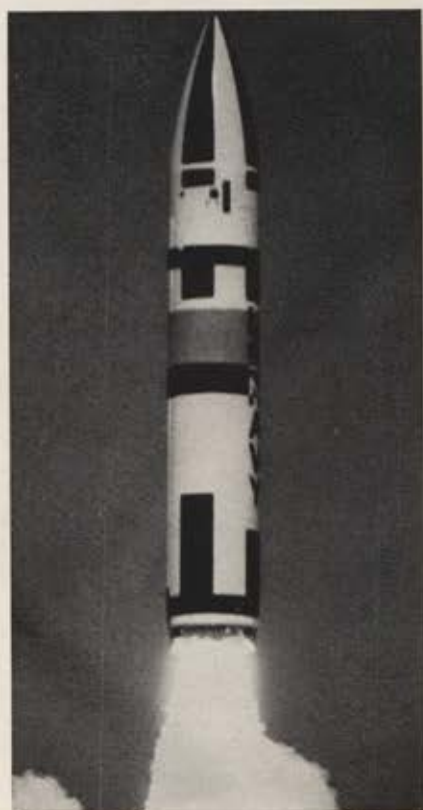
UNITED STATES NAVY



REGULUS



SUBROC



POLARIS A-3

SUBROC

Type—surface- or underwater-to-air-to-underwater weapon for firing primarily from submerged submarines against other subs or surface craft; **prime contractor**—Goodyear Aircraft Corp.; **range**—over 25 mi.; **size**—torpedo sized; **power system**—solid propellant; **guidance**—reportedly inertial; **warhead**—nuclear or conventional; **status**—entering operational service; final system will include advanced sonar equipment to compute target course and speed, and fire weapon; **other contractors**—frame, Goodyear; propulsion, Thiokol; guidance and fire control, Librascope, Kearfott.

REGULUS I

Type—air-breathing, surface-to-surface cruise missile; **prime contractor**—Chance Vought Corp. (now Ling-Temco-Vought, Inc.); **cruise speed**—600 mph; **range**—565 mi.; **ceiling**—40,000 ft.; **length**—34 ft.; **span**—21 ft.; **diameter**—4 ft. 6 in.; **launch weight**—14,000 lb.; **power system**—J33-A-18 turbojet with 2 solid-propellant boosters; **guidance**—command and preset; **warhead**—nuclear; **status**—being withdrawn from operational status in favor of Polaris; still used for test purposes; supersonic Regulus II project canceled in 1958; **other contractors**—

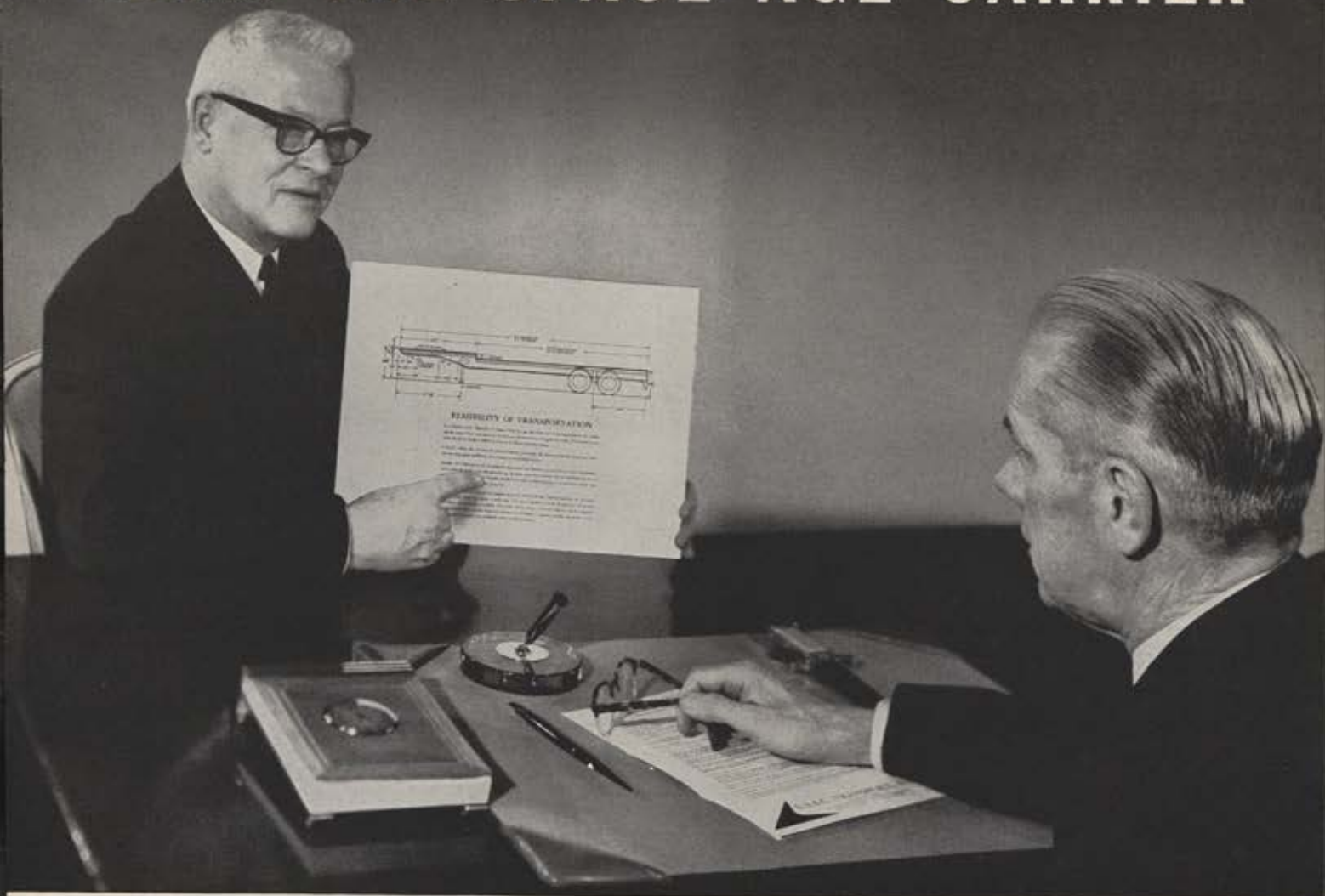
frame, Chance Vought; powerplant, Allison, Aerojet-General; guidance, Sperry.

