OCTOBER 1961 / 50¢

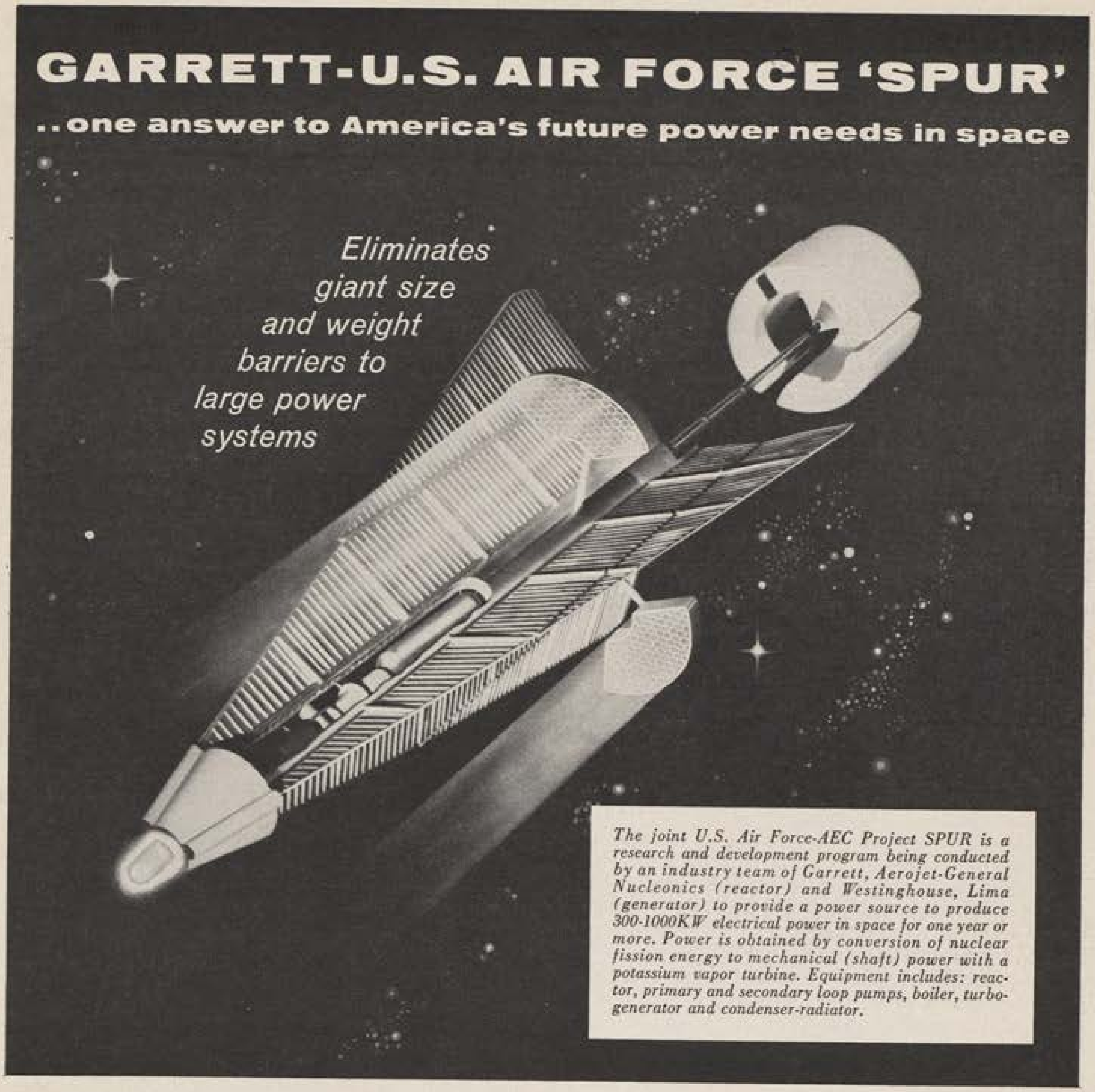
AIR FORCE

and SPACE DIGEST

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

Five Keys to Soviet Strategy


RELIABLE HUSKIE...
WELCOME SIGHT IN MISSILE SUPPORT
The kind of support a missile site may need in an emergency may be technicians, equipment, liaison or surveillance.
Regardless of weather, when support is needed, it is critical and it must be fast and reliable.
In its support missions, the Kaman HUSKIE can carry precious cargo inside, bulk cargo outside.
Built by the people who pioneered turbine powered helicopters, the HUSKIE, already on duty with the Air Force all over the world, has the reliability, capacity, and versatility to become the vital link in the chain of missile site support.
pioneers in turbine powered helicopters
THE KAMAN AIRCRAFT CORPORATION • BLOOMFIELD, CONN.
U.S. AIR FORCE
RESCUE



Long lead time is essential to the development of large nuclear space power systems. Present methods of power generation would require an impractical heat rejection surface nearly the size of a football field for a power output of one megawatt—power which will be needed for critical space missions already in the planning stage.

Garrett's AiResearch Divisions have now completed the initial SPUR design studies and proved the project's feasibility to supply continuous accessory power and low thrust electrical propulsion in space for long periods of time.

Cutting projected 1 MW power systems to 1/10th the size and 1/5th the weight of present power systems under development will be possible because of SPUR's capability to operate at higher temperatures, thereby sharply reducing the required radiator area.

Garrett has been working with the Air Force and the Atomic Energy Commission on SPUR as the prime contractor for more than one year and has more than five years of experience in space nuclear power development. Also an industry leader in high speed rotating machinery, heat transfer equipment, metallurgy and accessory power systems, the company is developing design solutions for SPUR in these critical component system areas.

THE GARRETT CORPORATION

AiResearch Manufacturing Divisions

Los Angeles 45, California • Phoenix, Arizona

Systems and Components for: AIRCRAFT, MISSILE, SPACECRAFT, ELECTRONIC, NUCLEAR AND INDUSTRIAL APPLICATIONS

An Editorial

POWER vs. POPULARITY

By John F. Loosbrock

EDITOR, AIR FORCE/SPACE DIGEST

IT IS strange but true that the Berlin crisis and the Soviet resumption of nuclear testing may prove to be blessings in disguise.

As a result of these actions we may be, as some claim, closer to the brink of war than at any time since the Korean conflict. But the truth is that we have been standing at the brink for some years, with the edge of the precipice lost in the swirling fog of wishful thinking and obscured by the rose-colored glasses of negotiation and competitive coexistence. Now the callous cynicism and naked power politics revealed in recent Soviet actions surely must serve to blow away the fog and strip the blinders from the eyes of those who have sincerely believed that we could bargain usefully and honorably with the Soviets.

Surely it is now clear that the United States must exercise its power and position as leader of the free world and cease behaving as if it were a candidate for an office which history has long since thrust upon it. Surely it is now clear, even to the most woolly minded, that Khrushchev places a higher value on getting ahead, and remaining ahead, of the United States than he does on what Nehru, or Nasser, or Nkrumah thinks. Surely it must now be clear that power and the willingness to exercise it are the best propaganda tools in today's world and that it is difficult to sway the mind of a man who has a hob-nailed boot on the back of his neck.

It is probably true that we scored a minor propaganda advantage in waiting out the Soviets on the resumption of nuclear tests. They did break the ban first, for whatever that may be worth. But it is certain that, over the whole span of the test-ban period, we lost much more than we gained.

The relative insignificance of our test-ban propaganda victory is indicated by the reactions of the so-called "uncommitted" nations meeting recently in Belgrade, Yugoslavia. If Khrushchev was really worried about what the "neutrals" thought, he would not have flexed his muscles just as they were convening. And if the neutrals were truly neutral they would have responded with more vigor than the pallid denunciation of the nuclear test resumptions that came from Nehru, and Nkrumah, and the rest. One can only imagine the roars of indignant anguish that would have poured forth from these "uncommitted" gentlemen had the United States been the first to break the test ban. They forget—or choose to ignore—the fact that it is only the wealth and the power of the United States that has thus far permitted them the luxury of remaining uncommitted.

The United States has yet to learn to be comfortable in the possession and exercise of its power. Even Franklin Roosevelt, who so well understood the uses of domestic political power, sold short on the international power market in his dealings with Stalin. And, since 1945, there have been few instances in which US power was boldly and imaginatively used—possibly only one, the Marshall Plan, which was bold in concept and execution. It was also essentially self-serving in purpose; the restoration of Western Europe was of prime importance to this nation from a political and military as well as an economic standpoint. We reacted well in the Korean aggression, much to the surprise of the Soviets, then failed to press our advantage and wound up with an unsatisfactory stalemate which is still an ever-present source of trouble.

Elsewhere across the world and the years, our record is one of timid holding actions and eventual erosion of our position. We have wished to be loved, rather than respected. We have counted our victories in United Nations roll call while the Soviets have counted theirs in terms of square miles conquered and millions enslaved.

The United States is still the richest and the most powerful nation the world has ever seen. Isn't it time that we used that wealth and that power to extend, rather than merely conserve, our social, political, and economic values? Do we believe in our system or don't we? Is it our aim to bury communism or isn't it? Do we really think a world can exist indefinitely half-slave and half-free? What are we aiming for? We had better decide and then go after it full-bore, or else resign ourselves to an eroding attrition that will ensure the waste of the tremendous total effort we have already poured into the defense of freedom.

Positive action to back up our recently muscular rhetoric may be costly in treasure, possibly in blood. It poses risks beyond those we have thus far found acceptable. We may lose some popularity, but it is dubious that we will lose any substantial support from our friends. And the stakes of the game are high enough to warrant great risks.

One thing is true. If our competitive system is not strong enough to bear the burden of the effort that is required—and that has yet to be mounted—in open competition with the Soviet system in every meaningful aspect of effort, then our system is not what it is cracked up to be, and those who say its decay is inevitable will be proven right. And we will wind up as the proverbial "richest man in the cemetery." The tombstone could bear this further tribute: ". . . and best loved." Mr. K would no doubt like that added touch.—END

A cross-section of the 40 subsystems incorporating 3500 electronic parts which go into TIROS III are framed by two satellites. All components must be thoroughly tested, precisely integrated and must function perfectly if the satellite is to perform successfully.

NASA's Hurricane spotting TIROS III maintains projects' fine performance record

With the successful launching of TIROS III, meteorologists for the first time will see the total cloud formations and measure the radiative energy balance of hurricanes which plague the eastern coast of North and Central America each year. For TIROS III was launched at this time for precisely this purpose. From information gained from TIROS III, meteorologists may learn much more about the birth and life cycle of tropical storms.

TIROS III DESIGN

Although the spacecraft configuration is essentially the same as the previous two highly reliable TIROS satellites, TIROS III has two wide-angle cameras and the National Aeronautics and Space Administration has placed new omnidirectional IR sensors aboard to measure thermal radiation from the earth and sun.

THIRD OF A FAMOUS FAMILY

TIROS III is the third of a highly successful series of experimental weather satellites which were developed, along with the associated ground equipment, for the NASA, under contract with the Goddard Space Flight Center, by RCA's Space Center. All of them have established "firsts" in the United States' space program.

TIROS II established a longevity record for a complex satellite. Still operating after nearly eight months and over 3300 orbits, TIROS II has transmitted over 34,000 photographs to the ground. Aside from its impressive meteorological achievement, historians may well point to this long-term performance as the first to prove that a satellite system could operate reliably for so many months in a space environment thus proving the feasibility of operational satellites.

TIROS I was the first satellite, carrying advanced television equipment, which sent photographs of the earth's cloud cover to meteorologists. From TIROS I's 23,000 photographs, meteorologists found that satellites could be used for weather observation and analysis. The pictorial information is particularly useful in the two-thirds of the world from which few or no weather observations are now available.

CONNOTATIONS FOR THE FUTURE

The TIROS series has proved beyond a doubt that the peaceful uses of space will benefit all mankind. Six nations participated in the utilization of information from TIROS II and more will take advantage of TIROS III. RCA is also already at work on the camera systems and space power supply for NIMBUS, the next generation of meteorological satellites.

If you are a professional physicist, engineer, or mathematician and interested in participating in such challenging projects and stimulating team efforts, contact the Employment Manager, RCA Astro-Electronics Division, Defense Electronic Products, Princeton, N. J. All qualified applicants are considered regardless of race, creed, color or national origin.

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The Most Trusted Name in Electronics

RADIO CORPORATION OF AMERICA

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

AIR FORCE

and SPACE DIGEST

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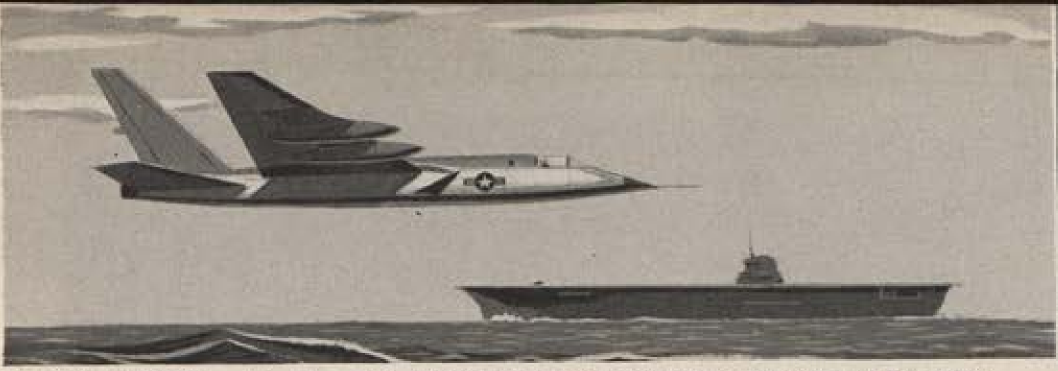
Recent months have swirled with ominous headlines made in Moscow. Berlin crisis. Nuclear tests in central Asia. Boasts of "superbombs" in the making. Gagarin orbits the earth. Titov achieves a seventeen-orbit flight. Military air might on show at Tushino. Russia's leaders mount a studied and massive effort to hobble the United Nations. Instigation in Cuba. Infiltration in southeast Asia. Obstructionism in Congo. All fit an emergent pattern of great and increasing Communist strength, of overwhelming Communist arrogance, of carefully laid Communist plans to conquer the world.

The new bomb tests completed the picture of the cynical Bear rampant. Four days before the Soviets blew up the first device in their series at Semipalatinsk, the United States and Britain proposed negotiation of a total ban on all nuclear tests. Two days after the first Russian shot, on September 3, the US and Britain called for an international pact both "to protect mankind" and reduce "international tensions." The immediate answer was the second Red shot the next day, September 4. Two days and two Red shots later, the Kremlin formally rejected the second western proposal. Russia, it had been, that attacked the US years back for nuclear testing on grounds that it poisoned the political and physical atmosphere. Now, after a three-year, three-nation voluntary ban on tests, the Reds simply went ahead and began to test when it suited their purpose —peace, political morality, or biological dangers be damned.

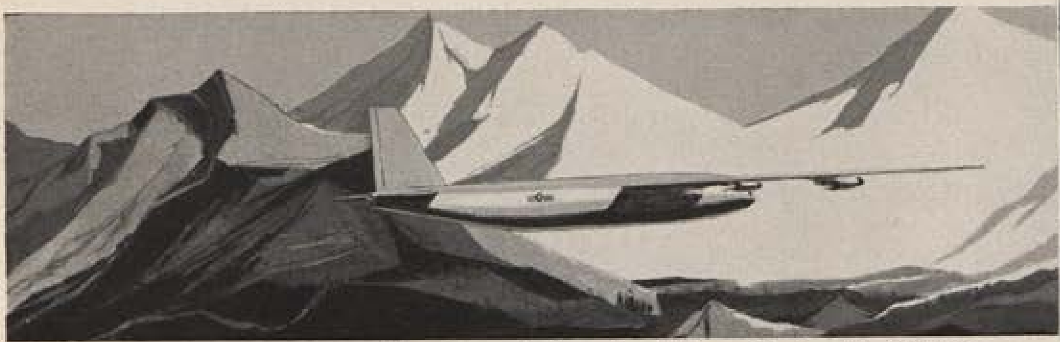
The nuclear blasts put a mushroom-shaped exclamation point to the made-in-Moscow headlines that had gone before. Even more, they emphasized the true peril that faces our free world.—F. M. P.

DEPARTMENTS

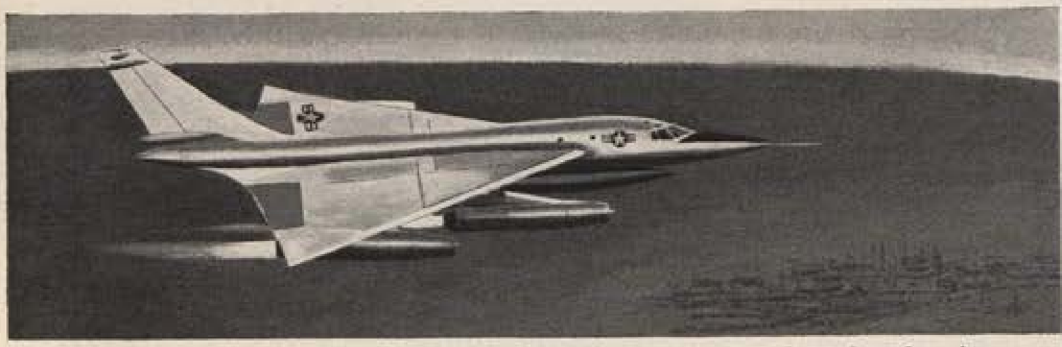
VOLUME 44, NUMBER 10 • OCTOBER 1961



NAVIGATION — Raytheon in 1958 developed a highly sophisticated Doppler Navigation System for the U.S. Navy's A3J. This system was the forerunner of an advanced Raytheon Doppler System now operational in the U.S. Air Force's B-58.



TERRAIN AVOIDANCE — Raytheon designed and is producing the U.S. Air Force's only operational low-altitude target acquisition radar. It is currently installed on the Strategic Air Command's B-52 intercontinental bomber.



BOMB-NAVIGATION SYSTEMS — Raytheon developed and produced an integrated radar-radome for the high performance B-58. With the Raytheon Doppler System (the most accurate in use today, despite severe environmental conditions) these radars are vital elements of the Hustler's bomb-navigation system.

Raytheon brings proven capability to

Experience and achievements give ample proof of Raytheon's ability to develop and produce operational equipments that would enable high-performance aircraft to carry out the deep penetration-low altitude attack mission: ■ Raytheon Doppler navigation radars for the A3J and B-58 ■ Raytheon terrain avoidance radars for the B-52 ■ Raytheon bomb-navigation radars for the B-58 ■ Raytheon low altitude guidance systems for interceptor missiles.

Add to these Raytheon's selection as prime contractor-systems manager for the U.S. Army's and Marine Corps' HAWK and the

the low altitude attack mission

U. S. Navy's SPARROW III missile systems; as producer of the 2nd generation Polaris' advanced guidance system; and as systems manager of the ARPAT Terminal Defense System program.

One of the world's largest scientific-industrial organizations, Raytheon can create the required technology and manage every phase of a complex defense or space system — from early study and design through development, production and field support of operational systems and equipment.

Missile and Space Division, Bedford, Massachusetts.

RAYTHEON COMPANY

RAYTHEON

MISSILE AND SPACE DIVISION

A report on the Free World's F-104

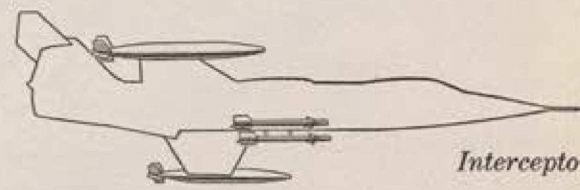
The F-104 Super Starfighter is the best multi-mission * aircraft in the world today. No other aircraft can match it in time-to-climb, or in the variety of bombs, cannons, rockets, and missiles it can carry to Mach 2. And with the right combination of black boxes and weapons, the F-104 comes amazingly close to matching the big one-mission jets at their own specialties. All this–in a small, single-

engine jet that's much cheaper to build, operate, and maintain... much cheaper to fly and service.

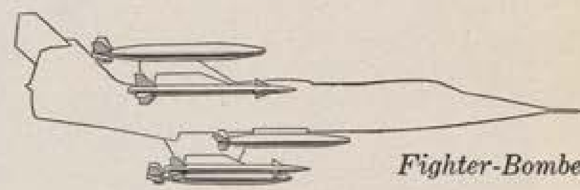
The F-104 is also the instrument that united seven Free World nations in a vast undertaking to forge one weapon for the common defense of all. F-104s are now being built by Belgium, Canada, West Germany, Italy, Japan, The Netherlands, and the U.S. Our allies will build most of their F-104s in their own factories, with their own money. By the mid-Sixties, nearly 2,000 F-104s will be in service.

The F-104 makes sense for our allies. It gives them one plane that will meet any situation for the next 10 or 15 years; gives them interchangeable parts, planes—even pilots; gives them worldwide production that can be stepped up overnight in an emergency.

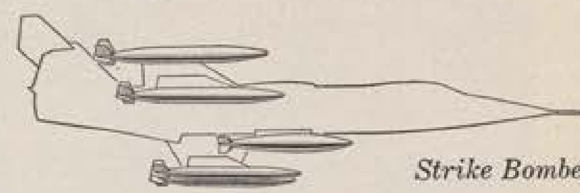
The F-104 makes sense for the U.S., too. Our allies are investing $58-million to develop this advanced version of the U. S. Air Force F-104. They have beefed up the structure and added a lot of new electronics to equip it for its many new missions. Thus, the Super Starfighter brings home the creative contributions of six other great air forces.



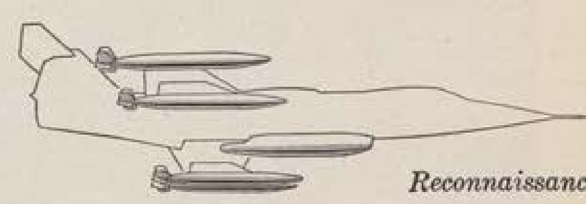
Interceptor



Fighter-Bomber



Strike Bomber



Reconnaissance

LOCKHEED CALIFORNIA COMPANY

BURBANK, CALIFORNIA
A DIVISION OF LOCKHEED AIRCRAFT CORPORATION

Class is now in session

Last month, the first group of Air Force student pilots began active training in the supersonic Northrop T-38. In the T-38 they will learn all the skills and techniques of supersonic flight under modern combat conditions. On completing their training schedule, they will be qualified to check out in the most advanced single or multi-jet aircraft in our inventory.

NORTHROP T-38

AIR MAIL

Moonbeams

Gentlemen: Congratulations on your continuing high-quality editorial content. Every once in a while, though, a seemingly widely versed writer lets his narrowness show through. I hope sometime Mr. Trevor Gardner gets familiar enough with the economics and fundamentals of business not to regard advertising merely as a ". . . 'sink' for our excess energy and wealth" *(August 1961 issue, "We're Going to the Moon . . . Does the Public Know Why?", page 58).*

Ronald H. Beam
Cedarville, Ill.

Space Chimp

Gentlemen: . . . We were delighted with the August '61 treatment of "Spaceman's Best Friend—the Chimp," reprinted from our publication, and were particularly gratified with the generous end-of-the-article acknowledgment to United Aircraft and the *Bee-Hive.*

Your magazine, as usual, is loaded with readability this month. You can be sure that each issue gets a thorough reading in our shop.

Francis J. Giusti
Ass't. to Dir. of Public Relations
United Aircraft Corp.
East Hartford, Conn.

St. Clement Danes

Gentlemen: The short write-up on St. Clement Danes *[August '61, page 92]* reminded me that when fund-raising was started for the rebuilding of this historical church, I was Surgeon of the Third Air Force, commanded by Roscoe "Bim" Wilson. I wrote a letter to the Chairman of the Fund Committee stating that the Medical Service of the USAF in England would be pleased to donate a stained-glass window in memory of RAF and AAF medical personnel if this was deemed appropriate.

In a very courteous and appreciative reply the chairman wrote that there were to be no stained-glass windows but if we wished we could contribute to General Wilson's fund to provide an organ for the restored church. We were naturally pleased to do this, and enough funds were raised not only to do this but also to provide an annual lecture each year from Oxford and Cambridge in memory of deceased medical personnel. The organ, by the way, is one of the finest in Europe.

The little poem in its entirety might be of interest to those unfamiliar with the bells:

Oranges and lemons say the bells
of St. Clements.
I'll give you five farthings, say
the bells of St. Martins.
When will you pay me? say the bells
of Old Bailey.
When I grow rich, say the bells of
Shoreditch.
When will that be? say the bells of
Stepney.
That I don't know, say the great
bells of Bow.

Brig. Gen. C. H. Morhouse,
USAF, MC
APO, San Francisco, Calif.

● *Back in '55* Air Force Magazine *participated in the campaign to raise funds for the restoration of St. Clement Danes. General Morhouse's letter reminds us that the first donation received came from a doctor who had served with the AF medics.*—The Editors

To the Lightning Drivers

Gentlemen: I noted with interest the article by Frederic M. Philips in the June '61 issue of Air Force Magazine, "Back in the Jug—After Twenty Years," which commemorated the first flight of the P-47 Thunderbolt.

I was among the first trainees in the P-38 Lightning (adapted as the F-4 and F-5) at Peterson Field, Colorado Springs, in 1942. Subsequently my unit, the 17th Photo Reconnaissance Squadron, began its part of the campaign from Guadalcanal to surrender. Our pilots made many acquaintances among the P-38 fighter squadrons during the campaign because of our common interest.

Many of my buddies at Colorado Springs headed for Europe at the same time we headed west. After these first overseas tours, many of us were together again at Oklahoma City and at Coffeyville, Kan., bases as instructors in photo reconnaissance training.

By means of our annual squadron newsletter (edited by William Getzendaner, 2431 Holt Ave., Los Angeles 34, Calif.) some of us have been trying to stimulate a squadron reunion for five years, but so far without success.

Perhaps the Thunderbolt reunion suggests our answer. Individual squadron reunions could be supplemental to a gala gathering of all of us Lightning drivers throughout the country, and the world.

I have no particular preference as to where such an event should take place, or exactly when. But I would certainly work hard to support such an occasion, and I feel sure we could do better than the Thunderbolt boys, just as we surpassed them with our Lightnings throughout the war.

Richard D. Burns
Norwich, N. Y.

Magazines for Libraries

Gentlemen: This is just a suggestion from my experience with my copies of Air Force/Space Digest. I am not a "fly-boy" but served with the Army Air Corps and then was absorbed into the Air Force and retired for line-of-duty disability. I have since, as a member of the Air Force Association, greatly enjoyed the publication but, of course, cannot absorb the more technical subjects.

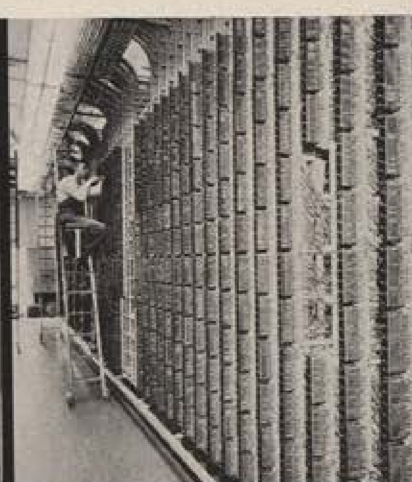
After I glean all I can from the magazines I take them to the local high school librarian. Upon inquiry after many months of this the librarian assures me that they are about the most sought-after reading that comes in. The boys, especially the seniors, and even some of the girl students, have become avid readers, particularly of the technical articles.

Maybe others do this same thing but I say, pass them on to these kids in your community. Who knows but there may be another LeMay, a Bong, an Astronaut, or a Lunarnaut in these schools today.

Lt. Col. Horace M. Witbeck,
USAF (Ret.)
Al Tahoe, Calif.

(Continued on following page)

Electrowriter® System expedites assignments for General Telephone of Florida



Electrowriter instruments play an important role in prompt, accurate customer service for the General Telephone Company of Florida at St. Petersburg.

The dispatcher writes authorizations for new and changed telephone numbers directly on the Electrowriter Transmitter; these authorizations are instantaneously recorded in writing by the Central Office's Electrowriter Receiver, four miles away, where wiring and switch racks are located.

Results? Assignments handled quicker, in writing, requiring only one person's time. Substantial saving in manhours are achieved. Busy frame men are no longer interrupted to receive assignments, for the Electrowriter Receiver takes written messages unattended. And permanent, written records streamline record-keeping.

NOW..."Write By Telephone"

You can "Write By Telephone" over regular dial networks* or private lines for alternate written message and voice service. Find out how your company can increase its efficiency and cut costs with Electrowriter Communication Systems. Send for full information.

*Electrowriter instruments are accepted for use over local and long distance facilities of the Bell System, General Telephone System, and independent telephone companies.

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® ELECTROWRITER
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U. S. PATENT OFFICE

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Gentlemen: I have, ever since becoming a Charter Member in the AFA, saved all my copies of Air Force Magazine. I would like to offer these to any group or school which would use them in their libraries as reference material.

I would also like to hear from anyone who has an extra patch insignia of the 47th Bomb Wing, 450th Bomb Group, 721st Bomb Squadron (known as "Cottontails" in World War II) which could be mailed to me.

William Kushnier
46 - 38th Street
Irvington, N. J.

Search Department

Gentlemen: Our chronologies have been started for and placed at many institutions, including the US Air Force Academy, US Air Force Museum, the Smithsonian Institution, Carnegie Museum, British Museum of London, Yale University Library, and other colleges and museums.

We are now trying to obtain information, such as the name or license number, of a B-29 which flew Air Force Day, September 18, 1948, from the Azores to Cleveland, Ohio. We'd also be interested in knowing the names and capacity of each flyer.

Sam & Wm. H. Krinsky
Aero Club
GPO, Box 1086
New York, N. Y.

Gentlemen: I'm trying to locate an ex-Air Force buddy, Arthur F. Nisbet. We were both stationed in Hochst (Eschborne), Frankfort, Germany, during the year of 1946. He was a corporal at that time. Can anyone give me a good lead?

Sylvester P. Lipiec
508 Baltic Ave., Box 49
Caspian, Mich.

Different Kind of Battle

Gentlemen: Peoples of the world had better spend less time fighting one another and pay more attention to fighting the forces of nature, such as insects, water shortages, and diminishing resources—things that have the final say about how we live.

William R. Sullivan
Los Angeles, Calif.

UNIT REUNION

388th Bomb Group (H)

Thirteenth annual reunion is being planned for next year, with site and date to be announced later.

Contact: 388th Bomb Group (H) Ass'n
863 Maple St.
Perrysburg, Ohio

How to lock on 28,000 frequencies—*blindfolded*

The General Dynamics/Electronics SC-901 single sideband transceiver speaks with all the authority and range of 100 watts, yet measures only 14" x 17" x 17" overall, weighs a trim 70 pounds. All in all, a compact, rugged, easy-to-operate and highly reliable unit.

Digital tuning gives you fast, precise selection of any one of 28,000 frequencies – from 2 to 30 megacycles – and locks on. Frequencies have a stability of one part in 10^7 per week. Highly transistorized, the unit draws less than half the power of comparable AM equipment; and where tubes are used, a unique heat-sink design eliminates forced air cooling.

General Dynamics/Electronics digitally tuned SSB equipment can be used with a 1 KW power amplifier now under development in our laboratories. It's one result of General Dynamics/Electronics communications development programs for all branches of the armed forces. If you're interested in the SC-901 or other advanced communications – write:

Military Products Division
1400 North Goodman Street
Rochester 3, New York

GD

GENERAL DYNAMICS | ELECTRONICS

What's New With ★ RED AIRPOWER

Here's a summary of the latest available information on Soviet air intelligence. Because of the nature of this material, we are not able to disclose our sources, nor document the information beyond assurance that the sources are trustworthy.

The giant MI-6 helicopter, NATO code-named Hook, is scheduled within one year to enter service with Aeroflot, the Soviet civil airline. This aircraft, the world's largest helicopter, grosses out at more than 70,000 pounds. It first appeared in public in 1957 and began setting world records in October of that year. One of its current records is a lift of 22,050 pounds to a 16,045-foot altitude.

Most Aeroflot airplanes go through about five years of flight tests before entering civil service. The MI-6 appears to have completed such a program.

Originally the Soviets said that the MI-6 was designed specifically to transport complete geological survey parties around Siberia. During the impressive summer air show at Tushino Airport, however, MI-6s carried Red Army troops and large ballistic missiles. In addition, a large flying crane, developed with MI-6 rotor and engine systems, was displayed for the first time at the show.

° ° °

Pilot escape capsules that may be employed at speeds up to about 15,000 mph reportedly have been developed by the Soviets. The latest models of the completely enclosed capsules are said to be catapulted clear of an aircraft by small rocket engines. Four telescoping arms are automatically extended to stabilize the capsule as it leaves the aircraft.

Soviet sources also describe designs in which the entire front end of an aircraft is detachable and serves as an escape capsule on hypersonic aircraft.

Russian designers feel their craft need capsules to provide for escapes at very high speeds. US experts disagree. The US view is that a vehicle such as the boost-glide Dyna-Soar is its own escape capsule at high speed. If trouble develops at hypersonic speed, this theory states that even the most sophisticated escape mechanism would be of little value. Current plans for the Dyna-Soar include a standard ejection seat for use below Mach 2. The Reds are apparently putting their capsule views to work.

° ° °

Alexander Yakovlev, renowned Soviet aircraft designer, made these predictions in a recent speech:

• **Manned spaceflight capabilities may hold the key to mankind's future; it will surely be a major factor in deciding the fate of nations. This view contrasts with the opinions of some major public figures in the US. But it only serves to underline the heavy Soviet commitment to a military space force.**

• Russia will develop a Mach 2.3 to 3.0 supersonic commercial transport in the "not too distant" future. Engines, fuel, and high-temperature structure are still major problems.

• Another Russian accomplishment in the near future will be development of high-altitude, high-speed VTOL aircraft for civil and military use. These aircraft will render the traditional airport "obsolete"—undoubtedly to the great relief of Soviet airport construction authorities who have been falling behind in their work assignments.

• The "full potential" of the helicopter has not been achieved. It has a bright future for short-range, high-lifting-capacity missions.

• • •

Conflicting reports on the deceleration systems used on Soviet space vehicles continue to come in from the USSR and Iron Curtain countries. One of the latest versions described by Communists strongly resembles the large drag brake proposed by AVCO a few years ago.

A knowledgeable Hungarian, Erno Nagy, Secretary of the Astronautics Department of his nation's Federation of Technical and Scientific Societies, has given this explanation of the Russian system:

"A braking rocket . . . decelerates the capsule by a few hundred meters a second to take it out of orbit and put it into a flat elliptical course. . . . On this course, which is only a few degrees from the horizontal, the capsule decelerates constantly. This is due to special braking surfaces which are opened out from its sides so that its resistance increases as it reaches denser atmosphere. . . . Once the space capsule has entered the densest atmosphere, a series of parachutes open beginning with the smallest ones, followed by successively larger ones so that the capsule touches the ground relatively gently."

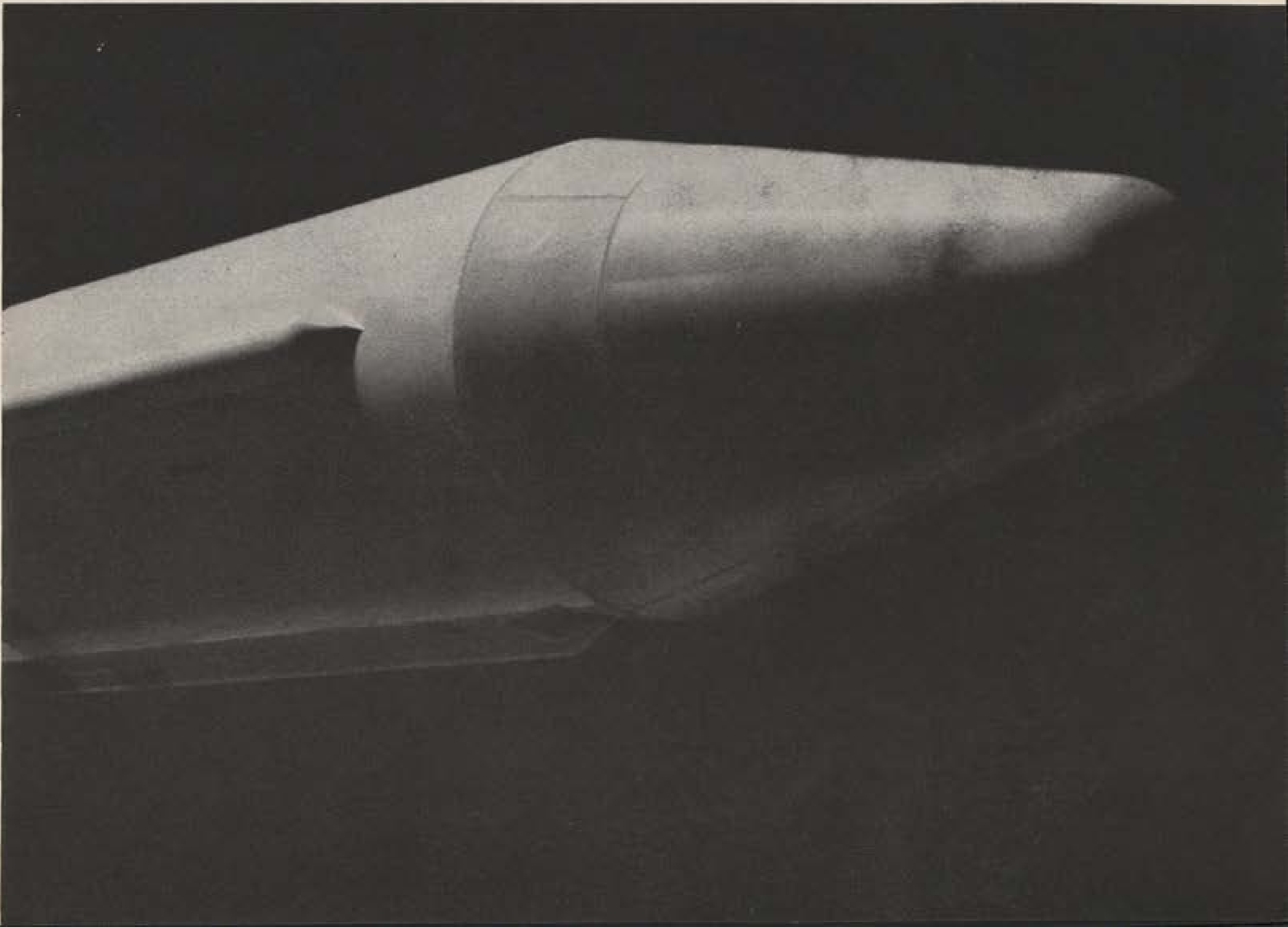
Soviet sources have made repeated references to the use of "drag brakes" or large surfaces which can be extended from the *Vostok* spaceship or other vehicles. If this is the system used by the Russians, there is little doubt that the vehicles can be controlled by the pilot during reentry.

