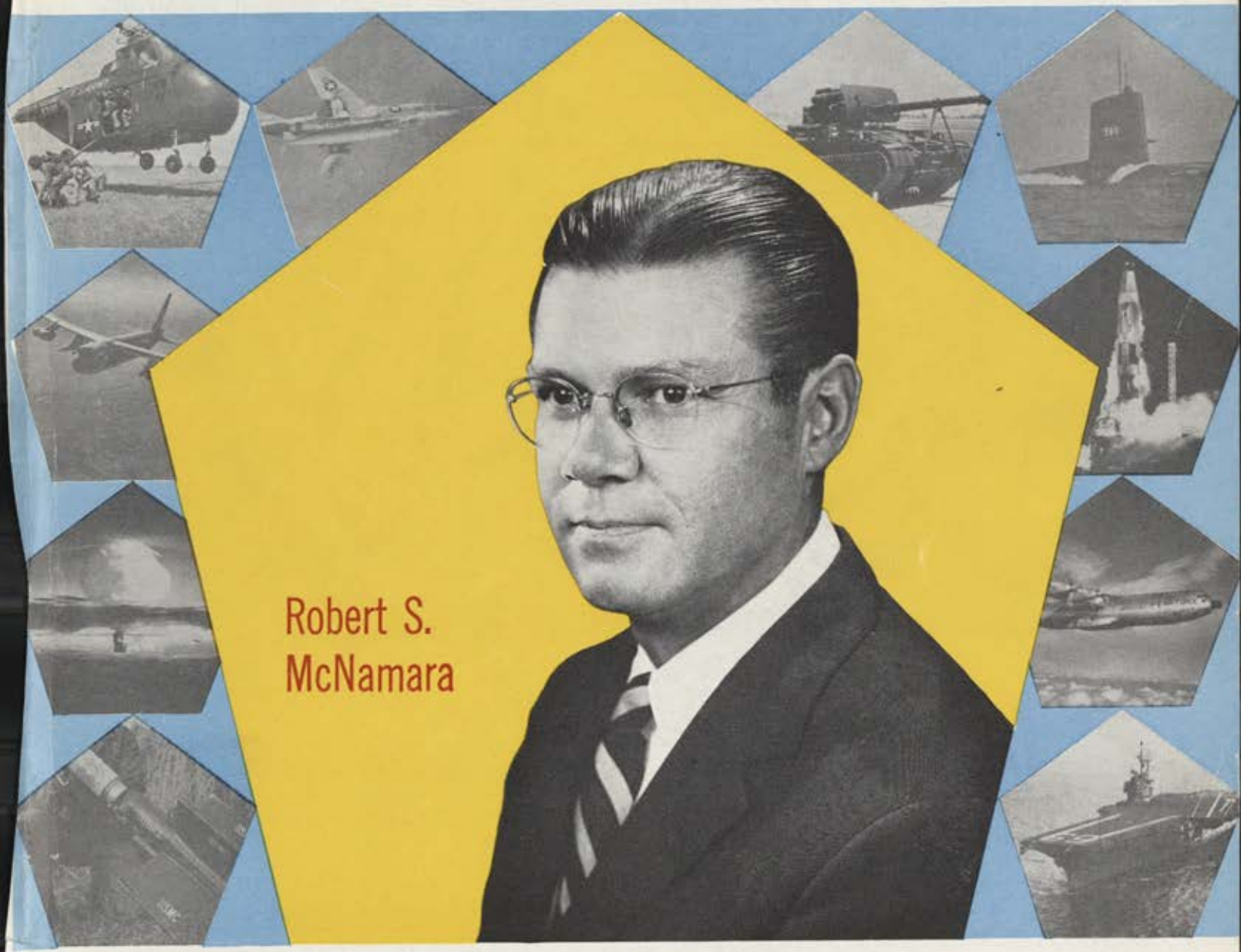
JANUARY 1961 / 50c

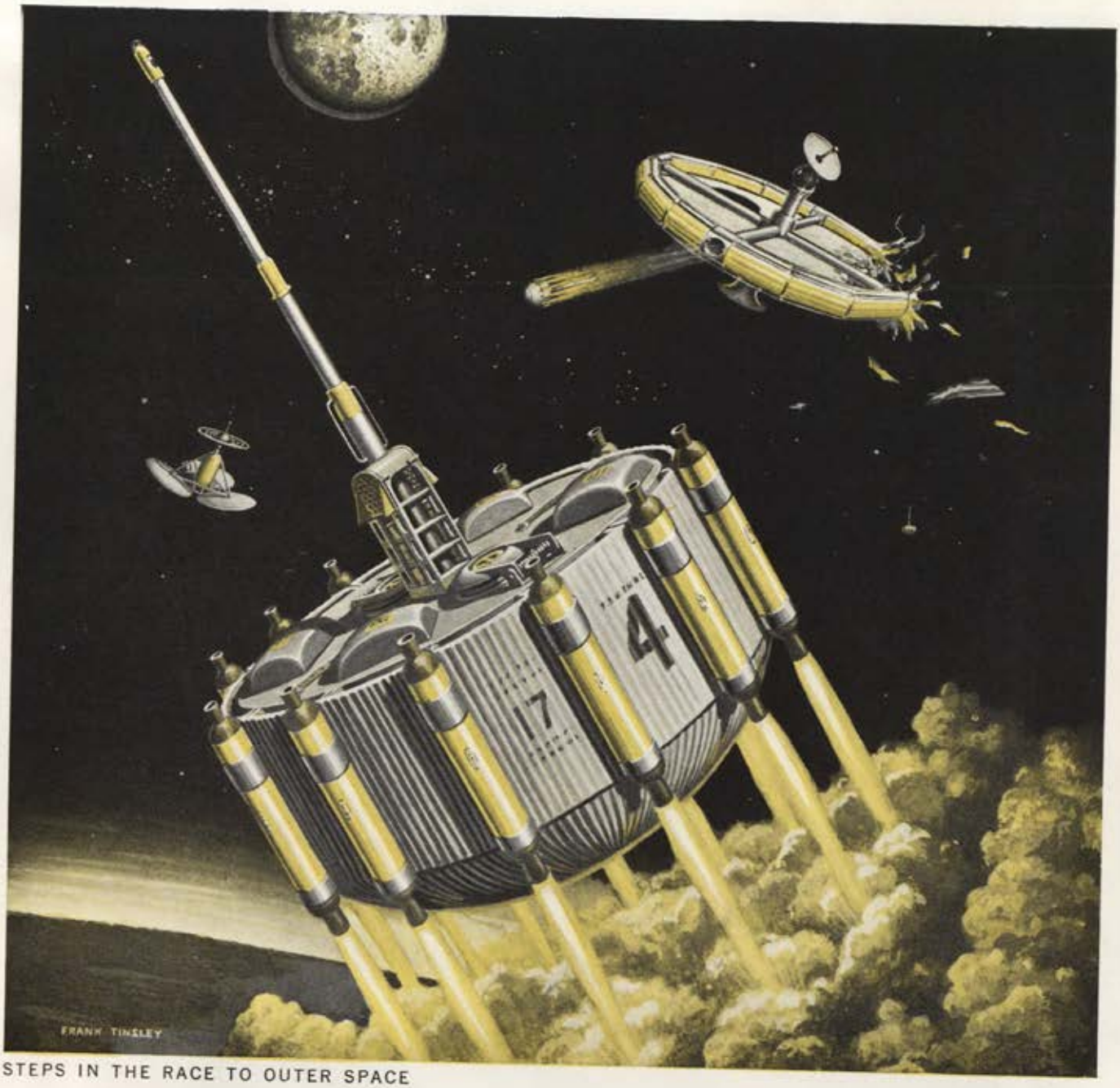
AIR FORCE

and SPACE DIGEST

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



The New Secretary of Defense



STEPS IN THE RACE TO OUTER SPACE

Escape In Space

The space-assembled super satellites of the future will periodically encounter disaster—collision, mechanical failure, military attack, or the long chance of being hit by a meteorite. When this happens, "life boats" like the one shown here will bring their crews safely back to earth.

Here is the operational sequence of an escape in space:

1. Crew members don pressure suits and strap themselves into decelleration beds within the pressure-intact unit.

2. At the "Abandon Ship" signal, low-power, RATO-type launching rockets blast the sealed capsule from the threatened station (upper right illustration).

3. Acting on orders from an astrogational computer, the retro-rockets check the capsule's speed and break it out of orbit. (Foreground. Note details of offset heat shielding, hatches, slow-down parachute covers.)

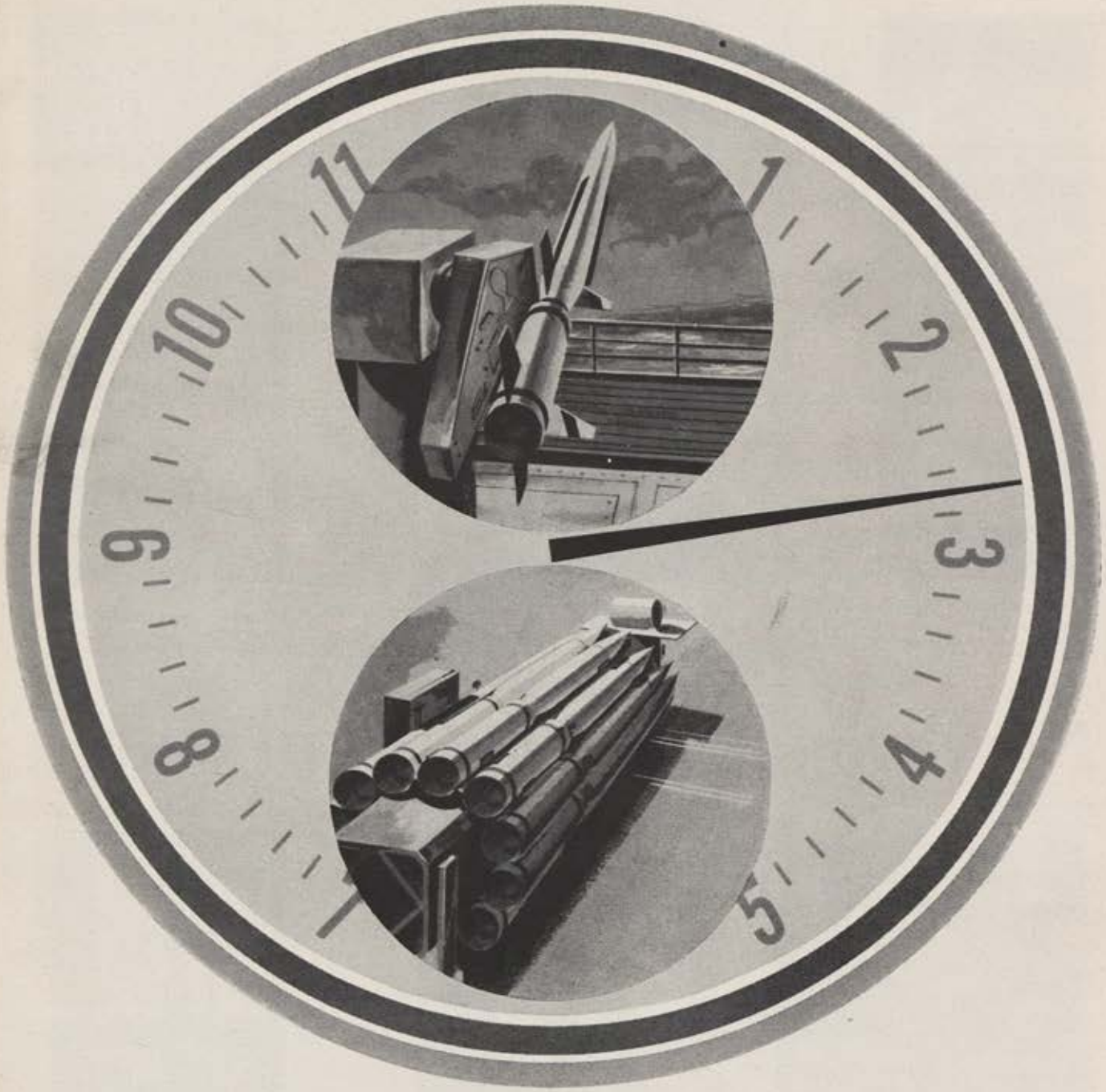
4. As the capsule enters the outer atmosphere, the heat shield protects the astronauts. The life boat's momentum slows even further, and the shield is jettisoned as it cools.

5. Four parachutes are released, acting as air brakes. After a computed interval, other chutes are released.

6. The capsule lands in a predetermined sea rescue area, and a ring of flotation bags inflate. A radio broadcasts the craft's location, and a bright sunshade serves as a visual and radar target for rescuers.

ARMA, now providing the inertial guidance system for the ATLAS ICBM and engaged in advanced research and development, is in the vanguard of the race to outer space. For this effort, ***ARMA*** needs scientists and engineers experienced in astronautics. ***ARMA***, Garden City, New York. A Division of American Bosch Arma Corporation.

AMERICAN BOSCH ARMA CORPORATION



FROM REST TO READY....**LESS THAN A MINUTE**

■ Below deck, missiles are stored naked, stripped of stubby wings. But in less than 60 seconds they're assembled, loaded and fired, thanks to automation. ■ Take this concept – develop the idea into today's mighty missile systems. Vitro did: its technical staff helped the Bureau of Naval Weapons design fully-automated missile handling and launching systems – ones now used aboard frigates, cruisers and carriers armed with fast, ship-launched Terrier and Talos missiles. ■ Vitro scientists and engineers went right to work during basic ship design – providing space needed for automatic storage and handling. Beyond this, Vitro takes ideas and develops actual systems for feasibility testing.