POLARIS, A-1, A-2, A-3

Type—underwater-to-surface or surface-to-surface fleet ballistic missile (FBM); **prime contractor**—Lockheed Aircraft Corp.; **maximum speed**—hypersonic (to Mach 15); **range**—A-1, 1,380 mi.; A-2, 1,725 mi.; A-3, 2,875 mi.; **length**—A-1, 28 ft.; A-2 and A-3, 31 ft.; **diameter**—4 ft. 6 in.; **launch weight**—A-1, 30,000 lb.; A-2, 32,000 lb.; A-3, over 32,000 lb.; **power system**—2-stage solid-propellant rocket; **guidance**—inertial; **warhead**—nuclear; **status**—A-1, A-2 operational aboard nuclear submarines, 16 missiles per sub; A-1 is deployed on first six Polaris submarines; A-2 on submarines 7 through 19; A-3 to be on subs 20 through 41, beginning in 1964. Upon completion of equipping program, first six subs will be modified to employ A-3. DoD has announced plans to provide surface ships with Polaris to be operated by NATO allies; **other contractors**—powerplant, Aerojet-General (first stage), Hercules (second stage); guidance—General Electric, General Motors, North American, Hughes. More than 11,000 contractors in all.

(Continued on page 153)

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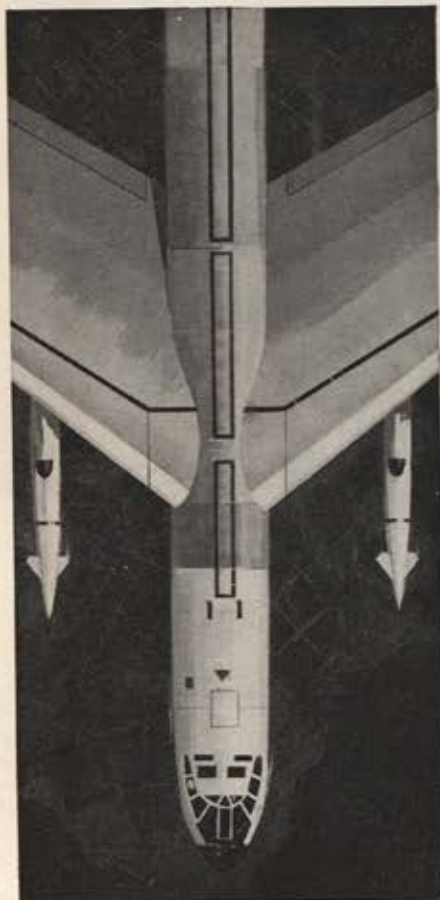
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AEROSPACE DIVISION / AMERICAN BRAKE SHOE COMPANY



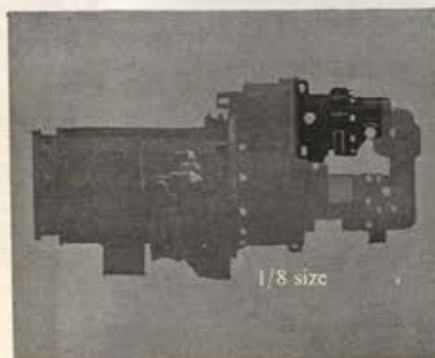
A Kellogg pump, a product of the Aerospace Division of American Brake Shoe, is an important part of the Garrett-AirResearch constant-speed drive—an efficient power source for aircraft cabin air compressors.



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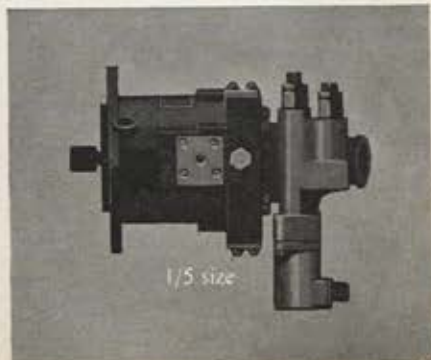
The Kellogg AP6VSC-6 pump, a single-stage, cam-actuated unit, is standard equipment on high-performance military aircraft and the Saturn I missile. The US Army's Chinook helicopter, produced by Boeing's Vertol Division, uses this pump as well as landing gear from Brake Shoe's Canadian subsidiary, Jarry Hydraulics, Ltd.



1/8 size



1/3 size



1/5 size



ADVANCED TERRIER



TYPHON



TARTAR

TYPHON

Type—surface-to-air and antimissile high-acceleration rocket, capable of employment against ships and shore targets; newest member of Bumblebee family; improving upon, and intended to replace, Talos and Tartar missiles; **prime contractor**—Bendix Corp.; **maximum speed**—3,000 mph; **range**—200 mi.; **length**—46 ft. with booster; **diameter**—38 in.; **power system**—solid-propellant booster, plus ramjet; **guidance**—microwave radar; **warhead**—nuclear or conventional; **status**—development; being tested on USS Norton Sound; **other contractors**—airframe, McDonnell; guidance, Westinghouse.