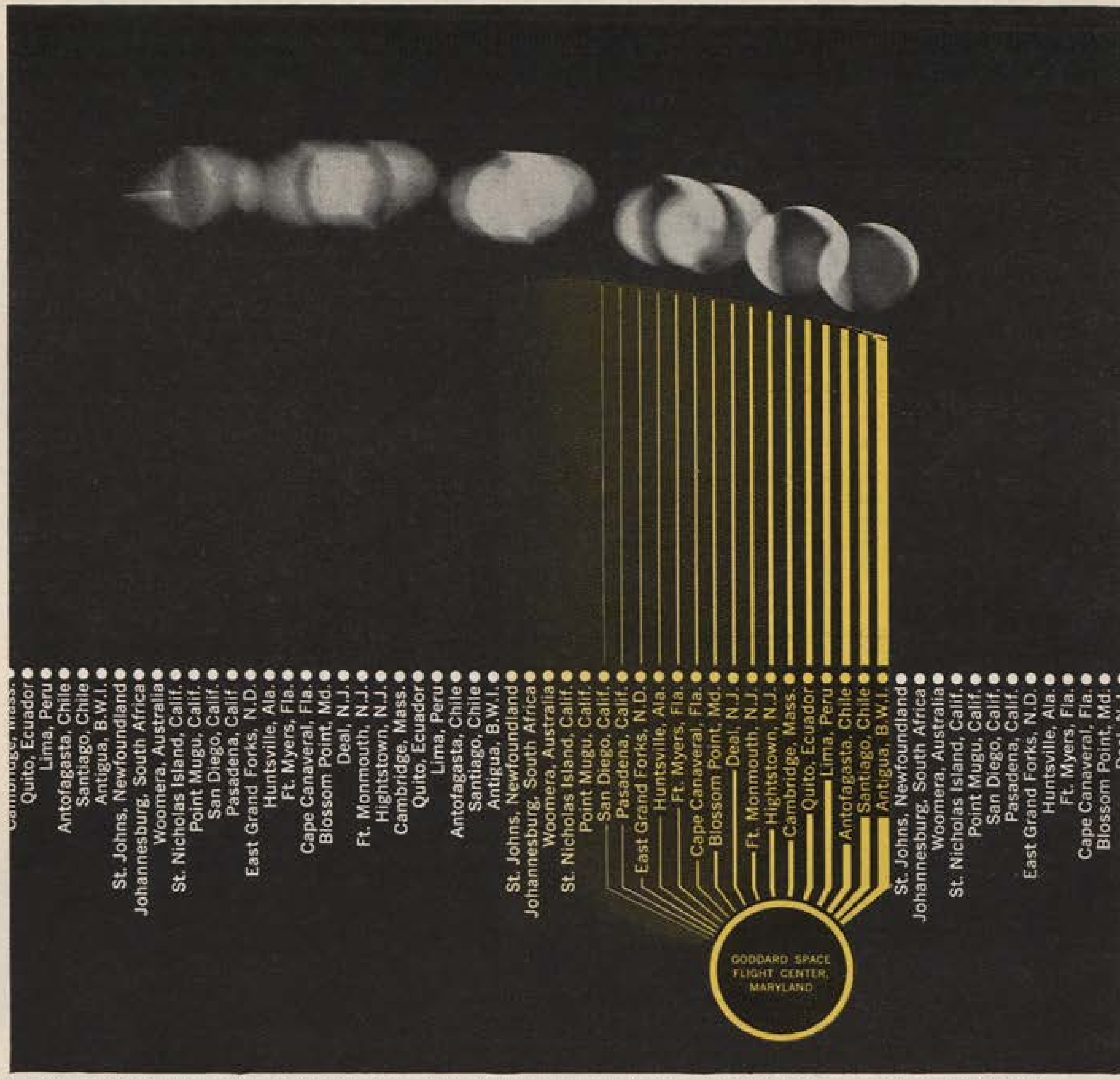
Such a flap-control system is being considered now for installation on an improved Mercury capsule in the US.

An ultimate goal of the Soviet space program is to create fully automatic systems to control the condition of man in space. One of the requirements during the development of such a system is a very small multichannel telemetry transmitter about the size of a package of cigarettes.

The Russians report good progress in the development of such a transmitter. They also point out the fact that this type of miniaturized equipment is already available in the United States.

To provide a complete picture of man's physical condition in space so that the automatic control system can be designed, the Soviets say that the following information must be telemetered to the ground over a long period: biocurrents in the heart, heart sounds, blood pressure, frequency and depth of breathing, biocurrents in the muscles to show muscle tension and coordination of movements, motion activity recorded by contact-type, tensometric, and piezoelectric sensors, and probably the quantity of inhaled and exhaled air.—END





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AIRPOWER in the news

Claude Witze
SENIOR EDITOR, AIR FORCE MAGAZINE

Why K. Doesn't Believe Us

WASHINGTON, D.C.

By this time there no longer can be any doubt about it. Nikita Khrushchev does not believe that the United States, or its allies, will use nuclear power to halt his Hitlerian march. Our conduct since approximately the first of the year has convinced him that the deterrent is not credible.

Let us be elementary about this. The only thing that has maintained an uneasy peace in recent years was our possession of overwhelming nuclear power, the vehicle to deliver this power on target, and the general understanding that we would use it if necessary. This was made clear, for example, by President Eisenhower in 1958. He said we would never fight a ground war in Europe and refused to consider bolstering our garrisons there for that reason. There was a retreat by the Kremlin after he said it.

Indeed, so credible was our deterrent strength that critics on both sides of the Iron Curtain worried publicly about the "trigger-happy" Americans. Without condoning trigger happiness, the fact remains that the world *believed* we were willing to use nuclear power in the defense of freedom.

Now all this has changed. We have nuclear capability without nuclear credibility, and Khrushchev no longer fears what he believes will not be used. And he therefore is no longer deterred.

It is fairly easy to get an argument on this subject in Washington if you charge openly that the credibility of our military might has been impaired by the diplomats. It is denied that Dean Rusk, the Secretary of State, ever suggested that we are turning away from nuclear weapons. The Defense Department, paying more attention to conventional warfare but still spending most of its money for strategic systems, says merely that it is adding more varied arrows to its quiver and that we must be able to use all of them in our bow. The White House says our nuclear weapon stockpile is big enough, implying we are as fully armed as we need be for this kind of war.

It is a difficult thing to prove that the inner councils of the government are being somewhat unrealistic and that Mr. Khrushchev finds some sound reasons for his assumptions. This column submits that his doubt about the credibility of our military might, which is to say our determination to use it, is justified on the basis of the published record.

Secretary McNamara: We will not use nuclear weapons if we can avoid it.

General Kuter: Only nuclear defense can assure "weapon kill" in wartime.

Here is an extract from the hearings of the Senate Defense Appropriations Subcommittee on the budget for fiscal 1962, pages 1667 and 1668. The principals are Secretary McNamara and Senator Leverett Saltonstall, a Republican from Massachusetts:

SENATOR SALTONSTALL: . . . I have just one more question which excites my curiosity, Mr. McNamara. You ask in here for additional inventories of nonnuclear Nike-Hercules. What would be your purpose in asking for an inventory of nonnuclear Hercules? Why should they not be just as powerful as they can be if you have to use them at all?

SECRETARY MCNAMARA: We have Nike-Hercules in Europe, and we can see circumstances under which we would wish to utilize these batteries without nuclear warheads, avoiding if possible the immediate escalation to nuclear war that might well follow the use of nuclear warheads in those batteries.

SENATOR SALTONSTALL: If you use the Nike-Hercules in

(Continued on following page)

this country presumably in a defensive attack, you would use nuclear, would you not?

SECRETARY MCNAMARA: Are you thinking of Nike-Zeus? [Zeus is under development as an anti-ICBM weapon system.]

SENATOR SALTONSTALL: No, sir; Nike-Hercules.

SECRETARY MCNAMARA: In this country I believe I am right in saying we are prepared to use either nonnuclear or nuclear warheads. If you have an individual aircraft, Senator, you don't need a nuclear weapon.

SENATOR SYMINGTON: I did not hear that.

SECRETARY MCNAMARA: If you have an individual aircraft a nonnuclear warhead is a very effective weapon. But if you get groups of aircraft, a nuclear weapon is a more effective weapon.

SENATOR SALTONSTALL: It just seems to me, Mr. McNamara, and I see your point in Europe in not getting into a nuclear war, but when you are firing a nuclear Nike-Hercules you are fighting to defend a city from a single airplane or a group of airplanes. It would seem to me that you would want then to use the strongest possible defense you could possibly have.

SECRETARY MCNAMARA: We believe we should be prepared for both eventualities. The cost is relatively small. We think the possible effect of initiating the use of nuclear weapons with a Nike-Hercules attack on a relatively small force attacking a city should be avoided if possible. At least we should have the option at that particular time and it is for that purpose that we are proposing the purchase of these particular weapons.

SENATOR SALTONSTALL: Thank you.

• • •

Here endeth the illustration. What the Secretary of Defense has announced is that if a "relatively small force" of Russian bombers is detected and appears on the board at Headquarters of the North American Air Defense Command, we will try to beat them off with conventional warheads. This means that the bombers which penetrate our defenses will be free to drop their nuclear bombs on New York or Detroit or Wetumpka. The advantage we will gain from this is that we will be free to say we did not "escalate" the war to nuclear proportions, that the dirty Russians did that.

This approach to our defensive problem, knowing that the Russians have more than 1,000 modern airplanes in their long-range bomber force, is contrary to the soundest military opinion available in the western world. For example, Gen. Thomas D. White, recently retired USAF Chief of Staff, said that "effective deterrence includes the possession of military forces to deter war; and should war occur, the military strength to prevail . . . the ability to prevail is what provides real and effective deterrence."

It follows that if we do not intend to prevail, which we could not do with conventional warheads in case of a bomber attack, we can no longer deter. This is a fact that Mr. Khrushchev can assume from reading Mr. McNamara's testimony before the Senators.

There is, on the record, sound and up-to-date military opinion on this subject. It comes from USAF Gen. Laurence S. Kuter, Commander in Chief of NORAD, who holds that Russian bombers remain a threat "in increasingly sophisticated forms" and that his command must be capable of meeting this threat. In a speech last month at the Canadian International Air Show in Toronto, General Kuter talked about how NORAD plans to approach this problem. He said that hostile bombers will be engaged as far out from North America as possible and that the fight will increase in intensity as the bombers near the target. He said increasing numbers and types of weapons will be used to provide "defense in depth with a family of weapons." Then the General met the issue raised by the Secretary of Defense:

"I am happy to report," he said, "that the percentage of NORAD's weapons which are nuclear is steadily increasing compared with the number of conventional high-explosive weapons.

"You may well ask why. As military men in NORAD, we are not at all interested in just having a bigger bang in our weapons. We recognize, of course, the advantage of the much greater area of effectiveness of a nuclear weapon which could wipe out several aircraft in a formation, whereas, a high-explosive weapon would be expected to knock down only one airplane."

In this, the General was confirming part of Mr. McNamara's concept. But then he added to the concept, providing some of the facts of life about air war in the nuclear age. Said he:

"In military terminology, we expect the high-explosive [conventional] weapon to obtain 'carrier kill'—that is, destroy a bomber or an air-supported missile, either of which could be carrying a very powerful [nuclear] bomb. This high-explosive weapon will not, however, assure 'weapon kill.'

"'Weapon kill,' which could be expected of an accurately placed nuclear air defense weapon, would not only destroy the carrier but would also destroy the bomb which is being carried.

"It is not at all unreasonable to expect that enemy bombs will be designed with dead-man fuzes. These fuzes permit the bombs to detonate on impact even though the aircraft or other device which is carrying them has been shot down in flames or has disintegrated in the air. *There is, therefore, enormous military advantage in the use of a nuclear air defense warhead which will kill the weapon and not just the carrier.*"

These are facts which were not presented to Senator Saltonstall. If they are known by Mr. McNamara, that was not made clear in his testimony.

General Kuter brought the point home to his Toronto audience by using that city's air defense problem as an illustration. He asked them to assume that a bomber attack threatened on a day when northwest winds prevailed.

"On such a day," he said, "a bomb or an air-supported missile with a five-megaton nuclear warhead could be released by an aggressor flying rather high downwind from the northwest. His weapon might be intended to burst on the surface and completely devastate Toronto's industrial and population resources lying within a radius of about five miles from ground zero. Moreover, fatal and very serious injuries might be inflicted on exposed personnel over a larger area of about twelve miles radius. Those living between twelve and fifteen miles, although subject to injury, would have a good chance of living.

"To obviate this holocaust, suppose that an interceptor airplane with a high-explosive [conventional] weapon had knocked the bomber out of the sky as it was approaching and when it was still fifty miles from Toronto. If the aggressor's bomb then detonated when it hit the ground, it is true that the buildings and factories of Toronto would be left standing, but it is also true that in about three hours or even less, heavy radioactive fallout from this large ground burst might prove fatal to unprotected persons throughout the entire city. Additionally, though the industrial facilities and residential areas remain standing, lethal

(*Continued on page 21*)

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A CREATIVE TEAM OF SCIENTIFIC, ENGINEERING AND PRODUCTION TALENT radioactivity might remain for about a week and be dangerous long after that.

"In this illustration the people in the Toronto area could have suffered as many casualties as if the bomb had proceeded on to its assigned target.

"On the other hand, had an interceptor fired a nuclear air defense weapon and destroyed the bomber and its bomb fifty miles away from Toronto, those people living in the city would probably not have seen or heard the detonation.

"With weapon kill, the bomb is destroyed, and only minor contamination is to be expected from the defensive weapon and the bomb debris. This contamination is of no appreciable significance. A few casualties might be expected from falling debris. This cost in human lives would be small, very small, compared with the hundreds of thousands of casualties if only the high-explosive air defense weapons were used."

Then General Kuter added some remarks bearing on the defense philosophy outlined by Mr. McNamara. Having told how this approach to air defense can increase the danger to our own people, he said that his recital was only "the military man's evaluation of the advantage of the nuclear air defense weapon over the high-explosive air defense weapon."

"I want to make perfectly clear," the NORAD Commander said, "that I have given you the military viewpoint of a hypothetical illustration, and as a military man I am in no position to criticize or to discuss the national policy of either of the two governments I serve. In our democracies, however, the military factors to be considered along with other factors in establishing national policies must be known by the citizens and the legislators and policy-makers whom they elect."

Toronto is not very far from Washington, as the bomber flies, and neither is Colorado Springs, home of NORAD. It is difficult to understand how the policy-makers can pretend to be so far from the realities of our air defense problem. So far, there has been no challenge offered here to the doctrine offered by Mr. McNamara, which presumably is that of the White House. This doctrine, by damaging the credibility of the deterrent, has increased the peril of war.

We don't know what Nikita Khrushchev believed when he took off his shoe to pound the podium at the UN. But we know what he believes now, and we know why he believes it.—END

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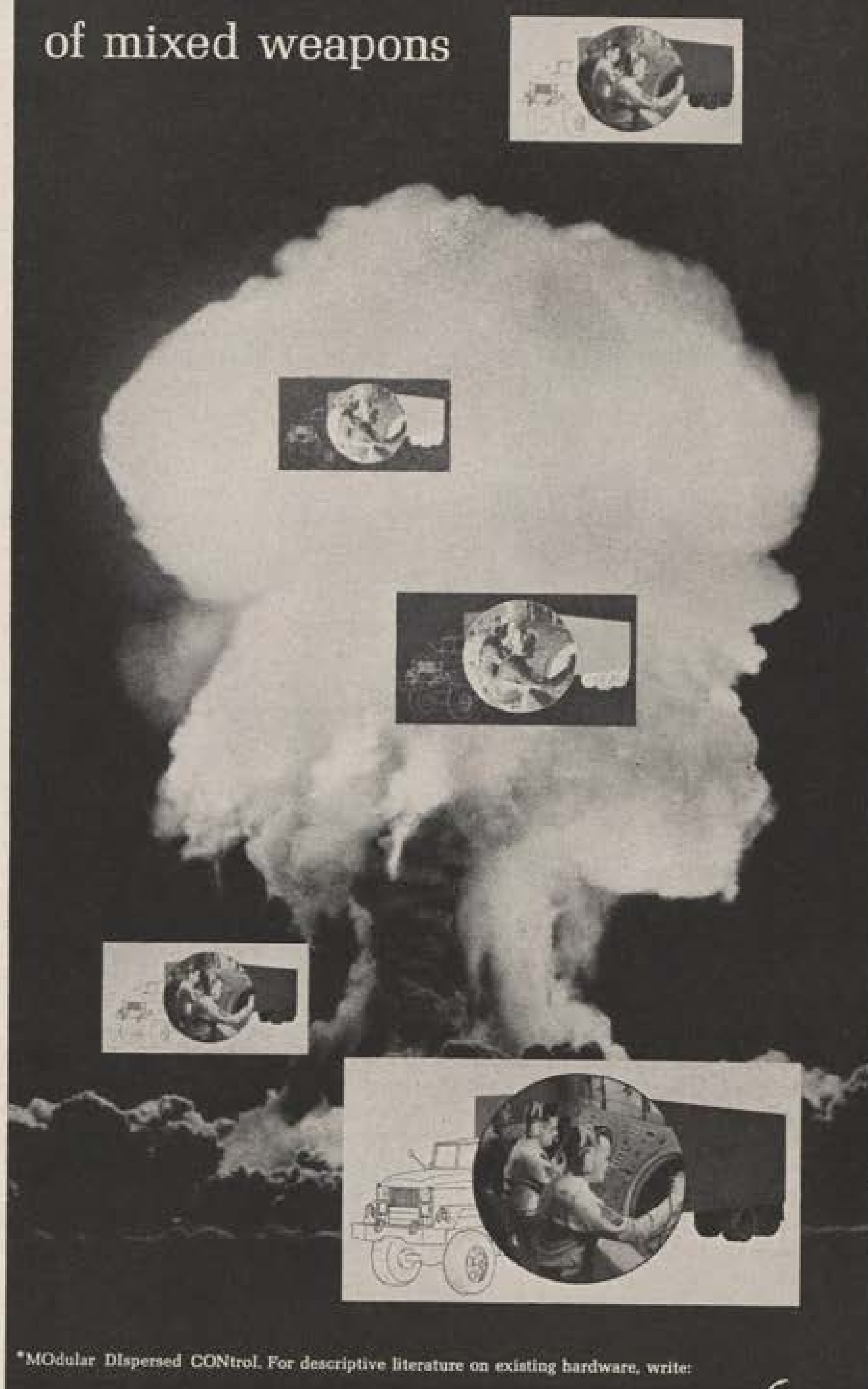

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News,
Views
& Comments

AEROSPACE WORLD

Frederic M. Philips
ASSOCIATE EDITOR, AIR FORCE MAGAZINE

August 28. The United States and Britain propose negotiation of a total ban on all nuclear tests including the smallest tactical atomic weapons. The proposal, at run-on Geneva nuclear talks, hinges on Soviet acceptance of strong controls. Russia has repeatedly rejected such arms controls.

August 31. The Soviet Union announces that it will resume nuclear weapon test explosions because the "hypocritical" US and its allies are planning such tests. Russia boasts that it will develop "a series of super-powerful nuclear bombs." The US charges that Russia is "increasing the dangers of a thermonuclear holocaust," declares that Soviet "atomic blackmail" will not work.

September 1. Russia sets off an atmospheric nuclear test explosion near Semipalatinsk in central Asia, about 1,650 miles southeast of Moscow.

September 3. The United States and Great Britain jointly propose to Russia that "nuclear tests which take place in the atmosphere and produce radioactive fallout" be banned "to protect mankind" and reduce "international tensions." The two powers ask for a reply by cable from Premier Khrushchev and a meeting in Geneva "to record this agreement" not later than September 9.

September 4. Russia explodes a second nuclear device said to be "in the same range" as the first, somewhat larger than the bomb dropped on Hiroshima in World War II.

September 5. Russia explodes a third nuclear device in the atmosphere. President Kennedy responds with the announcement that the United States will resume nuclear tests in the laboratory and underground with no fallout. He says that the US-British call for an agreement to end nuclear tests "remains open until September 9."

September 6. Russia explodes a fourth nuclear device in the atmosphere "east of Stalingrad," or about 1,600 miles west of the scene of the earlier blasts. John A. McCone, former Chairman of the Atomic Energy Commission, tells reporters after conferring with President Kennedy that the Russians probably "would follow these with larger-scale tests."

From Alaska comes the report that radioactive fallout from the explosions has been detected at Anchorage, Alaska.

Such was the timetable for a new element of cold war crisis. The US-British-Russian moratorium on nuclear tests had lasted since late 1958.

☆

The US armed forces called up the Reserves, some of them, this month as part of the buildup outlined by President Kennedy in his crisis speech on July 25. At the time, the President pointed out that the Berlin threat was but a part of a grim global challenge to America and its allies. Russia's resumption of nuclear tests dramatized the extent of this challenge.

For the Air Force, the immediate callup came to 23,600 men. The all-service total was 76,500. Nine Air National Guard wings—fighter, reconnaissance, transport—and one tactical control group were federalized. Two Air Force Reserve troop carrier wings were called (*see "Ready Room," page 79*).

The Air Force announced that it hoped to augment its strength further by voluntary retention of key personnel. Failing this, USAF was prepared to "retain involuntarily" in a range of officer and airman career skills essential to modern weaponry.

USAF, in an important show of crisis readiness, also dispatched four squadrons of F-100 Supersabres—seventy-two planes—to Europe in mid-September for NATO's Exercise Checkmate. The squadrons were the 356th of the 354th Tactical Fighter Wing, Myrtle AFB, S. C., the 614th of the 401st Tac Fighter Wing, England AFB, La., the 429th and 523d of the 832d Air Division, Cannon AFB, N. M. Announcement of this deployment of planes came less than twenty-four hours after Russia accompanied her renewed nuclear testing with announcement of air, sea, and missile maneuvers in the Barents and Kara Seas north of Scandinavia and the Soviet Union.

☆

Two records and a maiden flight highlighted the hardware news during the month:

★ A Navy-McDonnell **F4H Phantom II** set a low-level speed mark on August 28. Flown by **Lt. Huntington Hardisty,** with **Lt. Earl H. DeEsch** as radar intercept officer, the plane negotiated a three-kilometer course over the White Sands, N.M., Missile Range at an average speed of 902.7 miles an hour. Pilot Hardisty covered the 1.8-mile course twice in each direction at altitudes between seventy-five and 100 feet. It was the fourth record in the past year for the McDonnell plane and the nineteenth record set by a plane powered by General Electric J79 engines. Most recent Phantom II mark was two hours and forty-seven minutes across the country in May in the Bendix Trophy race. Best previous low-altitude speed record, 752.9 miles an hour, was established by another Navy pilot in 1953.

★ **Jacqueline Cochran,** world's record-holdingest woman aviator, president of the National Aeronautic Association, and a lieutenant colonel in the Air Force Reserve, broke the women's speed mark for fifteen kilometers on August 24. Miss Cochran attained a speed of 844.2 miles an hour in a Northrop **T-38 Talon** trainer over Edwards AFB, Calif. This exceeded a women's mark of 715.2 miles an hour

Month's fastest. At left, Navy Lieutenants E. H. DeEsch and Huntington Hardisty, with McDonnell Phantom II they flew to new mark for low-level flight at White Sands, N. M. Above, a triumphant Jacqueline Cochran poses in tassel-topped beret right after setting international women's speed record for fifteen kilometers at Edwards AFB, Calif. Official timers clocked her at an average 844.2 miles an hour, flying Northrop Corp.'s T-38 Talon jet trainer.

set by Frenchwoman Jacqueline Auriol in a Mystere IV monoplane in May 1955. Miss Cochran holds some seventy flight records. In 1953, at the controls of an F-86 Sabrejet, she became the first woman to fly faster than the speed of sound. During World War II Miss Cochran organized, trained, and led more than 1,000 woman pilots in the Women's Air Force Service Pilots (WASPs), who ferried planes from plants to airfields.

★ **Discoverer XXIX,** another in the important and continuing USAF satellite series, went into polar orbit August 30. It was the nineteenth Discoverer to orbit. Two days later, on September 1, three USAF paradivers pulled the satellite's capsule from the Pacific. **SSgt. Leote M. Vigare, SSgt. William V. Vargas, and A1C Charles W. Hoell, Jr.,** parachuted from a C-119 with a twenty-man life raft to perform the recovery north of the Hawaiian Islands. Vigare and Vargas had also taken part in USAF's first such recovery of Discoverer XXV's capsule. A Navy destroyer picked up Air Force frogmen and capsule early on September 2 after they had spent a night at sea. Payload aboard the capsule included human tissue and bone marrow cells, the heart of a three-day-old embryonic chick, soil bacteria, two types of viruses. It was the seventh recovery from space of a Discoverer capsule, first since XXVI's was air-caught early in July. **XXVIII** fizzled on a Vandenberg AFB, Calif., launch pad on August 4.

★ **A Minuteman** second-generation missile blew up on August 30 at Cape Canaveral in the first attempt to launch the missile from an underground silo. Minutemen had gone two for three in previous test shots. Most recent success was on July 27. This time, a spectacular blast of flame and smoke, described by one observer as resembling "an exploding ammunition dump," announced that all had not gone as planned. There were no casualties. Silo and launch facilities were undamaged.

★ The **C-130E** transport, new version of the Air Force's Lockheed Hercules transport, flew for the first time at Dobbins AFB, Ga. The plane can carry seventeen tons nonstop from East Coast bases to West Germany and one-stop from the West Coast to Japan. On hand for the demonstration flight of the E, which has greater range and lifting capacity than widely used earlier versions, were the House of Representatives airlift committee headed by its chairman, Congressman L. Mendel Rivers of South Carolina, and Lt. Gen. Joe W. Kelly, Commander of the Military Air Transport Service. The E, now in a flight test program, is scheduled to go to MATS early in 1962. The turboprop C-130 requires comparatively short takeoff and landing room, plays a key support role for the Tactical Air Command's Composite Air Strike Force (CASF).

★ NASA launched an Agena rocket **"space platform"** on August 27 at Cape Canaveral. Aboard it was a piggyback payload, Ranger I. The first stage of the booster, which put them both into space, was an Atlas. The drill was for the orbiting Agena to blast Ranger off on a giant orbit far out into space. Ranger, however, separated from Agena and rode with it on an almost identical orbit. NASA put an **Explorer XII** space-dust study satellite up on August 27; it fell from orbit within twenty-four hours. The civilian space agency also announced this month that it will enlarge the **Cape Canaveral launch complex** by more than five times and use it for lunar and deep space launches through the years to come. The Cape was chosen for this purpose over proposed sites in Texas, in New Mexico, and on Pacific islands.

☆

While world attention centered first on Berlin, then on mushroom clouds over central Asia, free world leaders kept their ears peeled for thunder in the Far East. The present Peiping regime, it was recalled, completed its conquest of the Chinese mainland during the first Berlin crisis in 1948 and 1949. In 1958, in the wake of a Lebanese crisis that required the as-

(Continued on page 25)

WESTINGHOUSE BRUSHLESS GENERATORS . . . flight proved on both commercial and military aircraft

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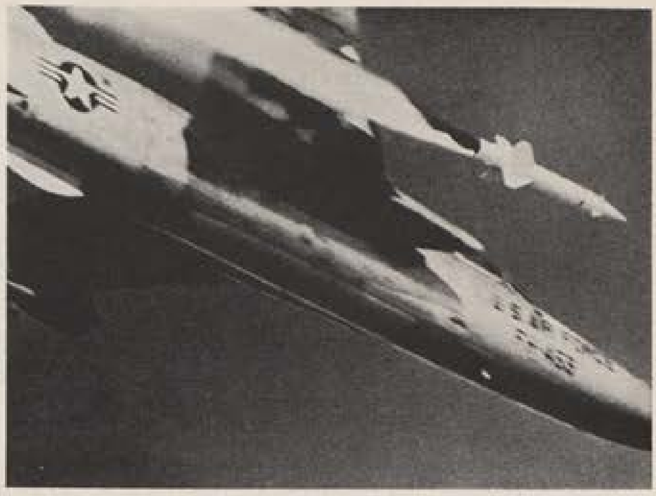
Giant ocean-spanning airlifter, Lockheed C-130E Hercules, pictured during first flight. Underwing fuel tanks will enable the plane to make nonstop transatlantic crossing carrying whopping cargo load of over seventeen tons.



Bullpup missile is launched from F-105 Thunderchief jet fighter on test mission high over Gulf Missile Range. Bullpup-Thunderchief combination gives USAF one of free world's most potent and versatile defense weapon systems.

sistance of US forces, the Red Chinese launched their most recent major offensive in the Formosa area. Were the Chicoms, in today's troubled world atmosphere, awaiting a moment to strike out once more?

Nationalist Chinese Vice President Chen Cheng, an official guest of President Kennedy some weeks ago, told the National Press Club in Washington that this is distinctly "a possibility." He went on to discuss Red China's military strength, political stability, and relations with Russia in these terms:

"The series of wars which the Chinese Communists have either instigated or in which they have intervened have created an inordinate fear in this and other countries of the prowess of the Chinese Communists. . . .

"There are people who shudder the moment they hear that the Chinese Communists have over three million men under arms, plus millions more of militiamen. They seldom stop to think that the same three million men could be a liability instead of an asset to the Chinese Communists. Most of these men are being used to keep the increasingly restive people from rising against the regime. Remember that in the Budapest uprising the Hungarian Communist troops refused to fire into the crowds and, instead, many of them turned around and fought on the side of the freedom fighters. When the time comes, the same thing could happen on the Chinese mainland. . . .

"One really has to go far into history before he can think of a regime more intensely hated than the Chinese Communist regime on the main-

—Wide World Photos, Inc.

Washington lawyer Steuart L. Pittman was President's choice as Assistant Defense Secretary for Civil Defense, will head fallout shelter program.

land. No better proof can be found than the decision of some 14,000 Chinese Communist prisoners in the Korean War, about eighty percent of the total number, to seek freedom in Taiwan instead of returning to the mainland when they were given an opportunity to choose. Furthermore, over the years a steady stream of refugees from the mainland has been escaping to Hong Kong and Macao at the risk of their own lives and often those of their dear ones left under the Communists.

"Recently, there has been much speculation that the Chinese Communists may soon become a nuclear power in their own right. A number of Chinese nuclear physicists are known to be studying in Russia and to have been working on Soviet-built experimental reactors. But our intelligence reports indicate that, because of lack of an industrial foundation, the Chinese Communists still have a long way to go before they can even begin making and stockpiling nuclear weapons of their own. If any such weapons should one day turn up on the Chinese mainland, you can be sure that they have been put there by the Russians."

☆

Elsewhere in the Aerospace World:

Defense Secretary McNamara announced at the end of August that a joint Defense Supply Agency would be created to save billions in the field of procurement, yet another step in the continuing process of achieving true unification of the US armed forces. Army and Navy deputies were at the same time appointed to serve under USAF Lt. Gen. Joseph F. Carroll, head of the new joint Defense Intelligence Agency.

A court-martial acquitted USAF Col. William M. Banks of negligence in the collapse of a Texas tower radar site off the New Jersey coast on January 15. Twenty-eight lives were lost. He had been responsible for the tower as commander of the Boston Air Defense Sector with headquarters

(Continued on following page)

This F-104J Super Starfighter, shown on its first flight, is one of three slated for delivery to Japanese Air Self-Defense Force by Lockheed Aircraft. A Japanese aircraft firm will manufacture total of 177 more F-104Js under license.

at Stewart AFB, N.Y. Charges against two of Colonel Banks's subordinates were dropped previously.

The US suddenly canceled plans to sign an agreement with Russia for reciprocal commercial air service between Moscow and New York. Earlier negotiations for such service were similarly terminated when the Soviets shot down a USAF RB-47 over the Barents Sea.

The Department of Defense's recently assigned civil defense responsibilities were emphasized on August 30 when President Kennedy named Washington attorney Steuart L. Pittman to the new post of Assistant Secretary of Defense for civil defense.

STAFF CHANGES. . . . **Maj. Gen. William J. Bell,** from Commandant, AFROTC, AU, Maxwell AFB, Ala., to Commander, Lackland Missile Training Center, ATC, Lackland AFB, Tex. . . . **Brig. Gen. Andrew B. Cannon,** from Commander, 63d Troop Carrier Wing (H), MATS, Donaldson AFB, S. C., to Commander, 6th AF Reserve Region, CONAC, Hamilton AFB, Calif. . . . **Brig. Gen. Robert D. Forman,** from Commander, 1611th Air Transport Wing, MATS, McGuire AFB, N. J., to Commander, 1602d Transport Wing, MATS. . . . **Brig. Gen. Ivan W. McElroy,** from Deputy for Operations, 12th AF, TAC, Waco, Tex., to Commander, USAF Recruiting Svc., ATC, Wright-Patterson AFB, Ohio. . . . **Brig. Gen. Howard W. Moore,** from Commander, 816th Air Division, SAC, Altus AFB, Okla., to Commander, 19th Air Division, SAC, Carswell AFB, Tex. . . . **Maj. Gen. Nils O. Ohman,** from Commander, 19th Air Division, SAC, Carswell AFB, Tex., to Senior AF Member, Military Studies and Liaison Division, Weapons Systems Evaluation Group, OSD, Washington, D. C.

Maj. Gen. Don R. Ostrander, from Director, Office of Launch Vehicle Programs, NASA, to Vice Commander, BSD, AFSC, Inglewood, Calif. . . . **Maj. Gen. Robert M. Stillman,** from Commander, Lackland Missile Training Center, ATC, Lackland AFB, Tex., to Commander, 313th Air Division, PACAF. . . . **Maj. Gen. John R. Sutherland,** from Commander, 313th Air Division, PACAF, to Vice Commander, 5th AF, PACAF. . . . **Lt. Gen. Herbert B. Thatcher,** from Special Assistant to the JCS for Disarmament Affairs, Washington, D. C., to Chief of Staff, UN Command, and US Forces, Korea. . . . **Brig. Gen. Henry G. Thorne, Jr.,** from Commander, USAF Recruiting Svc., ATC, Wright-Patterson AFB, Ohio, to Director of Personnel Planning, DCS/P, Hq. USAF, Washington, D. C.

PROMOTIONS. . . . To the rank of general: Truman H. **Landon,** William F. **McKee,** Bernard A. **Schriever,** Walter C. **Sweeney,** Jr. . . . To the rank of lieutenant general: Gordon A. **Blake,** Gabriel P. **Disosway,** Hunter **Harris,** Jr., Kenneth B. **Hobson,** Troup **Miller,** Jr., John D. **Ryan,** Robert H. **Terrill,** Herbert B. **Thatcher,** Edward J. **Timberlake.**

RETIRED. . . . Lt. Gen. Frank A. **Armstrong,** Jr., Brig. Gen. Edward N. **Backus,** Maj. Gen. Otis O. **Benson,** Jr., Brig. Gen. Homer A. **Boushey,** Maj. Gen. William M. **Canterbury,** Maj. Gen. John B. **Cary,** Brig. Gen. George S. **Cassady,** Brig. Gen Julian M. **Chappell,** Maj. Gen. Jarred **Crabb,** Brig. Gen. John E. **Dougherty,** Gen. Frank F. **Everest,** Brig. Gen. Donald D. **Flickinger,** Lt. Gen. William E. **Hall,** Brig. Gen. Franklin S. **Henley,** Maj. Gen. David W. **Hutchinson,** Maj. Gen. Daniel W. **Jenkins,** Gen. Leon W. **Johnson,** Brig. Gen. Lawson S. **Moseley,** Jr., Lt. Gen. Walter E. **Todd,** Maj. Gen. Harold **Twitchell,** Lt. Gen. Emery S. **Wetzel,** Brig. Gen. Bernard M. **Wootton,** Brig. Gen. Millard C. **Young.**—End

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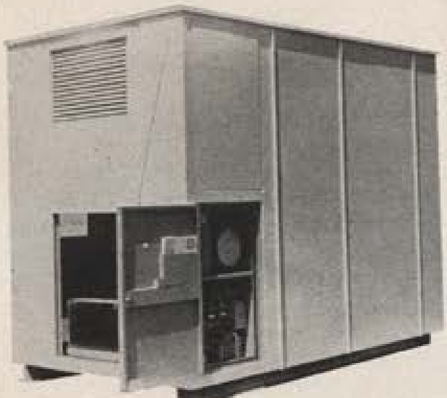

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- FUEL ELEMENT DEVELOPMENT
- VEHICLE DESIGN
- CRYOGENICS

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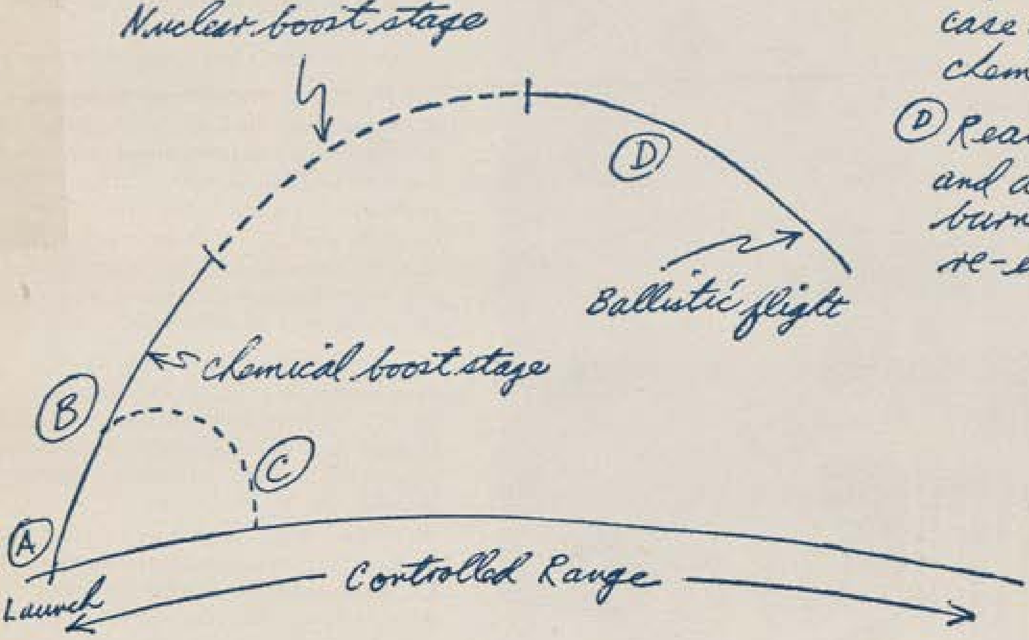
(B) Rapid reactor start-up without risk of a nuclear excursion

(C) Safe disposition in case of abort during chemical boost

(D) Reactor fragmentation and aerodynamic burn-up during re-entry

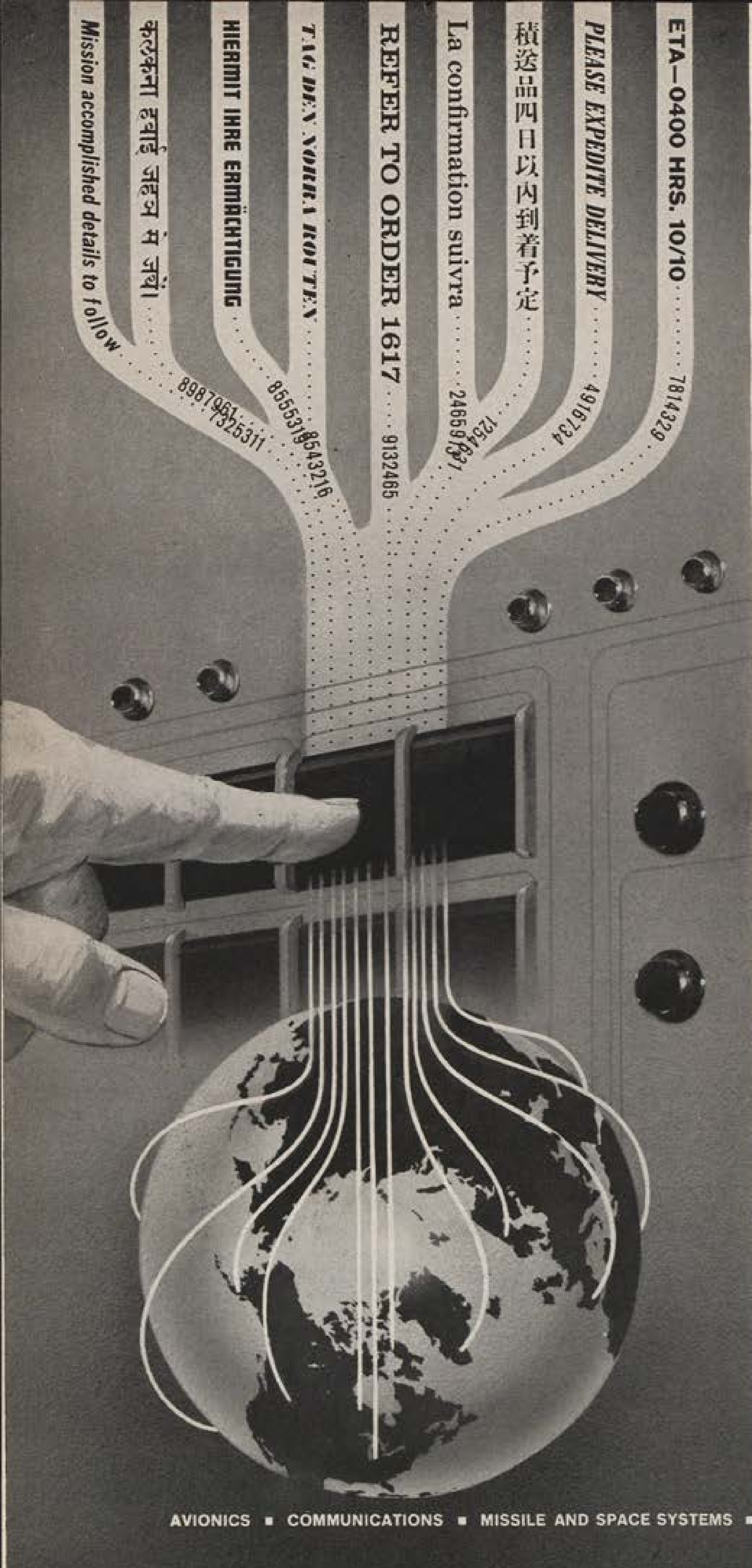


SAFETY ASPECTS OF NUCLEAR ROCKET FLIGHT TESTING

Safety is one of the many areas receiving continuous attention in the U. S. nuclear rocket program. Tests must be conducted to obtain data, to develop safety systems, and to demonstrate safety.