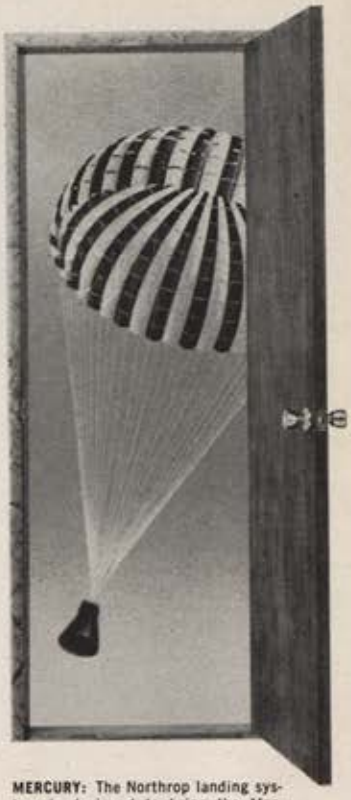
Vitro

VITRO LABORATORIES/Division of Vitro Corporation of America/SILVER SPRING, MD. • WEST ORANGE, N.J. • EGLIN AFB, FLA.

SCIENTISTS AND ENGINEERS: JOIN THIS TEAM

POLARIS: Northrop's Datico checks out Polaris at all levels of maintenance and operation.

SKYBOLT: Guidance and navigation systems are being developed by Northrop for this new and highly secret air-launched ballistic missile.



MERCURY: The Northrop landing system is designed to bring the Mercury astronaut down safely.

Northrop is now active in more

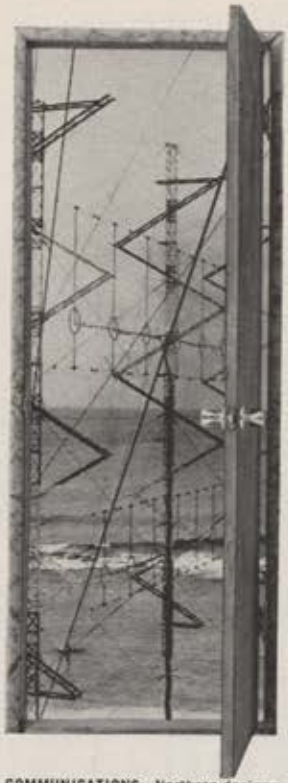
X-15: Northrop produces Q-Ball, the flight angle sensor for safe re-entry of X-15 and other aerospace vehicles.

AERODYNAMICS: Northrop's Laminar Flow Control technique is designed to greatly increase aircraft range, flexibility, cargo and passenger capacity.

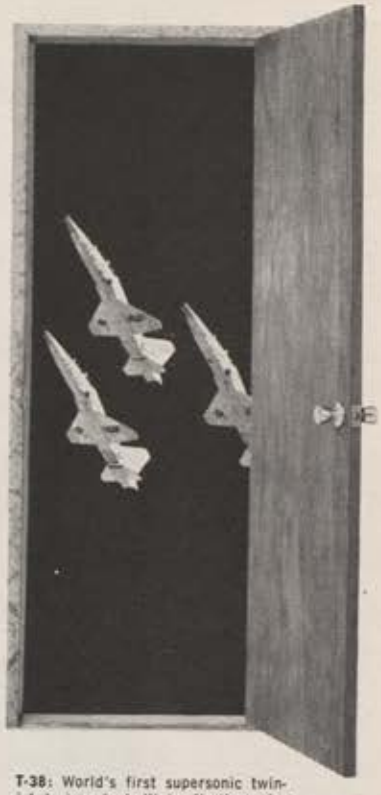
TITAN: Northrop supplies complete technical and industrial management to activate the T-2 Titan missile base.

Northrop Corporation, Beverly Hills, California • Divisions: Norair, Nortronics, Radioplane, Northrop International

HAWK: Northrop produces airframe components, ground handling and launching equipment for this air defense missile.

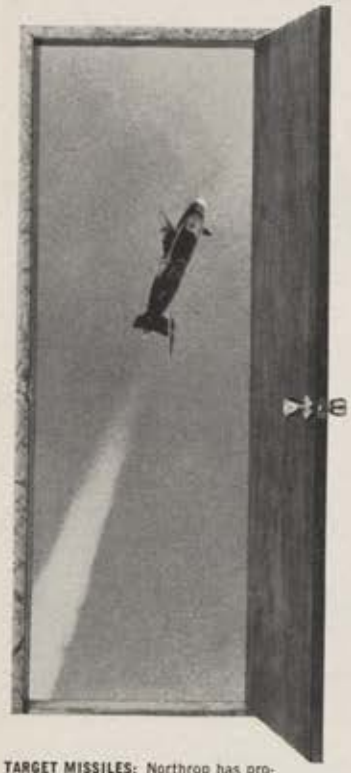


COMMUNICATIONS: Northrop designs the trans-Pacific Scatter Communications Network and other worldwide communication systems for U.S. and free world governments.



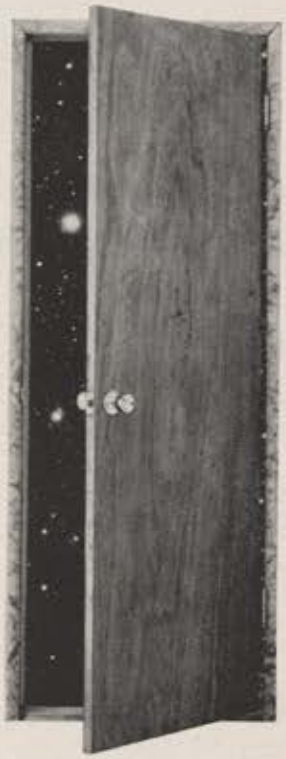
T-38: World's first supersonic twin-jet trainer is built by Northrop for the United States Air Force.

than 70 important programs



TARGET MISSILES: Northrop has produced more than 50,000 electronically-controlled aerial targets, and surveillance drones.

COMMERCIAL METAL PRODUCTS: Northrop produces aluminum architectural shapes for many important industrial and commercial buildings.



SPACE RESEARCH: Northrop's accelerated space research programs reach into such advanced areas as maneuverability, rendezvous, space vehicle maintenance, space probes, and the survival of men in space.

Subsidiaries: Page Communications Engineers, Inc., Acme Metal Molding Company.

BELL TELEPHONE GUIDANCE SYSTEM STEERS TIROS II INTO CIRCULAR ORBIT

Latest Experimental Meteorological Satellite on Course, Thanks to Bell Scientists — to Aid in Weather Forecasting

THE DAY of operational weather satellites is one step closer with the orbiting of the National Aeronautics and Space Administration's Tiros II.