TARTAR

Type—shipboard surface-to-air guided missile representing significant improvement over original Terrier; Tartar is approximately the same size and has the same range and speed capability, yet requires no booster; Tartar has virtually the same external aerodynamic configuration as the advanced Terrier; **prime contractor**—General Dynamics/Pomona; **speed**—above 1,500 mph; **range**—beyond 12 mi.; **length**—15 ft.; **diameter**—over 1 ft.; **power system**—1 dual-thrust solid-propellant rocket which lowers its thrust for sustained flight after a short high-acceleration boost to cruise speed; **guidance**—beam rider; **warhead**—conventional; **status**—operational, deployed on destroyers and escort ships; **other contractors**—frame, General Dynamics/Pomona; powerplant, Aerojet-General; guidance, Raytheon.

TERRIER

Type—surface-to-air guided missile for firing from shipboard and Marine Corps mobile launchers ashore; **prime contractor**—General Dynamics/Pomona; **speed**—2,000 mph; **ceiling**—over 50,000 ft.; **range**—over 12 mi.; **length**—15 ft., 27 ft. with booster; **diameter**—13 in.; **span**—4 ft.; **launch weight**—3,000 lb.; **power system**—2-stage solid-propellant rocket; **guidance**—radar beam rider; **warhead**—conventional; **status**—operational, advanced Terrier with more powerful rockets and over 20-mi. range entering operational service; advanced Terrier can be handled by same equipment as Terrier; **other contractors**—propulsion, Hercules; guidance, Sperry.

(Continued on following page)



TERRIER



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TALOS



SPARROW III ON NAVY AIRCRAFT

TALOS

Type—shipboard surface-to-air and surface-to-surface guided missile; prime contractor—Bendix Corp.; speed—Mach 2.5; ceiling—above 100,000 ft.; range—over 75 mi.; length—30 ft.; diameter—2 ft. 6 in.; span—9 ft. 4 in.; launch weight—3,000 lb., 7,000 lb. including booster; power system—solid-propellant booster for a few seconds, then cruise on ramjet engine delivering maximum of about 9,000-lb. thrust; guidance—beam riding with semiactive radar homing; warhead—nuclear or conventional; status—operational; deployed on cruisers; advanced version known as Typhon Long Range or Super Talos;

Talos also used to bombard surface ships at extreme ranges; other contractors—frame, Sikorsky; powerplant, McDonnell, Allegany Ballistics, Bendix; guidance, Sperry.

TERNE

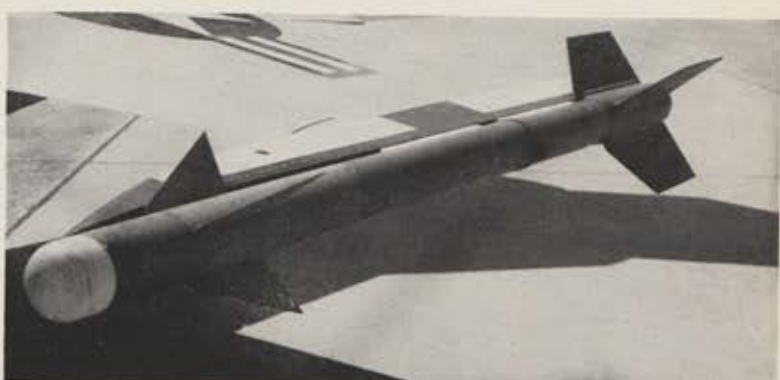
Type—ship-to-air missile; prime contractor—Kongsberg Vaa-penfabrikk, Norway; maximum speed—1,500 mph; range—10 mi.; power system—solid dual-thrust motor; guidance—beam rider; warhead—conventional; status—Navy is buying to equip two destroyer escorts; other contractor—systems integration, Arma.

How does Sundstrand





SIDEWINDER ON F-9J COUGAR



SIDEWINDER

SIDEWINDER

Type—air-to-air guided missile; prime contractors—Philco Corp. and General Electric Co. for 1-A; Philco and Motorola for 1-C; maximum speed—Mach 2.5; range—at sea level, 3,500 ft., at 50,000 ft., 11,000 ft.; effective ceiling—over 50,000 ft.; length—9 ft. 4 in.; diameter—5 in.; finspan—2 ft.; weight—155 lbs.; power system—solid propellant rocket; guidance—infrared homing; warhead—conventional; status—operational; used by Navy, Air Force, Marine Corps, several allied air forces; advanced all-weather model Sidewinder 1-C with both radar- and infrared-homing under development; other contractors—frame, Norris Thermador, Hunter Douglas; propulsion, Naval Propellant Plant, Aerojet-General; warhead, ACF Industries; fuze, Eastman Kodak, Minneapolis-Honeywell, Baldwin Piano; development, Naval Ordnance Test Station.

SPARROW III

Type—air-to-air guided missile; prime contractor—Raytheon Co.; speed—over 1,500 mph; range—8 mi.; effective ceiling—over 50,000 ft.; length—12 ft.; diameter—8 in.; span—3 ft. 4 in.; weight—350 lb.; power system—solid-propellant rocket; new version has packaged liquid propellant; guidance—semi-active radar-homing; warhead—conventional; status—operational, deployed on carrier-based aircraft; achieved first head-on interception of surface-launched guided missile in August 1962 when, fired from F-4B aircraft (F4H-1), it destroyed a Regulus missile over Pacific Ocean; other contractors—powerplant, Aerojet-General, North American; fuze, Longines-Wittnauer, Elgin Watch; warhead design, Naval Ordnance Laboratory.

(Continued on following page)

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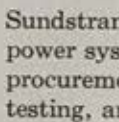


delivered over 35,000 drive units and is credited with many state-of-the-art advancements. Over 20-million drive-flight-hours have been accumulated on Sundstrand drives on military aircraft. The new geared differential drive design is typical of Sundstrand's continual progress in constant speed drives to meet the more stringent requirements of advanced aircraft electrical systems.