During the past several years, Martin has gained valuable experience in the safety field through its investigations and tests concerning the use of radioisotope-fueled generators for auxiliary power in space. Analytical investigations of nuclear rocket safety conducted by the company under the RIFT (Reactor in Flight Test) program for the National Aeronautics and Space Administration are being continued. The U. S. Atomic Energy Commission's SNAP program, under which The Martin Company developed the radioisotope-fueled generator that powers two radio transmitters in a Transit satellite, involved exhaustive safety studies and tests. This was the first use of atomic energy in a space vehicle. Experience in computer analysis of booster behavior, flight test of large boosters (VIKING, VANGUARD, TITAN and PERSHING) at Cape Canaveral, re-entry, system integration, missile test range control and rocket destruct systems, as well as extensive experience in nuclear technology, has been invaluable in the development of technical capabilities and facilities required for these investigations.

MARTIN



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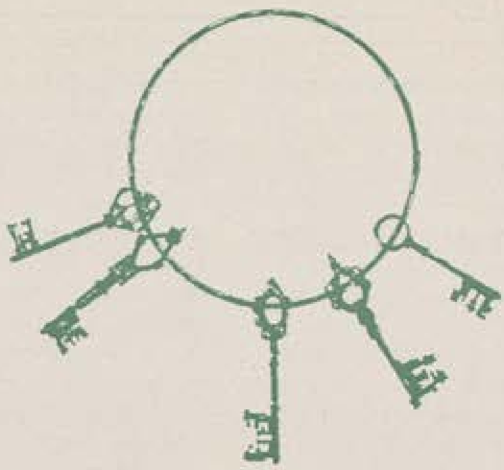

Five Keys to Soviet Strategy

A SPECIAL REPORT

Russian policy at times seems complex. It zigs and zags, blows hot and cold. But the central aim is simple: Total world domination through decisive superiority in nuclear weaponry . . .

- ★ Current Kremlin strategy is predicated on a need to wage unceasing warfare on a variety of fronts by an assortment of methods.
- ★ Fanning a war scare over Berlin now is the Soviet's way of achieving several urgent short-range and long-range goals simultaneously.
- ★ Top Russian priority has been assigned to a new push to win the weapons lead-time race with the United States.
- ★ While the Kremlin's hard line ostensibly may soften, basic decision—already taken—to accelerate preparations for the final nuclear showdown will not be altered.
- ★ Time is running out. Hard-headed realism about nuclear weapons is the only effective response the United States may any longer afford.

WHAT are the key facets of current Soviet strategy? Is the recent shift to intensified pressures on the free world temporary or permanent? Does Khrushchev want peace or war? Why did the Kremlin orchestrate the Berlin crisis to a crescendo while setting the stage for such an important event on the Communist calendar as the twenty-second Congress of the CPSU, scheduled to open at Moscow in mid-October?

During this complex and critical stage of the protracted conflict, it is particularly difficult to see the forest for the trees. However, examining the broad outlines of present-day Communist strategy, as disclosed by the Kremlin conflict-managers themselves, will sharpen our assessments.

The first key to unlocking the Soviet Union's strategic secrets may seem obvious, but the obvious is too often overlooked and therefore must always be reiterated:

1 Current Kremlin strategy is predicated on a need to wage unceasing conflict on a variety of fronts by an assortment of methods. However, political and technological developments during recent years have made it necessary to find new ways to apply this principle.

Khrushchev never tires of boasting about the decline of Western colonialism and the expansion of the Communist bloc since World War II. Somewhat more circuitously, he takes note of his increased opportunities for transforming "national liberation movements" into Communist-controlled states. He maintains that in the USSR itself the task of "building socialism" has been completed; the Soviet Union is said to have achieved technical superiority in key fields and to have entered the phase of transition to a true Communist society.

All these changes have complicated the Soviet Union's continuing effort to communize the entire world. While the military defeat of the principal enemy, the United States, and the successful occupation of our country would mean that the rest of the world would capitulate more or less automatically, devising a strategy for realizing this objective is extremely difficult. Despite his blustering over Berlin, at present Khrushchev is not inclined to risk the loss of everything communism has achieved so far by unleashing his ICBMs. Nor can he concentrate exclusively on an effort to defeat us gradually by applying a combination of so-called "salami tactics" designed to wear down our will to resist and to reduce our international influence little by little.

Even a dictator must pay some attention to his promises to his own people for better living conditions and more consumer goods. Particularly now, when the new draft CPSU Party Program has publicly promised that a Communist paradise will exist in the USSR by 1980, some attempts must be made to improve the well-being of Soviet citizens. Alternatively, a plausible excuse must be found for the continuing lack of tangible evidence of the transformation of the Soviet Union into a heaven on earth. Khrushchev knows that the Soviet population, the bloc, and the entire uncommitted world are watching and waiting with considerable skepticism to see how many of the cautiously phrased promises contained in the new draft program will be fulfilled.

Furthermore, if additional defections of whole nations from the Communist bloc are to be prevented —Yugoslavia still presents a thorny problem to the Kremlin—Khrushchev must pay some attention to coordinating his own domestic and foreign policies with the needs and desires of his Communist fellow dictators. The rulers of Red China have made it especially clear that they must be consulted on important issues.

Nor can Khrushchev completely ignore the existence of neutral and newly emergent nations. These are areas where he is seeking to expand Communist influence, to exploit all opportunities for transforming anti-Western leaders into pro-Communist tools, and ultimately to unseat them and to install dedicated Communist rulers in their place.

On a day-by-day basis, "peaceful coexistence" has not worked as well as Khrushchev had hoped. What pleases Nasser may antagonize Nehru; Pankow or Peiping sometimes object to a policy Moscow advocates. The Kennedy Administration showed little inclination during its first months in office to signify its endorsement of USSR policies. No concessions either to Soviet demands on Berlin and Germany or to the Kremlin's proposals for general and complete disarmament were obtained at Vienna. Having failed to achieve his objectives in the Congo, still waiting for the final installation of a pro-Communist regime in Laos and the capitulation of South Vietnam, having determined that the issues of Berlin and Germany could not be settled easily and quickly, and faced with the necessity to justify his policies to the other bloc leaders and to the twenty-second Congress of the CPSU, Khrushchev decided this spring to gradually implement new measures. Accelerating the Berlin crisis has furnished the necessary excuse.

2 Fanning a war scare over Berlin now is the Kremlin's way of achieving several urgent short-range and long-range goals simultaneously.

Numerous political and technological developments inside and outside the Communist bloc have necessitated a major reshuffling of Red priorities. Like all previous successful rulers of large empires, Khrushchev has decided that the cause of global revolution now requires that he be feared rather than liked. Although violent and nonviolent means of conquest still are to be closely interrelated and applied in an endless variety of combinations, the Soviet dictator has accepted the fact that nuclear firepower, used directly or indirectly, furnishes the only hope of completing the communization of the world.

If the Soviet Union could convincingly demonstrate that its offensive nuclear arsenal was overwhelmingly superior to that of the United States, and that the Soviet Union's capacity to survive a nuclear war was greater than ours, indirect use of these weapons might suffice to force our capitulation. However, before such a strategy of conquest-by-ultimatum can be attempted, the USSR must be fully prepared to fight if its ultimatum should backfire. Furthermore, the Soviet people and the Communist bloc must be psychologically prepared for such a maneuver, and the rest of the world —particularly the major Western powers—must be effectively conditioned by preultimatum strategems to maximize the chances of their responding in the desired fashion.

The gradual Soviet buildup of tension over the Berlin issue during the past few months marks the first phase of this conditioning process. All the elements of this move have been keyed to a far broader aim than mere achievement of a settlement of the German problem. This is the immediate goal, of course, but it also is serving as a stepping-stone toward a more distant objective. Recalling the highlights of principal Soviet moves will serve to clarify these relationships.

Early in June, in his discussions with President Kennedy at Vienna, Khrushchev made his position clear on two issues: (1) test-ban talks must be merged with negotiations on general and complete disarmament; and (2) the German question must be settled on his terms. In his television report to the Soviet people on the Vienna meeting on June 15, Khrushchev introduced a time deadline on Germany. He declared: "A peaceful settlement in Europe must be attained this year." The buildup of pressures against the West was intensified.

By July 8, Khrushchev had announced a decision to suspend planned manpower cuts in the Soviet armed forces and to increase the USSR's overt military budget for 1961 by twenty-six percent. He also had threatened that any Western resort to force in the Berlin dispute would be rebuffed. An intensive campaign was inaugurated to convince the Soviet people that the aggressive nature of imperialism had not changed; by contrast, a new war threat existed, necessitating mobilization and vigilance.

Meanwhile, the flood of refugees arriving in West Berlin reached record proportions. On July 25 President Kennedy firmly announced that the United States would defend its rights in West Berlin by force if necessary. Khrushchev reportedly countered by telling McCloy, during private conversations at Sochi, that he was considering whether or not to authorize the development of a 100-megaton nuclear weapon.

On July 30, the text of the new draft CPSU Party Program, scheduled for endorsement by the twenty-second Party Congress, was released. The document declared that the classic objective of communism remained unchanged: "Our effort . . . is . . . a struggle . . . for the triumph of socialism and communism on a worldwide scale." The new draft program also promised that "the material and technical basis" for full Communist society would be created in the USSR within the next twenty years; by 1980 the Soviet citizen's living standard would be "higher than that of any of the capitalist countries"—*if*, by Communist achievement of superior weaponry, the imperialists could be prevented from unleashing war in the meantime. The document said:

> "The peoples must concentrate their efforts on curbing the imperialists in good time, on preventing them from making use of lethal weapons. . . . This can be done by the present generation. . . . Socialism, having outstripped capitalism in a number of important branches of science and technology, has supplied the peace-loving peoples with powerful material means of curbing aggression. . . . Mankind is entering a period of great scientific and technical revolution, [a revolution] bound up with the mastery of nuclear energy and space exploration, [bound up with] the development of chemistry, automation, and other major achievements of science and engineering. But industrial integration under capitalism is much too narrow to realize a scientific and technical revolution. Socialism alone is capable of effecting this revolution, of applying its fruits. . . ."

On August 7, Khrushchev once more discussed the Berlin problem in a nationwide telecast. He made clear that any military encounter between the USSR and the United States would not stop short of global nuclear war. On August 13, East Berlin was sealed off, with Soviet troops backing up the move. On August 31, the Soviet Union served notice to the world's neutral leaders that they could not hope to influence the balance of power, even indirectly. Its declaration, on the eve of the Belgrade Conference of uncommitted nations of its intentions to resume nuclear testing also disclosed, for the first time, to the people of the USSR that their government intended to develop nuclear weapons with yields of "twenty, forty, fifty, and 100" megatons. The announcements was ambiguous about when these weapons might be tested. By this time, the threat of an imperialist attack had been played up so widely by Soviet propaganda media that some USSR factories were working overtime "to strengthen Soviet defenses." As the new test series began and the conditioning process continued, other actions and disclosures already had made clear the essence of revised Soviet strategy:

3 Top priority has been assigned to a new push to win the weapons leadtime race with the United States.

While the world was still recovering from the news of the flight of the first Soviet cosmonaut, Maj. Yuri Gagarin, and before the new draft CPSU program had asserted that the Communist revolution and the technological revolution were to be merged, Khrushchev

(Continued on following page)

had taken steps to ensure that even more spectacular "firsts" would occur in the future.

During April, May, and June, the Soviet R&D effort was reorganized to ensure that every facet of scientific endeavor, from pure research through all aspects of applied science and technology, would function at an even higher rate of efficiency in the future. This series of measures was heralded by *Pravda's* publication, on April 12, of a joint decree of the CPSU Central Committee and the USSR Council of Ministers. The decree established a State Committee on the Coordination of Research and Development to supervise the Soviet Union's entire scientific and technological effort. This Committee has authority over the USSR Academy of Sciences, the scientific academies of the individual Soviet republics, and all the research institutes of the various governmental ministries and departments. The State Committees established earlier to supervise work in such high-priority fields as atomic energy uses, radioelectronics, armaments technology, aviation technology, automation and machine-building, and chemistry have been subordinated to the new over-all supervisory unit. During June, Konstantin N. Rudnev, who has had a long career in the Soviet armaments industry, was appointed Chairman of this important new organization.

According to the decree which announced the new measures, the USSR Academy of Sciences in the future is to concentrate on "the most important long-run problems of science." Some work in the applied sciences is to be transferred from the Academy to appropriate State Committees, ministries, and governmental departments. However, the Academy and its vast network of institutes is not to become an ivory tower where the role of science and technology in the East-West conflict is to be disregarded. Its new President, Academician M. V. Keldysh, elected on May 19, has had more experience in Soviet weapons-development programs than in any type of "pure" research.

In mid-June, some 2,500 leading Soviet scientific and technological workers from all parts of the USSR met at the Kremlin for a three-day session with Khrushchev and other high-ranking political leaders. At this meeting, ways were worked out to eliminate duplication, to coordinate priorities, and to translate new scientific findings into practical applications even more rapidly than formerly.

Four days before the Soviet Union, on August 31, declared its intentions to resume nuclear testing, the head of the Soviet atomic energy program, Academician V. Yemelianov, boasted in *Izvestia* that the atom held the key to the future industrial and military might of the USSR. He added:

> "Nuclear physics, by far, has not yet realized all of its potentials. Physics research connected with the study of the atomic nucleus has established that elementary particles have their antipathy—antiparticles. In recent years, for example, the antiproton, the antineutron, and others have been discovered. These achievements already have pointed out yet another way to obtain nuclear energy—the way of particle annihilation. It was found that by uniting the proton and the antiproton, the particle mass is transformed completely into radiation. These processes are characterized by the very highest release of energy, approximately a thousand times greater than through thermonuclear fusion."

The United States had been served notice; would it interpret the communications correctly? Khrushchev hoped that it would not. It is far easier to overcome long lead times when the opponent fails to realize that a new push to attain nuclear superiority is under way.

4 While the Kremlin's current "hard" line ostensibly may soften, basic decisions—already taken—to accelerate preparations for the final nuclear showdown will not be altered.

At home and abroad, the Soviet leaders already have begun the conditioning process which they consider to be a necessary prelude to a strategy of trying to achieve Western surrender by nuclear ultimatum. They may continue indefinitely to try to conceal their ultimate intention under the mask of advocating "general and complete disarmament." Time must be gained to translate the stepped-up R&D effort into clear-cut weapons superiority. Just as their past record has been one of shifts back and forth from belligerency to accommodation, the Soviet leaders can be expected in the future to continue to display both faces of the Communist Janus.

As Khrushchev pointed out in a major speech last January, "The fight for disarmament is an active fight against imperialism, for narrowing its war potential." Since they have worked so well to now, there is no reason for the Kremlin to abandon any of the classical Communist devices for reducing enemy vigilance while pushing to gain superiority in nuclear weaponry.

5 Time is running out. Hard-headed realism about nuclear weapons is the only effective response the United States any longer can afford.

Since the Communists do not fear the atom, we cannot afford the luxury of terror. Whether or not current Communist strategy will ultimately lead to war does not depend on Moscow; it depends on the United States. We, too, must accept the existence of the nuclear age, with all its continuing promises for new breakthroughs with potential military as well as peaceful applications. Communist intentions are clear. If we should ignore the indicators and fail to adopt policies that will render them ineffective, our eventual capitulation will have to be attributed to our own unrealistic complacency.—END

View down through the center of the world's largest solid rocket shows rubberlike propellant charge framing two Aerojet-General engineers as they stand between the center pair of the motor's segments. Rocket develops half million pounds thrust.

The big solid-rocket program, a USAF responsibility, is now going to get its chance . . .

SOLID BOOSTERS

How Far Have We Come? How Far Can We Go?

By J. S. Butz, Jr.

TECHNICAL EDITOR, AIR FORCE MAGAZINE

SOLID rockets have now attained a really solid position in our space planning.

A year ago, few people familiar with the US space effort would have bet much money that solid propellants would ever be used as "superboosters," developing upward of fifteen million pounds of thrust. By last fall, in fact, the large solid-rocket program apparently was stuck for good on the treadmill of endless study and research.

Since Sputnik I opened the space age, the nation's solid-rocket experts had contended that multimillion-pound-thrust solid-propellant boosters would be cheaper, more reliable, and ready sooner than large liquid-fuel boosters. These contentions had fallen on deaf ears, however. Large solids remained in the "research" stage. No plan existed to put them into development.

Today, the situation has been completely reversed. The big solid rocket is going to get its chance. Development of these boosters has been made an Air Force responsibility, and about $60 million has been provided to begin the job in earnest during this fiscal year. All signs point toward a maximum-effort development program that will be pushed as fast as technology will allow.

Several factors contributed to this sudden change of fortune. Yuri Gagarin's orbital flight in April—in which the Red flyer became history's first spaceman—certainly was instrumental. It changed the entire course of the US space program by overcoming the go-slow philosophy of President Kennedy's scientific advisers. Strong elements in the Air Force had pushed for development of large, solid-fuel boosters. But one

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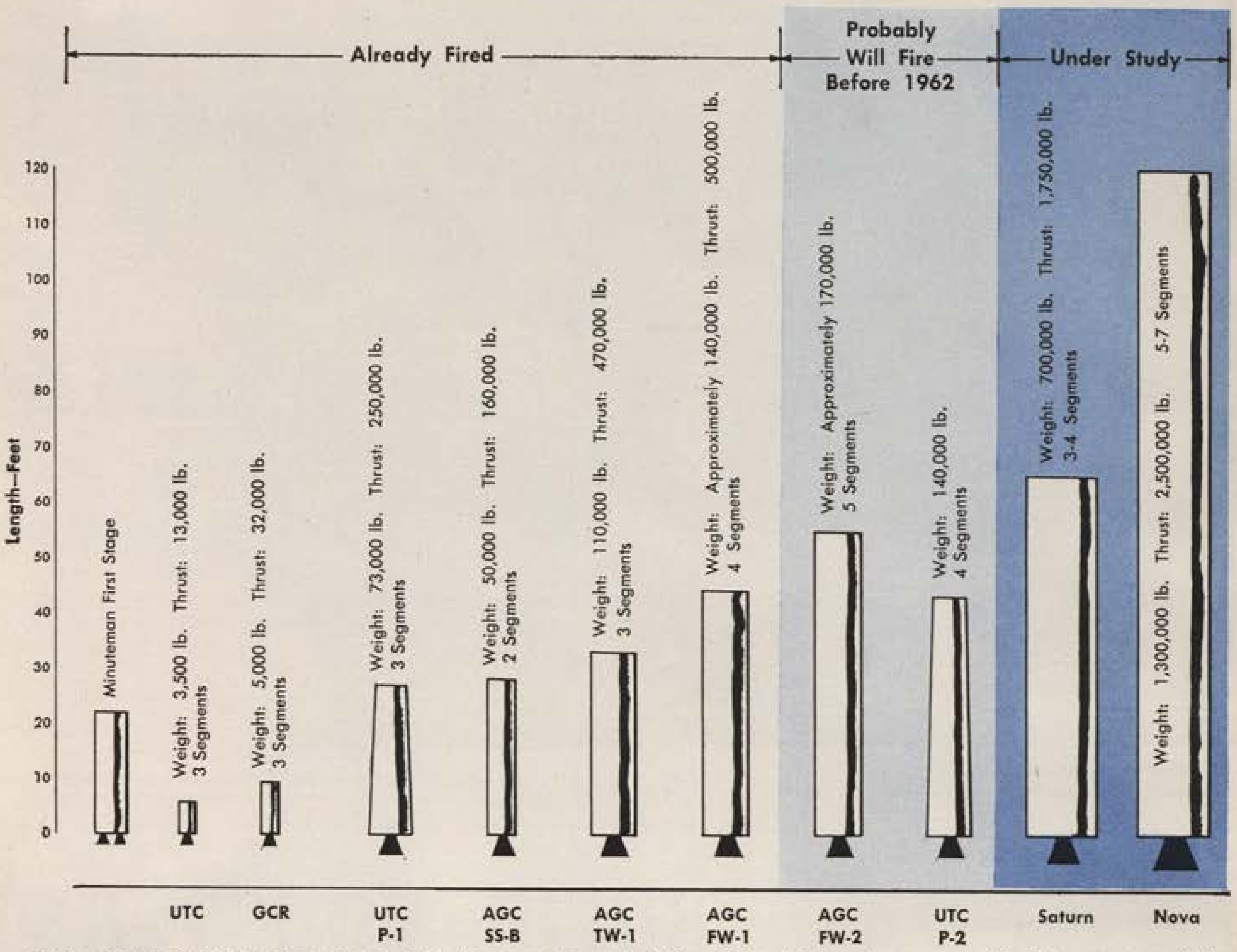


Large motors similar to those on the right above are the goal of the solid-rocket booster program. The biggest motor flight tested to date (extreme left) and the USAF-NASA series of experimental segmented motors are compared in size in this scale drawing. In clusters of eight or more the Nova motor could serve as a booster for a multistage moon rocket. In smaller clusters Saturn motor, second from right, could replace the liquid-fuel Saturn booster, which is now in development.

factor undoubtedly contributed more than any other to the rise of solid rockets. This was the fight that solid-propellant manufacturers put up against the "research" status they had been given by the National Aeronautics and Space Administration, which was in charge of all booster development until last May.

The solid-propellant companies carried their arguments to the Congress and to the public in every manner available to them. Company officials made innumerable speeches, appeared on radio and TV, and wrote or assisted with articles for mass-circulation magazines. They clearly regarded publicity and public education their main job in the fall of 1960 and early months of 1961. As a result, Congress probably is as thoroughly briefed on the arguments for solid-propellant rockets as on any technical subject. Large numbers of congressmen and senators on both sides of the aisle are convinced that solid boosters offer a possible means of getting ahead of the Soviets in booster power.

In principle, no overwhelming technical opposition has been registered against large solids, even by the most partisan supporters of liquid-fuel rockets. However, at budget time the paper proposals for solid-fuel boosters have always been pitted against established projects for large liquid-fuel systems such as the Saturn booster and the 1.5 million-pound-thrust F-1 engine. These have been in the works for several years. These projects soaked up all of the available booster-development money in the first three years of the space age when urgency, parallel programs, and technical insurance were not in vogue. Small sums of research money were then spread around to keep promising ideas going for possible development in the future.

The solid booster was clearly lodged in the research stage last fall. In the Eisenhower Administration's FY 1962 budget, $3 million was allotted for NASA to study large, solid-fuel rockets. Liquid-fuel rocket programs on the other hand received more than $65 million.

Congressional testimony showed that most NASA officials and liquid-propellant rocket experts from industry believed that time was against the large solid booster. The argument, in essence, was that the solid booster would eventually work but that it would take many years of research and development to bring it to a usable state. According to this theory, the solid booster would follow the liquid-fuel rocket booster into operational space use, just as the solid-fuel ICBM followed the liquid.

The change in Administrations last January brought no change in the solid-fuel booster situation. As President Kennedy's advisers reviewed the space program, NASA asked for an additional $5 million in solid-rocket research money, but this was refused and the appropriations request remained at $3 million.

Intense congressional pressure in the wake of the first Soviet orbital flight succeeded in reversing the picture. The solid-rocket booster now has the status of a parallel development to the liquid-fuel booster program. It is a backup for the ten-million-pound-thrust-plus, liquid-fuel Nova booster called for in the Kennedy Administration's moon program. It is probably also the main contender for the military space booster role.

The hard sell has brought the solid rocket equal status, so to speak, but it has also given wide publicity to a number of ambitious claims and predictions. If they can be realized as soon as the solid-rocket industry predicts, then the US space program will receive an almost miraculous speedup.

These predictions include:

• Demonstration of the reliability of a 3.5 million-pound-thrust booster, composed of a cluster of seven motors, within eighteen months, and its first flight test in two years.

• Flight test of a first-stage booster of twenty-one million pounds' total thrust, within thirty-seven to thirty-nine months. With the program pushed to the maximum, the first flight, it is said, could take place within two years.

• Payload of the largest solid booster, when combined with the proper upper stages, to be two million pounds in a 300-mile orbit, or about 600,000 pounds to the moon.

The optimism displayed by all solid-rocket manufacturers was based primarily on four facts prior to May of this year. They were:

• Almost perfect reliability. Thiokol Chemical Corp., as a typical example, could boast that their units had shown a 99.66 reliability in 875 Nike-Hercules flights and 99.98 in 5,000 Falcon firings.

• Scaling-up or increasing the size of solid rockets had not given any trouble in the past. The weight of propellant in a solid rocket is of more interest than the thrust it produces. The weight of propellant charges had been increased about nine times within seven years, from the neighborhood of 5,000 pounds to about 45,000 pounds. Solid-rocket engineers believed that the successful tests with 45,000-pound engines proved that it was possible to go directly to single motors holding more than 700,000 pounds of propellant.

• Most of the technical know-how needed to build large solid rockets had been made available in the Minuteman and Polaris programs. These two military rockets have done more than anything else to advance the solid-rocket state of the art. When the Minuteman and Polaris entered development, no one was absolutely certain that they could be built. Their performance specifications called for propellant efficiencies and structural excellence that were not possible at the time. Together they have caused the creation of a new solid-rocket technology. They have made it possible for the solid-rocket superbooster almost to equal the over-all performance of a similar type liquid booster using kerosene and liquid-oxygen propellants. The performance advantage, but not the cost advantage, would go back to liquids if liquid hydrogen and liquid oxygen were used as first-stage propellants as now being considered.

There is one major developmental unknown. It was not solved in the Minuteman and Polaris programs. This is the mechanism for controlling the vehicle by moving the thrust vector. Many engineers believe that gimballing nozzles will not be efficient on large motors. They point to small-scale experiments that show a fluid injected into the nozzle will cause the flow to cant. Others doubt the effectiveness of this method. These are questions that probably can be answered early in a development program.

• Clustering of large solid rockets is believed to be feasible on the basis of experience with the X-17 research vehicle, the Nike-Hercules booster, and the Little Joe test vehicle used in the Mercury program.

Obviously the people in charge at NASA and all of the authorities in the rocket industry did not agree with these estimates of the state of the art in solid-rocket technology. Solid-rocket specialists contend that popularly held notions of the state of their technology usually has been a state of mind among people who are usually about two years behind the fact.

(Continued on following page)

Segmented cases for experimental motors in the Air Force's Large Solid Rocket Motor Program are shown at right under construction at the Aerojet-General Corp. plant in Sacramento, Calif. Giant lathes are being used to perform the final machining on these 100-inch-diameter segments.

These arguments between solid- and liquid-rocket enthusiasts are not subsiding. The solid-booster development program being readied by the Air Force will have more than the usual number of Monday morning quarterbacks.

The first big series of tests that supposedly will settle some of the arguments began in May and extended over a four-month period. Four motors of record size were fired as part of the research programs financed by NASA and the Air Force over the past few years. They carried propellant charges weighing from 50,000 pounds to more than 125,000 pounds and produced up to 500,000 pounds of thrust. All of the tests were completely successful.

Coming so soon after the Kennedy Administration's decision to develop solid-fuel "superboosters," these firings have provided a great reinforcement to the optimism of solid-rocket proponents.

The four test motors are shown in the scale drawings on page 34. The United Technology P-1 motor was constructed under NASA contract and Aerojet-General's SS-B, TW-1, and FW-1 motors were financed by the Air Force. For comparison, the Minuteman first stage is shown on the left of the drawing. This motor designed and manufactured by Thiokol is the largest solid rocket flight-tested to date.

Hopefully, the Aerojet FW-2 and the United Technology P-2 motors will be fired before the end of the year. If these units are successful, it is possible that no more "subscale" motors will be tested, and the solid-rocket program will move immediately into the construction of motors similar to the ones shown on the right of the illustration.

In addition to improving the position of solid-propellant boosters in general, the four motors tested this summer apparently settled a basic argument among solid-rocket engineers. They proved that segmented motors were practical.

All four of the test motors used segmented construction. The motor cases were manufactured in segments, the segments were filled with propellant separately, and finally they were joined together just before firing at the test site. (*See page 35 for picture of engine segments.*)

In the opinion of many experts, segmented manufacture is the key to low-cost construction and operation of very large solid rockets. This design would allow relatively small segments of big engines to be prepared at any of a large number of existing facilities. The segments could be transported by rail to launch sites where they could be inspected with existing equipment and then assembled into large boosters.

Some respected solid-propellant engineers have strongly disagreed with the segmented concept. They believed that the joints between the segments could never be made completely leakproof. If hot-gas leaks developed, the motor in all probability would fail. Therefore, it was theorized that the segmented motor would not have the high reliability of the one-piece or monolithic type in service today.

If the large motors weighing more than one million pounds and more than 100 feet long had to be built in one piece, then they would have some unique construction and transportation problems. Proposals were made either to load propellant into the case at the launch pad or to float completed engines from the manufacturing plants to the launch complex. This technique would require new types of cranes to hoist the motors, new furnaces to heat-treat the cases, and new inspection equipment to make sure that the propellant charge had no cracks.

Both the segmented and monolithic designs have been studied by Air Force and NASA contractors. Each approach had its industry and government adherents.

Many planners at NASA and the Air Force want to limit the diameter of segmented motors to 160 inches even though diameters of more than twenty feet are possible. If the diameter stays below 160 inches, the motor segments can be transported on the railroads, greatly easing the logistical problems.

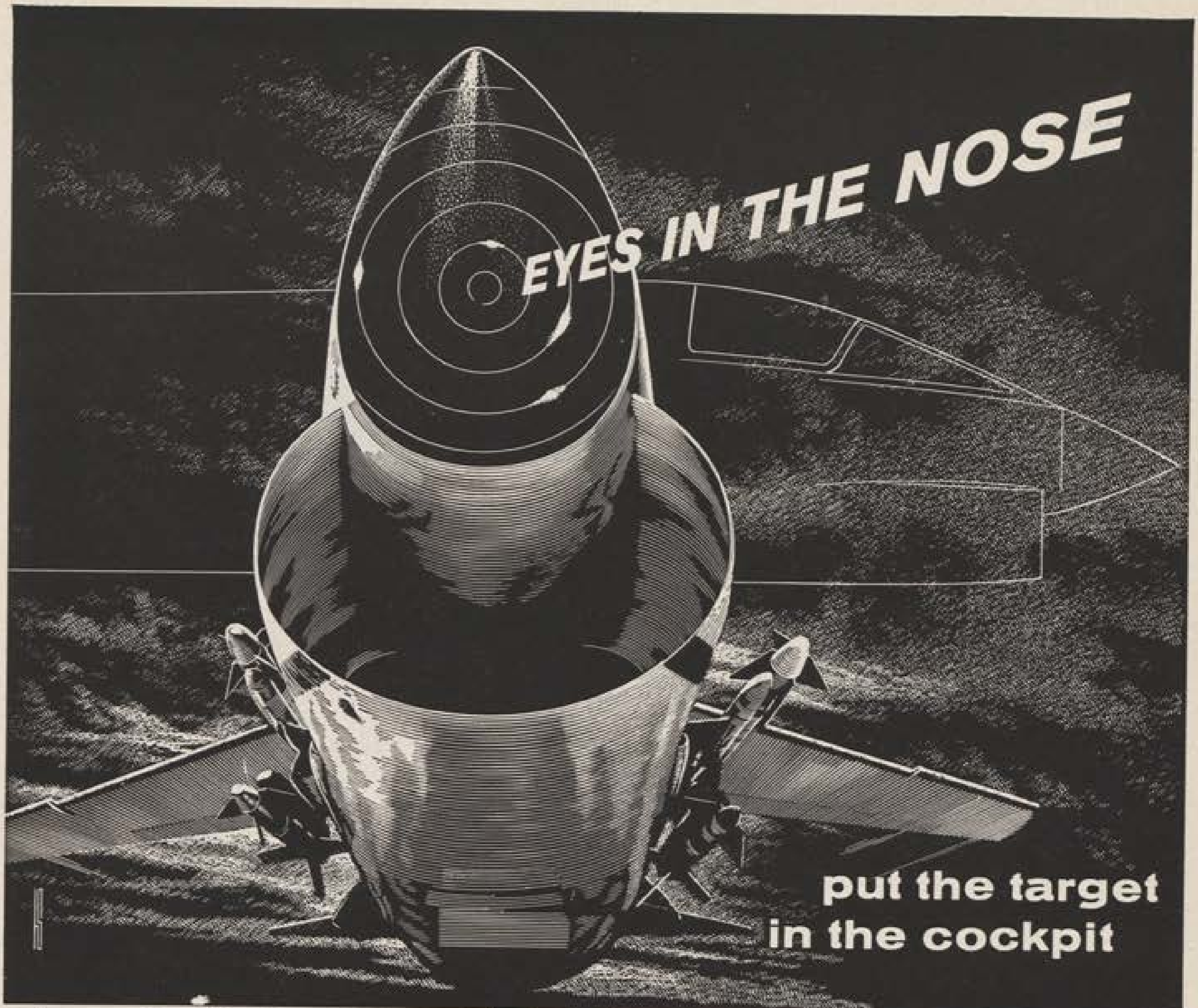
The diameter question and a host of others are now being settled by a subcommittee of a DoD-NASA long-range planning group known around Washington as the Gollovin Committee. These experts began meeting early in August and were asked to develop within ninety days a definite set of specifications for large solid boosters agreeable to both NASA and DoD.

The board, it can be seen, is playing a key role in the development of a national launch-vehicle program. Current ground rules call for civil and military agreement on the design of every booster that enters development.

This agreement is rather difficult to reach at this stage of the game. As one Air Force expert put it, "Our requirements only call for putting up footballs, and NASA has a mandate to orbit the whole stadium." It is hoped that a solid-rocket booster that can have a varying number of motors in its cluster and a varying number of segments in its motors will be adaptable over this very wide range of payloads.

One objective is certain. The maximum thrust of the solid-rocket booster to be developed by the Air Force will be somewhere between twenty and thirty million pounds. This is to allow the booster to be used as the base element in a moon rocket if NASA so desires after it sees the finished product. The payoff for the Air Force is that such a booster system would allow military space operations to step quickly out of the "football" class.

As one keeps time on the solid-booster program and the solid-rocket manufacturers to see if they can deliver all they have claimed, the "management" factor should not be neglected. Officially, the Air Force was given responsibility over the program last May. The subcommittee didn't meet until early August. It will not have an acceptable specification prepared until the beginning of November. After that, three months at the very minimum will be needed for USAF to ask for bids from industry, evaluate the bids, and select a contractor. So if the development contracts are let next February, there are no management delays, and the contractors are allowed to move as fast as they can, the first large solid-rocket booster should begin flight test early in 1964.—END



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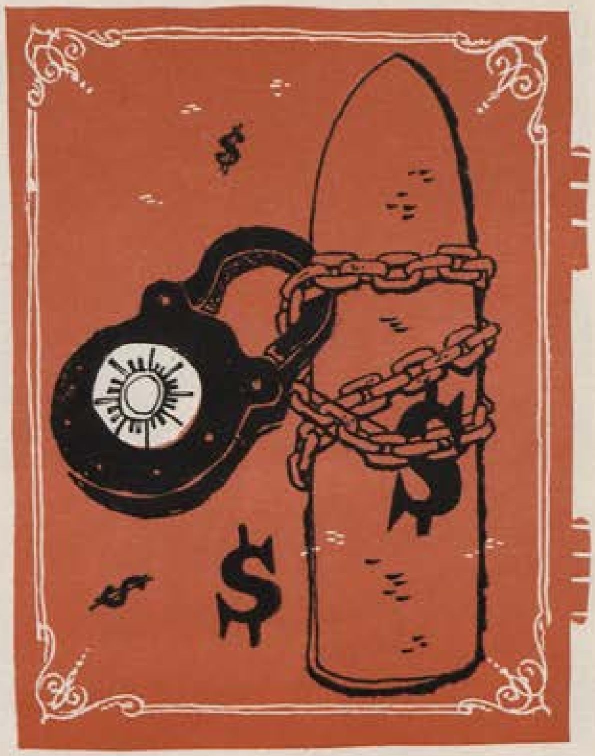
Traditionally, arms-control agreements have aimed simply at ending arms competition, reducing war-making ability, cutting defense costs. Today, the issue has grown more complex . . .

HOW WOULD ARMS CONTROL AFFECT THE DEFENSE BUDGET?



By Doris M. Iklé

LET BOTH sides explore what problems unite us instead of belaboring those problems which divide us. Let both sides, for the first time, formulate serious and precise proposals for the inspection and control of arms—and bring the absolute power to destroy other nations under the absolute control of all nations."

This quotation from President Kennedy's inaugural address reflects the increased determination of the United States to seek acceptable arms-control measures. The results of the renewed efforts cannot be predicted; among variables involved, obviously, are the current Berlin confrontation and other bubbling world crises. But it appears possible arms-control agreements may be reached in the near future.

Projections of the military budget must take account of this contingency. Both the level and the content of the budget could be significantly altered by such agreements.

Just how the budget might be changed would depend on the nature of an arms-control agreement, the type of inspection system to be used, and how military requirements not covered by the agreement would change as a result of the restrictions. It is impossible therefore to provide a specific answer to the frequent question of the impact of arms controls on the budget.

It *is* possible, however, to differentiate between those types of arms-control proposals which would tend to increase budgetary requirements, and those which might lower them. Also, it is useful to differentiate between the parts of the budget which are most likely to be reduced as a result of an agreement, and those which might expand. Furthermore, the time phasing of an agreement, as it affects budgetary requirements, should be considered.

Traditionally, arms-control agreements have been thought of in terms of stopping the arms race, or reducing the ability to wage war. As a result, arms control has been linked with the expectation of reduced military spending. The desire to reduce the burden of high levels of military spending has, in fact, been cited repeatedly as one of the reasons for seeking such agreements.

Recently, recognition of the need for complex and expensive inspection schemes has somewhat tempered this traditional view. There is a growing realization that, at least in the short run, the expense of assuring compliance with an agreement may be as large as, or even larger than, the savings resulting from arms restrictions. Yet this is only a partial step in recognizing the change that has taken place in the concept of arms controls.

Arms control has been broadened to include all arms-limitation measures agreed to by two or more nations, which will reduce the probability of war or reduce the destructiveness of war should it occur. Decreasing the ability to wage war is only one of a number of possible means of achieving these goals.

Another way of reducing danger is by increasing safety. Thus arms-control measures may consist of safeguards against the use of existing military forces. The "Open-Skies" proposal was an example of this. This proposal sought to reduce the chances of surprise attack, and of accidental war, by an exchange of information including a system of aerial reconnaissance over all territories. There was no plan to reduce any military activity. Approval of such a proposal is likely to increase the military budget, because funds would be needed to implement the reconnaissance and information system.

Still another reason why arms controls might result in larger expenditures is that they could result in in-

WHAT AN ARMS-CONTROL AGREEMENT WOULD MEAN

• Amid increased world tensions, the United States government is on record in its determination to seek acceptable international arms-control measures. What form might such an arms-control agreement take? How would it affect the US defense establishment, the US defense budget? The questions cannot now be authoritatively answered. But we do know this much:

• An arms agreement today might contain many gradations of control. The agreement could take a variety of forms. In almost any circumstance, the nation would be faced with the requirement for some level of military strength. It might actually be necessary for US strength, at least of some kinds, to be beefed up to meet the needs of a particular arms-control agreement or plan.

• Consequently, there is no certainty that the US arms budget could be cut as a direct and immediate result of an arms-control agreement. Defense costs could well go up in line with military requirements that resulted from the agreement.

creased total military requirements since the twin aims of arms control, to reduce the probability of war and to reduce the destructiveness of war, may be in conflict. If there is a reduction in the amount of destruction which an aggressor fears as a result of retaliation, he may be less hesistant to initiate a war. Likewise, reducing the danger of having large wars may increase the likelihood of limited conflicts. Nuclear weapons may be the cheapest way of maintaining peace *because* they demand the highest price for fighting wars.