An on-the-job, working satellite, the TV-equipped Tiros II will take pictures of cloud cover and transmit them to earth for limited, experimental use in forecasting weather.

But despite its many instruments—TV cameras, tape recorders, solar cells and antennas—Tiros II would not be as useful if it were not in a nearly perfect circular orbit, made possible in large measure by the Bell Telephone Command Guidance System.

To provide accurate weather data, the satellite must be at an almost uniform distance from the earth at all times. Tiros II's orbit varies within extremely narrow limits as it constantly circles the earth.

Our Command Guidance System for the Tiros launching vehicle is a result of research and development by Bell Telephone Laboratories and production by Western Electric. This amazingly accurate system has scored many other successes in America's space program.

It has guided the successful Air Force Titan ICBM firings, and it helped make possible the first nose cone recoveries after flights of ICBM range. It also guided NASA's Tiros I and Echo I into their carefully planned orbits, and will be used in other forthcoming space probes and satellite launchings.

This Command Guidance System is one of a number of ways the Bell System is participating in the nation's space effort. The skills and knowledge called for in this pioneering activity are important assets in the country's defense.

More than 9000 solar cells—an invention of the Bell System—ring Tiros II and provide power for its instruments.

BELL TELEPHONE SYSTEM

AIR FORCE

and SPACE DIGEST

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FEATURES

SPACE DIGEST

DEPARTMENTS

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BULLETIN FROM BOEING...

...WHERE CAPABILITY HAS MANY FACES

Expanding the frontiers of knowledge through basic research is the business of the Boeing Scientific Research Laboratories, left. Here Boeing scientists are at work in the fields of solid state physics, flight sciences, advanced mathematics, plasma physics and geo-astrophysics.

SPACE GLIDER. Artist's concept shows Dyna Soar manned space glider perched atop modified Titan ICBM for launching. In space, the glider and booster would separate, leaving Dyna Soar vehicle in piloted, near-orbital flight. Pilot could later glide to conventional landing at a selected base. Dyna Soar is being developed by the U. S. Air Force in cooperation with NASA, with Boeing as prime contractor for both the system and the glider.

FUTURE SKYLINER. Boeing, builder of famous 707, America's first jet airliner, has long been at work on next generation of aerial transports, which could look like the Boeing design pictured above. Supersonic jetliners, probably a decade away, could have speed in neighborhood of 2,000 miles an hour. Flight time, from Paris to New York, would be about two and a half hours!

SHOCK TUBE. Industry's most powerful shock tube, designed and built by Boeing Scientific Research Laboratories scientists, creates shock waves which begin at 300 times speed of sound, then collide in tube at "slowed" rate of 80 times speed of sound. Gas temperature within the tube reaches approximately one million degrees. Studies could be important in developing effective ion and plasma-propulsion systems for use in space.

BOEING

JET AIRCRAFT, MISSILES, HELICOPTERS, GAS-TURBINE ENGINES, WEAPON-SYSTEM MANAGEMENT, SPACE-FLIGHT VEHICLES AND SYSTEMS.

An Editorial

THE GOLD-PLATED HEADACHE

John F. Loosbrock
EDITOR, AIR FORCE/SPACE DIGEST MAGAZINE

IT'S only human nature, we suppose, when beset with problems to which one cannot find an easy answer, to lash out at handy targets, innocent though they may be.

It's a little like the man who, after a bad day at the office, comes home to quarrel with his wife, spank his kids, and kick the dog.

The psychiatrists may find this understandable, even condonable, in the case of an individual. In the case of a supposedly mature government, we find it inexcusable.

Yet that is about the way the government of the United States has attacked the so-called imbalance in gold payments—by striking, not at the causes in any meaningful way, but at those who cannot strike back—the men and women of the armed services and their dependents.

We see no reason why the recent directive drastically reducing the number of service dependents overseas should be implemented at all—at least not for the present—until the incoming Administration has had a chance to take a hard look at its inherited gold-plated headache. After all, action on the unfavorable ratio in the flow of gold had waited two years and more for a concrete step to be taken toward a solution. And then the wrong step was taken. Surely a wait of one or two more months will not make or break the bank at Fort Knox.

Our investigation has firmly convinced us that the action was precipitous, ill-advised, discriminating in its effects, and is contributing substantially little toward solving the problem. All that has been accomplished to date, in our estimation, is a punishing blow at the morale and confidence of the professional career force charged with translating the billions this nation has spent—and intends to spend—on hardware, bases, and alliances into the kind of force an implacable enemy understands.

All this is not to underestimate the gold-flow problem. But the problem is a national one and should be borne by the entire nation, not by the relatively few in uniform who are already sacrificing much in pursuing their chosen careers.

As we can determine, the facts behind the dependents' directive do not support either its issuance or its immediate implementation. Let's take a look at the background.

The gold crisis has been two years and more in the making. Very simply, more dollars have been flowing out of the country, in payments and investments, than have been flowing back, particularly from the prosperous hard-currency countries of Western Europe. The trend can be slowed, even reversed in many ways—all of which add up to reducing the expenditures or investment of American dollars in hard-currency countries abroad.

One way is to require our prosperous allies to assume more of the financial burden of their own defenses. Another is to restrict the number of dollars our tourists can spend abroad. Still another is to reduce our forces overseas, including dependents. Another is to pursue a vigorous "buy-American" program, including measures to make American products more competitive in price with goods from abroad. Another is to reduce outright foreign aid. Another is to reduce the numbers of nonmilitary government families abroad under the aegis of such agencies as the Department of State, the United States Information Agency, etc. Another is to restrict the flow of American dollars into foreign investments that hold out the promise of higher profits than the same money invested here at home.

We hold no degrees in economics. Nor do we pretend to expertise in international finance. The proper mix of such measures as are outlined herewith is something for study by those more qualified than we.