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support of the B-52, C-135B, F-100, and F4C aircraft programs. Sundstrand is also well along in the development of a lightweight cartridge/pneumatic starter unit for smaller classes of turbojet and turboprop engines.



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BULLPUP

BULLPUPS
ON NAVY FURY

SHRIKE

PHOENIX

Type—major armament for the F-111B, Navy version of TFX; prime contractor—Hughes Aircraft, engaged in defining system characteristics; there are no other details available at this time.

BULLPUP

Type—air-to-surface guided missile; prime contractor—Martin Co.; speed—1,400 mph; range—over 3 mi.; length—11 ft.; diameter—1 ft.; weight—571 lb.; power system—storable liquid-propellant rocket; earlier versions used solid propellant; guidance—command (radio signals from launch plane); war-

head—conventional; new version for USAF has nuclear warhead; status—operational, used by Navy, Marine Corps, USAF; being produced in Europe for NATO; other contractors—frame, Martin; powerplant, Thiokol; guidance, Maxson Electronics.

SHRIKE

Type—air-to-surface, antiradar missile; system manager—Naval Ordnance Test Station; Texas Instruments is prime contractor for development of guidance and control system; power system—solid propellant; guidance—electromagnetic; warhead—conventional; status—in early development.—END

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NATIONAL CONVENTION and

AEROSPACE PANORAMA

Washington, D.C.

September 11-15, '63

AFA HOTEL RATES

HOTELS	SINGLE	TWIN & DOUBLE	1 B/R SUITE	2 B/R SUITE
*Albert Pick Motor Inn	\$12-18	\$16-22	\$30-38	
*Burlington	\$ 8	\$13	\$15-25	
*Executive House	\$12-18	\$16-22	\$26-44	
*Georgetown Inn	\$13-17	\$17-22	\$36-38	\$51-58
*Gramercy	\$16-22	\$20-22	\$40	
*International Inn	\$12-18	\$15-24	\$40-45	\$70-100
Jefferson	\$15-18	\$19-22	\$30-40	\$46-60
Manger Hay-Adams	\$17-24	\$21-28	\$50-60	\$69-83
*Marriott Key Bridge	\$10-15	\$17-21	\$35	\$53
*Marriott Twin Bridges	\$10-15	\$16-20	\$38	\$56

HOTELS	SINGLE	TWIN & DOUBLE	1 B/R SUITE	2 B/R SUITE
Mayflower	\$10-24	\$16-28	\$40-65	\$58-89
Pick-Lee House	\$ 9-15	\$13-19	\$25-35	\$38-47
*Sheraton-Carlton	\$16-20	\$19-25	\$43-48	\$60
*Sheraton-Park	\$13-17	\$17-20	\$25-30	\$55-65
*Shoreham	\$16-18	\$18-22	\$30-60	\$60-100
Statler Hilton	\$12-24	\$17-26	\$56-60	\$80-85
The Madison	\$16-24	\$20-29	\$42-80	\$72-89
Washington	\$ 9-14	\$16-20	\$28-40	\$42-60
*Windsor Park	\$ 9-13	\$12-16	\$16-20	\$30
Woodner	\$12-16	\$16-20	\$18-30	\$35-60

*Indicates free parking for guests.

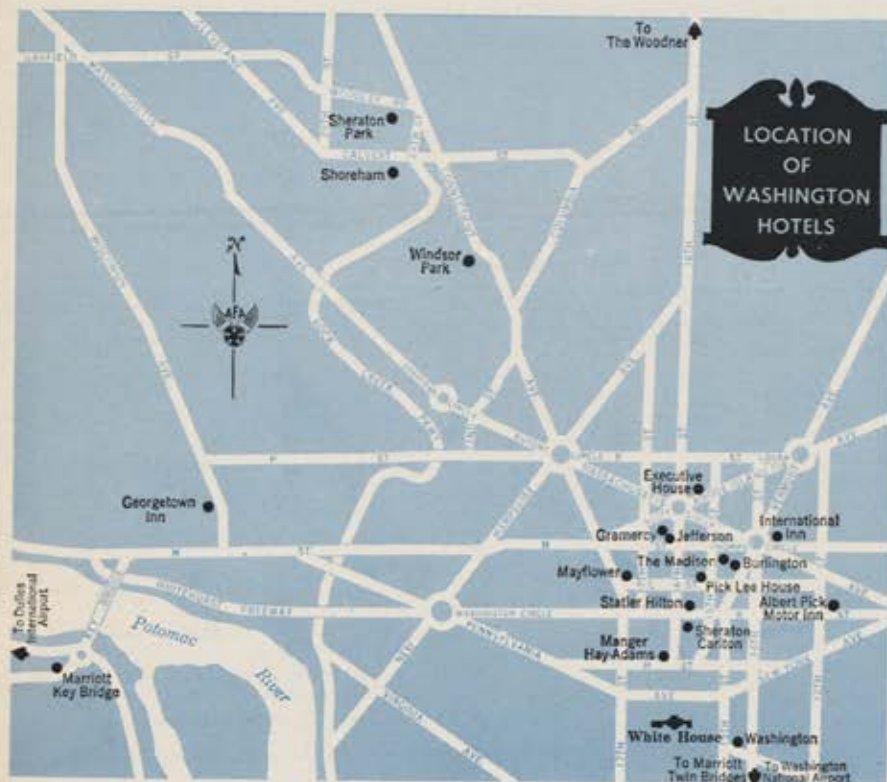


GENERAL INFORMATION

Listed on the opposite page are the names and rates of AFA's official hotels for the Air Force Association's Seventeenth Annual Convention and Aerospace Panorama, to be held in Washington, D. C., September 11-15, 1963. Several new luxury hotels have recently opened in Washington. The hotels designated with an asterisk offer free parking for their guests. All of the hotels are within a five- or ten-minute cab ride of the Sheraton-Park and Shoreham Hotels.