Current proposals to ban the use of nuclear weapons in limited wars illustrate this point. One result of such a ban, indeed its purpose, would be to reduce the danger of a limited war developing into an all-out war through escalation. Yet, this very purpose could well result in increasing both the scope and the frequency of limited wars. Consequently, the requirements for a limited-war capability would tend to increase. Expenditures for conventional forces would mount to meet these additional requirements. In addition, it probably would be necessary to increase conventional weapons and forces to meet the deficiencies generated by the elimination of tactical nuclear weapons. Furthermore, the restriction would probably not result in any substantial savings for tactical nuclear weapons. Unless each side were certain that the agreement would never be violated, the capability of retaliating in kind in case of a breach would probably be maintained.

Finally, increased national security expenditures might result from a restriction of one specific type of weapon, even if total military requirements were not raised. As long as there is no substantial reduction in the defense job to be done, other weapons would have to be substituted for those eliminated or restricted. Since most proposals seek to restrict the more dangerous advanced weapons, this means that conventional weapons would be employed, requiring larger forces and more weapons, and hence more economic resources.

In summary, the link between arms control and reduced budgets is rather tenuous for at least four reasons. First, an inspection and control system may cost more than the savings resulting from armament restrictions. Second, the agreement may consist of providing certain safeguards against the use of existing forces, without reducing these forces. Third, some restrictions could result in larger total military requirements. And fourth, even if requirements are not increased, a shift from one to another type weapon might increase costs.

Recognizing that arms controls may impose additional requirements on our national security budget is important both for those concerned with the defense budget, and for those now framing arms-control proposals. Proposals must be feasible not only from the military, political, and technical standpoints, but also from the budgetary one. It would be unfortunate if we were to negotiate an agreement involving a complex inspection system, then discover that either the US or the Soviet was unwilling to provide necessary funding. In the case of the nuclear-test-ban proposal, this danger may actually exist, since the contemplated inspection system would undoubtedly cost billions of dollars. This problem may be even more acute for those proposals which raise budgetary requirements in a less obvious fashion, such as the previously discussed ban on the use of tactical nuclear weapons. While national security may be increased if resources are provided to expand conventional forces, it might well be impaired if funds were not appropriated.

Thus far our discussion has centered on those pro-

(Continued on page 42)

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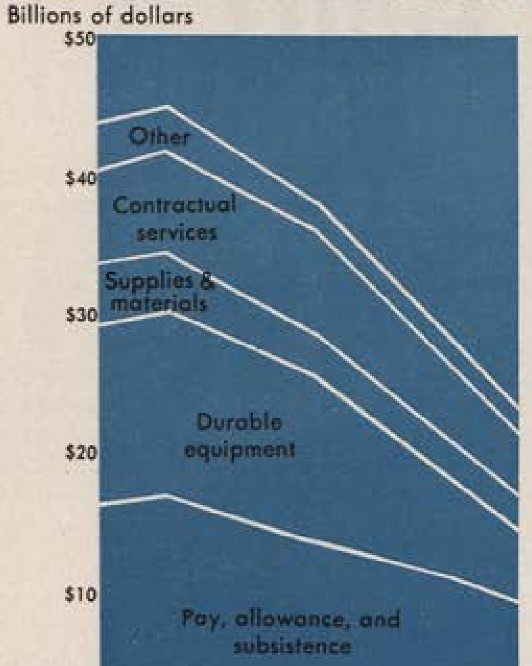
POSSIBLE IMPACT OF WESTERN PROPOSAL FOR GENERAL AND COMPLETE DISARMAMENT ON US DEFENSE BUDGET



During first year of complete disarmament, defense budget might increase because of costs of inspection and control. Thereafter, decreases would be steady in all categories.

posals which increase security without decreasing the level of armaments. Increasing security may, however, facilitate negotiation of other arms-control agreements which would reduce the level of armaments and, along with it, the national security budget. The most drastic cut in the budget would occur as a result of "general and complete" disarmament—that is, a reduction of all national military forces to the minimum necessary to maintain internal order, and the establishment of an international police force. It is this goal which is generally emphasized in discussions of the impact of arms controls on the budget and on the economy. Unfortunately, these discussions have consistently failed to consider the actual proposals for general and complete disarmament. As a result, they have been unrealistic in their basic hypothesis as to how the budget would be affected. At best, they have assumed a decline of a certain percentage in budget expenditures spread evenly over a number of years. At worst, they have discussed an immediate budget cut. In all cases, it has been assumed that the cut would hit all segments of the military budget in the same way.

Looking at the last published Western proposal, two things become clear. First, the most likely time sequence of the impact of total disarmament on the budget would be a slight budget increase, followed by a modest reduction, and ending eventually in a large cut. This is consistent with the Western position that sufficient inspection and control measures must be provided to give reasonable assurance of compliance with an agreement before military forces can be cut. Second, the impact on different segments of the budget would vary considerably, as to both the extent of the reductions and when they would take place.

The Western proposal of June 27, 1961, consisted of three separate stages. The main provisions of the first stage are: (1) The establishment of an international disarmament organization; (2) the exchange of budgetary information; (3) measures designed to lessen the danger of surprise attack including prior notification of launchings of missiles and space vehicles, the establishment of aerial and ground inspection zones, and the exchange of observers at military bases; (4) on-site inspection at operational air bases, missile launching pads, and submarine and naval bases as a first step to development of controls over use of nuclear delivery systems in subsequent stages; (5) a ban on positioning weapons of mass destruction in outer space; (6) the storage of agreed types and quantities of weapons in storage depots; (7) the cessation of production of fissionable materials for weapons, after controls have been established, and the transfer of agreed quantities of fissionable materials to nonweapon uses; (8) force level ceilings of 2.5 million, and later 2.1 million for the US and USSR.

During the second stage, further reductions of force levels would bring manpower ceilings to 1.7 million; all types of armaments and delivery systems would be reduced to agreed levels, the surplus to be destroyed or converted to peaceful uses; military expenditures would be reduced in amounts relating to the agreed reductions in armed forces and armament; and an international peace force, with sufficient personnel and armament to preserve world peace, progressively would be established within the United Nations.

During the third stage, forces would be reduced to the minimum necessary to maintain internal order, and the peace force would be increased to its full strength.

Clearly, the proposal itself is too vague to permit any precise projection as to its budgetary implications. There is no mention as to how many years would be needed for its implementation, the size of the police force and of the international peace force have not been determined, and we do not know what proportion of this international force would be financed by the United States. Furthermore, the "agreed levels" to which budget expenditures would be reduced during the second stage have not been decided, and there is no mention in the proposal of how expenditures for research and development would be affected.

Despite these limitations, it is possible, by making certain assumptions, to obtain a general picture of how the budget might look if there were an agreement for general and complete disarmament.

The assumptions made were:

(1) Each stage of the agreement would require two years, making a total of six years for implementation.

(2) The minimum force for maintaining internal order would be composed of one million men, equipped with conventional weapons. This was based on a special study by the Budget Bureau completed just before the recent change of Administrations.

(3) The international peace force would also have

one million men, equipped with somewhat more expensive weaponry. One-third of its cost would be borne by the United States.

(4) Research efforts would continue at their current levels until the last year of implementation, at which time they would be somewhat reduced.

(5) The reduction in expenditures during the second stage would correspond to the manpower reductions.

The accompanying chart illustrates how the budget might be changed as a consequence of such an agreement if implementation were started in 1963. The 1962 data are the estimates for direct obligations, by object classifications, derived from the budget. During the first year, the budget would increase because of the costs of inspection and control. Subsequently, there would be a decrease, chiefly in the personnel sector, followed by a sharper decline, concentrated in the equipment sector. The total defense budget, including outlays for the peace force, would decline to roughly half of its present size by the end of the implementation period. It could decline to one-third of its present size, if a force of a half million (the size of our force before World War II) was assumed adequate for maintaining internal order. About three-fourths of the total decline would occur in the last three years of the implementation.

The largest reductions are likely to occur in the durable equipment sector, while contractual services (which includes the bulk of research and development costs) would probably experience the smallest decline.

It should be noted that the Soviet proposal implies a somewhat different reduction pattern. According to the Soviet scheme, a significant portion of the reduction and destruction of weapons occurs during the first stage, and many of the control activities are reserved for the third stage. While the total reductions might be the same for the two proposals, the Soviet proposal would result in a larger proportion of the reductions occurring in the early stages of the implementation.

There is little doubt that a general and complete disarmament agreement involving a reduction of $20 billion in defense expenditures would have important repercussions throughout the country. It would involve a major relocation of manpower and resources from defense to nondefense production. However, the problem of transition would be greatly facilitated because the time needed to effect such a transition would be available. The defense budget would not be decreased until the second year of the agreement, and then only modestly. Reductions in the equipment sector would become effective only in the third year of the agreement. Given this time schedule, coupled with a vigorous policy of stimulating the demand for nondefense production through tax cuts and increased government expenditures on peacetime projects, transition problems should be manageable.

Thus far we have examined the two ends of the spectrum, an increase in budgetary requirements, and a large decrease. However, most arms-control proposals fall somewhere between these two extremes. Rather than attempt to estimate each proposal, or set of proposals, separately, it might be more useful to provide a framework which facilitates such calculations. Table 1

(Continued on the following page)

SOME CONSIDERATIONS IN MEASURING THE BUDGETARY IMPACT OF A FEW ARMS-CONTROL PROPOSALS

Type of Proposal	Changes in the Budget Due to: Main Provisions	Inspection	Possible Broader Effects
I. Specific Bans			
A. Nuclear test ban	No testing of nuclear weapons	Network of seismic stations, air and water sampling, satellite-borne detection for high altitude	Possible increase in conventional forces. Loss of potential savings possible with development of more efficient weapons. More expensive development. Possible lower requirements if Soviet development of weapons stymied.
B. Outer-space weapons ban	No procurement of outer-space weapons	Prelaunch — personnel at each launching pad Post-launch — Space-surveillance systems (radar, infrared, etc.)	No procurement of countermeasures. Perhaps larger cost for alternative weapon system. Possibly fewer alert measures needed. Possible increase in nonmilitary space activity.
C. Cease production of fissionable materials	No production of fissionable materials	Surveillance of all plants that might produce fissionable materials	Perhaps more conventional weapons. Possible reworking of existing stockpiles and more expensive guidance system. Reduced countermeasures against fissionable materials.
D. Demilitarize Antarctic	Possible future savings of not having military activities in Antarctic	Existing military facilities and personnel for spot checks	None?
II. Exchange of Information			
Aerial and ground inspection zone	Establishment and operation of inspection zone		Perhaps fewer alert measures needed.
III. Military reductions			
Manpower ceilings	Reductions determined by ceilings	Inspection organization	Possible shift to more mechanized forces. Increase contractual services.

provides such a framework, listing the major factors to visions of the proposals. For most proposals, though not all, this column involves a reduction in some sector of the budget. The amount of money saved by these limitations will not depend on what is currently being spent, but what would be spent in the future in the absence of an agreement. Thus, for example, considerable savings may accrue from a ban on outer-space weapons, even though little or no money is being spent at this time. (*See Table, page 43.*)

The second column lists the type of inspection and control systems needed to assure compliance with the agreement. These will tend to increase budgetary requirements.

The last column lists the possible effects of arms-control proposals on forces and equipment which are not covered by the agreement. These represent the largest area of uncertainty, since they essentially involve second-guessing how our military posture would change as a result of the agreement, the enemy's reaction to the agreement, our reaction to their reaction, etc. Changes in the force composition or levels may result from trying to maintain a given level of effectiveness in the face of limitations imposed by an agreement. They may result from a shift in the required level of effectiveness, because of the limitations on our enemies. Or, as in the proposal for a nuclear test ban, there may be changes in the costs of a weapon system resulting from a limitation on technology. These broader effects could have a more significant influence on budgetary requirements than the direct provisions of the agreement. Their tenuous nature presents one of the major problems in arriving at an estimate of how an agreement would affect the budget. For most proposals, a variety of reactions is plausible, each of which would affect the budget in a different way.

There is one final factor to be taken into account when estimating the impact of arms-control measures on the budget, and that is the institutional factor. In the past years the level, though not the content, of the military budget appears to have been surprisingly insensitive to any external factors short of war. Since Korea, expenditures on national security have never fluctuated by more than three percent from the average, after taking account of price changes. A completely naïve projection of the budget made in 1955, consisting of a straight horizontal line, would have proved more correct for the subsequent five years than either a slightly more sophisticated one which had taken account of the growth in Gross National Product, or a brilliant one which had foreseen the Hungarian revolution, the Suez crisis, Sputnik, the development of Polaris, and the "cancellation" and reinstatement of the B-70.

This is not a plea for ignoring such events, but rather a plea for a recognition of the institutional factors which play such an important role in determining the level of military outlays. While it may be very evident to the military analyst that improvement of our missile capability is both imperative to our future national security and very expensive, it is equally clear to Congress that a sizable increase in the defense budget can be realized only by raising tax rates or increasing the national debt, and there is strong resistance to both.

This suggests that any change in the level of the budget resulting from an agreement on arms control may be smaller than anticipated. If the agreement results in savings, programs which hitherto have been inadequately funded because of budgetary restrictions will tend to obtain more money. If the costs are high, other programs may be curtailed to permit the additional expenditure, or certain "economies" may be forced on the system.

The inertia of the level of the defense budget to change may be one of the important factors determining how we react to an agreement. For example, if there were an agreement to stop production of fissionable materials, conventional forces might be increased more if this released large amounts of money than if it resulted in small savings.

It is quite possible, of course, that arms-control agreements could provide the necessary impetus to dampen the importance of these institutional factors.

To summarize, an estimate of the impact of arms controls on the future budget must take account of: (1) The savings resulting from the specific restrictions imposed by the agreement; (2) the cost of the inspection and control system; (3) the change in military requirements resulting from (but not specified in) the agreement; and (4) the institutional factors which influence the level of the budget. While the third and fourth factors are extremely difficult to quantify, these may be the most important factors in determining how the level of the budget would change as a result of an agreement. Also, they may be important in determining the impact of the agreement on our national security position.

In conclusion, all types of arms-control agreements are likely to increase military budgetary requirements in the first year, including general and complete disarmament. In the longer run, arms controls may reduce the national security budget substantially if agreements are aimed at curtailing the ability to wage war. However, if the agreements are designed only to reduce the likelihood or destructiveness of war, expenditures may even increase in the long run.—END

The author, Doris M. Iklé, is a senior economist for the Broadview Research Corporation, a subsidiary of United Research of Beverly Hills, Calif. She is engaged in studying the economic implications of weapon system choice management. Miss Iklé was an economist in the cost analysis department of the RAND Corporation from 1957 to 1961, formerly was associated with the American Bankers' Association and the National Bureau of Economic Research. Miss Iklé holds B.A. and M.A. degrees in economics from New York University and has completed requirements for her Ph.D. in economics at Columbia University. She is a frequent contributor to economic journals.

—Photo by Victor Barnaba

In the field of modern development, the RIGHT answers point to national strength, security, peace, progress. Some present policies may have us headed on quite another route . . .

ARE WE USING OR ABUSING TECHNOLOGY?

A SPECIAL CONTRIBUTION

Today's Need: 'Quick Fixes'

- *Technology, in which the US has been world leader, is now a major problem area for this country.*
- *Technological advance wins wars. It is the key to strategy, to survival today and tomorrow. But this is an extremely complex area. Scientific and developmental problems are difficult in themselves. Major decisions also must be made in selection and utilization of key personnel and organization of the total effort.*
- *How does a nation get and/or stay ahead in this vital area? Some answers are a well funded research and development program, good scientific advice at all levels of decision-making, fast and flexible organization to compete in the international technological race. At the core of the matter are the scientists, who must be forward-thinking and oriented toward national requirements. This matter of "the scientists" has been one of the most troublesome one for the US.*
- *Many weaknesses have showed up in our technological development. One of the worst results has been the abortive nuclear-powered aircraft program. The government and the armed forces must act to set the technological house in order. "Quick fixes" immediately could combat the situation until longer-range solutions are achieved.*

FOR more than half a century, the United States has been the leading technological nation. But today we must ask ourselves:

- Is American military strategy technologically inspired?
- Do we understand technology and its impact on American security?
- Are we organized to win the technological race?
- Which of our scientists are making the right decisions? Are we listening to them?

These are questions of survival. The answers point in the direction of national strength, security, peace, progress.

Some of our present policies, one fears, may have us headed on quite another route.

Let us look first at principles, then at today, and then toward a future that CAN be safe for the free world.

Principle 1. Technology wins wars.

Principle 2. Technology paces strategy and determines its nature. Strategy can place demands on technology in order to meet momentary requirements. But over the long haul, changes in strategy come primarily from technology.

Principle 3. Technology is an impersonal force. Its major advances are more or less independent of decisions made by various governments, corporations, and academic research institutions. Funding is, of course, an essential factor. It can influence the speed and the direction of technological advance. But technology remains impersonal in its broadest aspects because discovery is largely a matter of chance as is the incidence of genius. Only one safe prediction can be made at this time: The advance of technology is accelerating.

Principle 4. Technology, to most of us in all walks of American life, is spelled m-y-s-t-e-r-y. One of the strange facts of our time is that, even though we are dependent on technologies of all sorts, we as a people have in a sense intellectually rejected the world of technological developments. We have tried to close our minds to a new world all around us that we grudgingly accept almost in the manner of a "necessary evil." Our high priests, "the scientists," do "understand," we hope. But as a nation, we are not sure how to fit them or their knowledge or their work into the total scheme of things. Neither high nor low among us finds it easy to judge their achievements, failures, recommendations. The problem is not an academic one in the field of national defense.

Principle 5. Technology is competitive. Many nations, friendly and hostile, swim in the same stream of technological progress. There are three typical situations. One can try to swim against the stream, one can have the same speed as the stream's current, or one can swim faster than the stream. If a nation competes with another nation that is making every effort to swim faster than the stream, obviously it can win the technological race only if in addition to being faster than the current it also is faster than the particular nation against which it is competing. Another important prerequisite for winning the technological race is to anticipate the direction and speed of the competitor. Technology offers an innumerable number of practical choices. No country is capable of adopting all choices but must make selections commensurate with its strategic tasks and its capabilities. By a proper anticipation of these choices, the competing country can then choose its own optimal combination and thus either negate the advantages of the enemy's choice or pull ahead. Conversely, by making the wrong choices it can fall behind.

Principle 6. Technological advances save money. Any time an attempt is made in a period of advancing technology to keep systems that have been passed by in effectiveness, the result will be extremely high costs for low performance—and ultimately futility, ineffectiveness, and possibly defeat. The fact of the matter is that the most technologically advanced weapon system, other things being equal, is also the cheapest weapon system. This is not just a matter of a few marginal savings, but more important in modern times is the understanding that attempts to maintain old technologies could easily bankrupt the economy of a very large nation. Naturally, there is the other side to the problem, that modern technologies usually require time before they can be used operationally and, furthermore, technological progress often has its unexpected delays. In practice, therefore, the technologically dated systems must be maintained and constantly improved until the new systems become feasible. The strategic choice is whether technological progress should be accomplished as fast as possible or whether one should hang on to the old fashioned systems as long as one possibly can.

How does a nation in today's world get and/or stay ahead in this vital matter of technology? The requirements for winning the technological race are many. These stand out. There must be properly directed, well financed, broad research and development. There must be good scientific advice on all echelons of strategic technological decision-making. The military must be able to make sound decisions from the technological point of view. In addition, they must be able to make these decisions fast and to carry through their procurement programs fast because otherwise they will lose the lead-time race. The political and budget decision-making must support the entire operation. There are, of course, numerous other requirements—such as good intelligence evaluations, proper training, suitable recruiting of scientists and technicians, and proper documentation services.

At the core of the matter are the scientists. Here the American public, the military, and the politicians are enormously confused. Just as men can be divided into athletes and nonathletes, so they can be divided into scientists and nonscientists. But if a man is an athlete he is not necessarily a good athlete, or being a good athlete he may be a baseball player or a gymnast. Scientists, too, have very pronounced qualitative differences. The majority of them have never gone beyond the B.S. or M.S. level, and the even greater majority have never been anything but specialists. Furthermore, there are broad distinctions among creative scientists, scientists who work best as assistants and experimenters, and scientific administrators. Many scientific reputations rest upon one particular discovery. Other reputations are derived from a long series of creative contributions. When talking about scientists it is very important to keep these distinctions in mind.

But this is not the end of the story. The history of science is replete with examples of scientists being grievously wrong. Scientists have believed firmly in the most abstruse theories. They have instituted veritable inquisitions against nonbelievers. They often refuse to accept evidence and have sometimes gone to rather comical lengths in becoming emotional about their own theories.

There is, in fact, no such thing as a scientist. There are only men who have scientific training, and this scientific training never eliminates their emotions, hopes, and their other human features as, indeed, it should not. The trouble is, however, that scientists often are inclined to transfer to themselves as individuals the "objectivity" of the scientific approach and to consider themselves to be far more objective than they are. They tend to confuse their brains with a computer, and they become particularly violent and emotional if the security of an established theory is threatened.

There is in modern American government, it is essential to note, an important distinction among members of the scientific élite—between the scientist who works full time on security problems and those who are "consultants."

The consultants can be further divided into the broad categories of scientists who work with industries (and usually, or sometimes at any rate, have a corporate ax to grind) and academic scientists (who are interested in government contracts but, in any event, spend most of their time teaching graduate and undergraduate students). When the time for "consulting" comes, they set aside three or four days to bone up on the problem on which they are consulted, then meet with other consultants who have had an equal amount of time to spare, and argue for two or three days. Then an executive secretary, usually a junior scientist, drafts a report incorporating what is called a consensus, but which, in fact, is usually a compromise to the lowest common denominator.

So far as their contributions are concerned, scientists can be seen as falling into three categories. One group is made up of those good at anticipating the future and at visualizing new possibilities and opportunities. In sharp contrast are those who are opposed to the future, in essence want to stop technological advance and if possible bury technological innovations so that no one ever finds them again. A middle group consists of those who would like to return to the past but realize this cannot be done but who also view the future with concern, would like to slow down technological progress, and frequently raise either genuine or spurious doubts about the feasibility of new concepts.

It must be realized that technological innovations usually call for new approaches and that while some of these approaches may be probable or less probable, nevertheless none can be proved until full experimentation has been carried out.

By raising doubts about the feasibility of an approach, the investigation can either be prevented or misdirected or financed on such a low level that five years later it can be claimed that "this approach has proved disappointing."

Scientists of this middle group, resigned but resistant about the future, have sometimes had a strong influence on US technological activity. This has on occasion proved most unfortunate. Some of the scientists who have been most influential in American security programs have not quite grasped the fact that today the stream of technological progress flows fast and wide. Some have believed that floating with the current and even occasionally working against the current would be the right type of action. Some have had the notion that it is possible to get out of the current and watch the spectacle from the river bank. In many areas, notably in nuclear physics, scientists advising on US weapons have argued that everything worth discovering already has been discovered. The effect such attitudes tend to have on developmental progress is obvious.

By contrast, scientists who are future-oriented—who understand the need to swim faster than the current and who are able to propose new technologies and new ideas—also sit in the councils of government but have often had less influence than might be desirable. They have, moreover, often been ridiculed.

At the same time, scientists of the remaining category, who want to bury new technology, have seemed to grow more influential with time, especially at the highest levels.

So much for "the scientists" as individuals and as groups of individuals. Now let us turn to our national defense organization in the area of science and technology.

Since the end of the war, the individual military services and DoD have endowed themselves with ever-larger research and development organizations. These organizations have functioned well in some instances, badly in others. The system as it stands, however, has many weaknesses. Among these weaknesses are: the bureaucratization of scientific inquiry with many of the bureaucratic scientists being worse offenders than the military; the slowness of the decision-making, probably due to the enormous paper war fought by scientists of all creeds; the overcentralization power in the hands of a few scientists who, while they are well versed in some specialty, are called upon to make judgments in other specialties; and an increasing split among the uniformed men who now tend to divide into "scientific types" and "operators," with an ever-widening chasm between them. All this is capped by the dubious budget policies that have bedeviled R&D efforts since their inception. In addition, key

(Continued on following page)

technological development in some areas vital to defense is managed outside the Defense Department. The most notable—or notorious—areas are atomic energy and space. The Defense Department does not have direct control over the types of firepower that are being developed. Its control over the delivery means also is greatly impaired. There are many small fields which also are run independent of the Defense Department. Obviously in a vast undertaking, such as scientific progress across the board, centralization would be a disaster. But the present system does not seem to be the right one, either.

The present set of bad circumstances surrounding development of nuclear-propelled aircraft is a case in point. The scientific decision process twisted the military in knots in this case. In an effort to advance nuclear technology while living within budget ceilings, the military tried to play scientific politics. Because of the need to justify funds on the basis of predicted systems, the military tried to set up "requirements" for nuclear-powered systems. These requirements were beyond the realm of technological possibility and resulted in opposition from the scientific community. At other times, the program was justified by the military on the basis of being a scientific experiment. Here they subjected themselves to arguments and divisions among scientists. The decision fell to the timid. In any event, the whole problem was never placed in a historical context such as comparing it to the invention and development of the jet engine. If Whittle's work had been subjected to influences similar to those that decided the fate of the nuclear-powered engine, we would not have jet aircraft today.

A further difficulty was that some members of the military never quite understood the problem. Some were ready to sacrifice the over-all project for systems that could be made available at an earlier time. Others wanted immediately an airplane with performance characteristics superior to those of our most modern jets—as though an entirely new technology does not require lead times and as though a mature chicken jumps out of the egg.

The scientists, who should not really have mixed in the strategic debate, but who are really the only ones who argued the question, broke up in several groups opposing or rejecting nuclear aircraft, nuclear rocket propulsion, nuclear ramjets, or dismissing nuclear propulsion altogether. The scientists who have had the most impact on the decisions affecting the nuclear-propelled aircraft negatively are the graduates from one laboratory which always—for good or bad reasons—was opposed to this program. While they were instrumental in killing the plane, neither did they advance appreciably the cause of the nuclear ramjet or rocket.

The politicians didn't understand the whole matter. One Secretary of Defense, for example, called the nuclear-propelled aircraft a "shitepoke" that could barely get off the ground.

The result was that there were innumerable go-and-stop decisions. One billion dollars were spent. Perhaps a half were expended on waste motion. Yet, we do have something to show—potentially, that is. We have the know-how to fly a low-speed, experimental, test aircraft. We should be flying this now. We're not, for the complex of reasons that hampered the project all along.

This urgent problem of technological strategy does not lend itself to a few pet solutions. We have none to offer. We can think of a few quick fixes that could improve the situation very rapidly and dramatically.

Among these quick fixes would be new emphasis and new dependence on forward-looking, bold scientists. "Political" scientists, those who have political objectives in their work, should not be utilized. We could use a fresh set of ground rules for scientists in government activities. First, no one should be a consultant when he is not really fully knowledgeable about this problem, and in particular, knowledgeable about the unfolding rather than the past technology. Second, the system of "unanimous reports" should be abandoned and instead a system be instituted in which the submission of minority views is encouraged. It is necessary to force the imaginative, future-looking scientists into the open, to overcome their reluctance to make statements that later may be proved wrong, to persuade them that they must make clear to the decision-making parts of the government, both the greatest opportunities confronting us as well as the greatest threats which possibly may emanate from the opponent.

There may, of course, be a practical need to consolidate various points of view. But the scientists should understand that the government's policy is to move ahead in technology as fast as practical, that their conclusions should be reached on that basis rather than on the basis of extreme prudence, slowest speed, least cost. Also, it is incumbent upon the government and those who appoint scientists to various advisory positions to make sure that they know the record of predicted success and failure on the part of those scientists. Those scientists who have an almost unfailing record of always being wrong should be left out of the defense picture. Several one could name would qualify under this heading.

Finally, another institutional innovation may be overdue. Just as the Industrial College of the Armed Forces was established to prepare the nation economically, and to familiarize the military with problems of mobilization and industrial management and resources, so the time now has come to set up a Technological College. The function of the college would be to make technological strategy a reality—to study technological strategy, to bring together scientists and military men in an academic atmosphere, and give them the opportunity to study strategic problems together.

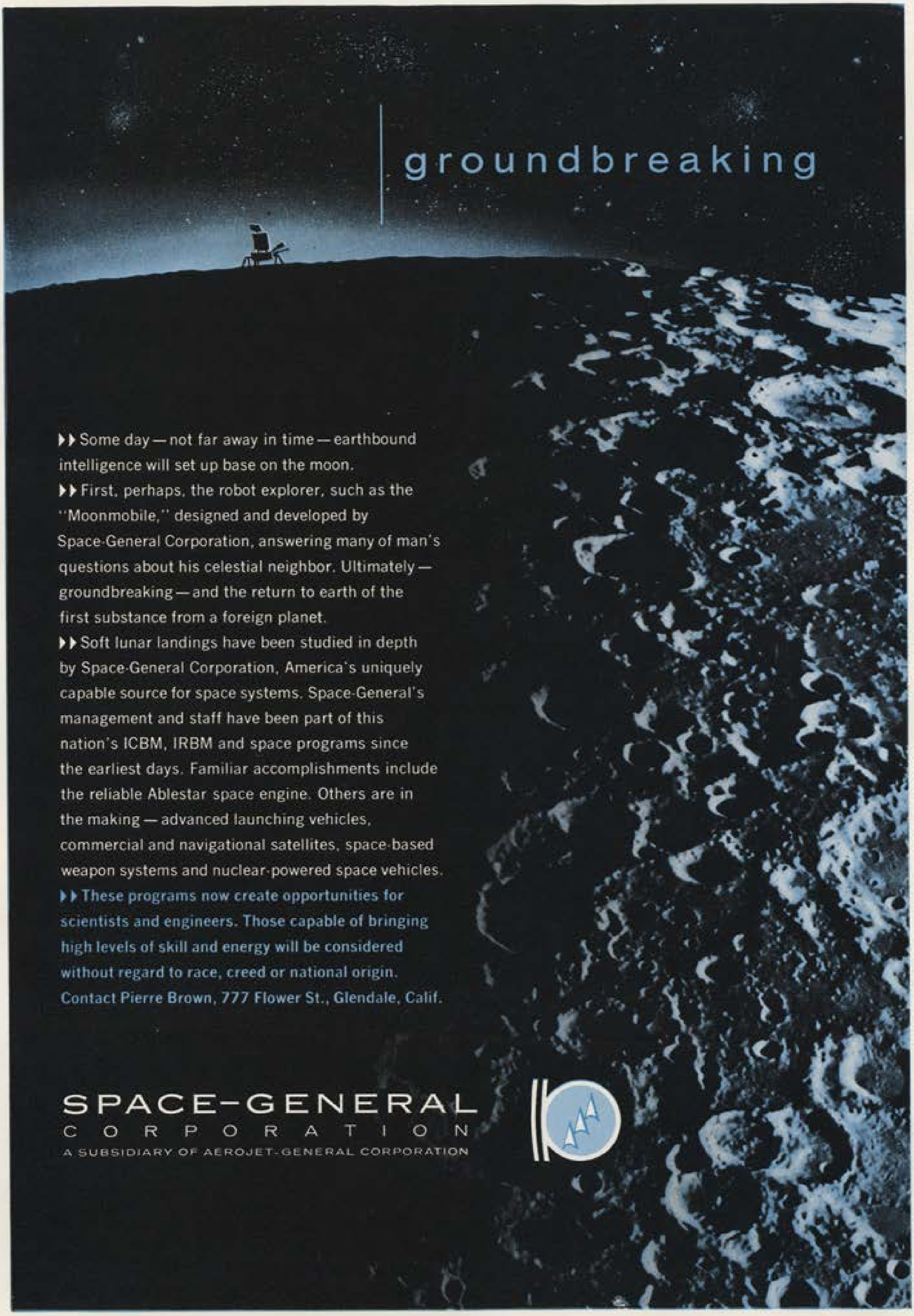
The government and the armed forces must act now to set the technological house in order. If they do, the future may still belong to free men.—END

This article represents the collaborated effort of two outstanding military analysts who, because of their official positions, prefer to remain anonymous.

THE SPACE AGE IN PERSPECTIVE

SPACE DIGEST

VOLUME 4, NUMBER 10 • OCTOBER 1961


groundbreaking
▸▸ Some day — not far away in time — earthbound intelligence will set up base on the moon.
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▸▸ These programs now create opportunities for scientists and engineers. Those capable of bringing high levels of skill and energy will be considered without regard to race, creed or national origin. Contact Pierre Brown, 777 Flower St., Glendale, Calif.
SPACE-GENERAL
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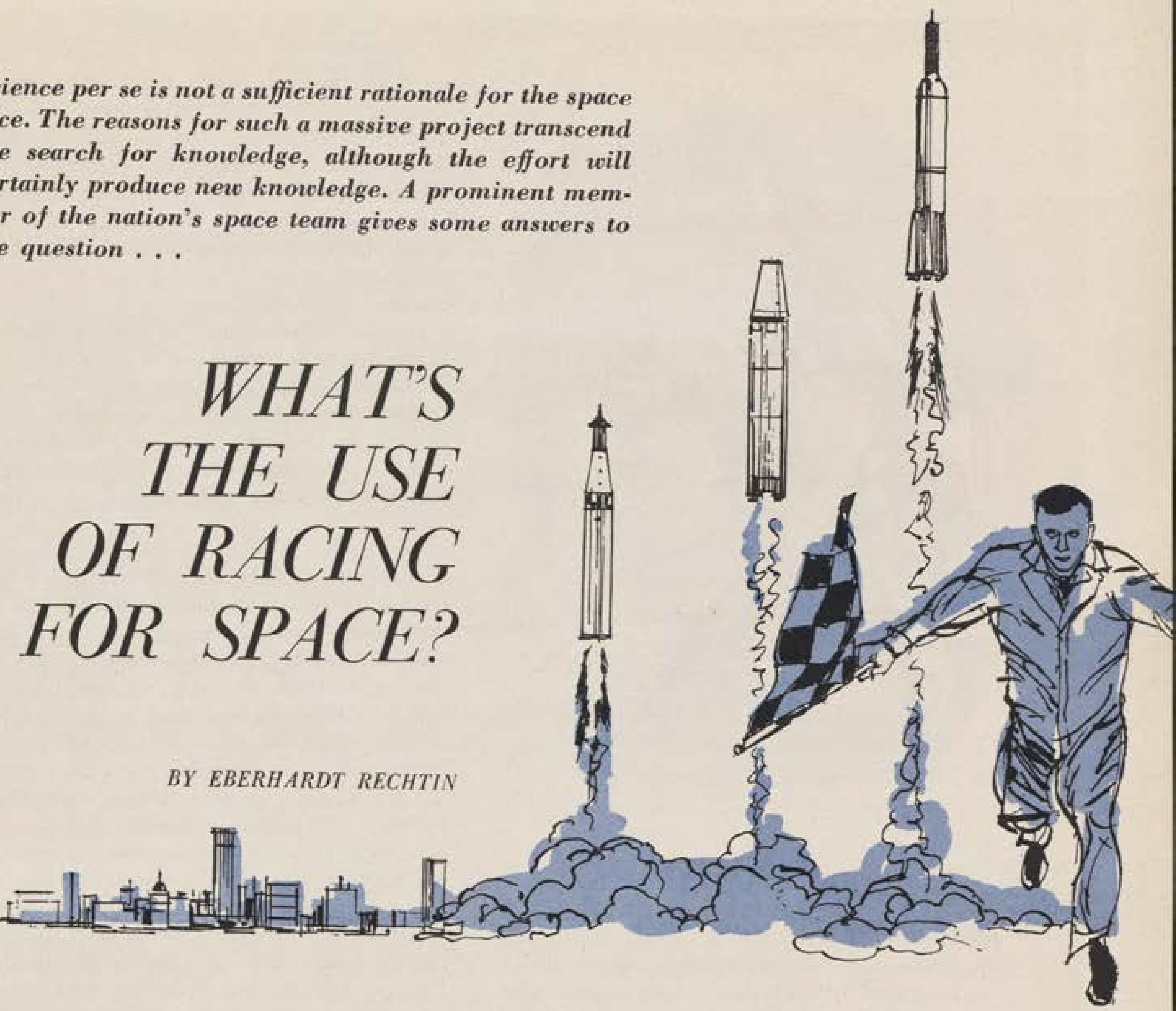
Science per se is not a sufficient rationale for the space race. The reasons for such a massive project transcend the search for knowledge, although the effort will certainly produce new knowledge. A prominent member of the nation's space team gives some answers to the question . . .

WHAT'S THE USE OF RACING FOR SPACE?

BY EBERHARDT RECHTIN



DESPITE the great interest of scientists in the space program, it is my own opinion that science is not, and cannot be, the driving force for space exploration. The reasons for this are quite fundamental. Advanced science is so abstract and so little understood even to the scientist himself, that it makes very poor public relations and propaganda to people at large. Therefore, it is not reasonable to expect a ground swell of support for scientific projects just because they are scientific. Scientific exploration, by its very nature, is seldom successful more than fifty percent of the time and often less than ten to fifteen percent of the time. Consequently, any scientific proposal is immediately subjected to alternate scientific proposals whose presumed success ratio might be higher.

For this reason, scientific studies in space are often roundly criticized by scientists working in other fields because they maintain that by spending even a small fraction of the money spent in the space program, they could obtain far greater results. This criticism, as we have seen, is classical.

The more general criticism, however, which might be paraphrased in an extreme form by the question, "Was it worth $150 million to discover that the earth was pear shaped?" or, "Was it worth $20 million to discover the Van Allen belt?" can certainly not be so easily dismissed. These questions, even in such an extreme form, have been asked by sincere individuals; they should not be ignored. The answer to such questions is most simply given by declaring that the purpose of such programs is *not* only scientific

but in addition is political, economic, social, and psychological. If we *must* assign costs, we should therefore start by first assigning costs to these non-scientific requirements of the program. In so doing we find that the net cost of performing a scientific experiment is actually quite small.

It is no more correct to bill the scientific experimenters in the space program for space technology than it is to bill the oceanographer for the cost of finding the best hydrodynamic shape for a submarine. Indeed, the use of scientific merit as a major criterion in evaluating space programs yields such patently peculiar answers that the criterion itself *must* be incorrect. Quite obviously, there must be less expensive ways of discovering the Van Allen belt and discovering that the earth is pear shaped than the way which was actually used.

Since these experiments were done by satellites and since there is every prospect that further experiments will be carried out, the answer must lie in the fact that there are considerably more returns to the space program than just the scientific results. Also, it is true of science that no great discoveries are made until the technology is ready for them, and when that time comes, the discoveries are often made independently by a wide number of researchers. The underlying principles of physics have presumably always been the same, and yet the discovery of the motions of the solar system had to await the development of the telescope, the formulation of the laws of electromagnetism had to await the development of simple electrical components, etc.

At the present time, the amount of science which can be accomplished in space must await the launching of larger and larger payloads, better and better communications, guidance, control, and so forth. By any comparison which we would wish to make, the expense of developing technology far outshadows the cost of the novel scientific experiment.

One further feature of science precludes its being used as the driving force for the space program (and as the sole justification for funds). The value of scientific results is very seldom known at the time of discovery, and unfortunately, there is no theorem which states that all scientific discoveries will be valuable. It is difficult to gain immediate support when the value of scientific results is determined ten to a hundred years later.

For example, more than 100 years ago, Michael Faraday was demonstrating his electromagnetic equipment to a British government committee in the hope of obtaining government support. One member of the committee admitted he was fascinated but asked Faraday, "What practical benefits can we expect?" "I can't answer that question," Faraday replied, "but I can tell you this: 100 years from now you will be taxing this."

Virtually by definition, the greatest amount of effort and cost in a large program is devoted to technological advancement. The scientist who wishes to participate in such a program sometimes must do so at his own risk. To the technologist there would always be high value in reaching the moon or the planets or the stars even if there were too little weight allowance to permit any scientific measurements to be made on the first attempt. The technologist's point of view is only seldom understood by the scientist who would maintain that there is no point in having gone to your destination unless you can measure something while you are there. In my mind, the scientist has the weaker argument: If you cannot get to your destination, you certainly won't make any measurements.