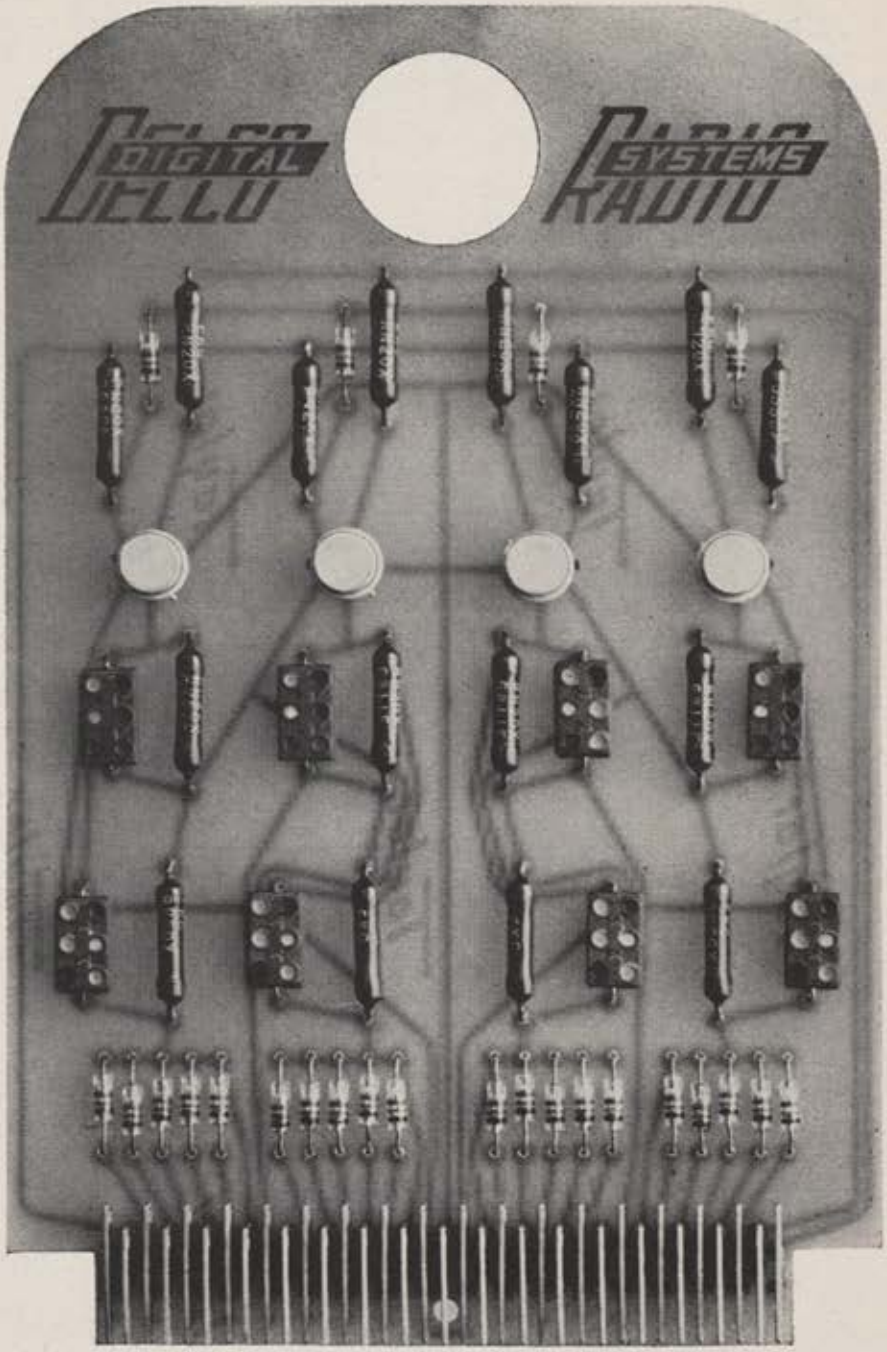
But we do know that the dollar savings to be obtained by the dependents' directive are but a drop in the gold-flow bucket. We are also satisfied that the timing of its issuance was somewhat cynically determined by political considerations. It was timed to fall neatly between our national elections and the visit of Secretary of the Treasury Anderson to Bonn in his ill-fated attempt to persuade the West German government to pay the bill for US troops stationed there. The action, we are told, was calculated to "dramatize" the seriousness with which the United States viewed the Bonn talks and the gold situation in general.

Well, the election is over, and the Bonn talks have failed of their purpose. We see no further purpose in continuing what has been called the crucifixion of American servicemen, their wives, and children upon the "double-cross of gold."

At this writing it is but a month until the new Administration takes over the reins of government. We ask, therefore, a moratorium on the reduction of American service dependents abroad at least until that time, so that the gold-flow problem can be surveyed in its broad aspects by the men who will have to live with it for the next four years.

Historically, the professional military man and his family have been, as Secretary of Defense Gates states, "accustomed to sacrifice." But sacrifice is one thing. Needless discrimination is another.

"Theirs not to reason why" has never been a believable slogan for the American services so let's blow "halt" to this fiscal "Charge of the Light Brigade" before we have to start counting unnecessary casualties.
—END



DIGITAL MODULES

...building block or plug-in card

Which package fits into your design? Packaged either way, Delco Radio Digital Modules meet or exceed all MIL-E-5272D (ASG) environmental requirements. Continuing life tests on these computer circuits now exceed four and one-half million transistor hours *without a failure*. The modules perform all the standard logic functions and come in many basic types and variations. Delco modules in the transistorized building block package are ideally suited for airborne guidance and control because of their extreme ruggedness, compactness and reliability. All miniature building block modules employ three dimensional welded wiring techniques and are vacuum encapsulated in epoxy resin. Delco Radio can offer you off-the-shelf digital circuits packaged as building blocks or plug-in cards, or can supply circuits to meet your specific needs. Our Sales Department will be happy to send you complete engineering data. Just write or call. ■ *Physicists and electronics engineers: Join Delco Radio's search for new and better products through Solid State Physics.*

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RELIABILITY

Division of General Motors • Kokomo, Indiana

HITCO-developed fabrication techniques are now providing portions of the heat shield for production Atlas and Titan nose cones

ABLATIVE MATERIALS ENABLE FIRST ICBM NOSE CONE RECOVERY

This RVX1-5 was the first nose cone to travel full ICBM range and be successfully recovered intact. Speeds up to 15,000 mph, temperatures to 12,000°F, high heat inputs, and high acceleration and deceleration forces were encountered. The RVX1-5 was enabled to withstand these severe re-entry conditions through the use of REFRASIL* and AVCOITE† ablative heat shield materials.

ENGINEERS AND SCIENTISTS CAPABLE OF HIGH LEVEL TECHNICAL RESPONSIBILITY ARE INVITED TO CONTACT M. C. BOUGHEN

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Careful Analysis Comes First

Gentlemen: The article by Claude Witze entitled "USAF Makes Up Its Mind" in the November issue is an excellent discussion on the procedures used by the Air Force in arriving at decisions on weapon systems. I think it is an excellent idea to present this information to industry. Also, I believe it is important to show these decisions are made after careful analysis of the facts, including funding as a prime consideration.

Perhaps some of those agencies which have been critical can better understand the careful, objective analysis made by the Air Force prior to deciding on the make-up of its weapon systems force structure.

Congratulations on a job well done.

Col. R. J. Watson, USAF (Ret.)
Falls Church, Va.

Gentlemen: Your article "USAF Makes Up Its Mind" in the November issue of AIR FORCE/SPACE DIGEST was excellent. I have been fussing around in Air Force channels for many years, but never knew the story as well as you have described it. . . .

Edward J. Odlum
Senior Vice President
The Kaman Aircraft Corp.
Bloomfield, Conn.