RESERVATION PROCEDURE

All requests for rooms and suites should be sent to the AFA Housing Office. The hotels will not accept any direct requests. Reservations will be confirmed on a FIRST-COME, FIRST-SERVED basis. Be sure to fill in all three choices of hotel, your arrival date and hour, and your departure date. If you plan to arrive after 6:00 p.m., your reservation request must be guaranteed. After receiving your confirmation, send all changes and cancellations to the AFA Housing Office.



Important

Please complete this form in FULL and mail to the following address:

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WASHINGTON 6, D. C.

Be sure to list first, second, and third choices of hotels and arrival DATE and TIME. If room is not available at rate requested, next nearest available rate will be assigned. For arrivals after 6:00 p.m., reservation requests MUST BE GUARANTEED.

HOTEL RESERVATION FORM

17th ANNUAL AIR FORCE ASSOCIATION CONVENTION
Washington, D. C. • September 11-15, 1963

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Firm/Organization _____	
Mail Address _____	
City & State _____	
1st Choice Hotel _____	2d Choice Hotel _____
3d Choice Hotel _____	
Type of Room—Be specific for single, double, twin room, or suite _____	Desired Rate _____
Others Sharing Room _____	
Arrival Date and Hour _____	Departure Date _____

NOTE: For arrivals after 6:00 p.m., reservation requests must be guaranteed.

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25-29	11,000	20,000	25-29	16,500	30,000
30-34	12,500	20,000	30-34	18,750	30,000
35-39	13,000	20,000	35-39	19,500	30,000
40-44	13,500	17,500	40-44	20,250	26,250
45-49	12,500	13,500	45-49	18,750	20,250
50-54	10,000	10,000	50-54	15,000	15,000
55-59	10,000	10,000	55-59	15,000	15,000
60-64*	7,500*	7,500*	60-64*	11,250*	11,250*

*Continuing benefits. Policy must be purchased prior to Age 60.

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Application must be accompanied by check or money order. Send remittance to INSURANCE DIVISION, AFA, 1901 PENNA. AVE., N.W., WASHINGTON 6, D. C. 4-63



Olmsted Squadron's first member signed up the day the campaign opened. He was Governor William B. Scranton, second from right, and he is shown here with AFA President Montgomery, Maj. Gen. Frederic H. Miller, Commander, Middletown Air Materiel Area, where the membership drive was concentrated, and Maj. Gen. Thomas White, who is the Pennsylvania State Adjutant General.

Number-one question at Olmsted AFB these days is directed at the identity of the 2,000th member in the big campaign. Shown below are Oliver R. Johns, General Chairman of the drive, Harold M. Donley, the 1,000th member, General Miller, and "Mr. Question Mark." At press time the Squadron had fewer than 100 members to go for the big one.

"Who'll be Mr. 2,000?" is the question they're asking in Harrisburg, Pa., where AFA's Olmsted Squadron is winding up one of the most successful membership drives AFA has seen . . .



Olmsted Squadron: 1,000 In, Shooting for 2

AFA's high-flying Squadron in Harrisburg, Pa., named for nearby Olmsted AFB, headquarters of Logistic Command's Middletown Air Materiel Area, is still counting noses after one of the most successful membership campaigns in AFA history. It all began last November when AFA's President, J. B. Montgomery, spoke to a combined civic club luncheon in Harrisburg. An interested member of the audience was Maj. Gen. Frederic H. Miller, Middletown Commander and an AFA Charter Member. After the program Mr. Montgomery, General Miller, and William T. Lunsford, Jr., Olmsted Squadron Commander, got together to map out a campaign aimed at developing Association membership at Olmsted, where the Air Force employs about 14,000 civilians.

Subsequent meetings resulted in the appointment of a chairman within each of the twenty-five organizations on the base. "Operation 1,000 Plus" was the name given to the project. The kickoff took place on January 23, when Mr. Montgomery appeared before 1,100 members of the Olmsted Civilian Management Club, speaking on AFA objectives. He extended an invitation to the club members to affiliate with AFA. General Miller appeared on the program to second Mr. Montgomery's remarks with some forceful comments of his own. And so did Schaefer T. Day, Jr., Management Club President and also a member of the Olmsted Squadron.

The first new member signed up in the drive was Pennsylvania Governor William B. Scranton, an Air Force Reserve major. The thousandth new member was reached before the campaign hit its halfway mark.

He is Harold M. Donley (*see cut*). With the original objective reached so quickly, the Squadron decided to try for 2,000, and Mr. Lunsford is confident that the goal will be met—and with room to spare.

Oliver R. Johns, former Olmsted Squadron Commander, is Campaign Chairman, and even he is surprised by the overwhelming success of the project. While he is credited by Mr. Lunsford with prime responsibility for the campaign, Mr. Johns states that without the outstanding support of General Miller and others at the Olmsted Base, the drive would still be struggling along. Among those to whom Mr. Johns gives credit are Col. I. R. Perkin, Director of Maintenance, whose office furnished more than 900 new members; and Capt. Juanita Schiltz, Director of Information, whose division now boasts more than eighty percent membership in AFA.

Jack Millar, Squadron Vice Commander; Rush Mauney, Deputy Director, Maintenance Division; and James Moore, Civilian Personnel Officer at Olmsted, comprised the three-man steering committee assisting Mr. Johns in the campaign, which had an immediate result of placing the Olmsted Squadron in second place among AFA Squadrons on the membership ladder. Only Omaha, with more than 3,000 members, is larger.