Using science as the criterion is an excellent way, in my opinion, of producing a wrong answer to the question of the value of the Mercury program. It is evident to most people, including most of the people in the Mercury program, that the "pure science" in that program is zero. (The few people who believe that the program is scientific in nature use a definition of science which is so broad as to include all of advanced technology.) As a matter of fact, one quick way of distinguishing between a space scientist and a space technologist is to ask the individual in question what he thinks of the Mercury program. The scientist will invariably say that it is a terrible program. The technologist will almost always state that this program is advancing technology as rapidly as it possibly can and that, as such, it is a valuable and worthwhile program. Given that the Atlas is the only boost rocket presently available to the program and that there are many other aspects of technology which must be pursued regardless, one can generally obtain agreement among the technologists on the positive value of the Mercury program.

We now come to the question of military participation. Again, on a historical basis, we can see that in the past there have been programs with the military present and those with the military absent. The presence or absence of the military, per se, seems to be less correlated with success or failure than with the prevailing conditions at the time. If the nation is strongly concerned with national defense and security, it will have mobilized a fair amount of its national effort along those lines for some time. The military arts, including military science and engineering, will be strongly developed and will attract some of the finest brains in the country. Under these circumstances, we find that the military technologist is not only present, he is extremely valuable. The proportion of civilian to military has varied from one extreme to the other. One example which is particularly good in this respect is the construction of castles. There are castles which are designed as strong military bastions. There are castles which are fragile palaces designed for peace, comfort, and prosperity. And there are all kinds in between.

I believe that the space program is inherently a good idea and that, after the difficult start, both the civilian and the military programs are proceeding in a generally worthwhile direction. Whether we are proceeding at a great enough pace is another question altogether. The answer to this question lies in a comparison with the Soviet Union. In this kind of a race, it does not now, and never has, paid to be a poor second. It is not always necessary to be markedly out in front, but it helps. It would be foolish of us to maintain that the Soviet Union is not presently the pace setter in the space program.

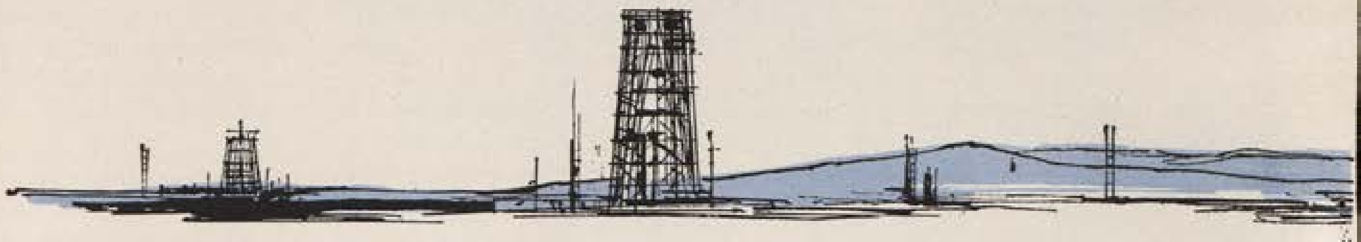
We are probably three to five years behind the Russians in those aspects of space technology which depend upon large chemical propulsion units. These aspects, unfortunately, control the size of the launching booster. On the other hand, the prediction of the future may be surprisingly bright for the United States. The United States has often been compared, unfavorably, to other countries in terms of our generation of science; on the other hand, the United States has never been unfavorably compared with any other nation in its astonishing ability in technology. Inasmuch as the space race is a demonstration of technology, the United States has available to it some basic assets which no country, including the Soviet Union, can claim.

One encouraging aspect of most races is that the initial pace setter does not necessarily win the race. Instead, the successful winner is often the racer who has mastered the art of being second when it is not so important, and then being first at the final payoff. This is a real art. It involves crowding the pace setter in such a way that the pace setter will begin to make mistakes and will begin to feel the pressure.

We now know that we are in a space race and that it is likely to be a fairly long one. We are not racing purely for science. We are racing to demonstrate that we are a successful and dynamic society. We are racing for the prestige necessary in a purely economic world market situation. We possibly are racing as one method of channeling our excess energy and productivity and for such other side benefits as may result. Many of us, myself included, are racing to demonstrate that democracy is every bit as good if not far superior to communism, and, at times, we are racing out of the sheer joy and exuberance that has long been characteristic of a proud and capable people engaged in a pursuit of happiness.—END

Dr. Rechtin, Program Director, Deep Space Instrument Facility, at California Institute of Technology's Jet Propulsion Laboratory, was author of "The Stakes in the Space Race," which appeared in SPACE DIGEST *in January 1960. The above is excerpted from a speech to the November 1960 Washington, D. C., meeting of the Armed Forces Communications and Electronics Ass'n.*

Not only the earlier start by the Soviets but also an overcomplication of our technology have caused the US space lag, writes the Department of Defense's Director of Defense Research and Engineering, who suggests some ways of . . .



Bringing Astronautics Out of Adolescence

BY HAROLD BROWN

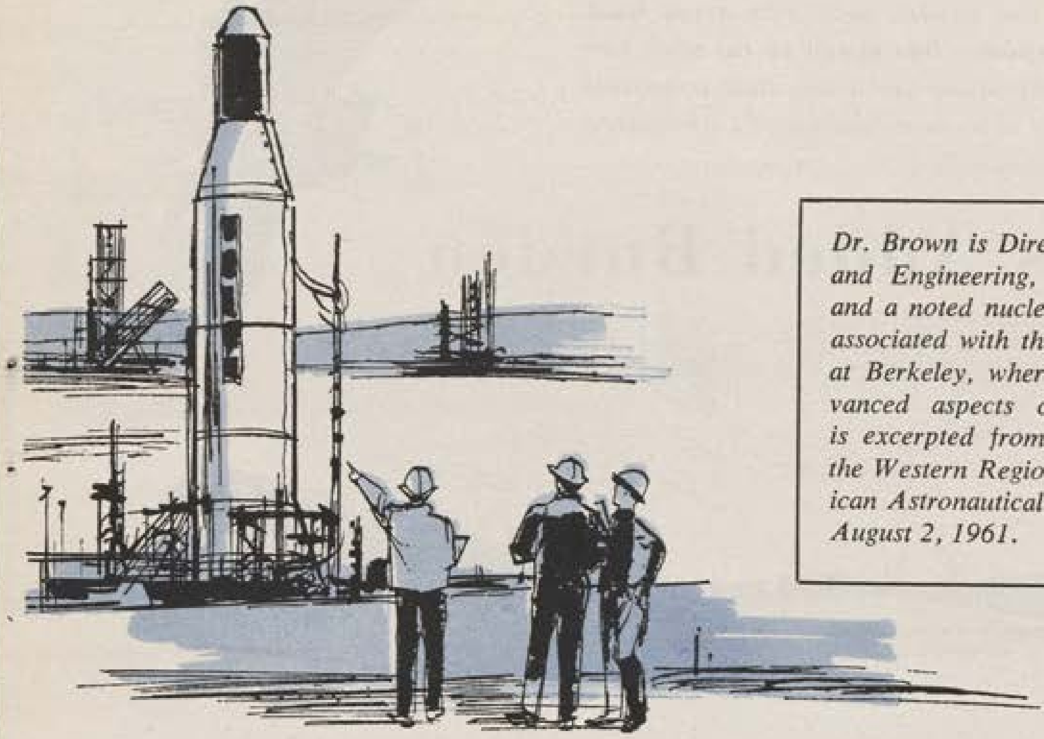
WE HAVE spent an enormous amount of money on our space program already, more than $2 billion through fiscal '61. This is probably considerably more than the Soviets have spent on theirs. Yet we have lagged behind in a number of important achievements. Why?

There are a number of reasons, some having to do with an earlier start by the Soviets, and with their earlier pursuit of large boosters. These are the results of decisions made ten or more years ago, which gave us an initial handicap which explains some of our difficulties. Of course, this is partly a result of our earlier success with light thermonuclear warheads. However, there is another reason for our failures which extends over the past five years and which is even less forgivable. Without this failing, the enormous effort which we have put in on space, beginning in the period 1955 to 1957, would have produced very much more memorable results. This deficiency is the practice of building a separate vehicle for almost every payload, of building too many different stabilization systems for satellites, too many different power supplies into our satellites and space vehicles, and too many different telemetering systems. We have had over fifteen different prime booster upper-stage vehicle combinations with many significant model changes within this prime grouping.

The reliability achieved in this way has been just what you might expect—not good. The ratio of space vehicles put into orbit to those attempted to be put into orbit is roughly fifty percent out of over eighty launches. It is notable that the Thor-Agena combination, which constitutes about a third of those launches, has had a record approaching seventy percent success in putting its payload in orbit, a clear commentary on the way in which reliability increases with the number of launches of a relatively standardized vehicle. This seventy percent success figure would no doubt have been even better had it not been for model changes and introduction of new subsystems.

An allied mistake has been our tendency to try to get every last possibility of performance out of each of our components. This has partly been the result of the lack of large boosters to which I have previously referred. However, if the effort which had gone into upgrading every part of the vehicle and the rest of the system to the highest possible performance, with consequent degradation in reliability and increased complication, had instead gone into building a somewhat bigger system in each case, our record would have been much better.

The lesson is fairly clear. Henceforth we must try to standardize rather than optimize. We must build standardized building blocks in boosters, in upper stages, in final-stage vehicles and spacecraft.



Dr. Brown is Director of Defense Research and Engineering, Department of Defense, and a noted nuclear physicist most recently associated with the University of California at Berkeley, where he did research in advanced aspects of nuclear energy. This is excerpted from an address delivered to the Western Regional Meeting of the American Astronautical Society at San Francisco, August 2, 1961.

There must be only a very few different systems for telemetry, for supplying power, for stabilizing in orbit. If we do that, the flights and experiments in our space program are likely to work. If we do not, we can easily spend $20 or $40 billion and still wind up a poor second.

To do this will not be easy. It will take considerable restraint and self-discipline on the part of industry, because there is a natural temptation to offer an alternative booster or an alternative spacecraft which, by duplicating, doubles the development cost, and actually does provide five percent better performance. It will take equal self-discipline on the part of those in government who manage such programs.

To illustrate this fact, I note that I and some of my colleagues in the Department of Defense have been expressing the above sentiments to each other for a number of months. Nevertheless, confronted with some new payload which must be gotten up and for which the present launch vehicles are not quite capable of doing the job, we also see in ourselves a tendency to add duplicative programs that are just a little bit better and will get us over our immediate problem. Thus we see ourselves falling into the same trap that I have just been criticizing. However, we think we recognize this trap and we are going to try very hard to avoid it. When we fall into it, I think that we will at least know that we are doing so.

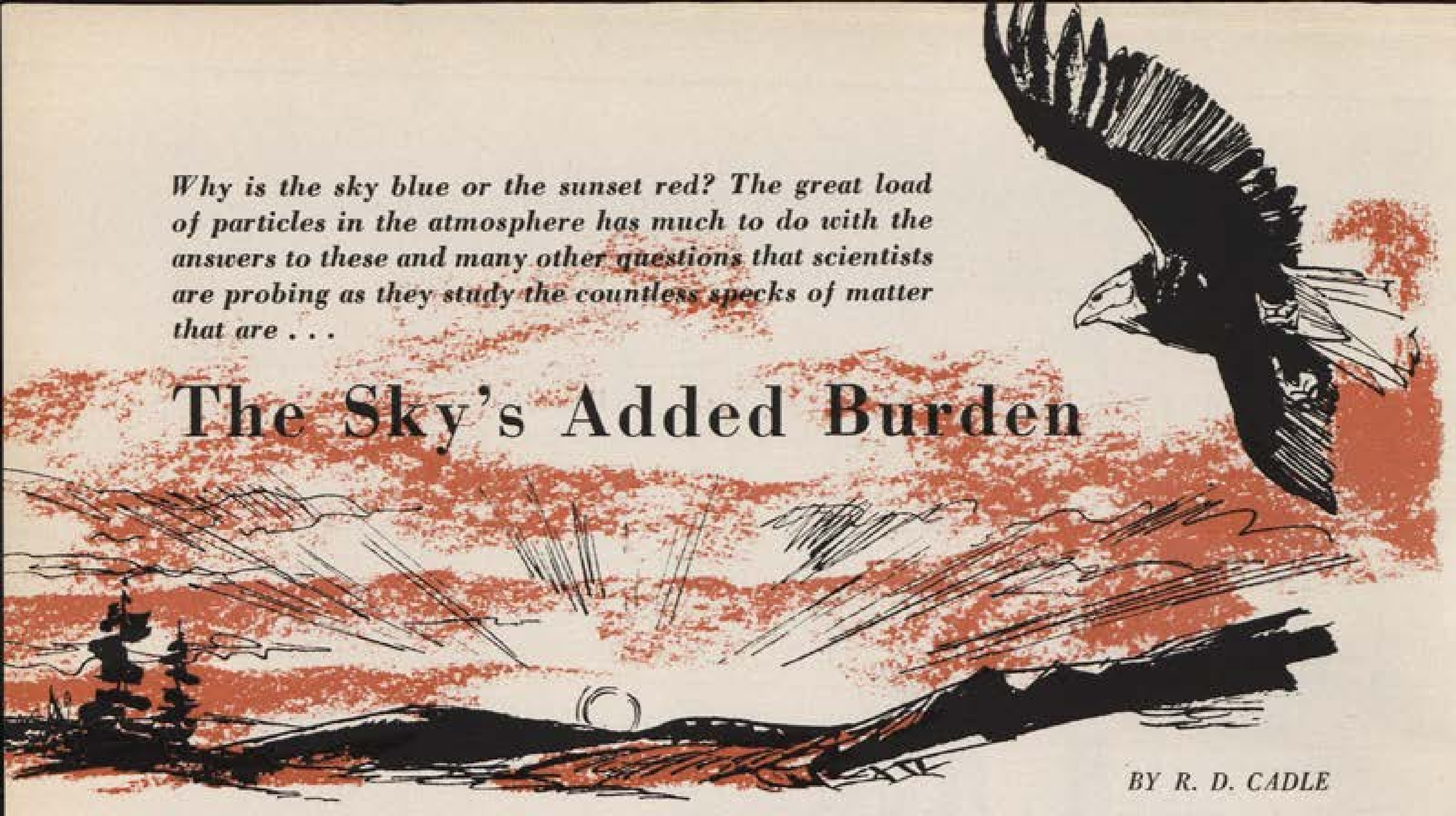
We are going to strive very hard to have a series of building blocks in the various areas of concern: propulsion, telemetering, power supplies, etc., which are a factor of several apart in their capacity. If a mission arises which takes a payload of fifty percent too big for one of these arrangements of building blocks, we will go to the next bigger one, even if that provides too much payload capacity by a factor or two. This is somewhat wasteful, but it is very much less wasteful than building a new vehicle for the purpose.

To conclude, the space age is in the teen-age or adolescent stage. It is big, it has achieved a lot of growth, it is unpredictable, it wants to do more than it is ready for and at the same time in some areas it can do more than it thinks it can. In some respects it looks like a youngster, in others it is fairly close to maturity. How soon it matures is dependent on the way in which it is handled.

Within the government, the National Aeronautics and Space Administration, and DoD, and the Atomic Energy Commission (for nuclear rockets) are joining hands and working as a closely knit team. Industry is going to be called upon to do the same. I cannot overemphasize the magnitude of the task ahead of us in the next few years. We will have to marshal all of our technical capability and resources and work together as a team if we are going to meet, successfully, the goals of our national space program.—END

Why is the sky blue or the sunset red? The great load of particles in the atmosphere has much to do with the answers to these and many other questions that scientists are probing as they study the countless specks of matter that are . . .

The Sky's Added Burden



BY R. D. CADLE

EVERYONE is familiar with large particles in the atmosphere—rain, snow, hail, and wind-driven sand and dust. However, very few people are aware of the vast numbers of different types of very fine particles that are always in the atmosphere. The particles are so small that they do not settle at appreciable rates; yet, even if we except the aqueous fogs and clouds, such particles have a great influence on the behavior of the atmosphere and thus on our lives. For example, they can act as condensation or freezing nuclei, aiding in the formation of cloud droplets or snowflakes. They scatter light, thereby decreasing the visibility and sometimes imparting unusual colors to common objects, such as clouds and mountains at sunset. Some of them have undesired biological effects, such as bacterial diseases and allergies produced by pollens. Not all of them are from natural sources—the potential hazards of smog particles and of worldwide radioactive fallout are well known.

With the exception of fog and cloud droplets, particles of sea salt, which are mainly sodium chloride, are perhaps the most important single type of particles in the atmosphere. This is because they are so numerous, are so widespread over both the oceans and continents, and because of the important role they play in cloud formation.

Sea-salt particles over the oceans may at times be as concentrated as 100 per cubic centimeter, although about one per cubic centimeter is more common. However, there are so many different types of particles in the atmosphere that, even over the ocean, salt particles make up a minor percentage.

The salt particles are formed by the evaporation of airborne droplets of sea water. For many years it was believed that they were produced by the spray of breaking waves. It is now known that they are also produced by the bursting at the ocean surface of the innumerable bubbles that are constantly being formed by wave action.

Forest, brush, and grass fires are another major source of airborne particles. It has been estimated that an average grass fire extending over one acre produces about 20,000 billion billion (2×10^{22}) fine particles! The particles range from largely inorganic ash through carbon to complex tars and resins. Local effects of the smoke from forest fires are well known.

A demonstration of the distance smoke from forest fires can travel was provided by the "blue sun" which was observed in Edinburgh, Scotland, in September 1950. The phenomenon lasted for only a few hours, during which the sun appeared to be a deep indigo blue. Fortunately, it was studied with spectrometers at the Royal Observatory in Edinburgh and was found to have been caused by scattering of sunlight by smoke from forest fires in Western Canada. The phenomenon continued into the night, and a "blue moon" was also observed. One can only speculate whether such phenomena were responsible for the phrase "once in a blue moon."

Chemical analysis of material filtered from the air shows that over continents and even over the oceans a large fraction of the fine particles must have originated from the rocks and soil. Many, and possibly most, of them are raised by gentle winds. However, at times strong winds have produced dramatic effects. The dust storms of the central plains of the United States during the 1930s are examples.

Some of the particles are created directly by other windborne particles eroding any obstruction. Perhaps the most dramatic effects of this process are the grotesque forms carved from rocks in arid regions.

Volcanoes are another important source of fine particles and probably have been throughout most of the earth's existence. Any discussion of this process usually mentions the 1883 eruption of Krakatoa in the East Indies, which produced explosion clouds eighteen miles high and turned day into night in Batavia, 100 miles away. However, less violent eruptions that produce vast amounts of fine particles are common occurrences. For example, I flew the 200 miles from Hilo to Honolulu during the January 1960, eruption of Kilauea. A thick haze concealed all of the islands but the mountaintops from the air, and pilots said that they had followed the haze to Wake Island, about 2,000 miles away. The islanders call the haze Pele's smog, Pele being the Hawaiian volcano goddess.

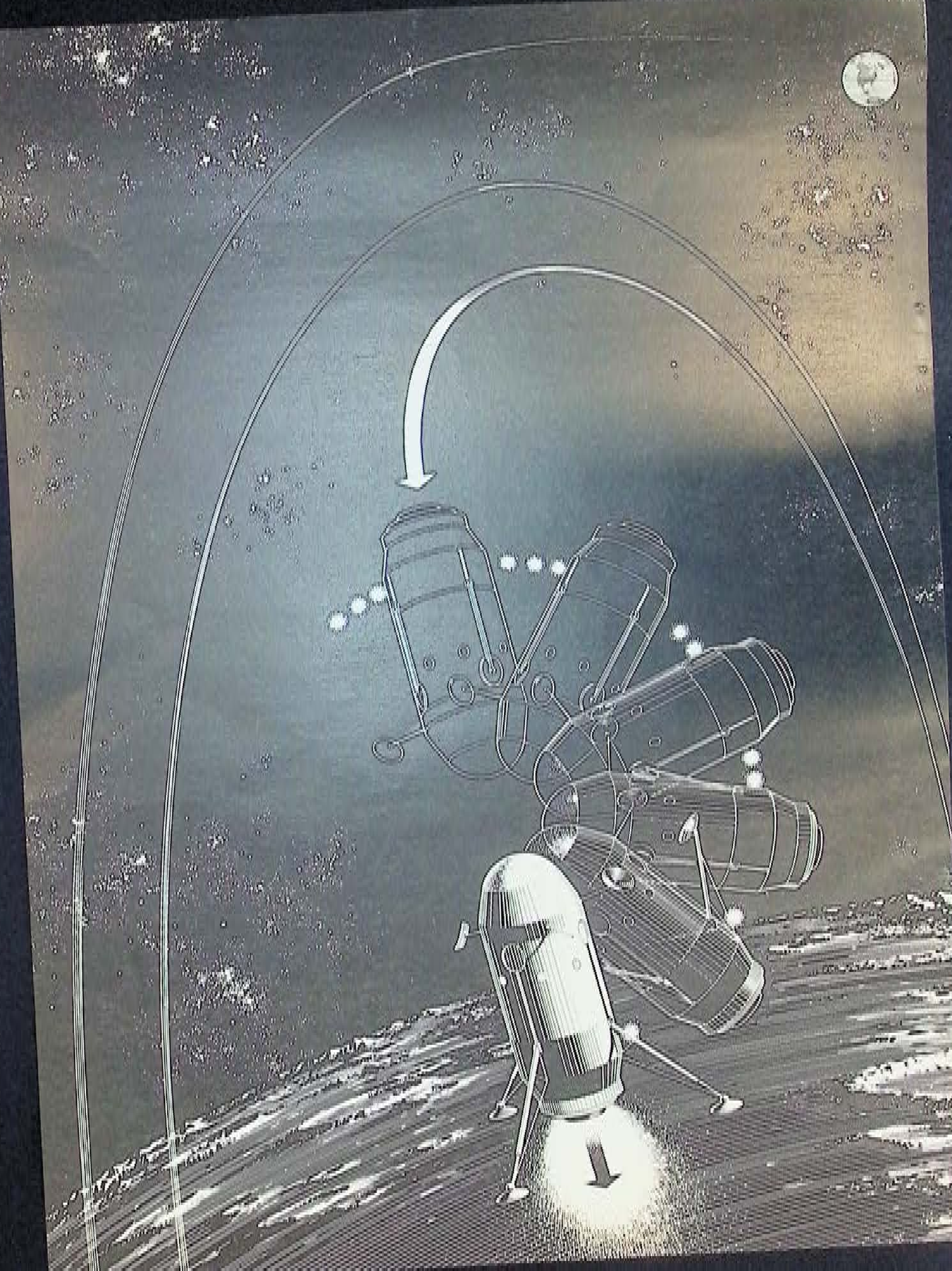
The contribution of fine meteoric particles to the total particulate loading of the earth's atmosphere has intrigued at least a generation of atmospheric researchers. It has been estimated that about 1,000 tons of meteoric dust arrives at the earth each year. Although this seems like a great mass of material, it would add only about three ten-billionths of the earth's total mass in a billion years. Most of this addition is associated with particles so large that they settle out rapidly, and the concentrations of smaller particles are probably so low that they have little influence on atmospheric behavior. However, they may supply part of the sodium observed spectroscopically in the night air glow.

Recent research concerning meteoric dust has been undertaken using high-altitude aircraft equipped with dust samplers. The object was to determine any change in concentration of particles in the atmosphere above about 30,000 feet with changing altitude. If the particles originated near the earth's surface, their concentration should decrease rapidly with increasing altitude; but if they are of meteoric origin, the concentrations should be about the same at great heights as lower in the atmosphere. The results to date, obtained at altitudes up to 60,000 feet, suggest that the particles are meteoric. Tests are planned which will include attempts to identify the particles chemically, and the use of balloons to measure concentrations up to 100,000 feet.

As every hay-fever sufferer knows, particles of biological origin are an important constituent of the atmosphere. Obviously, the atmosphere contains a tremendous array of biological entities varying in size from viruses through bacteria, spores, and pollens, to insects and large birds. The small biological particles are not important to the behavior of the atmosphere. However, the study of aerobiology has provided information concerning the transport of other materials in the atmosphere. Biological aerosols have been found at great distances from their sources. Spores of various fungi have been collected above the Caribbean Sea 600 miles from their sources, and allergens have been found at least 1,500 miles from their probable origin.

The military services are very much interested in the behavior of airborne biological material because the possibility of biological warfare exists whether we either individually or nationally like it or not. Biological warfare can be waged, in principle at least, with bacteria or viruses directly against humans, or with spores indirectly against humans by interfering with food supplies. The most direct method of attack is to release the biological agents into the air to form aerosols that are carried by the wind to the region to be infected.

Ever since the first nuclear explosion in 1945, the air has contained radioactive particles introduced by such explosions. Their nature and distribution are being studied with unusual thoroughness because of their possible physiological effects. The physical and chemical nature of the particles depends to a large extent on conditions at the time of the explosion. Thus, particles produced by a nuclear explosion on the surface of a coral atoll consist largely of white calcium compounds from coral plus traces of bomb debris including radioactive products. Much of the total mass and radioactivity is associated with rather large particles that fall out close to the source. Particles produced



A New Achievement in Precision Controls for Space Application

Marquardt Documents 1,000,000th Pulse of Radiation Cooled Bipropellant Rockets

A three year research and development program directed at advanced space propulsion and control systems reached a significant milepost on September 8 when The Marquardt Corporation documented the 1,000,000th re-start of radiation cooled bipropellant pulse rockets. These rockets, operating at pulse frequencies up to 100 cycles per second, demonstrated that combined response and delay times of .006 second and effective pulse widths of .003 second are now attainable. Development to reduce these times is currently in progress.

Typical of Marquardt's pulse rocket development in the range of 0.2 to 100 lbs. thrust is a 25 lb. thrust rocket for a current satellite propulsion requirement. *This engine demonstrated an intermittent operational life of over 50 minutes at rated thrust, and has achieved a remarkable 46 minute continuous run.* At the end of the test, there was no evidence of system deterioration. This type of rocket engine has repeatedly demonstrated a space Isp of 310 seconds using hydrazine and nitrogen tetroxide as propellants.

Coupled with Marquardt's secondary injection, gimballing techniques, and throttleable rockets, these pulse rockets make possible a range of control systems that can meet the most advanced space control requirements. In a complex lunar landing-return mission, a Marquardt system can provide main course velocity control, orbital ejection-injection, descent-ascent control, and lunar circumnavigation.

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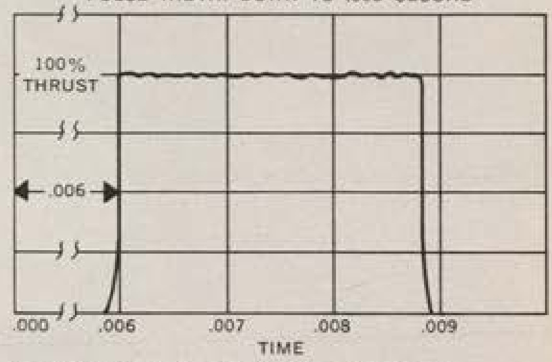
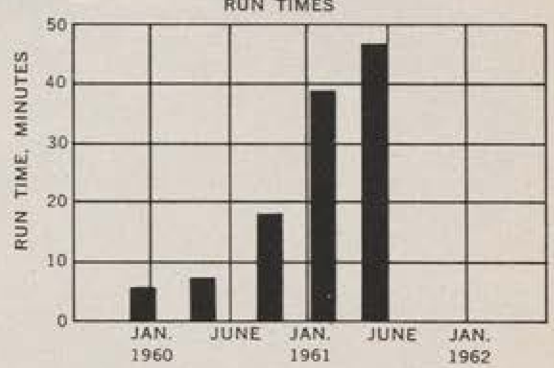
THRUST LEVEL: FROM ONE TO 300 POUNDS
PULSE WIDTH: DOWN TO .003 SECOND



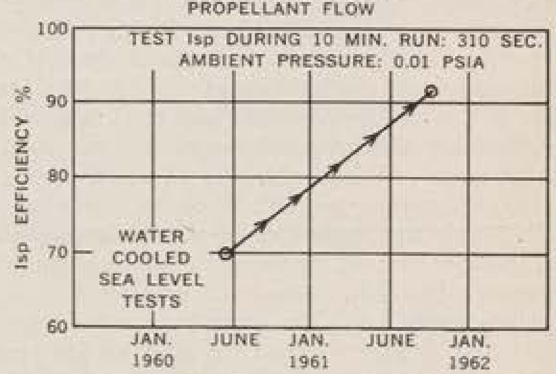
DOCUMENTED IMPULSE CAPABILITY
The above trace represents one impulse bit — demonstrating controllability of pulse width down to .003 second.

MAXIMUM CONTINUOUS RUN TIMES



RADIATION COOLED THRUST CHAMBER RUN
Continuous 46 minute run duration of radiation cooled thrust chamber with N_2H_4 and N_2O_4 demonstrated a 90% efficiency with no degradation in performance during run and showed no adverse effects on the system.

THRUST MEASUREMENT
PROPELLANT FLOW



DEMONSTRATED Isp EFFICIENCY
This chart shows thrust efficiency increase over slightly more than two years. Latest tests prove an Isp of 310 seconds, during a ten minute run at 0.01 PSIA.

FAIRCHILD BASIC RESEARCH LABORATORY ADDS A NEW DIMENSION TO PHOTOGRAPHIC CHEMISTRY

New insight regarding the interaction of light with solid state photosensitive surfaces is now being gained at Fairchild's Basic Research Laboratory. Defense Products Division scientists are also discovering new facts about the role of free radicals and molecular complexes in the photographic development process. Such knowledge can produce photographic materials of unprecedented speed and resolution which are capable of virtually instantaneous processing. Another result can be very thin solar cells of wide area and sensitive to radiation from the ultraviolet to the infrared which can be of great value in space exploration. Vastly improved developers can also be foreseen in new data concerning photographic chemistry. This basic and applied research and development is contributing advanced products and techniques for military and industrial application, assuring Fairchild's continued leadership in the photographic field. The Basic Research Laboratory and its achievements are available for your programs. For a brochure and further information, write the Director of Marketing, Defense Products Division.

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by a high-altitude explosion, however, consist almost entirely of material condensed from the vaporized bomb, and are so small that they can remain suspended in the atmosphere indefinitely. There also is considerable variation with bomb type. Thus, a so-called "clean" bomb in which most of the energy is produced by thermonuclear reactions results in fewer radioactive particles than a bomb that produces a large part of its energy by nuclear fission.

The more mundane activities of human beings dump tremendously greater quantities of particulate material into the atmosphere than the military activities. By far the greatest contribution is from the wide variety of combustion processes such as home heating, the operation of motor vehicles, power-plant operations, and rubbish burning. However, other sources are also important. For example, various smelting operations emit large quantities of metal sulfides and other inorganic materials.

Some materials emitted as gases are chemically converted into particulate material. A notorious example is smog formation over Los Angeles, where nitrogen oxides and gasoline vapors from automobile exhausts react in sunlight to produce an obnoxious mixture of gases and particles. Another example is the conversion of sulfur dioxide dissolved in fog droplets to sulfuric acid. Subsequent evaporation of most of the water leaves a haze of sulfuric acid droplets. This is a process that is probably quite common over London and other coal-burning cities where smog is, as its name implies, a combination of smoke and fog.

Sometimes natural hazes are produced by chemical reactions between gases. F. W. Went has suggested that hydrocarbons given off by various plants react with atmospheric oxygen in sunlight to produce haze in the form of finely divided, suspended particles. Study of such natural "pollution" might help develop criteria for distinguishing natural and man-made haze, criteria that might be of considerable use in air pollution studies.

Research concerned with the particulate composition of the atmosphere during the next few years is apt to be largely along three lines. One of these involves improvements in the techniques for the analysis of particulate material collected from the atmosphere. Increasing emphasis on the analysis of individual particles rather than on material collected in bulk form is likely, since results obtained with bulk samples are often misleading.

A second line of research will probably involve collecting more and better data from atmospheric regions already accessible. Little is known concerning the composition of so-called natural haze, especially in mountain and desert regions. Perhaps some is produced by the mechanisms mentioned.

Finally, there may be opportunities to collect particulate material at much higher altitudes than has previously been possible, using aircraft, balloons, and rockets. Unfortunately, advances will probably be slow because little money is available to support research concerning the natural particulate composition of the atmosphere.

The structure and dynamics of the atmosphere have a marked effect on the distribution of particles throughout the atmosphere. For the purposes of this discussion, the best way to classify the zones of the atmosphere is by temperature. The *troposphere* is the lowest region. In it, the higher the altitude, the lower the temperature.

Immediately above the troposphere, starting at an altitude of about 35,000 feet, is the *stratosphere*, a region in which there is little change in temperature with height. Exchange of air between the stratosphere and the troposphere is very slow. Above the stratosphere is the *mesosphere* extending from about fifteen to fifty miles. This is a region of relatively warm air between two cold regions. The thermosphere is the top layer, extending indefinitely into space. It is a region in which temperature increases with altitude, probably to an area in which molecules can escape into outer space.

In addition to the permanent structure, temporary zones often form that have considerable influence on the distribution of particles. One of the most important is the *inversion*, which consists of a layer of air that is warmer than that immediately beneath it. Just as the rate of exchange is slow between the stratosphere and the troposphere, very little exchange occurs between the warm and cold layers. Such an inversion, if formed over a city or other source of air pollution, may trap the contaminants and cause a serious smog condition.

A problem that often arises in connection with air pollution and related studies is the rate of growth and dilution of a cloud of fine particles. The cloud can be produced by an "instantaneous point source," such as a nuclear explosion, by a "continuous point source," such as a smokestack, or by instantaneous or continuous "line sources." The clouds are constantly diluted as they travel downwind by a process of attack by small atmospheric eddies. The problem of mathematically estimating or predicting the particle concentration at various distances from a source is complicated by the large number of essential meteorological factors. However, by setting up simplified mathematical models of the behavior of such clouds, crude but useful estimates can be achieved. Such estimates are employed in air pollution studies for predicting the effects of a given source of pollution (such as a factory stack emitting sulfur dioxide) on plant and animal life in the vicinity. Together with a knowledge of local microclimatology, they can be used in plant site studies. They are also used in estimating effects of biological, radiological, and chemical warfare.

A cloud of water droplets can become supercooled, a state in which the droplets remain unfrozen many degrees below the freezing point. In fact, water droplets have been supercooled to minus-forty degrees Fahrenheit in the laboratory. Solid atmospheric particles can serve as freezing nuclei, decreasing the temperature to which droplets containing them must be supercooled before freezing occurs. The nuclei do not even need initially to be imbedded in the droplet. Since the vapor pressure of water is much greater above liquid water than above ice, the droplets evaporate and ice crystals grow until the cloud is composed entirely of ice crystals. If there are relatively few freezing nuclei, large, rapidly falling snowflakes form, which may melt at lower altitudes to form rain. In fact, much of the world's rain is believed to be produced by this process. If a cloud is not sufficiently supercooled to freeze, the introduction of efficient freezing nuclei may produce first snow and then rain. This is the basis for the "cloud seeding," which has received much notoriety during recent years. Such seeding, however, produces rainfall only when certain rather stringent meteorological conditions are met.

Generally, people become aware of fine particles in the atmosphere only when they produce haze or other visible effects. The decrease in visibility caused by clouds of suspended particles results largely from the scattering of light by the particles, rather than from light absorption.

The effectiveness of a given particle for scattering light is a complicated function of the particle's size, composition, and the wave length of light. For particles considerably smaller than the wave length of light, the scattering ability decreases rapidly with decreasing particle size and increasing wave length. This effect is demonstrated by the behavior of the molecules in air, which scatter blue light more effectively than red, a behavior largely responsible for the sunset colors, the blue sky, and "purple" shadows.

Fine particles suspended in the air usually follow the movements of the air. However, they also are constantly moving independently to some extent, and under some conditions these independent motions can be quite important. For example, one might expect that raindrops and snowflakes would tend to intercept fine particles on the way down and scrub them from the air. However, this mechanism is relatively ineffective for small, independently moving particles, since these tend to follow the airstream diverted around the falling drop or flake.

Particles reach various surfaces by various mechanisms, and, if they adhere, they are removed from the air. One of these mechanisms is settling, and this occurs to some extent in spite of both air turbulence and the random movement of the particles resulting from bombardment by air molecules (Brownian movement). Brownian movement can also produce deposition, and so can direct interception of the particles by objects past which the air is moving. If a surface is charged electrically, it attracts particles.

Particles suspended in air of nonuniform temperature are subjected to forces that move them in the direction of decreasing temperature. This effect may be largely responsible for the deposition of dust and soot on walls behind steam radiators. Since temperature gradients are the rule in the atmosphere, this mechanism may be important to the worldwide deposition of airborne particles. Recent work has demonstrated that thermal forces on certain types of particles are much greater than had been believed and demonstrates that much remains to be learned concerning the mechanism responsible for such forces.

Thus, even on the clearest day, the atmosphere is loaded with fine particles of many types. For all their smallness, they have an enormous effect on conditions and life on earth. More research, more knowledge of these tiny particles can add significant gains to man's effort to control his environment.—END

Dr. Cadle is Manager of Atmospheric Chemical Physics at the Stanford Research Institute, Menlo Park, Calif., where he works on such problems as aerosol formation and atmospheric contamination. Author of a book on particle size determination, Dr. Cadle joined SRI in 1948. The above is reprinted with permission from the Stanford Research Institute Journal, *Third Quarter, 1961.*

Speaking of SPACE

WILLIAM LEAVITT
Associate Editor, Space Digest

Technological Terror As National Policy

Despite all the hopes to the contrary, despite the faith of some well meaning scientists that their art is international and that given time and patience the Soviets might join in a multinational space effort devoted to peaceful purposes, it becomes increasingly evident that the Communists have meant all along to exploit their technological advances politically and militarily.

Their choice of technological terror as policy has been dramatically illustrated by the announcement of the resumption of nuclear tests and the attendant discussion of 100-megaton bombs. That decision startled not only the "neutral" nations meeting at Belgrade but also the coterie of commentators in the US who have talked of the essential rationality of the Soviets, of the supposed Soviet "mutual stake with the US" in keeping the peace. Hitler was a madman and started his war, these commentators have said, but Khrushchev is no madman, and although he will take great risks, he will start no war. What is forgotten, of course, is that Hitler, in 1939, did not believe that England would fight for Poland, and gambled, it turned out, stupidly. Khrushchev is apparently willing to take that sort of chance now, and whether he is a madman or not (this is a relative question) his tactic is Hitlerian.

Astronautics is an integral part of the Red pattern of aggression; this is true no matter how many polite messages of congratulation we send to the Soviets on their space achievements and no matter how many pious hopes are expressed that the United Nations must somehow create controls for the internationalization of space.

Through Walter Ulbricht, the bearded Red Gauleiter of East Germany, we have already heard the not very subtle threat that the formidable engines that carried Major Titov around the earth could also carry nasty superatomic weaponry.

It is interesting to note the change in Soviet approach to international space propaganda exemplified by Ulbricht's fist-shaking. In the early days after Sputnik, the Russians concentrated on extracting maximum "technological superiority" benefits from their space triumphs. The world was told repeatedly that the tide of history was turning in the Soviet direction and that Sputnik and its successors showed the innate superiority of the Soviet system. Meanwhile, teams of Russian scientists appeared at the right places at the right times, at scientific meetings in the West, pontificating on the peaceful scientific purposes of the Russian space program, and presenting "scientific" papers which told virtually nothing to their western confreres. It was really an incredible performance. The writer recalls asking, at a Washington meeting a couple of years ago, the white-haired Russian rocket scientist Blagonravov about published reports on a Russian man-in-space training program. Blagonravov blandly replied that such reports were newspaper fairy tales. They were anything but fairy tales, and Blagonravov had, of course, lied barefacedly before an assemblage of scientists, where truth was supposed to be the common coin.

That phase of Red propaganda, annoying as it was to the West and particularly to the US, where overconservatism a few years earlier had made it that much easier for the Russians to get as far ahead as fast as they did, seems now to be melding into a method far more menacing—outright blackmail and threat.

Shortly after Sputnik, some suggested that the ultimate Soviet aim was to reach a point where the Russians could inform the world that it could destroy any point on earth from space—surrender or be blasted from space. Such ideas were dismissed then by too many as bloodthirsty and melodramatic. Yet the mutterings of Ulbricht and the Russian use of outright terror, rather than persuasion, against the conferees at Belgrade, many

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of whom could have been counted on to support the Red cause, suggests that those who have argued from the start that astronautics has obvious military uses—and that the Russians would eventually exploit space militarily—were on the right and uncomfortable track.