Good News

Gentlemen: I read your editorial entitled "Minimum Deterrence Is a Phony" in the October 1960 AIR FORCE/SPACE DIGEST and the first AFA Statement of Policy entitled "The Fallacy of Minimum Deterrence" in the November 1960 edition with maximum interest. Frankly, a publication with your reputation and circulation maintaining such a well founded argument is the best news I have heard in many a month. . . .

Capt. James J. Romer
Pope AFB, N. C.

Ad for TAC

Gentlemen: I would like to extend my compliments on the wonderful and well placed Lockheed advertisement on pages 2 and 3 in the November issue of your fine magazine. It is your fine layout and over-all design and the location of advertisements such as this that help bring the mission of the Tactical Air Command to the forefront of the public eye.

I thoroughly enjoy AIR FORCE Magazine and look forward eagerly to its monthly publication. I find it extremely helpful in keeping current with overall Air Force planning, recent Soviet advances in Red airpower, and especially that portion of the magazine reserved for SPACE DIGEST. . . .

Capt. Donald B. Millard
Langley AFB, Va.

Pleasant Surprise

Gentlemen: I have been a member of AFA since 1957, when I first heard about your flight pay insurance. I'm very happy to say, however, that I have never had an occasion to use it. But it has been a comfortable feeling knowing that I had such protection.

In addition, I have enjoyed our relationship in ways that I didn't expect. I had never read your magazine until I became a member and was quite pleasantly surprised when I found that it had some real content and not just the insipid and valueless ramblings of a fraternity magazine. Also, I came to realize, mainly from your editorials, that there are people in our country who are not only intelligent but also articulate. And it's encouraging to know these people have a good understanding of our problems and sound ideas on how to solve these problems. . . .

1st Lt. Patrick M. E. Prather
APO, San Francisco, Calif.

Correction Noted

Gentlemen: In the interest of accuracy, may I point out an error in "Airpower in the News" in your December issue? Marx Leva, who served with Senator Symington on President-Elect Kennedy's committee to study defense reorganization, is not a business partner of the senator. Mr. Leva's partner is A. Lloyd Symington.

Lee Stevens
Philadelphia, Pa.

Unlimited Requirement

Gentlemen: Your article on the Congo Airlift in October was excellent.

Certainly we see nothing in the future which would diminish the requirement for strategic airlift, either in war (God forbid!) or in meeting the many commitments our nation has to its friends and allies in the cold war.

Lt. Col. Raymond L. Towne
Hq. MATS
Scott AFB, Ill.

Guts We've Got Plenty Of

Gentlemen: The Orlando (Fla.) *Sentinel* and the Chicago *Daily Tribune* published this letter. I hope that you have the guts to do the same:

"There is no one who is a greater believer in freedom of the press than I am; however, it is hard at times to explain the military information that is put out freely in the papers and magazines.

"Test failures at Cape Canaveral are immediately blazoned on the front pages of papers and on the radio, as well as television. Also other news of military character, which it seems to me should be hush-hush, is also too often published.

"The top officials of the Red butchers in Russia do not advertise their test failures, which we know they have had and many of them. Besides, any new devices which we get up are immediately published in enough detail to at least set the Russians to thinking and their slaves to thinking.

"In my opinion too much of what we do is an open book to the Red butchers. At times I wonder why they even need spies or their embassies, councils, and groups in our cities, states, and the UN."

Lt. Gen. George E. Stratemeyer,
USAF (Ret.)
Winter Park, Fla.

● *An old gentleman of our acquaintance once told us, "You can fight fire with fire but usually it's better to use water." We still think a little too much freedom is better than not quite enough.*—THE EDITORS

Religion and the Scientists

Gentlemen: Please accept my hearty congratulations on having the best publication of its class ever put out.

(Continued on following page)

It is one of the most valuable aids imaginable for keeping us veterans and interested persons abreast of latest developments, data, defense, and other happenings in our Air Force, as well as information on what the potential enemy of our country is doing and has by way of air armament.

Along with the roses, please allow me to include a small thorn or two. As a patriot of this glorious country of ours, fully and patiently blessed by God, I would like to object to the nature of two articles which were recently published in our magazine. I refer to "Cosmic Garbage," by Thomas Gold in SPACE DIGEST, May '60, and the one in the November '60 issue entitled "A New Theory of Creation," by Reginald O. Kapp. . . .

These articles attempt to explain the hows and whys of creation—"Cosmic Garbage" telling how something from outer space left bacteria, etc., from which life developed on this earth. The "New Theory" article expounds on how life originally came from the sea, and "evolved" from there to what is on the earth now. . . .

The authors of these articles have let it be known that they have done considerable research into their theories. The only trouble is that they followed the wrong trails in their delving into the facts. If they had done a little research into the unchangeable, ever-existing word of God, the Holy Bible, the irrefutable facts of creation and life itself, their eyes would have been opened as to the hows and whys of life on this earth.

The "New Theory" article questions why some of the species of life that existed ages and ages ago are not found alive on the earth now. The answer is very simple (and the findings of archaeologists will bear it out). Recall the Great Flood, whereby every living thing that existed on the earth was destroyed except those species transported in the Ark. True, certain species are undoubtedly different from those originals which walked or by other means conveyed themselves back onto the drying earth—the very natural, commonplace result of breeding and interbreeding.

In these days of so-called advanced education, every American child is sometime or other exposed to extremely dangerous theories, and many are misled from the truth and grow up with little or no trust or faith in God—in spite of our motto "In God We Trust" remaining on our coins. It is my belief that every important document our forefathers drew up, and which are still used as a guide to modern-day Americans, was drawn up with mention of God and our Creator. . . .

I strongly feel that we should list among the first duties that of making absolutely sure that our children as well as we are taught the real truths through the materials we read. Of course, I realize that without a doubt the scientists responsible for the articles I object to are not deliberately attempting to cause a turning away from God by their writing. On the other hand, if we as a nation disregard Him, and continue the way we are, we will awaken some day to the fact that the blessing of God has been removed from our nation—only too late for us to do anything about it. . . .

As a publication, the Air Force Association's magazine could, I believe, use the same good judgment it uses in printing the other articles, and gently eliminate these highly misleading articles. After all, is not this nation obligated to the leading and guiding of other smaller nations in the world, and do we not fully adhere and agree with the age-old saying, "And ye shall know the truth, and the truth shall make you free?" Such divergent articles actually serve our enemies by making us a weaker, more atheistic nation.

AFA's object in part is dedicated to national security and world peace—please let us fully ensure this by a closer censorship of these misleading "scientific" articles.

John R. Clinton
Marquette, Mich.