Mr. Lunsford is now concerning himself with the question of starting programs that will retain the interest of his large membership, but Ollie Johns is asking a more basic question: "Who's going to be number 2,000?"

—GUS DUDA

ANY FLYER CAN BE GROUNDED AND LOSE FLIGHT PAY \$2,500,000

PAID IN AFA FLIGHT PAY BENEFITS IS PROOF OF THIS

AFA has paid two and a half million dollars in claims to grounded flyers since 1956—money that meant the difference between living, and just existing, to hundreds of Air Force families.

We are pleased that a program of insurance which AFA originated has helped Air Force families so substantially. And we believe the information we have gained about grounding can help *you* in evaluating your prospects.

For example, the chart below shows the ages when most flyers are grounded—a time when families can *least afford* loss of income.

You can see, too, that the money you would get from just *one* 90-day grounding would pay for your flight pay insurance during the years you are most likely to lose flight pay.

If your flight pay is not protected, you owe it to your family to get this income protection now.

NOTE: All policies are dated on the last day of the month in which the application is postmarked, and protection against accidents begins as of that date; protection against groundings due to illnesses begins 30 days later. Of course, coverage cannot be immediately extended to include illnesses which existed prior to the time at which you insured your flight pay, but after 12 months you are fully covered against all illnesses.

EXCLUSIONS: The insurance under the policy shall not cover loss to any Member resulting in whole or in part from or due to any of the following:

1. Criminal act of the Member or from injuries occasioned or occurring while in a state of insanity (temporary or otherwise).
2. "Fear of flying," as officially certified by responsible authority of the

Member's Service and approved by the head of the Service in accordance with applicable regulations.

3. Caused by intentional self-injury, attempted suicide, criminal assault committed by the Member, or fighting, except in self-defense.

4. Directly or indirectly caused by war, whether declared or not, if act of an enemy in such war is the direct cause of loss insured hereunder, hostile action, civil war, invasion, or the resulting civil commotions or riots.

5. Failure to meet flying proficiency standards as established by the Member's Service unless caused by or aggravated by or attributed to disease or injuries.

6. Inability of a member to continue to meet physical standards for Hazardous Flight Duty because of a revision in those standards, rather than because of preceding injury or disease causing a change in the physical condition of such member.

7. Mental or nervous disorders.

8. Alcohol, drugs, venereal disease, arrest, or confinement.

9. Willful violation of flying regulations resulting in suspension from flying as a punitive measure, or as adjudged by responsible authority of the Member's Service.

10. Suspension from flying for administrative reasons not due to injuries or disease, even though the Member may have been eligible for or was being reimbursed at the time of the administrative grounding because of a previously established disability.

11. Loss of life shall not be deemed as loss for purposes of this insurance.

12. Primary duty requiring parachute jumping.

13. Voluntary suspension from flying.

14. A disease or disability preexisting the effective date of coverage, or a recurrence of such a disease or disability, whether or not a waiver has been authorized by appropriate medical authority in accordance with regulations or directive of the service concerned, unless the Member was insured under the master policy issued to the Air Force Association for 12 continuous months immediately prior to the date disability (grounding) commenced.

Underwritten by Mutual Benefit Health & Accident Association (Mutual of Omaha).

CHOOSE EITHER CONVENIENT PAYMENT PLAN. MAIL THE APPLICATION TODAY!

AFA FLIGHT PAY PROTECTION PLAN/AIR FORCE ASSOCIATION, 1901 Pa. Ave., N.W., Wash. 6, D.C.

Send me my Flight Pay Protection Policy.

BILL ME FOR:

- \$_____ semiannual premium (1% of annual flight pay, plus \$1 service charge)
- \$_____ for full payment of annual premium (2% of annual flight pay)

I ENCLOSE:

- \$_____ semiannual premium (1% of annual flight pay, plus \$1 service charge). Bill me every 6 months
- \$_____ in full payment of annual premium (2% of annual flight pay)

This insurance is available for AFA Members only ☐ I am an AFA Member ☐ I enclose \$6 for annual AFA membership

Rank (please print) Name _____

Address _____

City _____

Zone _____

State _____

\$ Annual Flight Pay _____

Years Service for pay purposes _____

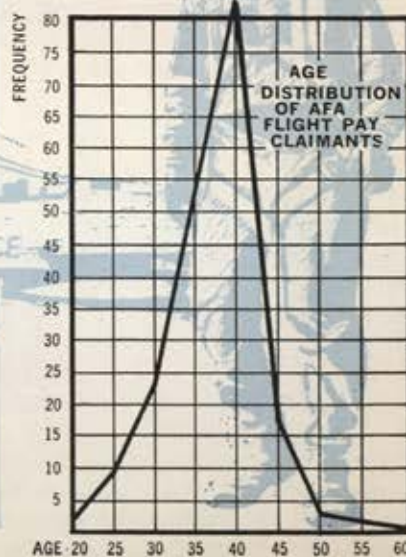
I understand the conditions and exclusions governing AFA's Flight Pay Protection Plan, and I certify that I am currently on flying status and entitled to receive incentive pay and that to the best of my knowledge

I am in good health, and no action is pending to remove me from flying status for failure to meet physical standards. I authorize AFA, or AFA representatives, to examine all medical records pertinent to any claim I may submit.

Signature of Applicant _____

(Underwritten by Mutual of Omaha)

Date _____



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TERRAIN AVOIDANCE



U.S. Air Force

...the Problem Was Easier then!

Today terrain avoidance has been complicated by higher air speeds, ground search radars and more deadly defensive weapons. Thus the critical need for research on the terrain avoidance problem.

Evidence of Cornell Aeronautical Laboratory's leadership in researching the problem is given by the recent receipt of its 15th contract in this field. Since the first contract was awarded to CAL a decade ago, the Laboratory has performed such research for the Air Force, Navy, Army, commercial sponsors, and the United Kingdom.