Where does this leave us? Is it too late for us to meet such a challenge? There are no sure answers to such a question. But it can at least be reasoned that, given the proper encouragement now, our military planners who see methods of providing defensive and offensive spaceborne weapon systems can provide a viable hope for the needed reply to the coming Red threat from space.

To create rapidly such US space capabilities will require a final dissipation of our national obsession with "world opinion." From the start of the space age, we have been convinced that it is essential to present a primarily peaceful face on our space efforts. This philosophy pervaded the Eisenhower Administration, and its scientific advisers, and influenced the Congress that wrote the Space Act of 1958 which set up the National Aeronautics and Space Administration, providing it with a charter so broad as to be nearly all-inclusive. It was only the intervention of quiet but effective realists on Capitol Hill that assured the insertion of a clause into the original Space Act laying claim for the Department of Defense to activities associated with national security.

At a recent hearing of the Senate Space Committee, at which Department of Defense Director of Defense Research and Engineering, Dr. Harold Brown *(see "Bringing Astronautics Out of Adolescence," page 54)* was testifying in behalf of abolition of the Civilian-Military Liaison Committee set up in the Space Act, Sen. Stuart Symington remarked that Congress had made some errors in writing the Space Act and that he for one, was willing to take his share of the blame. This courageous comment went unnoticed at the time. Yet it indicated a disenchantment with earlier American hopes that somehow astronautics could be confined basically to the pure science approach.

As has been noted in this space before, this disenchantment with "space for peace," regardless of Russian bluster, has begun to show itself in the higher national councils. The President has warned that we cannot allow any hostile power to dominate space. This is a far cry from the statements of his predecessor about not being concerned "one iota" about Russian space feats.

Yet, sooner or later, and the sooner the safer, full acceptance by the Administration of the military mission in space must come. This question transcends the ancient military versus civilian argument. It is not a matter of the Air Force or any service trying to grab responsibility away from the civil space agency. In a time like now, it is mendacious to even suggest such a motive. If we are willing to entrust massive destructive power to the uniformed men of the Strategic Air Command within the atmosphere, why shouldn't we be willing to extend such power, for the sake of the country's defense, into space?

The climax to the Berlin crisis must eventually come, and, in the last analysis, it is the Soviets who will determine whether there is peace or war. If we get through the crisis, the conflict will proceed, and our duty to ourselves and the free world will require us to extend our strength beyond the confines of our planet.

Space Capsules

An international METEOROLOGICAL SATELLITE WORKSHOP is scheduled for Washington, D. C., November 13 to 22. The Workshop, first of its kind, is being arranged by the Department of Commerce's Weather Bureau and the National Aeronautics and Space Administration. Dr. F. W. REICHELDORFER, Chief of the US Weather Bureau, and DR. HUGH L. DRYDEN, Deputy Administrator of NASA, have issued invitations to directors of foreign meteorological services. The countries have been asked to send one or two meteorologists to the ten-day workshop, where they will hear a series of short lectures on engineering aspects of US Tiros weather satellites, research results, and future program plans. . . . The Air Force, in an effort to analyze national space capabilities, is making an inventory of men, money, and material invested in bioastronautics in this country. For the Bioastronautics Office of the Air Force's Systems Command, CORNELL AERONAUTICAL LABORATORY at Buffalo, N. Y., is surveying universities, nonprofit research groups, and industry for information on bioastronautical and allied studies now under way. Systems Command spokesmen stress the seriousness of the "bottleneck" current in bioastronautics and the need to mobilize scentific talent for the successful implementation of manned spaceflight programs. . . . On the same front, REP. EMILIO Q. DADDARIO, Democrat of Connecticut and a member of the House Committee on Science and Astronautics, is continuing his call for full utilization of scientific personnel and facilities in national space programs, especially the utilization of existing military facilities. In a September 2 letter to NASA ADMINISTRATOR JAMES E. WEBB, he said, in part: "The single greatest concentration of resources for the development, test, and operation of vehicular space systems on an orderly time schedule lies within the armed services. As we develop our space program, these facilities may not remain in such a preeminent position, but they ought to be used to their fullest capacity and [be] developed simultaneously with civilian programs to meet the challenges before us." The Connecticut legislator, referring to NASA's plans for a $60 million manned spaceflight laboratory, added that "proper utilization and planning transcends even the very important biomedical question and there is a strong need for consideration and examination of existing and planned programs within DoD to make certain that NASA programs for costly new test chambers and the like will not be duplicative."

While conservative scientists debate whether we ought to be going into space at all, DR. FRITZ ZWICKY, Professor of Astrophysics at the California Institute of Technology, is thinking farther out than almost any of his colleagues. Dr. Zwicky outlined in a recent issue of Caltech's monthly publication, *Engineering and Science,* a number of projects, which in the words of the Associated Press's Ralph Dighton make science fiction sound as dull as a lab report. One of Dr. Zwicky's advanced ideas: Reshuffle the planets of the solar system to make them habitable. Mercury and Venus, for example, are now, because of their nearness to the sun, too hot for human comfort, but with controlled nuclear explosions, Dr. Zwicky believes, they might be moved into orbits nearer to earth and far enough away from the sun to allow proper temperatures for human habitation and a place for excess earthly population. Another intriguing idea of Dr. Zwicky's concerns the giant planet, Jupiter. "Jupiter is so big and its gravitational pull so strong that man would find it difficult to move about on the surface. The answer is to whittle it down to proper size with terrajets [a rock-melting machine designed by Dr. Zwicky] and nuclear power, using the debris to increase the size of Jupiter's moons, so they, too can be colonized."

Probably the most striking idea of all is Dr. Zwicky's suggestion that the sun itself could be moved by firing large "bullets" into it in a highly precise manner. Why move the sun? To convert it into a space probe in its own right. The sun, with its planets, would itself voyage to new positions in space, providing us in hundreds of years with knowledge that via spaceships we could build in the foreseeable future it might take thousands of years to obtain. "We wouldn't want to cause too big an explosion on the sun at one time," Dr. Zwicky warns, "just continuous little jolts to keep it speeding up. Over the years, the buildup in speed would be incredible." . . . An interesting report, "Self-Maneuvering for the Orbital Worker," which describes studies at the Air Force's Wright Air Development Division, Wright-Patterson AFB, Ohio, of possible methods of spacecrew personal propulsion in the weightless state is now available at seventy-five cents from the US Department of Commerce, Washington 25, D. C. Write to Commerce, with remittance, for WADD Technical Report 60-748. . . . AIR FORCE/SPACE DIGEST is honored to note its inclusion as a suggested periodical reference in the Cleveland Public Library's *The Open Shelf,* bulletin on "The World's New Frontier: Space.". . . The NATIONAL AVIATION EDUCATION COUNCIL, which distributes aerospace education material in schools and to educators, has released the newly revised version of "The Space Frontier," a condensation prepared by AIR FORCE/SPACE DIGEST's editors of material which appeared originally in the March 1958 "Space Weapons" special issue of this magazine. The revised version, including our Astronautics Glossary, brings the text up to date as of June 1961. It is available from the National Aviation Education Council, 1025 Connecticut Ave., N. W., Washington 6, D. C. at fifty cents.—END

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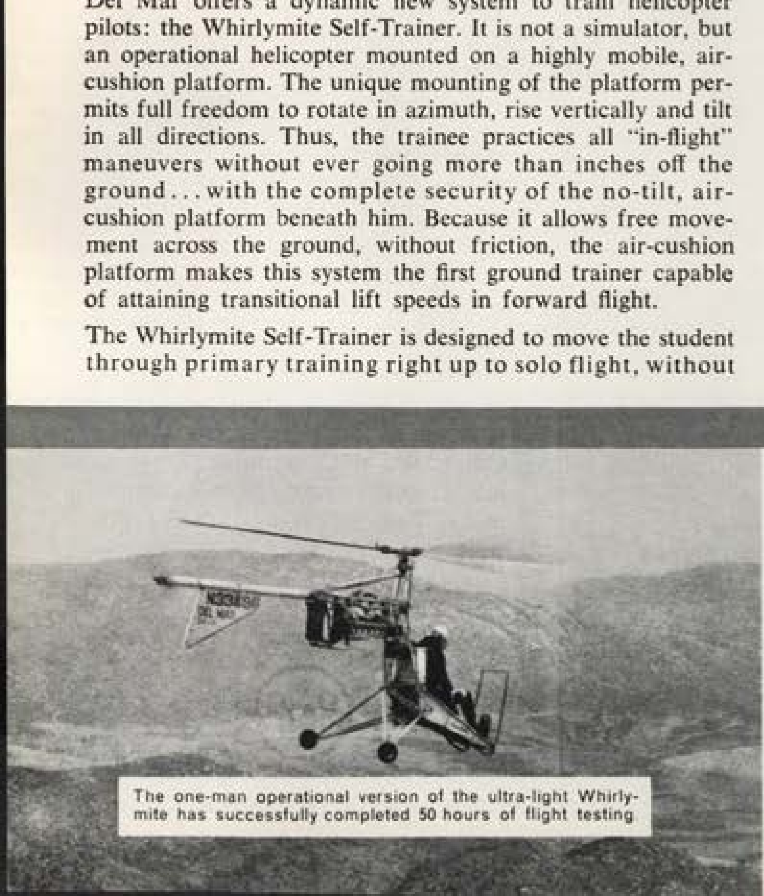

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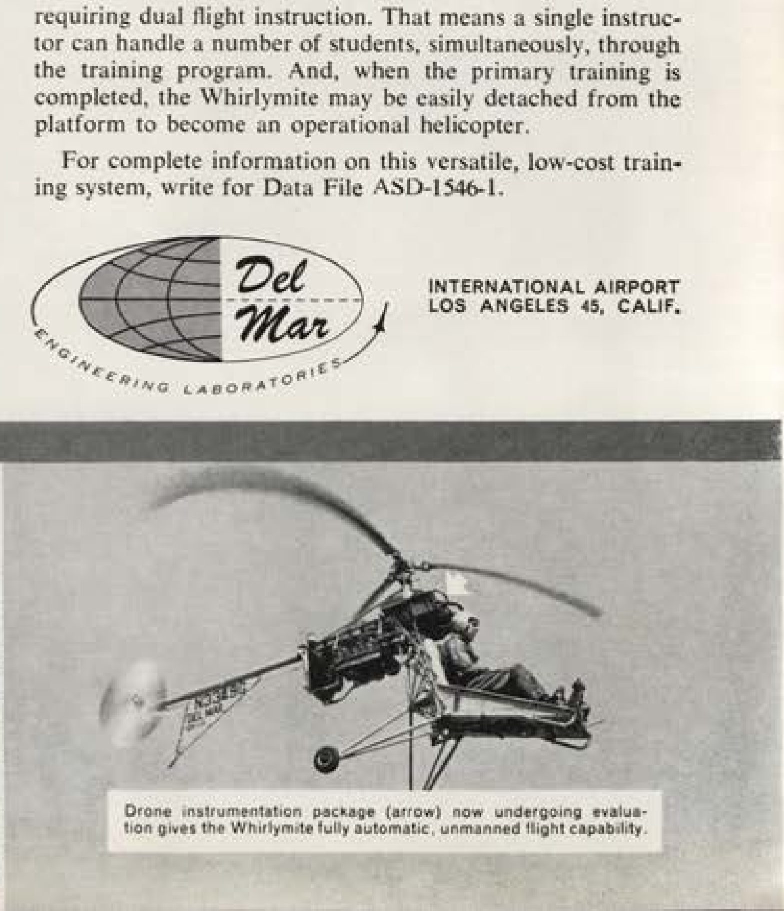
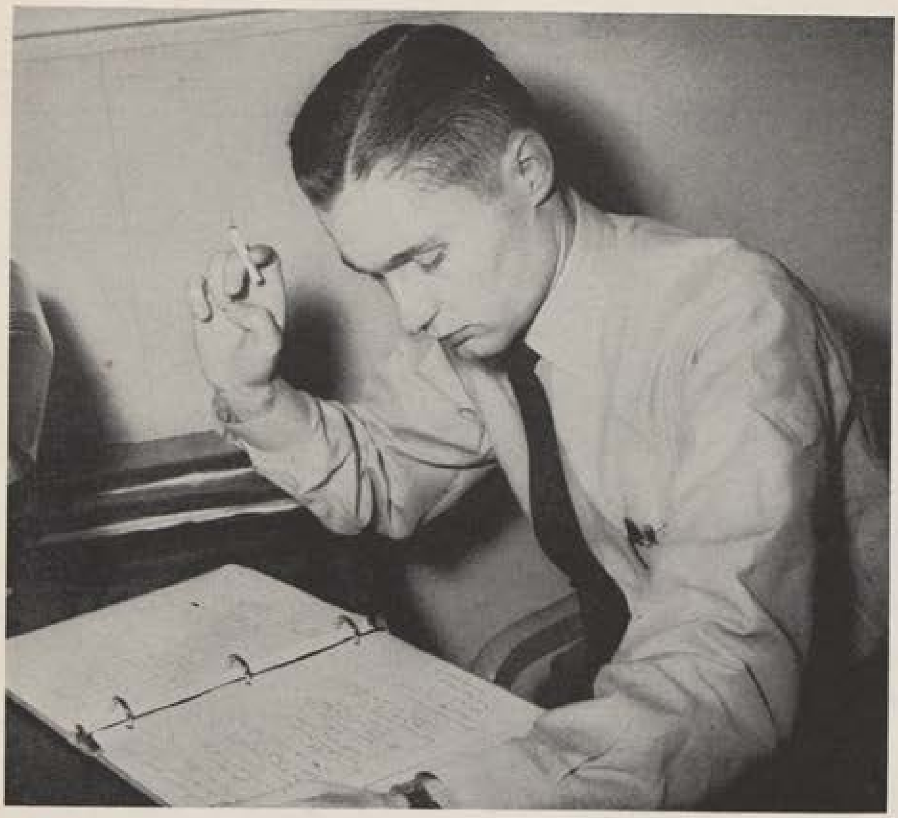


Drone instrumentation package (arrow) now undergoing evaluation gives the Whirlymite fully automatic, unmanned flight capability.



AIR FORCE
OCTOBER 1961

Programs to train urgently needed missilemen have swung into high gear at Sheppard AFB, Tex., the nation's prime training center for operation of the big birds . . .

MEN TO MATCH THE MISSILES

By Louis Alexander

AT SHEPPARD AFB in Texas, the mission is men to match the missile deterrent. Here USAF officers and airmen learn to maintain and operate the big birds —and to fire them in anger should the need arise. Sheppard is one of the nation's prime intercontinental-missile training centers. Atlas and Titan missiles, ICBMs number one and two for the free world, get the most attention these days. Instructors from Sheppard are also training Italian crews for the Jupiter IRBM, just as they trained British crews to operate the Thor.

By early this year, enrollment at the missile training center—which is commanded by Brig. Gen. Thomas Moore—was about 900.

On another part of the big base, about 2,000 airmen were learning to repair and maintain aircraft and engines. But ICBM training is becoming more important to the Air Force and to the free world every day. Next spring, officials of the Technical Training Center expect enrollment at the missile school to rise to about 2,250 and enrollment in the aircraft and engine school to recede.

The missile training center at Sheppard, part of Air Training Command's Technical Training Center, enrolled its first students at the end of 1959. In mid-1960, the school was able to take over ICBM training from the missile manufacturers. USAF assumed responsibility for turning out missilemen. The raw material is flying officers and skilled aircraft technicians, young lieutenants with engineering degrees, and bright new recruits. End products required are launch control, operations, and maintenance offi-

(Continued on following page)

Sheppard trainees learn to fire Atlas ICBMs like the one at right. Top, 2d Lt. Bob Weinaug does some intensive cramming for launch-control course.

Lieutenants Weinaug and Ward get the feel of an actual countdown at an exact duplicate of launch-control console for E-series Atlas. 1st Lt. Robert B. Christensen, their instructor, discusses countdown procedures. Young lieutenants like these take missile training alongside former flying officers, skilled aircraft technicians, bright new recruits. They will be launch control, operations, or maintenance officers for the big birds after reporting for duty at their operational launch sites.

cers, and guidance, control, missile systems, and maintenance technicians.

All of these students attend classes in Kearby Hall, a windowless, top-security, air-conditioned building. Visitors, if they get in at all, must wear badges and be accompanied everywhere by a badge-wearing escort. The hall, newly built, cost $3 million. It is named for fighter ace Col. Neel Kearby, a native of nearby Wichita Falls, Tex., who won the Congressional Medal of Honor over New Guinea in 1944. He was killed in the action.

Kearby Hall has 126 classrooms and laboratories and a really huge missile bay that harbors two Titans and two Atlases. One Atlas and one Titan are complete. The others are broken down for training purposes. These are real birds, brothers of those on operational sites.

The reporter walked into one of the large air-conditioned training rooms on the building's first floor. An intent second lieutenant sat at a control console, the exact duplicate of the control setup in an Atlas launch site blockhouse. He and an instructor ran through mock launch procedure. Console lights glowed red, yellow, green. Instructor and student learned that the ground-support units for an Atlas were in working order, that the hydraulic-pneumatic system was ready, the liquid oxygen and fuel system completely loaded and ready to flow.

When a light failed to change color in proper sequence, they considered what this would mean on the launching pad. Then they went through the procedure of telephoning instructions to the enlisted technician—who in this case sat at the other end of the classroom. Other students stood at one side watching.

In a room at the other end of Kearby Hall a B-47 pilot, a captain, frowned, moistened his lips, concentrated over the lights of another control panel. This one was the control position for a Titan missile. Except for instructor Terry Green, a tall first lieutenant, the captain was just as alone as he had been in his office atop the B-47, facing a busy instrument panel and surrounded by miles of circuitry hidden inside the fuselage and wings, along with several thousand gallons of jet fuel.

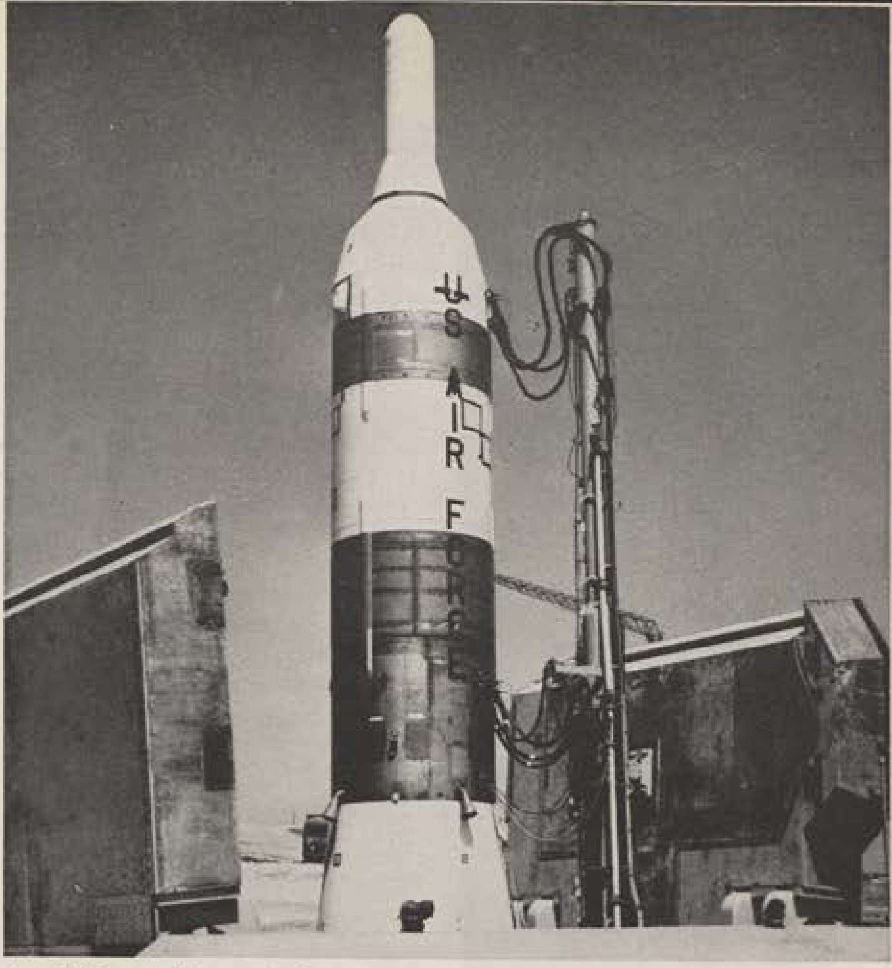
Behind the student captain, Lieutenant Green walked nervously up and down, waiting to see if the student would manage to send his missile on its way toward target despite pitfalls built into the problem.

The student consulted his check-list. Carrying it, not trusting to his memory, he walked to a cabinet, opened the door, checked transistors and wires within. At each step, he called to instructor Green, told him what he was up to. Then he returned to the console, resumed the countdown.

This was typical missile control training—training to control mazes of circuitry, equipment costing millions of dollars—one man in charge of it all, relying on a checklist and his own quick mind to keep the countdown moving. Officers at Sheppard tell you that in missilry, more than in B-47s, more than in maintenance depots, more than on the production lines, success depends upon the quick understanding of a complex system by one extremely well trained man, capable of quick judgment and quick action.

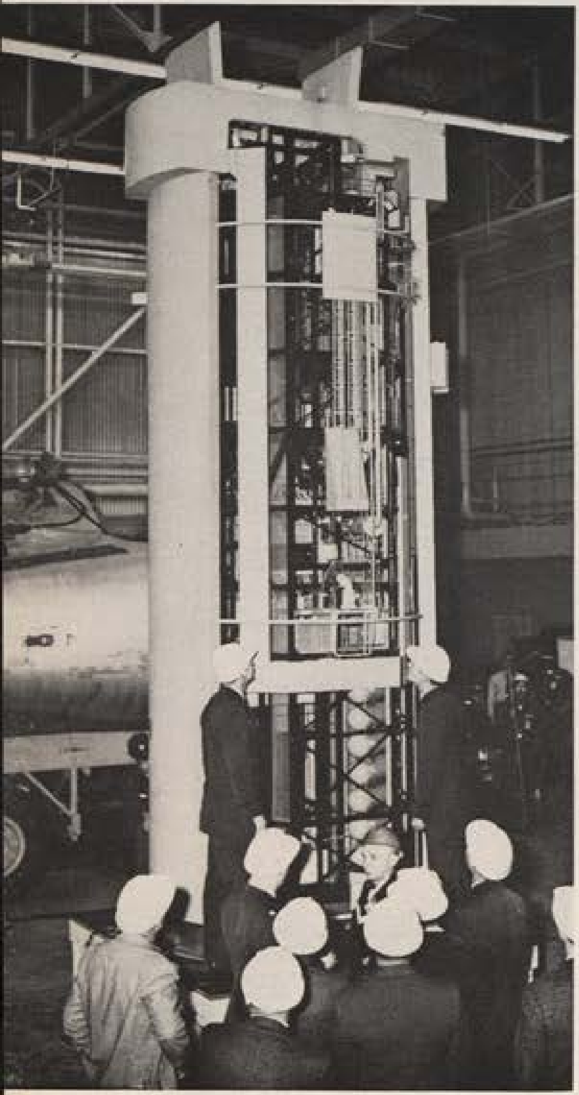
Like the captain learning how to launch a Titan, many pilots and navigators of B-47s and other aircraft are becoming missile retreads. B-47s are gradually phasing out of SAC, missiles are phasing in. When Atlas launch complexes began rising on bases likes Forbes AFB, Kan., where B-47 bombers had reigned supreme, many aircrew members read the handwriting on the wall.

In classes with the flyer retreads
(Continued on following page)



In addition to Atlas, missile trainees at Sheppard also learn launch and maintenance techniques for Titan, above, as it emerges from its underground silo.

Two staff sergeants take a test on a Titan's second stage. At least one test during their training lasts a full six hours. Airmen who are trained to maintain one ICBM while at Sheppard may later learn about another missile while on the job.



Instructor demonstrates working model of silo from which advanced Atlas, starting with "F," will be launched.

are young second lieutenants, fresh out of college and new to active duty. Engineering degrees put them on the inside track to missile duty as far as the Air Force is concerned. "I chose missile training because it's the coming thing," a 1960 Air Force Academy graduate explained.

Sheppard has devoted a major share of its attention to the training of skilled technicians. Training of airmen at the missile center began when it opened its doors in 1959. Officer classes did not commence until this year. For the first missile classes, USAF selected some of the best aircraft and engine technicians in the service. They were men whom their units hated to lose. The Air Force was determined to build a core of highly capable missilemen, the effort was a success.

Airmen today go through courses of ten to twenty-four weeks to become technicians and supervisors on missile maintenance. They learn one specialty, closely related to their previous experience if they are old-timers, such as hydraulics repair, electrical repair, guidance systems, or control systems. They learn their specialty for one missile, the Atlas or the Titan, but not both. Later, if they transfer to a site with the other missile, they know enough to learn anew on the job.

In the huge missile bay at Kearby Hall one day recently, a master sergeant and his staff showed student airmen and officers the inner workings of propulsion, hydraulic, and other systems of the Atlas. Another NCO supervised Titan students. The teaching aids were the Center's torn-down Atlas. During exams, later on, the students would spend a lot of time rechecking the interiors of the sections, finding or verifying their answers. The course is demanding; at least one exam during it lasts six full hours.

In a small room just off the big missile bay, advanced students check every element of the myriad of gyroscopes, accelerometers, and the maze of circuitry in the guidance and control systems. Rather than using a magnifying glass and a watchmaker's pincers, they call data-processing machines to their aid—in training just as they will later in actual operation. The atmosphere in the Automatic Programmed Checkout Equipment system room (APCHE) is like that of a business office, except that young men in fatigues are walking around instead of trimly dressed girls clacking across the floor on high heels. The student puts a deck of punched cards in a data-processing machine. Wires run from the desk to the guidance canister, or whatever else is being checked.

As the cards run through the machine, a printed tape begins to flow out. For every swift entry on the tape, the wires and gadgetry have checked out one element of the equipment and printed the report on the tape. It's done by numbers; each element must check out within a high and low limit, and the APCHE technicians can see for themselves on the tape when an element is all right and when it needs adjustment or repair.

The technician students, like student control officers, learn quickly how much they must know in order to supervise a little kingdom within the world of maintenance.

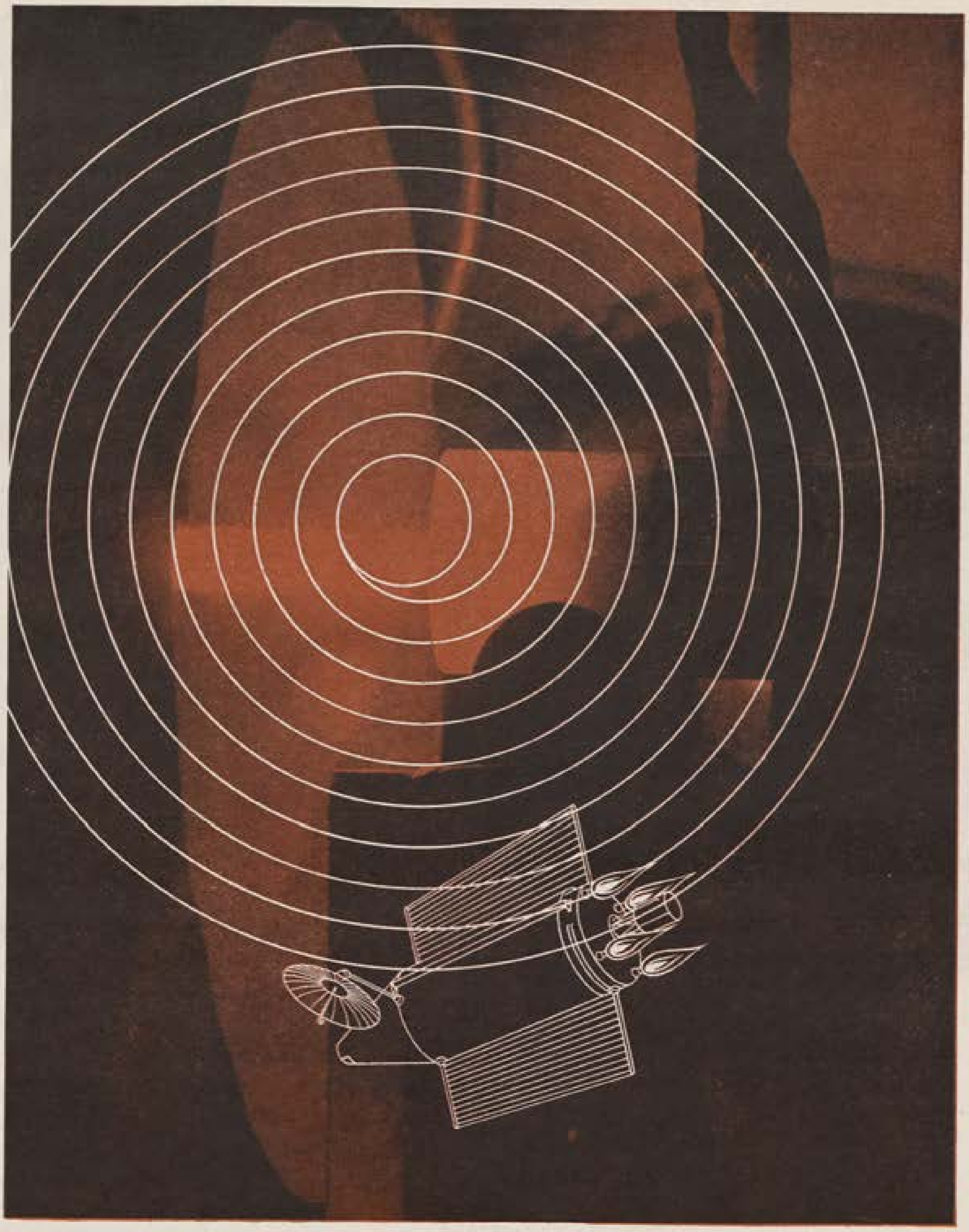
"Maintenance men on missiles have responsibilities that rival those of operations men," points out Lt. Col. Frank C. Watrous, deputy commander of the training group which oversees missile and other training at Sheppard. "The missiles in our inventory have brought about a maintenance requirement that's almost unbelievable."

In addition to the core control officer and technician courses, Sheppard also provides a special two-week course in supervising and planning for senior officers who may command missile troops or do staff work that affects them. Students in supervising and planning often are senior officers with leaves or eagles on their shoulders. Some of them wear one, two, even three stars.

All of this activity points up the Air Force's missile-and-space new frontier. To meet the challenges of a new age of military technology, USAF realizes it must train, train, and retrain. The emphasis at Headquarters USAF in recent months has been on plans to provide the service of today and the future with a reservoir of officers and airmen with adequate technical background and competence. In the mill are highly significant scientific-technical and general education programs to prepare the men of the Air Force for a revolutionary weapons era.

Sheppard's missile training center is making a major contribution to USAF capability at the dawn of this era.—END

The author, Louis Alexander, is a veteran contributor to AIR FORCE/SPACE DIGEST. *His last article to appear in these pages was "The Air Force's Junior Partners," a report on the Civil Air Patrol, published in February 1960. Mr. Alexander is a former newspaperman, an Air Force Reservist, and a busy free-lance writer. A Texan, he is married, father of two children.*



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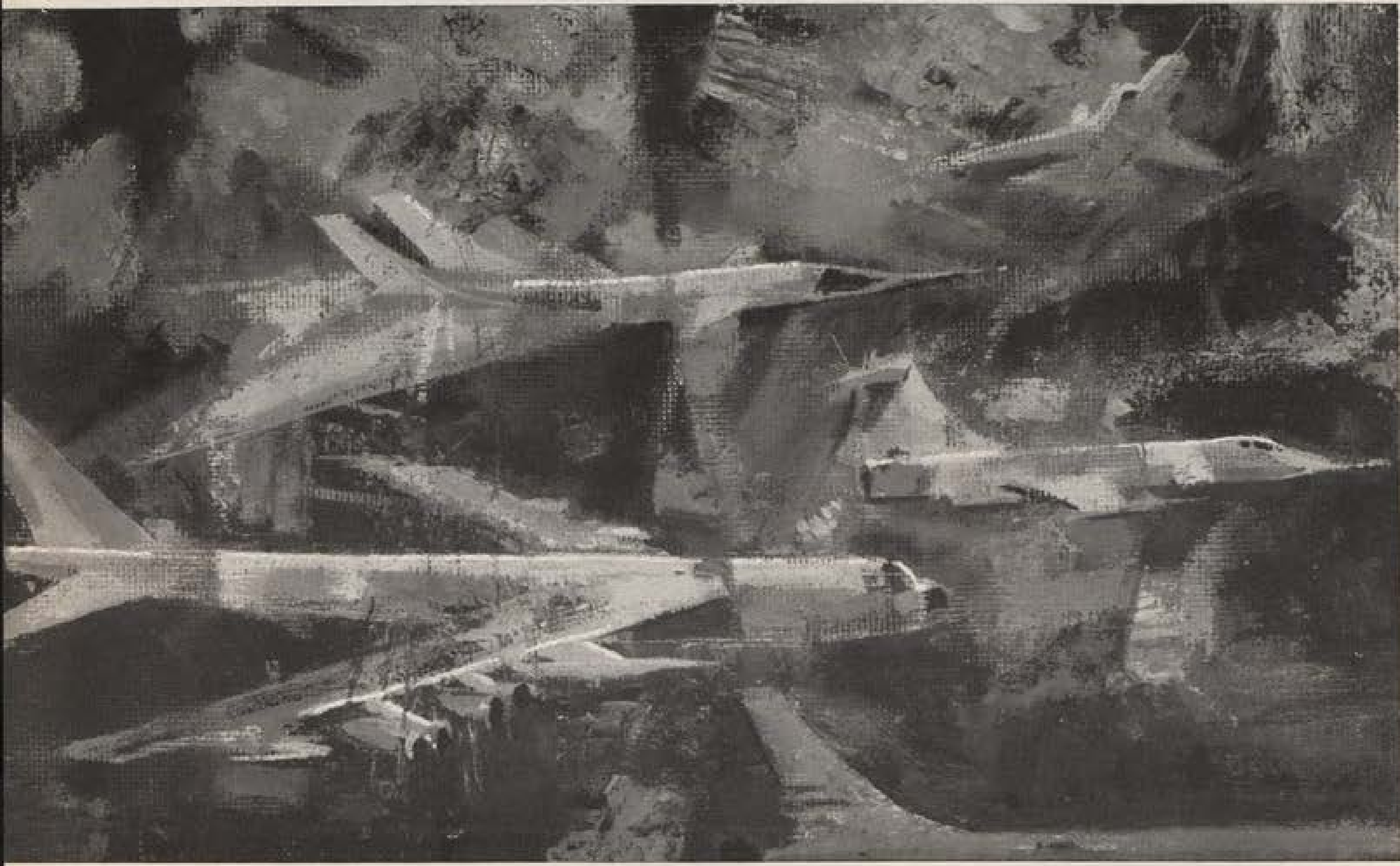

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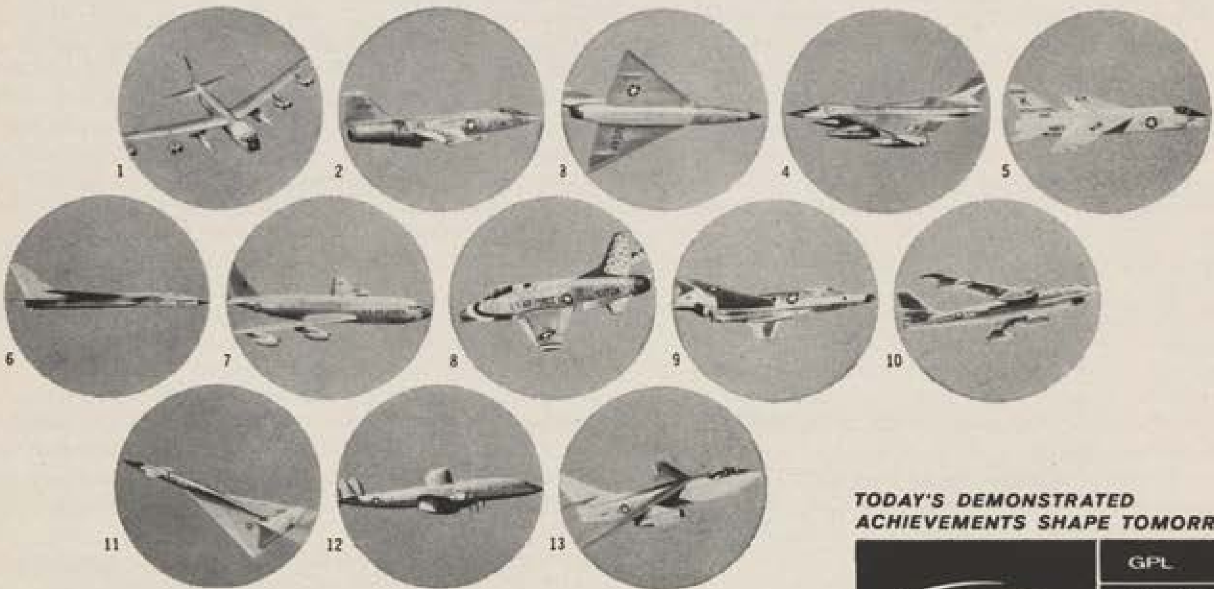

TODAY'S DEMONSTRATED ACHIEVEMENTS SHAPE TOMORROW

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SAC's 376th Bombardment Wing at Lockbourne AFB, Ohio, last year "adopted" the University of Kentucky's Air Force ROTC Wing. The results have been beneficial all around . . .

THIS IS PROJECT 376

How do you motivate the right kinds of young men to seek careers as Air Force officers? Col. R. W. Boughton, USAF, Professor of Air Science at the University of Kentucky and author of this article, here describes his experience with an imaginative Air Force unit-ROTC sponsorship program. He has found it a "most effective motivational method."

SAC'S 376th Bombardment Wing, Lockbourne AFB, Ohio, has "adopted" the University of Kentucky's 290th Air Force ROTC Wing.

The object is career-motivation for the Kentucky Cadets through 376th sponsorship of Cadet activities and Cadet visits to Lockbourne to see USAF in action. USAF and Air Force Academy units have conducted such joint programs for the past several years.

We at the University of Kentucky are proud of this 376th Cadet activity—for its accomplishments to date and its promise for the future in serving the Air Force. We also believe that such programs as this would make a really major contribution if they were undertaken by active Air Force and AFROTC units across the country.

Project 376, the name chosen for the 376th Kentucky program, came into being last October. Since then, it has included a wide range of activities, including two Cadet field trips to Lockbourne.

In November, some fifty Cadets and twenty young lady members of Kentucky's AFROTC Sponsor Corps were week-end guests at the Ohio base. Activities included a tour of base facilities and aircraft, a briefing on the history and accomplishments of the 376th, a dinner dance at the Lockbourne Officers Club for the 376th and the Cadets, and a Sunday brunch. A Sponsor "queen" was crowned at the dance. The second field trip took place in February of this year. Events included further briefings on base operations, a reception coffee hour given by 376th wives, and an exhibition provided by the Lockbourne Judo Club. Noncommissioned officers of the 376th played a major role in the February visit.

The 376th is solidly supporting Kentucky's Cadet Wing in several ways.

Col. Charles L. Wimberly, Commander of the 376th, presented two trophies at Kentucky's annual AFROTC Honors Day ceremony on April 22. One went to the outstanding Cadet majoring in Aerospace Science. The other went to the Sponsor contributing the most to the AFROTC program. On hand for Honors Day, incidentally, was Maj. Gen. William J. Bell, Commandant of the AFROTC. He was commissioned a Kentucky Colonel by Governor Bert Combs for "outstanding command support of the University of Kentucky's AFROTC program."

The field trip judo exhibition was so successful that it suggested another area of 376th support. The chief instructor of the Lockbourne Judo Club will make periodic visits to the Kentucky campus to give concentrated instruction to members of an AFROTC Judo Club. The Cadet group, although less than a year old, hosted the first intercollegiate judo tournament to be held in the eastern United States as a part of Honors Day festivities. It was held in the Memorial Coliseum on the Kentucky campus.

The 376th and the Kentucky Cadets have appointed liaison officers who maintain close contact. A large pictorial display is maintained in a prominent place in the facilities of each organization; pictures and press clippings depicting events and activities of interest involving each unit are posted in the other's display. One set of photos and clips at the AFROTC quarters concerns the fact that the 376th took first place in the Eighth Air Force and placed second in all of SAC for 1960 in operational effectiveness competition for bombardment wings. Also on display there is a set of framed pictures of airplanes and missiles that the 376th sent to their youthful protégés.