● *Theology is, of course, not our forte, yet we feel that discussion by recognized scientists of aspects of the generally accepted theory of evolution need not necessarily indicate a rejection by science or individual scientists of the divine origin of our universe. From a religious point of view, it seems to us that one of the functions of science is to examine God's work, and to explain those aspects of His work which can be understood. Although these men might differ specifically with you on the question of literal interpretation of the Scriptures, we believe scientists would agree with your admonition that the truth shall make us free. Each searches for the truth according to his lights; the final mystery is God, and there is possibly no greater proof of His existence than the infinite complexity of His creation and the diversity of paths taken to His abode.*—THE EDITORS

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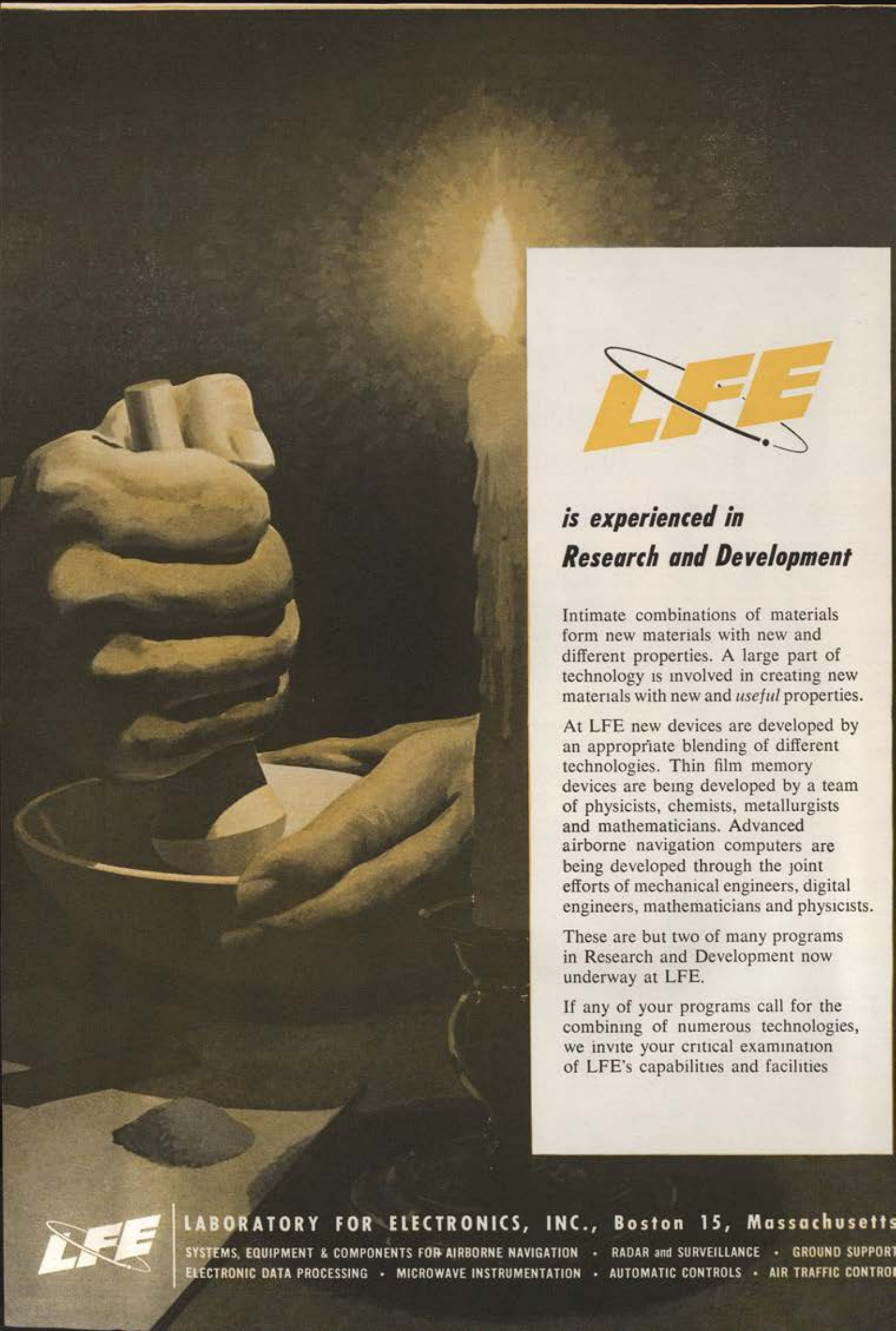

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What's New With ★ RED AIRPOWER

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 Soviet Union is operating or has operated at least forty-three nuclear reactors. Twenty-seven of these are experimental or research units, most of which are still in use, and sixteen are operational types producing power in stationary plants or in propulsion systems. The three reactors in the icebreaker *Lenin* are included in this operational group. The *Lenin's* reactors, along with their energy-conversion systems, are considered to be the final prototype of a nuclear power system for marine use. The *Lenin* first sailed a year ago. Nine more operational reactors for power stations are under construction and are scheduled for start-up in 1961.

The United States now has more than 350 reactors either operational, under construction, or in the planning stage. This figure includes research, materials test, power station, propulsion, and all other types of reactors. Three power-station reactors are in operation. Eight more are being built, and an additional eight are planned. More than a dozen reactors are operational in submarines; one is under construction for a merchant ship; two more are scheduled. A nuclear aircraft carrier is being built.

The information available on the Russian reactor program indicates that they may favor indirect-cycle engines for powering aircraft. No details of any experiments with gas-cooled reactors suitable for a direct-cycle aircraft engine has been given in the Soviet literature. On the direct-cycle nuclear turbojet the reactor takes the place of the engine's combustion chamber, and the engine air is heated by passing through the core.

However, liquid metal reactor coolants needed for efficient indirect-cycle engines have been the object of extensive investigation. Russian scientists indicate that the liquid metal coolant data is used in the design of compact ground power reactors, two of which are now under construction. Somewhat in opposition to this intention is the fact that the liquid metal heat-exchanger systems needed to transfer the reactor heat into a turbine power plant have been experimented with in both the one- and the two-loop configurations. US studies show that a heat-exchanger system using one loop of liquid metal appears possible for a ground power station while the two-loop system using two separate circuits of liquid metal tied together by an intermediate heat exchanger is necessary for a propulsion engine in which shield weight is a critical item.

The dam on Soviet nuclear information did not break until 1955, and no reactor data was published before that year. Since then many details of reactor construction and experiments have been described in scientific publications and have at least partially filled out the history of Russian reactor development back to 1947 when the first one went "critical." The latest information from Russian open sources tells of the operation of pulsed reactors and the use of metallic beryllium and beryllium oxide ceramics for reactor structure and neutron reflectors. Beryllium compounds are opening the way to lighter, less bulky reactors which have higher operating temperatures and are consequently more efficient.