By making this new knowledge available to scientists and to the military services concerned, CAL is actively advancing the state of the art. For the illustrated story of CAL's contributions in this and other areas of science, mail the coupon below.



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OF CORNELL UNIVERSITY

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Buffalo 21, New York

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STATE _____

For All AFA Members / AFA ACCIDENT INSURANCE

GIVES YOU AND YOUR FAMILY COMPREHENSIVE COVERAGE AGAINST ACCIDENTS!

ACROSS THE WORLD

ACROSS THE STREET

IN YOUR OWN HOME

AFA's uniquely flexible Accident Insurance offers you accident coverage, twenty-four hours a day, every day, in amounts up to \$50,000.

You choose the amount that meets *your* family's requirements.

You have your choice of the money-saving family plan that insures you, your wife, and *all* of your children under 21—or individual coverage that makes separate policies available to you and as many other members of your family as you wish (up to \$50,000 for adults, \$5,000 for children). The table below shows you the amounts of coverage available, and the way the Family Plan works.

Units of Coverage	Your Coverage (Basic Amount)	Extra Benefits of Family Plan	
		Wife	Each Child
1	\$ 5,000	\$ 2,500	\$ 500
2	10,000	5,000	1,000
3	15,000	7,500	1,500
4	20,000	10,000	2,000
5	25,000	12,500	2,500
6	30,000	15,000	3,000
7	35,000	17,500	3,500
8	40,000	20,000	4,000
9	45,000	22,500	4,500
10	50,000	25,000	5,000

All of these benefits increase 5% each year for the first 5 years at no increase in premium.

If you are presently insured under AFA's old Travel Accident Insurance, please do not apply for Comprehensive Accident Insurance at this time. To avoid the expense to you of short-rate cancellation, we will automatically send you an application for AFA Comprehensive Accident Insurance when your present coverage expires.

1. Either plan you choose offers coverage against *any* accident (except those specifically listed as exclusions below) anywhere in the world. Coverage as a passenger in *all* military aircraft is provided at no extra cost. This provision does not, of course, apply to crew members performing their assigned duties.
2. In addition to the accidental death benefit, your policy also provides indemnity for accidental loss of limbs or sight.
3. And, for any injuries you incur, money is set aside in an amount up to \$500 for medical expenses not reimbursed by other insurance in excess of \$50 deductible for every family member.

LIMITS OF LIABILITY: The Insurer's Aggregate Limit of liability with respect to all insured persons holding certificates issued under this master policy while in any one aircraft shall not exceed \$500,000. Should the total of the individual limits of liability with respect to such insured persons while in any one aircraft exceed \$500,000, then the amount applicable to each insured person shall be proportionately reduced to effect a proportionate distribution of the said aggregate limit.

EXCLUSIONS: The policy does not cover: (a) suicide or attempted suicide, while sane or insane; (b) death or injury sustained while insane or under the influence of intoxicants or narcotics; (c) death or injury resulting from invasion, bombardment, or enemy action; (d) death or injury sustained while operating or riding in any aircraft or other vehicle used in a manner or for a purpose prohibited by law; (e) death or injury directly or indirectly resulting from medical or surgical treatment (except where such treatment is rendered necessary by bodily injury caused by an accident within the scope of the policy); (f) injuries or death sustained by a minor child in an auto accident wherein the driver of the auto is under 21 years of age.

AIR FORCE ASSOCIATION COMPREHENSIVE ACCIDENT INSURANCE

(Underwritten by Mutual of Omaha)

Name (applicant) _____

Address _____

City _____ Zone _____ State _____

Beneficiary* _____ Relationship _____

*Under the family plan a beneficiary should only be named for the above named family head (applicant). In the event of death of any of his family members the applicant will be the beneficiary.

☐ I am an AFA member ☐ I enclose \$6 for AFA membership

Application must be accompanied by check or money order. Send remittance to: Insurance Division, AFA, 1901 Pennsylvania Ave., N. W., Washington 6, D. C.

ANNUAL COST

Basic Amount†	Family Plan†	Individual Plan
\$ 5,000	☐ \$ 9.50	☐ \$ 6.00
\$10,000	☐ \$19.00	☐ \$12.00
\$15,000	☐ \$28.50	☐ \$18.00
\$20,000	☐ \$38.00	☐ \$24.00
\$25,000	☐ \$47.50	☐ \$30.00
\$30,000	☐ \$57.00	☐ \$36.00
\$35,000	☐ \$66.50	☐ \$42.00
\$40,000	☐ \$76.00	☐ \$48.00
\$45,000	☐ \$85.50	☐ \$54.00
\$50,000	☐ \$95.00	☐ \$60.00

†Family plan includes 50% of basic amount for wife and 10% of basic amount for all children, regardless of number.

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The Air Force Association is an independent, nonprofit airpower organization with no personal, political, or commercial axes to grind; established January 26, 1946; incorporated February 4, 1946.

Objectives

- To assist in obtaining and maintaining adequate airpower for national security and world peace.
- To keep the AFA members and the public abreast of developments in the field of aviation.
- To preserve and foster the spirit of fellowship among former and present personnel of the United States Air Force.

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Active Members: Individuals honorably discharged or retired from military service who have been members of, or either assigned or attached to, the USAF or its predecessor services, or who are currently enrolled in the Air Force Reserve or the Air National Guard.

Other individuals who have asserted their interest in furthering the aims and purposes of the Air Force Association. \$6.00 per year.