How successful has Project 376 been? It is too early to speak of tangible results, of course. But indications are that it has created strong interest toward Air Force officer careers on the part of a number of Kentucky AFROTC Cadets. They were strongly impressed by what they saw at Lockbourne—the high state of military and technical proficiency of the 376th Wing, the high morale, and strong dedication of its members.

Here is how Project 376 got off the ground last October. First, some preliminary talks took place among staff members of our Kentucky Air Force unit officers, SAC personnel staff people, and the Commander and staff of the 376th Bombardment Wing. Col. R. G. Wilkinson, Chief of SAC's Officer Personnel Division, was intrigued by the possibilities and played a key role in setting up the joint program. Next, Cadet Lt. Col. Michael J. Hinton, Commander of Kentucky's 290th AFROTC Cadet Wing, paid a visit along with some of his staff to Colonel Wimberly of the 376th at Lockbourne. At this meeting, the possibilities of the program and various mutual activities were explored. The talks ended in complete and enthusiastic agreement on both sides as to the mutual value of the program. The relationship was officially started up with an exchange of letters between Colonel Wimberly and Cadet Hinton. Brig. Gen. William E. Creer and Col. O. F. Lassiter, past and present Commanders of the 801st Air Division, of which the 376th is a part, both have lent strong command support to Project 376.

During the first academic year of its existence, the Project drew favorable comment from top SAC and AFROTC officers as well as from prominent University of Kentucky faculty members headed by University President Frank G. Dickey. President Dickey declared that it promised many "beneficial results" and both our Cadets and the Air Force would "profit immeasurably from the arrangement." Which pretty well sums up Project 376.—END

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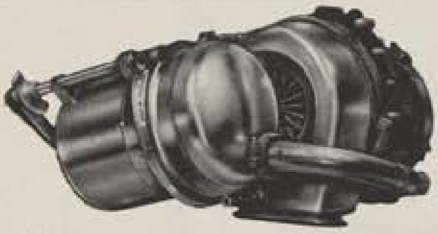

Production configuration of Sundstrand B-52H Cartridge-Pneumatic Starter, being produced under Air Force contract. Lightweight self-contained unit for scramble or emergency starts.

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Servicing Cartridge-Pneumatic Starter on B-52H 1000-hr test aircraft. (Illustration courtesy Boeing-Wichita.)


ACTION!
Major advances, coming in increasingly rapid succession from the leaders of the solid rocket propulsion industry, give dramatic evidence of the quickening pace of this nation's big booster effort.
The next major achievement will be the firing soon of a giant operational prototype solid rocket of approximately one-half-million-pounds thrust at UTC's Development Center.
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the Ready Room — RESERVE AND AIR GUARD NEWS

More Muscle for the Active Air Force

The US Air Force is stronger by **eleven wings** and **more than 24,000** well qualified men this month, as members of the **Air National Guard** and **Air Force Reserve** enter on active duty for "twelve months or less" as part of the buildup to meet **Red pressure in Berlin and elsewhere.**

Nine wings come from the Air National Guard—**six tactical fighter, one tactical reconnaissance,** and **two long-range transport**—plus a **tactical control group** with radar and communications equipment to direct the tactical squadrons.

From the **Air Force Reserve** come two wings of heavy C-124 troop carriers.

The **Guard Wings** are: **117th Tactical Reconnaissance Wing,** Birmingham, Ala.; **146th Air Transport Wing,** Van Nuys, Calif.; **122d Tactical Fighter Wing,** Ft. Wayne, Ind.; **113th Tactical Fighter Wing,** Andrews AFB, Md.; **102d Tactical Fighter Wing,** Logan International Airport, Mass.; **133d Air Transport Wing,** Minneapolis-St. Paul, Minn.; **131st Tactical Fighter Wing,** St. Louis, Mo.; **108th Tactical Fighter Wing,** McGuire AFB, N. J.; **121st Tactical Fighter Wing,** Lockbourne AFB, Ohio. The Guard group is the **152d Tactical Control Group,** Roslyn, N. Y.

USAF Chief of Staff Gen. Curtis E. LeMay, Army Lt. Gen. T. J. H. Trapnell, other top officers at Swift Strike exercise in Carolinas in August. Reserves performed well.

The **Air Force Reserve wings** are: **435th Troop Carrier Wing,** Homestead AFB, Fla.; and **442d Troop Carrier Wing,** Richards-Gebaur AFB, Mo.

Their first couple of weeks will probably be spent at home stations, settling into daily operations, acquiring men for any vacancies that may exist in the units.

Some individual Reservists could be called to active duty this month to fill space remaining in mobilized units. The Air Force has preferred to have the **squadrons themselves recruit volunteers** to reach full strength. USAF will call up individual Reservists who possess the needed AFSCs.

It appears quite possible that the tactical units may go overseas. From Europe come reports that **vacant fighter bases are being refurbished** for new tenants.

Transport squadrons, both Guard and Reserve, may remain based in the US, but they will be making **frequent runs overseas,** first in support of the tactical unit movements, then probably to help move and supply Army forces.

Will more units be called? Apparently not, unless world conditions deteriorate further. **Secretary of Defense Robert McNamara** told the press late in August that these "represent the total action required, so far as callup of units is concerned, to meet the program presented by the **President** and approved by the **Congress.**"

What's Ahead

The call of **Reserve Forces units** to active duty has drawn so much attention in recent weeks that some of the possible long-range implications of the **Berlin crisis** on the Reserve Forces may have been overlooked.

There is, first of all, a "where do we fit in?" question in the minds of **in-training Reservists** whose units have not been called.

It is already apparent, however, that the need for these remaining units in the Reserve has not diminished in the slightest. In fact, major **Air Force commands** are more conscious than ever of their need for Reserve Forces to **bolster their operational capability.**

—US Army photo

Swift Strike commanders oversee operations in C-135 flying command post. Left to right, Brig. Gen. Frank Bailey, Maj. Gen. Charles DuBois, and Maj. Gen. Maurice Preston.

Some **twenty-six Air Guard air defense squadrons** have been standing twenty-four-hour runway alert under **ADC control** since July 1. They are involved in **Sky Shield,** the **NORAD-wide test exercise** scheduled for October 14.

The Reserve's **thirteen troop carrier wings** will continue to work closely with the **Army** in joint exercises, which in the past year have carried them from Panama to Alaska. These exercises will be augmented as the Army converts its three training divisions to combat readiness.

MATS is ready and anxious to use the Guard's **five remaining C-97 squadrons** in training missions as they develop operational capability. Meanwhile, the Air Guard's **ten aeromedical evacuation squadrons** comprise the major portion of MATS' resources in this field.

The importance of Reserve recovery and base-support squadrons in event of a nuclear attack is apparent. USAF

(Continued on following page)

knows, too, that these units need training now if they are to be effective.

In this context, then, Reserve Forces are coming in for full attention from the active establishment. On the other hand, the buildup of active forces has shut off for the present the conversion of some units to newer aircraft and missions. For example, the **145th Aeromedical Squadron** of the **Ohio Air National Guard** recently moved from **Akron-Canton** to the **Clinton County Airport** south of Dayton in the expectation of converting to an air-refueling mission with KC-97 tankers. But now SAC is holding on to its B-47s and the KC-97s needed to refuel them; the 145th continues to fly C-119s.

Similarly, the Air Force is keeping its C-124s, C-121s, and other aircraft previously **earmarked for Reserve and Guard squadrons.** Conversion to newer aircraft may be resumed later.

There were, of course, many unanswered questions in this whole area—as there would have to be. But one thing is certain. The **Reserve Forces concept** has proved its value in making possible swift expansion of the Air Force in the present crisis. **Air Force chiefs,** both civilian and military, are convinced of the continuing need for Reserve Forces on the Air Force team. They are open to suggestions on how the Reserve Forces can best continue to support **Air Force missions.**

Advice for the Secretary

Secretary of the Air Force Zuckert made it clear he intends to work closely with his Air Force Reserve Forces Policy Committee by calling the committee to Washington in August to get its concurrence on USAF plans to employ Reserve Forces units in the Berlin buildup.

After a series of briefings on aspects of the buildup and deployment, the committee endorsed the "principle of Ready Reserve participation" and assured the Secretary of its support of his plans. Four days later the **Secretary of Defense** announced those plans in a **press conference at the Pentagon.**

The committee took advantage of its meeting to forward several other recommendations to the Secretary:

- Pointing out that Congress had appropriated funds to provide **forty-eight paid drills a year** for recovery and base support units, it asked **Secretary Zuckert** to urge the **Secretary of Defense** to double the present twenty-four-drill authorization.
- Recognizing that some airlines have petitioned the Secretary of Defense to release pilots from going on active duty with alerted units, the committee recalled that in 1958 the **air transport industry** had succeeded in getting the Air Force to revoke a directive prohibiting **key airline employees** from holding positions in the Ready Reserve. Because "all personnel in the Ready Reserve, including those of the air transport industry, have signified their intentions and availability to serve in the event of mobilization," the committee recommended that they be ordered to active duty with their units.
- Citing a report by the **Senate Appropriations Committee** that "concerted effort be made to equip, man, and train the **Air Guard units** to the highest degree possible to ensure maximum operational readiness," the **policy committee** recommended that immediate action be taken to bring the authorized strength of all units to full manning, that additional school spaces be provided to meet training requirements, and that flying hour minimums be raised to 150 hours a year for jet pilots and 200 hours for conventional pilots.

A Draw for Swift Strike

Some 4,500 members of the **Air Force Reserve** and **Air National Guard** who engaged in **Exercise Swift Strike** in August went through a more strenuous workout than perhaps any previous participants in the four-year **Pine Cone** series.

The battle, pitting 30,000 men of the **Army's 82d and 101st Airborne Divisions** against one another, supported by Reserve and Guard tactical air units, raged over one and a half million acres of private land in the sandhills of North and South Carolina. It was the biggest exercise since 1941 to be held on civilian domain.

This substantial area produced a more realistic combat situation for both ground and air forces.

In the **fourteen-day exercise,** troop carrier units led by **Brig. Gen. John Bagby** of Willow Grove, Pa., dropped 11,615 paratroopers in four major aerial assaults and air-landed another 3,000 in combat zones. Tactical fighters and reconnaissance planes, plus SA-16 amphibians operating in support of special forces, flew more than 2,000 sorties, accumulating some 3,500 flying hours. Tactical air forces were commanded by **Brig. Gen. Frank Bailey** of the Arkansas ANG.

"This was the most responsive, able and best air support I've ever seen," said **Maj. Gen. Charles W. G. Rich,** 101st Airborne Division Commander.

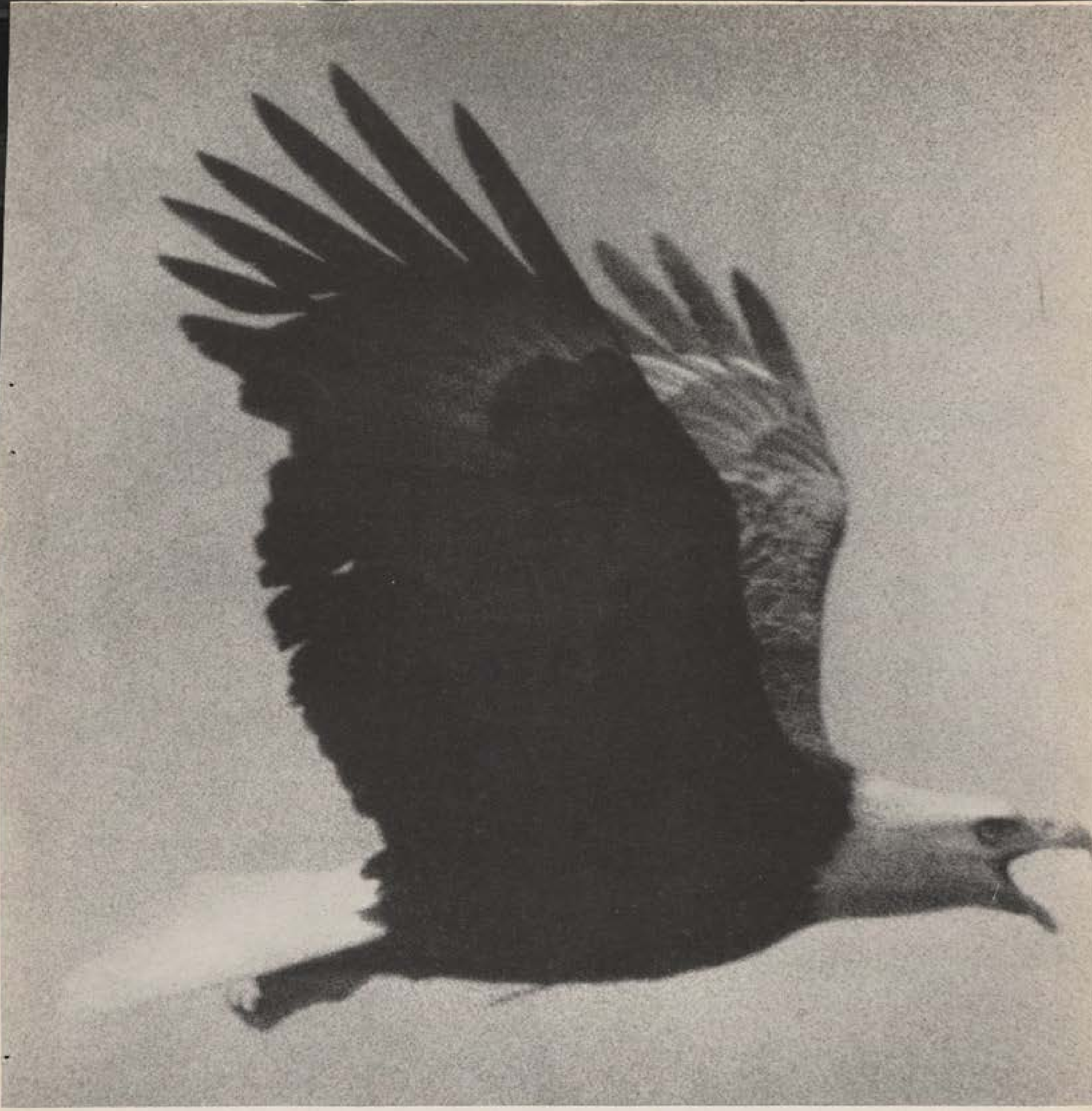
The exercise was jointly planned and directed by **Lt. Gen. Paul D. Adams,** Commanding General of the Third US Army, and **Maj. Gen. Maurice A. Preston,** Commander of TAC's Nineteenth Air Force. General Preston's deputy was **Maj. Gen. Charles H. DuBois,** Chief of Staff of the Missouri Air National Guard, who had commanded Air Guard units in **Dark Cloud/Pine Cone II** two years ago.

A surprise **airdrop of 800 men** in the final hours of the exercise spearheaded a successful counterattack by the aggressor 101st that enabled it to wind up in a virtual draw against the friendly 82d after the two-week battle.

Reserve and Guard crews weren't much concerned over which side won. They fought alternately on both sides.

• • •

SHORT BURSTS. . . . A new civil defense mission for individual Reservists not assigned to Category A units has been referred to the **Air Reserve Forces Policy Committee** for consideration at its regular meeting in Washington late in October. The committee's fall meeting begins with a visit to **MATS Headquarters at Scott AFB,** Ill., on October 20, and to **ADC at Colorado Springs, Colo.,** on the 21st. Members will return to Washington on the 22d for three days to consider some twenty recommendations. . . . The Air Force switched signals on **Maj. Gen. Chester McCarty,** who heads the Air Force Reserve Forces. General McCarty's appointment as Vice Commander of USAFE had been announced, but in view of the world situation USAF decided to keep General McCarty, a career Reservist, in the Pentagon post. . . . A board will convene at the **Air Reserve Records Center** from October 16 through 27 to consider 12,000 Reserve captains for promotion to major. To be eligible, captains must have promotion service date prior to July 1, 1956, and total service from July 1, 1949. They must also have been in active status for at least a year before the board's convening date. . . . **Brig. Gen. J. M. Chappell,** former DCS/O at CONAC and more recently Commander of the Air Reserve Records Center, retired July 31 after thirty years' service. New ARRC Commander is **Brig. Gen. J. L. Riley,** a career Air Guardsman who had been **Deputy Director of the Air Force Personnel Council** in Washington.—END



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Once we merely breathed the air, now we inhabit it. Millions of people have flown. And the largest percentage did it on American Airlines.

American's know-how is one reason flying is easy today. Look at the history of commercial aviation. You'll find that one airline has been responsible for these advances:

The DC-3, the plane that made commercial aviation, was built to American's specifications.

The first non-stop, round-trip, transcontinental service was on an American DC-7, another plane built to our specifications.

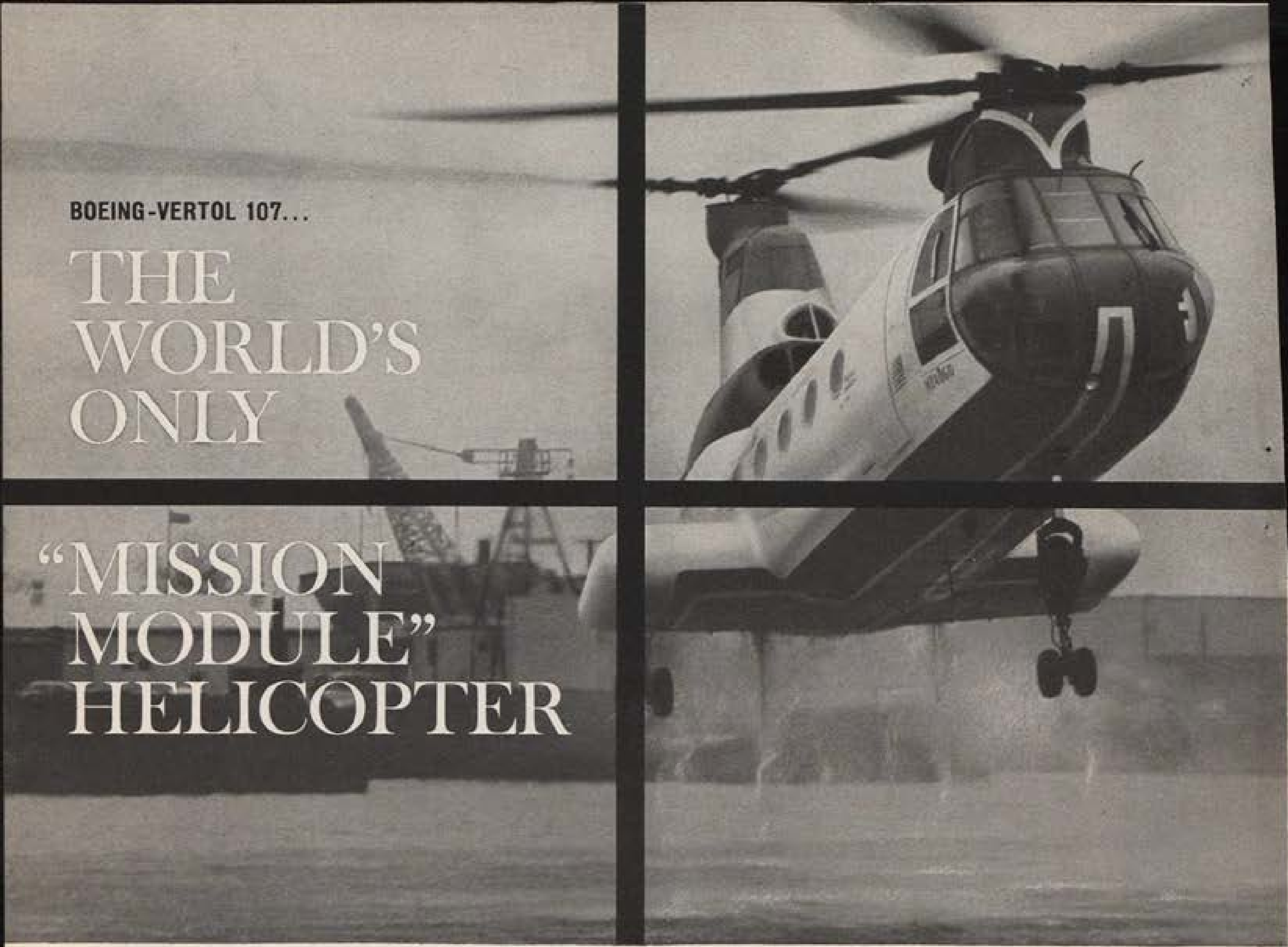
We were the airline to pioneer weather radar. The first to have transcontinental jet service. The first to build a jet-age maintenance plant. The first airline to be equipped with DME (Distance Measuring Equipment), the most significant advance ever made in airline navigation, even beyond radar.

Today, American offers 707 Astrojets,* the first commercial airliners to be powered with fan-jets, the engines that opened Jet Age: Stage II.

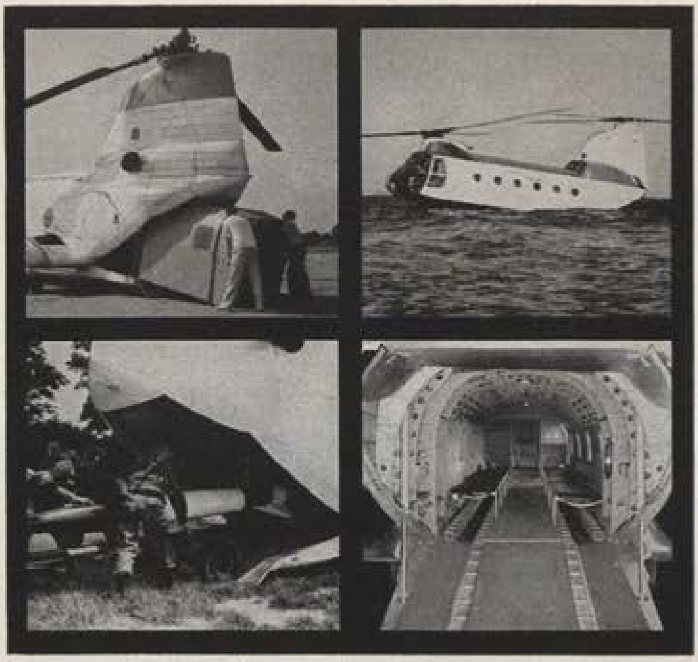
When experienced travellers pick an airline, it's usually American. And there are obvious reasons why.

*Service mark of American Airlines, Inc.

AMERICAN AMERICA'S LEADING AIRLINE



SIGNIFICANT FACTS ABOUT THE 107's WATER CAPABILITY



In the 107 helicopter, water landing capability has been achieved without special flotation equipment or the weight or drag penalties of floats or boat hull. Thus over-water operation can be carried out in full confidence that, should it be necessary, the helicopter can alight and take off even in conditions as severe as Sea State 3 (waves up to five feet high). Flotation is assured by a factory-sealed fuselage of unique, flexible design. The fuselage has good water taxiing characteristics; and a remarkable degree of lateral stability is provided by extended stubs on either side of the fuselage that house landing-gear support structure and fuel tanks. Elevated mounting of the rear rotor permits descent and landing in a nose-up flared attitude of as much as 30 degrees with no change in fuselage attitude required before touchdown. This is important in water landings at night, in low visibility or on glassy seas.

The "mission module" versatility of the Boeing-Vertol 107 means a high potential of all-around usefulness in operations. For example, pre-packaged, "plug-in" modules for anti-submarine warfare, minesweeping and rescue missions can be installed internally in a matter of minutes between flights. In addition, the same aircraft can tow, lift or carry heavy or bulky loads externally. Cargo of more than two tons can be speedily loaded or unloaded in the fuselage via the full-width rear ramp.

Along with its water landing capability and "mission module" versatility, the 107 offers the reliability of twin-turbine power. All in all, it is one of the most tactically and logistically useful aircraft available to the Armed Forces.

VERTOL DIVISION BOEING
MORTON PENNSYLVANIA

TECH TALK

J. S. BUTZ, JR.

Rocketdyne's 1.5 million-pound-thrust, liquid-fuel rocket, under development for NASA, will be ready for full operational use **early in 1965 if all goes well.** This would be right on schedule. The complete F-1 has been fired more than thirty times at a **thrust level of about one million pounds.** During runs at this power level, the flightweight turbopumps deliver about **two tons of propellant per second.** At full thrust, they must deliver about **three tons of liquid per second.**

In separate tests of major components, the thrust chamber has been fired **more than 100 times** at thrusts up to 1.6 million pounds.

During the first public firing of the F-1, with a large press contingent present, the rocket shut down **automatically after 2.5 seconds** of running. This premature cutoff was attributed to **faulty instrumentation** that indicated trouble in the engine when there was none. Ordinarily, test runs are **cut off after about twenty seconds** to conserve propellant. During flight operations, the engines will **operate for about 2.5 minutes** per launch. Full duration runs are **rare in the development stage,** however; the major troubles during static engine firings occur within about **ten seconds after start.**

After development has been completed and the engine enters operation, it is estimated by Rocketdyne engineers that the F-1 will have a **time between overhauls of 1,500 to 2,000 seconds.** This would mean that each engine could be used in about **ten launchings of large boosters** before it had to be torn down for major overhaul.

* * *

A far-ahead **"escape" centrifuge** will be built at the **Aerospace Medical Laboratory at USAF's Aeronautical Systems Division,** Wright-Patterson AFB, Dayton, Ohio. **Astronauts and Dyna-Soar and B-70 pilots** will be among those who train in it.

Primary purpose of the machine, to be called the **Dynamic Escape Simulator,** will be to reproduce **unusual motions and loads** that may occur during an ejection from **supersonic and hypersonic craft.** In addition to exerting G forces, it will simultaneously **apply vibrations, buffeting, and tumbling motions.** Flight conditions expected during **cruise in rough air, maneuvering, and so forth,** also can be created. Maximum accelerative load is **twenty Gs.** Tumbling during ejection training would range up to **150 revolutions a minute.** Vibrations up to **fifteen cycles a second** would also be possible.

The current schedule calls for the simulator to be **operational early in 1963.** It will be designed, developed, and constructed by the **Franklin Institute of Philadelphia** under a $1.7 million contract.

* * *

Final flight tests have been successfully completed on the **GSN-5A automatic landing system (ALS)** developed by **Textron's Bell Aerosystems Company** for the Air Force. Representatives of the Army, Navy, Air Force, Federal Aviation Agency, American Airlines, and Air Transport Association witnessed the final tests. **All of these organizations are interested** in the system, in its potential modifications and variations.

Sixty-five flights in four aircraft were made during the final tests. Army, Air Force, Navy, and American Airline pilots participated.

The GSN-5A system will be delivered to the Air Force in the near future for **personnel training and further evaluation.** The first ALS that Bell built for the Air Force, the GSN-5(ST), is being evaluated at the **FAA's Atlantic City, N. J., flight research facility.**

A Bell system for **automatic landings aboard aircraft carriers** is edging toward operational status with the Navy.

* * *

A new metal-strengthing process utilizing **intense cold** rather than heat has been used to build **very lightweight, high-strength casings for solid-propellant rockets.** The new cryogenic process, developed by **Arde-Portland, Inc., Portland, Me.,** has pushed the **ultimate tensile strength** of stainless steel rocket casings up from the current range of 200,000-220,000 pounds per square inch **to 260,000 psi.** A jump in strength of this magnitude could produce a **weight saving of about 1,000 pounds** in an ICBM-size, three-stage solid rocket. This saving could then be **converted directly into a 1,000-pound increase in payload** or a 400- to 1,000-mile range improvement.

The improved strength results from **stretching the steel cases** some thirteen percent in diameter (*see picture, page 84*) after they have been cooled down to **minus 320 degrees Fahrenheit.** It had been known for some time that **rolling and cold-working stainless steel** at cryogenic temperatures would provide a large improvement in strength at room temperatures. However, it has not been possible to use this cheap, high-strength material for many purposes because it **loses its strength when welded.** Arde-Portland has met the problem in this way. The untreated sheet steel is first **welded into a rocket case.** The case is then **cooled to cryogenic temperatures** and **stretched with high-pressure nitrogen gas** so that the welds as well as the parent metal are strengthened. After **final machining** at room temperatures, the cases are **ready for propellant.**

Test of F-1 1.5 million-pound-thrust rocket at Edwards AFB in California.

Cost savings with the new process apparently **would be substantial.** Studies by Arde-Portland has indicated that **more than thirty-five percent** could be cut from the sale price of the steel rocket case for a small air-to-air missile. The savings **would be even greater** if the new cryogenically pro-

(Continued on following page)

Arde-Portland firm of Portland, Me., has developed a cryogenic method of treating steel that holds great promise in missile, space production. Vessel at far right has not been treated. Other has. It's larger, much stronger.

duced casing were **substituted for current light but expensive rocket casing materials** such as titanium and aluminum.

A primary advantage of the new process appears to be that it could be used to form **cases of virtually any diameter or length** without elaborate facilities. The size of the **heat-treat furnace** is a limiting factor in traditional case manufacture. Maximum diameter of the furnaces now in existence is **about fourteen feet.** In this new process, an enclosed space of **virtually unlimited size,** filled with a cryogenic gas mix, would replace the restrictive furnace.

Possible applications for the process include **gas-storage spheres** for aircraft and space vehicles and **ultra-lightweight members** for space structures.

* * *

Thirty-two-year-old **USAF Capt. R. C. Wingerson** has suggested a promising new device that could lead to construction of the **first thermonuclear power generator.** Captain Wingerson is currently doing graduate physics work at the Massachusetts Institute of Technology.

Theoretical work by Captain Wingerson has led him to a theory that a **corkscrew-shaped magnetic field** could be used to **create a controlled thermonuclear reaction.** This reaction, which occurs at temperatures of **many millions of degrees,** has been the elusive night-and-day goal of hundreds of the world's best scientists for more than a decade.

Wingerson's new magnetic field configuration puts an **old idea to work in a new way.** A number of large magnetic devices have been used without complete success in controlled thermonuclear research in the **US, Russia, England, Sweden, and other European countries** in the last few years. Wingerson's proposed device is regarded with enthusiasm by specialists at **The Massachusetts Institute of Technology and some Atomic Energy Commission personnel.**

An **eight-foot-long scale model** of his machine is under construction at MIT. If this proves successful, full-scale machines **fifty to one hundred feet long** will be needed to produce electricity from the fusion of the hydrogen nuclei.

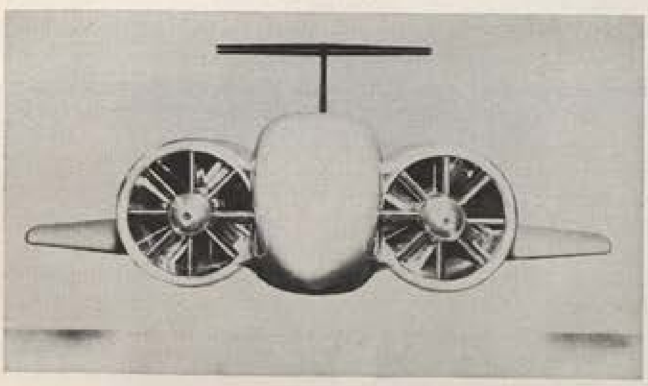
Using sea water, thermonuclear generators could supply **virtually unlimited power for centuries.** Thermonuclear engines also could revolutionize space travel. Studies at **Space Technology Laboratories** and elsewhere have shown that a single thermonuclear rocket could have **a higher thrust than any chemical rocket now planned** and at the same time have **greater specific impulse, or efficiency, than an ion or plasma engine.** Such performance clearly could **render obsolete all other types of space engines** and would completely alter the character of space activities near the earth. In addition, thermonuclear engines probably would allow **flights beyond the solar system.**

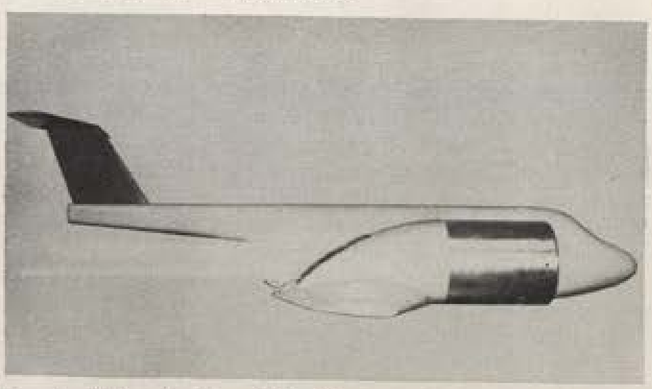
* * *

The **US nuclear rocket program** took a step forward this past summer when the **Atomic Energy Commission and the National Aeronautics and Space Administration** signed a contract with **Aerojet-General** for management of the first phase of the **Nerva engine development.** A part of the **Rover program,** the Nerva engine will be the **first flightweight nuclear rocket.** The **"Kiwi" reactors** and engine components that have been under test for several years in the Rover project were all nonflyable. They provided the **technical base necessary to design the Nerva engine.**

The current $6.3 million contract with Aerojet is to cover a six-month period. This will be devoted primarily to **preliminary design, preparation of a development plan, and mechanical testing.**

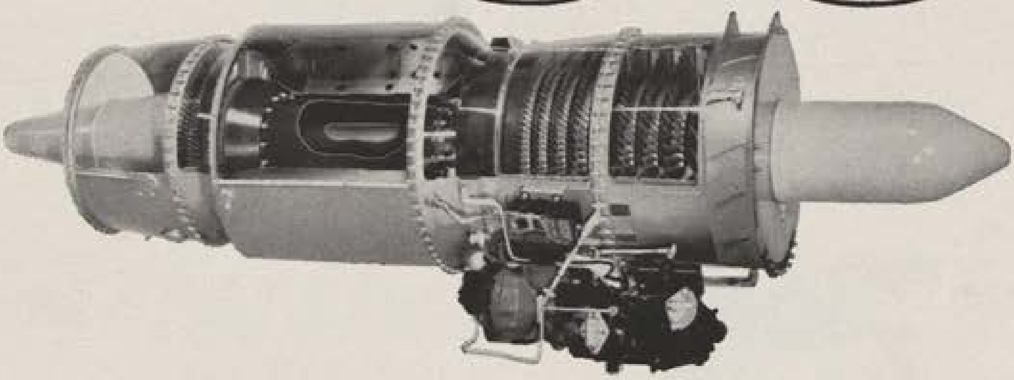
Westinghouse, the major subcontractor under Aerojet-General, will handle the nuclear portion of the work.—END





An airplane without landing gear, the Boeing-Vertol GETOL (ground effect takeoff and landing) is shown above. During takeoff and on landing, its props create a cushion of air under the wing. In forward flight the prop air is ducted rearward.

J60



WHAT WILL THIS VERSATILE TURBOJET DO NEXT?

Pratt & Whitney Aircraft's J60(JT12) jet engine, which weighs only 436 pounds yet produces 3,000 pounds of thrust, has demonstrated its versatility in a broad range of applications.

For the United States military forces, it powers the T-39 twin-engine trainer, the C-140 four-engine utility transport, and the SD-5 reconnaissance drone. It supplies power for the Canadian Air Force CL-41 single-engine trainer. The world's fastest executive transport uses the J60 which also has been ordered for a West German high altitude research glider.

Add a free turbine, and the J60 becomes a turboshaft engine, developing 4,050 shaft horsepower. Two of these turboshaft engines will give advanced helicopters power to lift nine tons. This version of the J60 is also projected for VTOL aircraft.

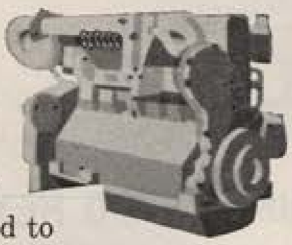
A modified J60 for industrial uses will supply power for pumps, compressors, electric generators—and can be adapted for use in ships and heavy earth-moving vehicles.

Whatever its application, the J60's simple, rugged design ensures high reliability and easy maintenance.

Pratt & Whitney Aircraft

Division of UNITED AIRCRAFT CORPORATION
East Hartford, Connecticut

Capability in Power and Mobility for defense



Problem: To develop more horsepower without increasing diesel engine size. *Needed:* A new method to increase fuel burning capacity without robbing engine horsepower. *Developed:* A responsive turbocharger being used in Caterpillar's compact, high horsepower diesel engines. This advance in engine efficiency was the result of a Caterpillar research group which devoted itself exclusively to turbo study and testing. Today, the company is one of the world's leading authorities on high-speed rotational phenomena, the problem and their control. • In conjunction with turbocharger manufacturers, Caterpillar has also pioneered in the field of turbocharged engine performance and proper matching of turbo and engine. As a leading manufacturer of heavy equipment, Caterpillar has outstanding resources in research, engineering and manufacturing. This experience, talent and manufacturing capacity are available for your vehicle, engine and component needs. Write for Bulletin No. 40-20265, Defense Products Department, Caterpillar Tractor Co., Peoria, Illinois.

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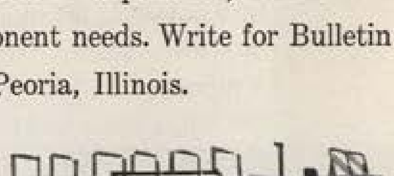
RESEARCH • DEVELOPMENT • MANUFACTURING FOR DEFENSE



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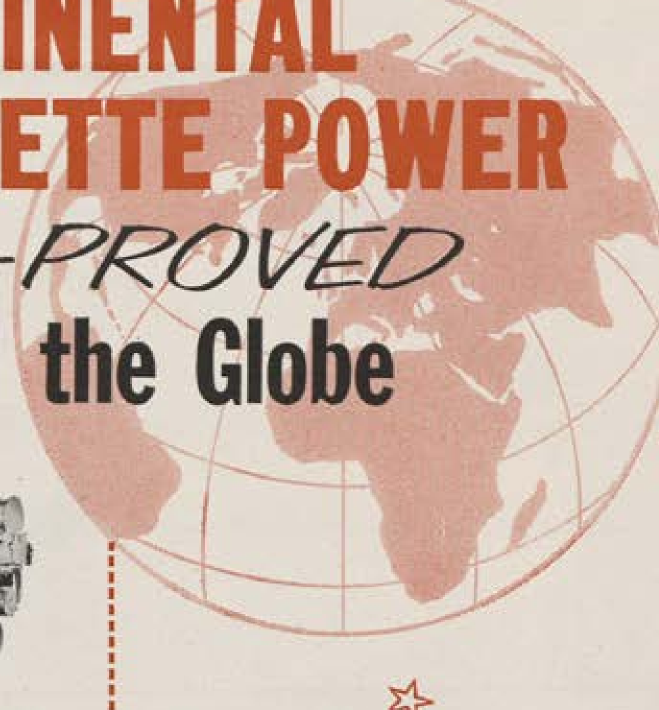
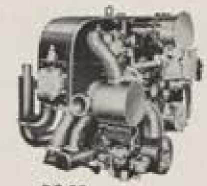
CONTINENTAL PACKETTE POWER

USE-PROVED

Round the Globe



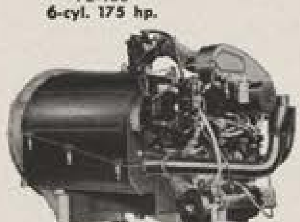


PC-30
2-cyl. 34 hp.

PC-60
4-cyl. 70 h.p.

PE-90
4-cyl. 110 hp.

PE-150
6-cyl. 175 hp.



PE-200
8-cyl. 250 hp.