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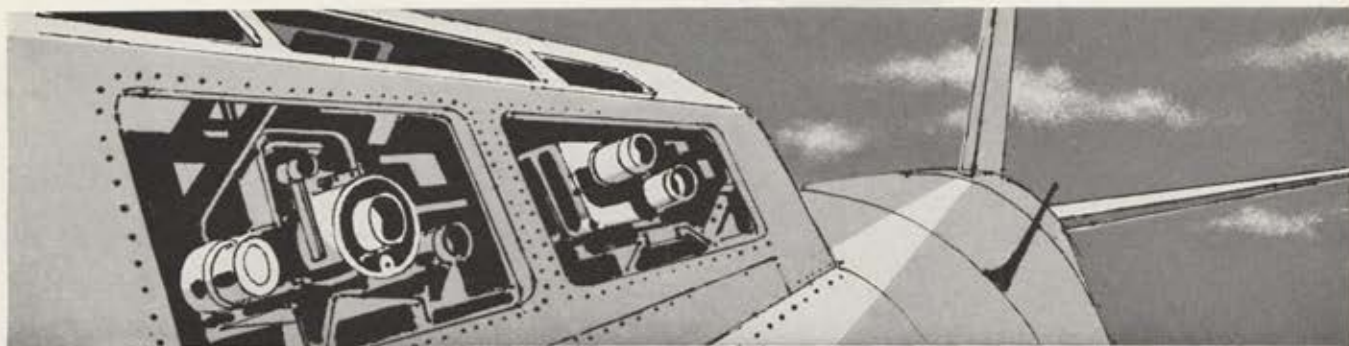
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AN EIGHT-MILE HIGH RESEARCH LABORATORY



Operating at over 40,000 feet in a specially modified KC-135 jet aircraft, a team of "flying physicists" from Aerojet-General's Astrionics Division is conducting a series of unique experiments in the study of ballistic missiles. Their purpose: to obtain highly reliable data on the radiation characteristics of missiles in flight... data which provides design parameters for future warning and deterrent systems. Their research tools: infrared trackers, radiometers, spectrometers, and spatial measurement devices. These studies, known as Project RAMP ...Radiation Airborne Measurement Program...are a joint Advanced Research Projects Agency /Air Force Aeronautical Systems Division project. ■ Astrionics Research has been active in radiation physics for over eighteen years. Its scope of activities encompasses radiation physics, systems research, space physics, and computing sciences. Areas of special interest are advanced detection, tracking, and guidance systems, with applications ranging from surface warfare devices to infrared satellite surveillance systems.



ASTRIONICS DIVISION/AZUSA, CALIFORNIA

EARTH ORBITAL REENTRY

Four spacecraft programs, each engineered to explore diverse techniques for earth orbital reentry, are underway at McDonnell.

MERCURY



MERCURY, America's first manned orbital spacecraft, utilizes a non-maneuverable ballistic reentry. After retro-rockets slow the spacecraft to bring it out of orbit, reaction jets position it for reentry. Mercury's ballistic shape maintains alignment with the drag vector as it follows a ballistic path through the atmosphere to drogue chute deployment at 21,000 feet. Final descent to an ocean landing is accomplished with a 63-foot ring-sail parachute.

ASSET



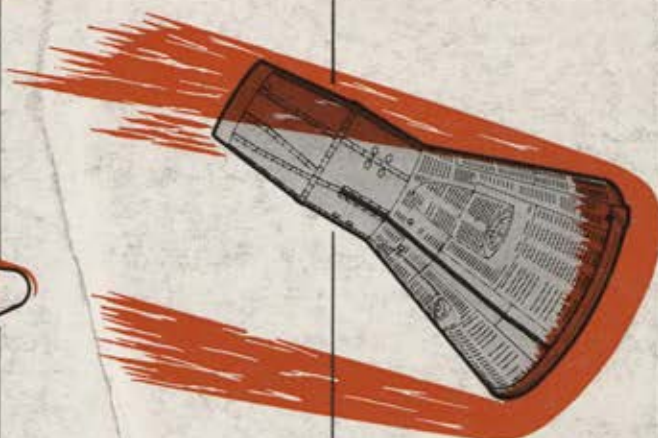
ASSET, an instrumented, unmanned, winged vehicle, will reach speeds of 13,000 miles per hour in sub-orbital flights at altitudes of over 40 miles. This space research program will provide for study of glide reentry technology, refractory materials fabrication experience, and accelerate the development of maneuverable reentry techniques. A parachute landing system enables recovery of vehicle and data package for post flight analysis of test data.

AEROBALLISTIC



AEROBALLISTIC is a word coined to describe the lifting body concepts proven by flights of McDonnell hypersonic missiles from Cape Canaveral in early 1959. The test flights demonstrated precise atmospheric control, the aerodynamic efficiency of an Aeroballistic vehicle and were the first breakthroughs in the design of maneuverable reentry spacecraft. Space missions utilizing an Aeroballistic type vehicle would terminate with a conventional runway landing.

GEMINI



GEMINI is a two-man orbital spacecraft for long duration and rendezvous missions. Upon reentry, the crew will position Gemini's off-set center of gravity with attitude control jets to re-orient the drag vector and create a lift component. This lift will enable the crew to maneuver Gemini to any point in a 28,000 square mile landing area. A paraglider will be deployed in later flights, enabling precise astronaut control of the glide to the landing field.

With MERCURY, ASSET, AEROBALLISTIC and GEMINI Spacecraft, McDonnell is perfecting reentry techniques, shapes, materials and manufacturing processes necessary for the achievement of U. S. leadership in space.

MCDONNELL



FIRST FREE MAN IN SPACE

- Mercury and Gemini are being designed and built by McDonnell for NASA under the technical direction of the Manned Spacecraft Center.
- Asset is being developed and built under the sponsorship of the Aeronautical Systems Division of the Air Force Systems Command.
- Aeroballistic vehicles were developed and tested under contract with the U.S.A.F. and development is continuing with company funding.

ST. LOUIS