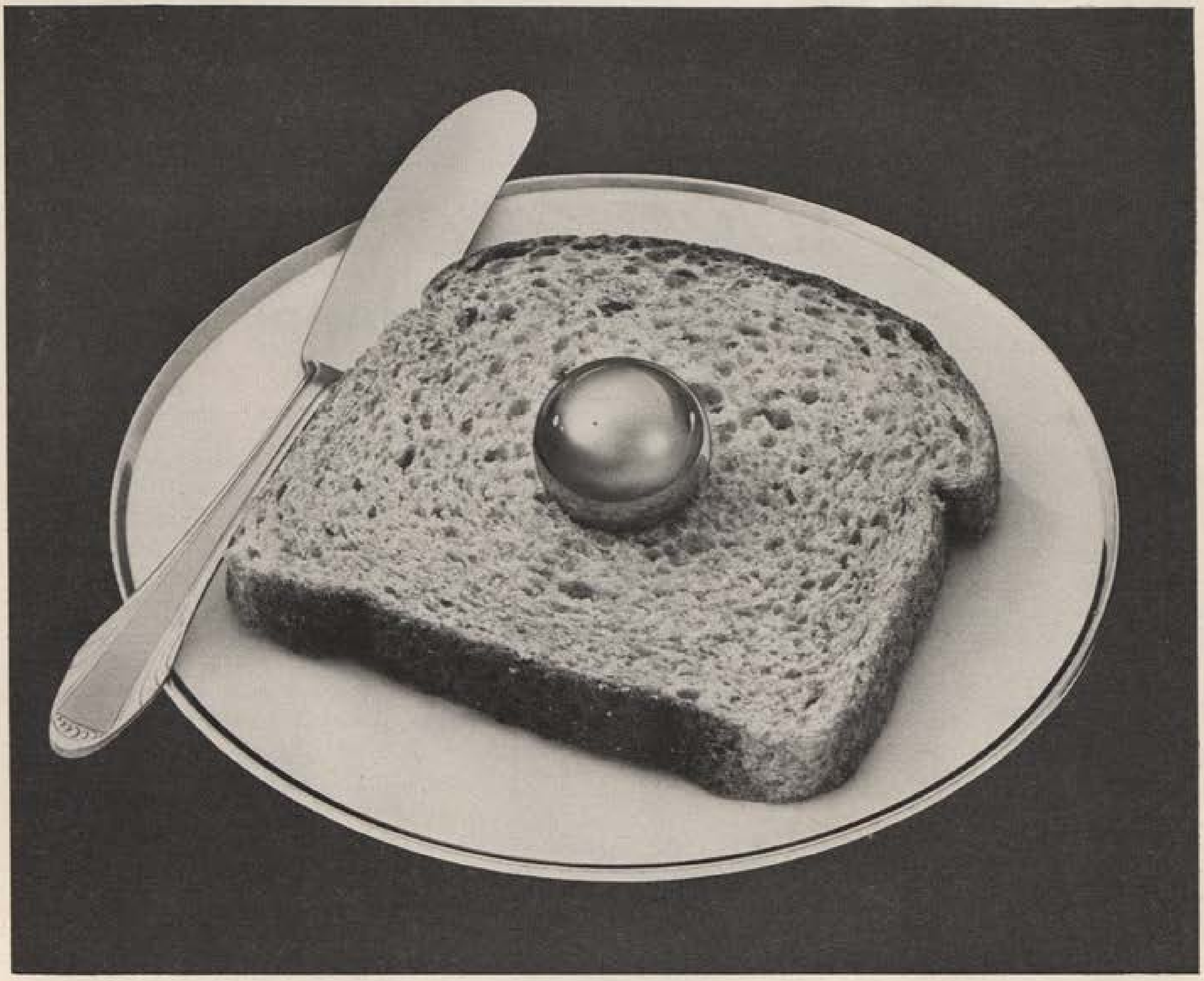
Ground support equipment built around Packette power is proving itself today on defense installations all over the free world.

Developed by Continental Motors, with the famous Continental air-cooled aircraft engines as their basis, these five Military Standard models [Mil. E-26248 (USAF)] range from 30 to 250 hp, combine compactness and light weight with ease of servicing and upkeep, and operate at any temperature from equatorial heat to polar cold. Of special interest and importance, as simplifying maintenance in the field, is the wide interchangeability of parts among the several Packettes, and between them and the models in the Continental aircraft engine line.

They're use-proved NOW in air conditioners, compressors, crash trucks, generators, test stands, refuelers, heaters, blowers, Rollagons, multi-purpose tugs and other applications. Experience is proving: IF THE APPLICATION FALLS WITHIN THEIR POWER RANGE, NO OTHER ENGINE WILL DO THE JOB SO WELL.

WRITE FOR COMPLETE INFORMATION

Continental Motors Corporation
AIRCRAFT ENGINE DIVISION
MUSKEGON • MICHIGAN



Siegler spreads metals like butter

In implementing our aerospace and defense programs, Siegler capabilities go beyond the field of electronics. For example, Siegler pioneered the development of Spin Forging in this country—a unique metal forming process. In both volume and productive capacity, Siegler is now the major source for Spin Forging requirements in the United States, producing missile and space vehicle components for all major aerospace programs.

Siegler's new Spin Forge facility, largest in the world, includes a 120″ Spin Forge. This giant machine tool can apply force in excess of a million pounds per square inch, to form components up to 10 feet in diameter and 25 feet long. The process *flows* metals into surface of revolution configurations such as cylinders, cones, venturiis and domes—to extremely precise tolerances.

Siegler has produced various Spin Forged components from almost every known metal used in missile and space applications. These include a wide variety of tool steels, stainless steels, aluminum, Titanium, Molybdenum, Tungsten, Beryllium and Mag-Thorium. Insofar as is known, the process is applicable to all metals, including exotic metals that cannot be formed by conventional methods.

Siegler capabilities in Spin Forging are one of many examples of outstanding Siegler performance, deriving from closest coordination of all Siegler divisions. Siegler coordinated capabilities range from basic research to production in military, industrial and consumer electronics; aerospace components; heating and air conditioning equipment.

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THE SIEGLER CORPORATION Los Angeles 5, California

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AFA NEWS

SQUADRON OF THE MONTH

Erie, Pa., Squadron, Cited for

sponsorship of the highly successful third Annual Aviation Show, a two-day event attracting a total audience of more than 100,000.

The third edition of **Erie, Pa., Squadron's Annual Aviation Show** was held at **Port Erie Airport** on July 1 and 2. It was the most successful of the series to date. More than 100,000 persons turned out to take a close look at the dozens of static exhibits of missiles and aircraft (*see cut*). There were flights over the countryside for some of the luckier individuals, flybys featuring **USAF, Air Reserve,** and **Air National Guard** units, and an exhibition by a team of "sky divers." Thirty-five acres were set aside by the **Airport Authority** for the event.

Squadron committees for the event were headed by **General Chairman Ralph Young.** The concessions were operated by the Squadron, which also received the aid of local **Boy Scout** groups in handling the huge crowds.

Erie is one of the newer AFA Squadrons in Pennsylvania. This and other programs it has sponsored have helped it to gain stature and an enviable reputation in airpower circles. We're proud to pay tribute to the fine job this outfit is accomplishing.

The crowd begins to assemble shortly after the official opening of the third Annual Aviation Show, sponsored by the Erie, Pa., Squadron at Port Erie Airport. The two-day program attracted a record turnout of more than 100,000.

• • •

Five Squadrons provided a shining example of cooperative effort in July. All in the **Los Angeles area,** the five staged a **Fifteenth Anniversary dinner** at **USAF's Ballistic Missile Division Officers' Club.** Squadrons participating (*see photo*) were **Santa Monica, Pasadena, Los Angeles, First Reserve,** and **South Bay.** A crowd of more than 200 attended the Anniversary dinner.

Gill Robb Wilson, former **President and Board Chairman of AFA,** was guest speaker. His topic was "What AFA Means to Me." Among the top

(Continued on following page)

Brig. Gen. Eugene B. LeBailly, Deputy Director of Information, USAF, was the guest speaker at the annual meeting of the Wisconsin Wing in July in Milwaukee. The Billy Mitchell Squadron was host. General LeBailly, since reassigned to the Azores as Commander of US Forces there, is shown above being greeted by Wing Commander Gary Ortmann, left, and Past Commander Robert W. Gerlach.

Maj. Gen. David Wade, Commander, 1st Missile Division at Vandenberg AFB, signs in as a Charter Member of California's new Goddard Squadron. He is shown with Commander Jack Withers.

Gill Robb Wilson, guest speaker at Anniversary Dinner in Los Angeles (*see text*), shown with Miss Shirley Thomas, well known author, and C. S. Irvine, Commander of the Pasadena Squadron, one of five units sponsoring program.

C. E. A. Brown, Ohio Aeronautics Director, addresses the Installation Banquet of the Columbus Squadron, held at Lockbourne AFB in July. Col. O. F. "Dick" Lassiter, Commander, 801st Air Division, is seated next to rostrum.

AFA leaders at the affair were **Bill Gilson**, Far West Regional Vice President; **Ron McDonald**, Wing Deputy Commander; **Martin Ostrow**, Wing Secretary; **Jim Sorrentino**, LA Squadron Commander; and **Lt. Gen. C. S. Irvine** USAF (Ret.), Pasadena Squadron Commander.

• • •

At the opening of **AFA's 1960 National Convention** in **San Francisco**, an application for charter was submitted for an AFA Squadron in **Riverside, Calif.**, with over 340 signatures. This made it the largest group ever to apply for a charter. Now we're pleased to report that that mark may fall.

New Squadrons are being formed in **Tulsa, Okla.**, and **Fort Worth, Tex.** We've been advised by the leaders of both groups that a primary objective is to top Riverside's record. The Tulsa activity was sparked by **Brig. Gen. H. F. Gregory**, USAF (Ret.), a longtime friend of the Association and an executive of **Midwestern Instruments** in Tulsa. The officers of the new Squadron, all of whom have been extremely active in organizing the unit, include **Bill Hyden**, Commander, who is with television station KOTV in Tulsa; **Henry C. Thompson**, Vice Commander; **Robert V. Freeland**, Secretary; and **G. R. Storms**, Treasurer.

In Fort Worth, the ball got rolling initially as part of Regional V.P. **"Bo" McLaughlin's** campaign to organize additional Squadrons in Texas. The key to this particular effort was found in the person of **Phil North**, Vice President of the Fort Worth **Star-Telegram**, and an old friend of former AFA President **"Jock" Henebry**. North was elected Commander of the Squadron. Other officers include **Fred Korth**, President of Continental National Bank, Vice Commander; **Arch Rowan, Jr.**, an investment broker, Treasurer; and **Joe L. Shosid**, President of Advertising Unlimited, Secretary. Even before the ink was dry on the letter to AFA Headquarters requesting charter information, the group announced plans for a big community banquet in tribute to **Maj. Gen. Nils Ohman**, Commander, 19th Air Division, Carswell AFB, Tex., who is being transferred to Washington after five years in Fort Worth.

We hope to report to you next month that both these Squadrons have topped the mark set by Riverside. And we hope the new marks, in turn, fall in a short while. Competition of this sort is a healthy thing for AFA.

• • •

Jersey Wing Commander Henry Carnicelli, Joseph Bendetto, and Hudson, N. J., Squadron Commander Bill Bromirski (on wing), are shown with the Aerospace Award winners of recent Science Fair cosponsored by Squadron in Jersey City.

CROSS-COUNTRY . . . Wing Organization Director **Bill Bromirski** advised us in January that his objective for 1961 was the addition of three new Squadrons in **New Jersey.** With the chartering of the **Burlington Squadron** in August, he has accomplished this ambitious program. **Atlantic City** and **Tri-County** were the other two units. The addition of these three brings New Jersey's total to eight Squadrons. Not all the work was done by Bromirski, of course, but we salute the Wing effort through him. . . . **Lew Good**, Vice Commander of the **New Mexico Wing**, reports plans well along for a big civic program in **Albuquerque** October 13 celebrating **AFA's Fifteenth Anniversary.** The banquet toastmaster will be **Richard Boone** of television fame. The Governor, and the Mayor of Albuquerque, will be on hand.

—Gus Duda

Exclusively for members

AFA Insurance Programs

These programs are constantly reviewed to provide maximum protection at minimum cost. Taken as a whole they offer a full shield of protection to AFA members and their families.

NO AMOUNT of insurance can make up for the real loss when the head of a family is disabled or dies. Nor can insurance minimize the hazards that we all accept as a normal part of our everyday lives.

But insurance can and does ward off the pinch of financial hardship when trouble strikes. An adequate insurance program provides money or goods or services when they are needed most. It is the one sure way of guaranteeing security and protection for those we love.

In recognizing these services that are rendered by insurance programs, AFA not only attempts to make them available to members but also keeps its programs under constant review, making revisions and changes as they are deemed necessary. The latest example of this never-ending review program is the new *all*-accident insurance program which has replaced the former policy covering only travel accidents. This and other programs are briefly described below.

All-Accident Insurance

This new program, available to all AFA members, offers full twenty-four-hour protection against all accidents, regardless of how or where they occur. It is offered in units of $5,000 up to a maximum of $50,000 and is available either singly or in the popular new family plan at unbelievably low rates.

Coverage under the family plan provides insurance for each member of the family, under one policy. Under this plan the wife of the policyholder is insured for 50% of his coverage and each child, regardless of number, is insured for 10% of his coverage.

Coverage is also provided for nonreimbursed medical expenses of over $50, up to a maximum of $500. Under the family plan each member of the family is provided this extra coverage. In addition, policyholders receive an automatic 5% increase in the face value of their policy each year (at no increase in cost) for each of the first five years of coverage.

Life Insurance

AFA Group Life Insurance is available to all active duty officers and NCOs of the first three grades. It provides a graded amount of coverage, with a top amount of $20,000, depending on age and flying status. The death benefit is increased by 50% of the policy's face value if death is caused by any kind of accident.

As an additional benefit policyholders may keep their insurance in force at the low group rate after they leave the service, provided their coverage has been in effect for more than a twelve-month period immediately prior to the date they leave the service.

Flight Pay Insurance

Guaranteed flight pay protection is available to rated personnel on active duty. Protection is guaranteed, even against pre-existing illnesses, after a policy has been in force for more than twelve consecutive months. This plan was first introduced in 1956 and since that time AFA has paid more than $1,800,000 in claims. Each month checks go to between 100 and 150 grounded flyers.

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AIR FORCE ASSOCIATION

Insurance Division, 1901 Penna. Ave., N.W., Washington 6, D. C.

Please send me complete information about the AFA Insurance Program(s) I have checked below. 10-61

- ☐ All-Accident Insurance
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- ☐ Flight Pay Insurance

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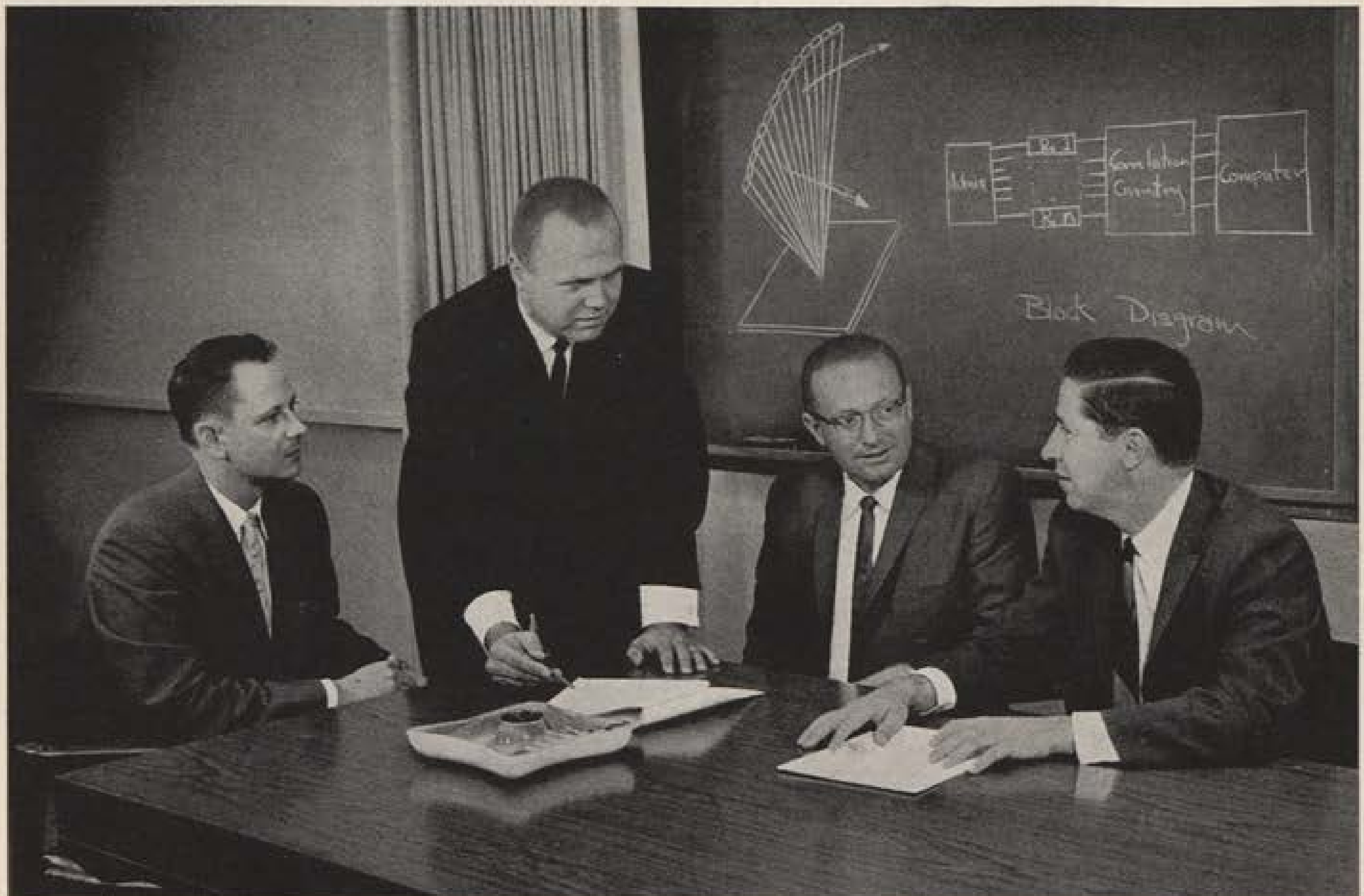

Discussing a system for space target detection (left to right): Dr. R. W. Bickmore, Technical Assistant to the President; Laboratory managers H. E. Shanks and M. G. Chernin; and M. D. Adcock, Director of the Electromagnetic Systems Division.

A Report from American Systems Incorporated...

Multiple Space-Target Detection

One of the key tasks of modern sensor technology is the determination of the positions and velocities of aerospace vehicles. A particularly important aspect of this problem, now being studied by American Systems Incorporated, is the radar detection of multiple targets. Usually such targets move in relatively small clusters, at high altitude and extremely high velocities. To track the individual objects making up a cluster, new antenna array techniques are under consideration.

This study is being conducted by the Electromagnetic Systems Division, the activities of which encompass research in electromagnetic physics, development of complete sensor systems, and design of special microwave components. Among the scientists and engineers contributing to this work are Dr. R. W. Bickmore and H. E. Shanks, inventors of Time Domain Radiation, and M. G. Chernin, microwave specialist. With active contracts in a number of important areas, the Division is contributing both to basic research, and to the creation of special microwave systems.

The Division's programs include Time Domain and Doppler approaches to measurement of the radiation patterns of large antenna systems, investigation of signal interference problems in areas of high density radio and radar installations, and the development of passive reflectors providing coded target returns.

Front line technical efforts are also under way in six other Divisions of the Company.

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Data processing subsystems research and development; logic of command and control complexes; optical recognition systems.

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airman's bookshelf

Spotlight on Khrushchev

***Khrushchev: A Political Portrait,* by Konrad Kellen (Praeger, 1961, 271 pp., $5)**

Reviewed by Anne M. Jonas

Despite Nikita Khrushchev's numerous public and private contacts with non-Communists, the free world has no clear understanding of his complex personality. His biography has been disclosed only in barest outline. His day-by-day behavior during the numerous and critical behind-the-scenes power struggles which took place within the Soviet hierarchy during the five years between Stalin's death and his own emergence as the unchallenged leader of the Soviet Union can be traced only partially. Even less has been revealed about his earlier personal relationships with Stalin and with those surviving "old Bolsheviks" he gradually demoted and replaced with his own protégés.

In this book, Konrad Kellen has attempted to uncover key elements of Khrushchev's personality by recreating the political environment in which he was living and working from young manhood up to his return from the UN General Assembly session late in 1960. It is to the author's credit that he has, in most instances, clearly indicated which parts of his argument are his own speculations and which are irrefutable facts. Unfortunately, Kellen's documentation of one of his most significant pieces of evidence is insufficient to permit a valid assessment of its authenticity. Khrushchev is said to have been deprived of power by a majority vote of the Central Committee Presidium in June 1957, to have insisted on appealing the Presidium's decision to a plenary session of the full Central Committee, to have succeeded in convening that body, and to have obtained a revocation of the Presidium's earlier "oust Khrushchev" vote.

If this description of the critical events of June 1957 (which preceded the Central Committee's purge of the so-called "anti-Party group" and its appointment of a new Presidium composed of Khrushchev's followers) indeed is true, it demonstrates beyond question Khrushchev's ruthless willingness to run unprecedented risks when he estimates he can guarantee that victory will be his. This type of mental attitude might profoundly affect his decisions on whether, and under what conditions, to initiate nuclear war. Hence, the accuracy or inaccuracy of the story should be established beyond question, if possible. Instead, Kellen asserts that it is authentic because Khrushchev himself is reported to have offered this description of his 1957 triumph to an unnamed guest at an unspecified reception at Bucharest in July 1960. While authors sometimes are not at liberty to disclose in detail their sources of information, Kellen fails to note that John Gunther presented a similar account in his book, *Inside Russia Today*, published in 1957. Nor does he recall that this version also was carried in July 1957 by both the New York *Times* and the *New Statesman*. While the story is plausible, it may be no more than a rumor.

Kellen, nevertheless, has produced a highly readable and an important work. Those facets of Khrushchev's psyche which he convincingly has illuminated too often have been ignored in the West; they deserve attention. The author concludes that Khrushchev is a master semanticist and a hard-headed adapter of Marxist-Leninist doctrine to present-day conditions. He depicts Khrushchev as a sincere believer in Communist ideology who has been oriented virtually from birth to a world view completely different from our own, and as a man who throughout his career has alternated between vigorous, sometimes violent, overt drives for power and concealment of his intentions behind a cloak of modest humility—depending upon which tactic for the moment furnished the best guarantee that he would realize his immediate aims.

One must agree with Kellen that the West can understand Nikita S. Khrushchev only if we stop projecting our own thought modes and world view on to the Soviet leader and attempt instead to evaluate him from the entirely different orientation which he applies to his own assessments of the world and his role in it.

ABOUT THE REVIEWER: *Mrs. Jonas is a member of the research staff of the Social Science Department of The RAND Corporation and a long-time student of Communist doctrine, strategy, and tactics.*

NOTE: Any book reviewed in Airman's Bookshelf may be obtained, postpaid, from the AeroSpace Book Club, 1901 Pennsylvania Ave., N.W., Washington 6, D. C. Full payment must accompany order. Information on the Book Club may be obtained from the same source. Club members are eligible for substantial savings on Club selections.

Missile-Age Workhorse

***The Mighty Thor: Missile in Readiness,* by Julian Hartt (Duell, Sloan & Pearce, 1961, 271 pp., $4.50)**

Reviewed by Maj. James F. Sunderman, USAF
Chief, USAF Book Program

Launchings of the reliable Thor missile have become commonplace and draw but little attention in newsprint. The missile itself has been overtaken by technology and strategic events in US thinking so that, aside from the operational-ready squadrons in Britain, it is strictly now the "workhorse" of the R&D space program. So writes Julian Hartt in this well phrased and well-thought-out biography of this missile which, in less than three years from drawing board to operational status, represented a twentieth-century technological achievement of the greatest magnitude.

Hartt probes the story of the Air Force Thor accomplishment against the background of the lean years of missilry, 1945-1956, and the apparent disinterest in unmanned weapon systems in high civilian and military circles during that time. Thor evolves in a crash program mainly through the efforts of a small AF group headed by General Schriever, currently commander of the Air Force Systems Command, and including men like Ed Hall, Col. Richard "Jake" Jacobson, and others who plowed through veils of red tape and opposition to cut the R&D testing by at least one-third.

Author Hartt considers the political crosswinds that swept the missile field both prior to and during Thor development. He treats the parallel, competing Army Jupiter, overgrown V-2 whose only original aspects, including the engine, were borrowed from the Thor. He brings the Thor story up to date in its manifold uses and models in military and research configurations.

Manned spaceflight will become a reality sooner than expected because

(Continued on following page)

GENERAL METALS ACQUIRES AIRCRAFT PRODUCTS BUSINESS

General Metals Corporation, Industrial subsidiary of Transamerica Corporation, announced today that it had acquired the Aircraft products business of Gladden Products Corporation, Glendale, Calif.

William E. Butts, General Metals' President, said the acquisition includes lines of hydraulic and pneumatic components for aircraft and missile, the production of which will be continued from the General Metals Adel Division Plant at Burbank, California. Technical and production personnel engaged in their manufacture at Glendale will continue that activity for General Metals at the Adel Plant.

The other subsidiary companies of Gladden were not included in this transaction, Mr. Butts said.

Adel Division of General Metals specializes in the design and manufacture of hydraulic, pneumatic, fuel and electro-mechanical systems and power generating packages for aircraft, missiles, rockets and ground support applications. Butts said the combined operation will continue to specialize in these fields, offering products which have been developed through the experience of each company during many years.

During the past eighteen months, General Metals has completed the enlargement of its facilities in Houston, Texas and in the San Francisco Bay Area has integrated the Enterprise Division with its iron and steel facilities in Oakland. The Company's Enterprise Diesel Engine Division at Oakland produces Diesel Engines for stationary power plant and Marine application.

ADEL

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of Thor, not for its lift capability, but for its contributions to probing space with smaller experimental packages—the moonshots, satellite orbitings, and above all, the highly successful Discoverer program which has kept this nation in the international space running.

In final analysis, writes Hartt, the only missile Mr. Khrushchev may truly fear today is the warhead-loaded intermediate-range Thor positioned in England in quantity on twenty-four-hour alert status. Thus it is that the all-purpose, trusted Thor, a stepchild project to begin with, is indeed our "missile in readiness" for war or for peaceful experimentation.

Aerospace in General

Sifting through thousands of scientific and nonscientific Soviet publications, speeches, radio and TV programs, Alfred J. Zaehringer compiles a factual assessment of Russian rocket, missile and space achievements from Tsiolkovsky to the Luniks in *Soviet Space Technology* (Harper, $3.95). This report on the evolution of the Soviet technology and the present state of the art makes an informative, useful general document, though it is not definitive nor complete. The author admits this weakness, since most Soviet developments in space technology fall behind a curtain of secrecy. There are few clues to be found other than indirect references. The Soviets themselves, he claims, probably could not make a complete picture of their program. It is too vast and scattered. Zaehringer compares wartime German and current American R&D to Russian design of missile hardware. He devotes emphasis to Russian liquid and solid rockets, cruise missiles, ramjets, hybrid rockets, nuclear propulsion, as well as to the Sputniks and Luniks.

• • •

The Aerospace Yearbook, 1961, edited by James J. Haggerty, the forty-second annual edition of this reference classic (American Aviation Publications, $10), is up to its usual fine standards. This complete reference to American aero-astronautical endeavor covers military and civilian aviation, industry, airline, and related facets of the field. Attractive features include a day-to-day chronology of 1960 events, an over-all air chronology, 1784-1960, photo-narrative-statistical-three-view-drawing layout and presentation of all current American air and rocket / missile / spacecraft hardware (operational, test, and R&D), and essay surveys of major areas of American air and space technology.

• • •

Outside the closed circuit of test pilots, aviation historians, and a few air buffs, *Testing Time: The Story of British Test Pilots and Their Aircraft*, by Constance Babington-Smith (Harper, $4) will find limited interest in the American edition. While the places may ring familiar, Farnborough, Cranwell, Eastleight, etc., the British test flight "greats" are largely unknown to the average air reader here. Their personal stories, intimate glimpses into their lives and their work, are well presented in typical undramatic British phrase by the capable author of *Air Spy*. She has woven into the account a massive amount of test flight details from John William Dunne's "D.1" of 1907 to the English Electric pilots of today, bracketing the whole evolution of powered flight in the British Isles.

Volumes You Should Know About

The Silver Dart: The Authentic Story of the Hon. J. A. D. McCurdy, Canada's First Pilot, by H. Gordon Green (Brunswick Press, Fredericton, N. B., $4.95)—The true story of McCurdy's early life, his association with Dr. Alexander Graham Bell, the development and first flight of the "Silver Dart" aircraft, and the events leading to the creation of the RCAF and commercial aviation in Canada.

Atoms to Galaxies: Introduction to Modern Astronomy, by James Stokley (Wiley, $6)—A survey of the universe as seen through the eyes of modern science, treatment of spaceflight, life on other planets, and evolution of the universe.

Planets, Stars, and Galaxies, by Stuart J. Inglis (Wiley, $6.75)—The facts of the universe and informed speculation on its age, origin, and evolution. Ideal for student use.

The World Around Us, by Sir Graham Sutton (Macmillan, $3.95)—A series of six essays on earth science and space exploration.

Project Vanguard, by Kurt R. Stehling (Doubleday, $4.50)—The detailed story of this early missile project by the head of its propulsion group.

DH: An Outline of DeHavilland History, by C. Martin Sharp (Faber and Faber, London, $5.88)—The full story of Sir Geoffrey De Havilland and the aircraft industry he built, covering a large segment of the history of flight in England.—END

FREE! ANY BOOK ON THIS PAGE

Journey of the Giants, The Story of the B-29—Maj. Gene Gurney, USAF. Introduction by Gen. Thomas S. Power. Retail $4.95. Member's Price $3.95. The fascinating story of the B-29 Superfort . . . the full drama of its creation, production, and finally use as a great weapon . . . from the gamble behind its production to the long chance taken by Gen. Curtis LeMay when he ordered all 399 planes, stripped of armor and guns, into the air for a long-range attack on Tokyo.

On Thermonuclear War—Herman Kahn, 651 pages. Retail $10. Member's Price $5.95. The most authoritative work on this vital subject ever to appear. Of this book, the AIR FORCE INFORMATION POLICY LETTER FOR COMMANDERS said on Feb. 1, "Undoubtedly one of the most important current books on modern military strategy is *On Thermonuclear War* by Herman Kahn. Based on the 'Kahn Briefings' familiar to men in the Air Force, it is a mine of information on national defense. . . ."

The Wild Blue—John F. Loosbrock and Richard M. Skinner, 620 pages. Retail $5.95. Member's Price $4.95. A forty-two-year accumulation of the best writing and thinking of American airpower selected from AIR FORCE/SPACE DIGEST . . . which traces its origin back to September 21, 1918, when the first issue of the AIR SERVICE WEEKLY NEWSLETTER came out in four mimeographed pages. Told in the words of the men who themselves made history . . . Billy Mitchell, Hap Arnold, George Kenney, Jimmy Doolittle, Tommy White, etc.

Atlas, the Story of a Missile—John L. Chapman. Retail $4.00. Member's Price $3.25. The full story of America's first intercontinental ballistic missile, from its beginning to the 16,000-mile-an-hour, 6,300-mile-long leap from Cape Canaveral.

Man High—Lt. Col. David G. Simons, USAF. Retail $4.50. Member's Price $3.95. The true story of the first man to reach 102,000 feet in a record-breaking balloon flight.

Rocketship X-15—Myron Gubitz. Retail $4.95. Member's Price $3.95.

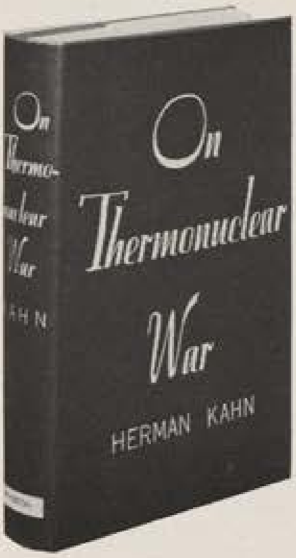
Man in Space—Lt. Col. Kenneth Gantz, USAF. Retail $4.00. Member's Price $2.95. About the USAF space program. Foreword by General White.

Strategy in the Missile Age—Bernard Brodie. Retail $6.50. Member's Price $4.90.

Baa, Baa, Black Sheep—Lt. Col. Gregory Boyington. Retail $4.50. Member's Price $3.95.

Montgomery's Memoirs—Field Marshal Montgomery. Retail $6.00. Member's Price $4.80.

Soviet Strategy in the Nuclear Age—Ray Garthoff. Retail $4.50. Member's Price $3.95.



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The Academic Instructor and Allied Officer School at Air University, the Air Force's college of education, has won a nationwide reputation for excellence . . .

Teaching The Teachers

By Lt. Col. Carroll V. Glines, USAF

AIR FORCE Maj. Ed Jackson walked crisply but nervously into the small classroom. He stepped behind a podium and fidgeted with a sheaf of notes. His hands shook. His face was drawn and pale.

Nine other Air Force officers waited patiently for the start of Major Jackson's lecture.

Voice strained, the handsome, many-ribboned veteran of aerial combat over Germany and Korea finally began, "Uh . . . Gentlemen . . . this subject of today's lesson is . . . uh . . . the United Nations and . . . uh . . . uh . . . what it has done for uh . . . world peace."

The class members squirmed in embarrassed sympathy for the Major. They could sense the strain he was under. And they wondered at the strange paradox of a man who had been decorated with the Distinguished Service Cross for bravery in air actions against the enemy, yet seemed almost petrified with fear as he attempted to teach a class.

"Uh . . . before we can . . . uh . . . discuss . . ." the Major droned on, "uh . . . the UN . . . uh . . . we should first understand . . . uh . . . why it was . . . uh . . . organized."

Twenty minutes later, Jackson was through. He mumbled some words of conclusion. Then, still pale and trembling, he walked quickly to a seat and sat down in embarrassed silence. A young lieutenant, poised and relaxed, took Jackson's place before the class. Smiling, he said, "Gentlemen, I want to commend Major Jackson for his selection of such a worthwhile topic for today's lesson. He had obviously researched his subject, and we will agree, I'm sure, that this is his greatest strength. On the other hand, the Major has some teaching weaknesses which are serious, yet can be remedied. I'll take those weaknesses one at a time, and we'll see what recommendations we can make so he might improve future presentations."

The class was attentive. Jackson made careful notes as a younger officer, ten years and two ranks his junior, criticized his performance.

". . . and the habit of verbalizing a pause—saying 'uh' in his case—is a common fault which many, if not all, of us seem to have to some degree. Perhaps it is an unconscious desire to hold our listeners' attention while we fish for words. But, whatever the reason, it is a distraction to our listeners and should be corrected. Being aware that we have this habit is sometimes enough. . . ."

The audience, including the Major, drank in the Lieutenant's every word. They were impressed with his critical analysis of what had been an unsuccessful attempt to impart some learning to an attentive and alert audience.

The scene was a typical one at the Air Force's school for teachers—the Academic Instructor and Allied Officer School, Air University, Maxwell AFB, Ala. The much-decorated Major in this case was a student at the school working for his "wings" as a teacher. The Lieutenant was the instructor.

The Air Force's only "College of Education" has won a national reputation for doing the impossible. In the short span of six weeks, officers, airmen, and civilians with many different backgrounds, are given intensified instruction and practice in the art of teaching. Then they are sent directly to classrooms throughout the Air Force. Their teaching assignments may vary from the instruction of individuals in marksmanship to the presentation of formal lectures on nuclear physics to groups of 1,000.

"But, we don't say that we have all the answers to the secrets of successful teaching by any means," Col. Wilson T. Jones, World War II bomber pilot and now school Commandant, cautions. "What we do say is that we feel we can improve anyone's ability to teach from whatever it was when he arrived on the first day. To do this in a short six weeks, we have taken the best knowledge in the whole field of teaching techniques, condensed it, and organized it into logical patterns which can be absorbed by anyone of average intelligence and background."

Educators who hear of the Air Force's attempt to cut through a regular four-year college curriculum and make topflight classroom teachers out of airmen and officers, tend to scoff—at first. For example, Dr. Ohmer Milton, professor of psychology at the University of Tennessee, was asked if he would like to attend the Academic Instructor Course several years ago. "My initial reaction was one of incredulity," he recalls. "After all, I possessed a Ph.D. degree and had eight years of experience as a college teacher. What more could I possibly need to be an effective dispenser of knowledge?

"Alas, my illusions and delusions were shattered during the first week. I found the faculty members to be masters of effective classroom communication. Their lectures were

(Continued on page 99)

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3. **Administered by the Air Force Association on a non-profit basis.** Underwritten and guaranteed by United of Omaha, one of the world's largest life insurance companies.

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superior in every way; I found myself listening avidly, yet feeling quite uncomfortable in the face of such talent.

"There were further disillusionments to come," Dr. Milton continued. "In the weeks that followed, each student was required to give several short talks and teach five different classes. After a faculty member and fellow students had completed most thorough critiques of each performance, I began to suspect that something else was involved in college teaching than years of experience and a Ph.D. degree. It is a sobering experience to have a group of intelligent men agree that a 'gem of wisdom' that you dropped has not been uttered in understandable fashion—that you did not communicate to your audience. And, although I told my auditors repeatedly that the subject of *my* lessons was important and that they *ought* to become acquainted with such scholarly and erudite matters, they didn't invariably respond with the proper respect and enthusiasm."

Since 1948, this top Air Force teacher's course has turned out more than 14,000 graduates who have manned the Air Force's classrooms around the world as we moved through the jet age and into the space age. Two-thirds of this total have been officers, the remainder airmen and civilians. About 300 allied officers are also full-fledged graduates.

Dr. Boyd E. Macrory, educational adviser to Colonel Jones, has watched the many changes that have taken place in the curriculum during his ten-year tenure. "And, believe me," he said recently, "there *have* been changes in the course since I first came here. The dynamics of the curriculum is another one of the 'secrets' that impresses the professional educators 'outside.' When we find a better way to teach —a new method, technique, or instructional aid—we try it out thoroughly within the faculty first and then give it to our students. We are able to react to new ideas and things faster than most civilian colleges of education and are not at all reluctant to forge ahead into the unknown if it will help our students."

Examples of this fast reaction to new ideas can be found all through the curriculum. Teaching by television, for example, while still comparatively new in the civilian world, is offered as one of a dozen elective laboratories. In addition, three of the four teaching methods are demonstrated through the medium, and as soon as the school has its own studio later this year, teaching by television will be exploited to the fullest. The ten-hour TV laboratory gives students the opportunity to plan and produce a lesson which is then given to the entire class.

AIC students are thoroughly aware of how important the communication process is by graduation day. Classroom hours of instruction are presented on all phases of it: reading, writing, listening, speaking, audio-visual aids, group dynamics, and organizing for communication. Eight- to ten-hour laboratories are offered in speaking, writing, audio-visual aids, and group behavior. A twenty-three-hour lab is offered in reading for those who want to improve their reading speed and skill.

I was deeply impressed with the scope and extent of the Academic Instructor Course and remarked, "You must have quite a faculty here to be able to give your students such a course in just six weeks."

Colonel Jones smiled. "We've got a good, dedicated faculty here," he said. "Only two or three of them possess education degrees but all of them are graduates of our course. We like to think that that is what makes them so good."

One of the reasons for their outstanding proficiency, I found, was that all AIC instructors must go through the same rigorous preparation for each hour of instruction that is demanded of their students. Many hours of research and writing go into each lesson. Even if one instructor is giving a lecture which had been presented for years by a predecessor, he still must do his own research in order to bring new life to the subject matter. When a faculty member has thoroughly researched and organized his material, the first of what may be many "dry runs" of his presentation is made before an audience of his colleagues who suggest ways of improvement.

"And that was one of the most harrowing experiences of my life," one much-decorated ex-fighter pilot said. "When I concluded what I thought was a well organized, skillfully presented lecture, nothing that was thrown at me in my P-38 over Germany could equal the well aimed —and well deserved—bursts of criticism I got from that audience. My first reaction was defensive and I tried to rationalize everything I had done. When I was praised on my strong points, I didn't want to hear any more. Then, slowly, I began to realize that these men were not only telling me what my weaknesses were, they were *showing* me what would be better. I finally accepted their criticism as it was meant and when I gave my lecture several weeks later, I received a standing ovation from the students."

Almost every student who successfully completes the course leaves with more poise before an audience, an improved speaking ability, and more expertness in organizing his material than he had when he came. And, in addition, he takes with him an introspective look at his own personality, aptitudes, and abilities. It is this aspect of personal improvement that has earned the nickname "Charm School."—END

The author, Lt. Col. Carroll V. Glines, is Deputy Chief, Public Information Division, Air Force Office of Information. He is the author of three books including Grand Old Lady, *the story of the Douglas DC-3, and a regular contributor to* AIR FORCE/SPACE DIGEST. *He wrote "Persuaders in Blue" in the May 1961 issue.*


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