One of the important uses of pulsed reactors today is to emit very strong bursts of radiation to simulate atomic explosions in tests which determine the damage which can be inflicted on electronic systems and other equipment in ballistic warheads, controllable warheads, and similar vehicles. It is believed that near misses by nuclear-armed defensive missiles can disable such vehicles in space if certain portions of their equipment are not heavily shielded.

Detailed information is also available on sixteen reactors in other Communist nations, most of which have been supplied by the Soviets. Bulgaria, North Korea, and Romania each has received one Russian reactor while Czechoslovakia, East Germany, Yugoslavia, Hungary, and China each has two reactors in operation or in the late stages of construction.

The first Red Chinese reactor produced power late in 1958 at the Institute of Nuclear Physics at Peking. It is rated at ten megawatts thermal output from the core and was furnished by the Russians. The second Chinese reactor to be started up is much smaller but has the distinction of being entirely a domestic product. It was designed, built, and is operated by the faculty and students of Nan-K'ai Polytechnic Institute of Tientsin.

Poland apparently has the most nuclear capability of any Red nation outside of Russia, even though the first Polish reactor did not operate until 1958, and it was of Soviet manufacture. Since then the Poles have run several reactors which apparently are part of a test series leading to the operation of a high-temperature, high-power density, gas-cooled reactor. This advanced design is the type needed in direct-cycle nuclear aircraft engines and in very high-efficiency power stations.

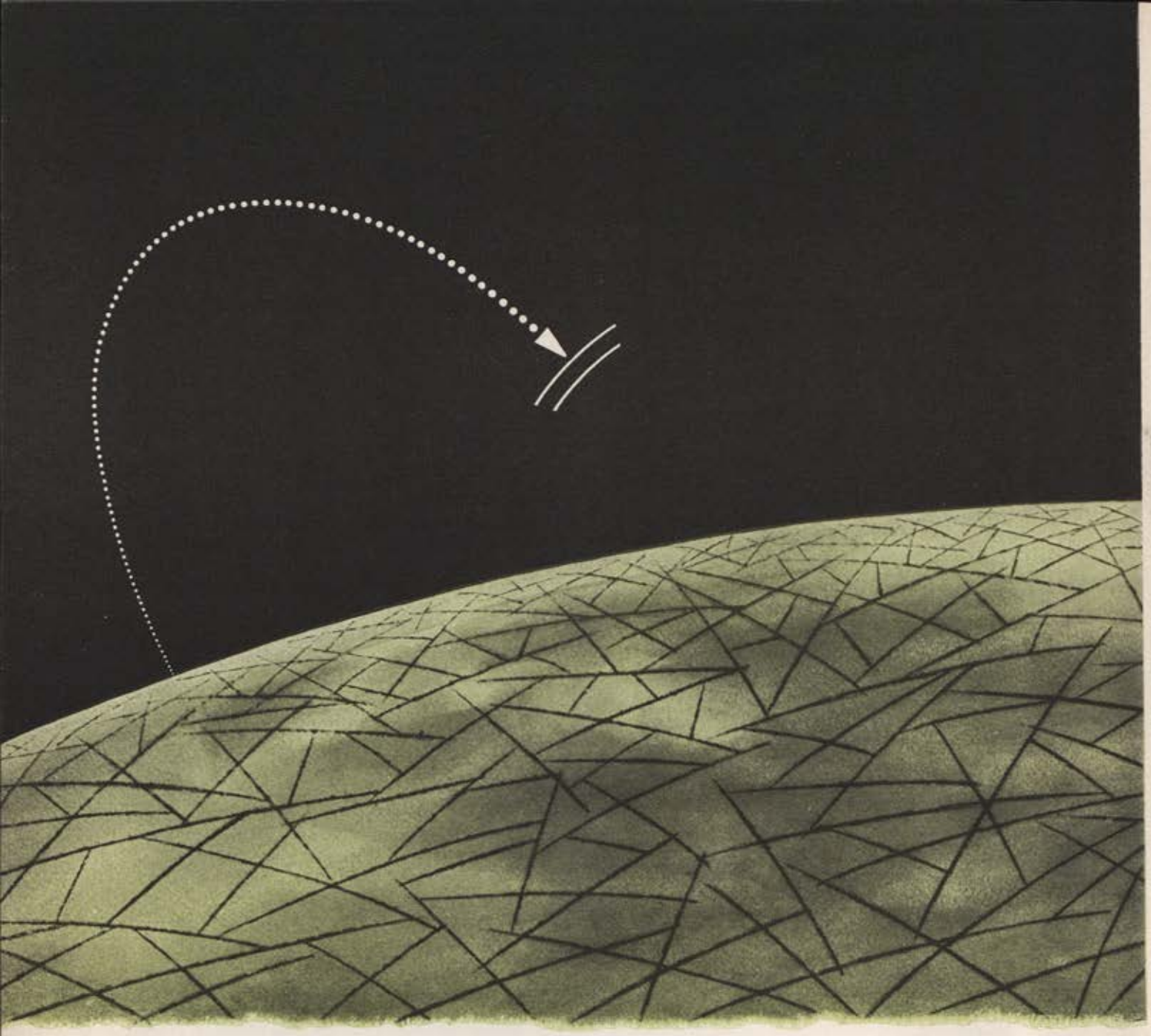
One Russian reactor has already found its way to Africa and is being used by the Egyptians for research, teaching, and the production of isotopes.

* * *

The Soviets are pressing their effort to develop chemicals which, when taken internally, will protect the human body from damage by ionizing radiation. Tests are being run on animals to determine the protective properties of various chemicals from the direct radiation that comes from a reactor or the explosion of a nuclear weapon. Animals are also used in studies aimed at acquiring a full understanding of the nature of radiation damage in various types of tissue and living organisms.

This understanding probably will be required before there is a hope of finding the proper protective substances. Part of the program has the objective of limiting the damage done by radioactive isotopes in the fallout from nuclear explosions. Most isotopes attack a particular portion of the body such as the bones, blood, or one gland or another. It is believed possible to find chemicals that will bolster the body organs against isotope damage and will flush the radioactive particles from the body.

Such chemicals would materially increase the survival chances of the civil population during an all-out nuclear attack. They would substantially reduce the shielding weight and increase the performance of nuclear-powered vehicles, and, in addition, they would make flights into and beyond the radiation belts surrounding the earth much more of a probability than they are at present.—END



LORAL: Solving both sides of the

DETECTION: The time lapse from initial detection of an approaching missile to the latest possible moment for intercept is a very few minutes. Into that gap must go signal analysis and interpretation, programming of an anti-missile, and the intercept flight. Early warning is the first factor to be considered, and we have been active in bomber early warning for years, with airborne detection equipments now operational on many military aircraft. Now we are applying our experience to the study of missile early warning systems; using our background in data analysis and integration for: target location and tracking, programming the weapon to find efficient intercept paths, and creating unbreakable lock-on techniques. Can a lock-on be unbreakable? That leads us to the other side of the equation...

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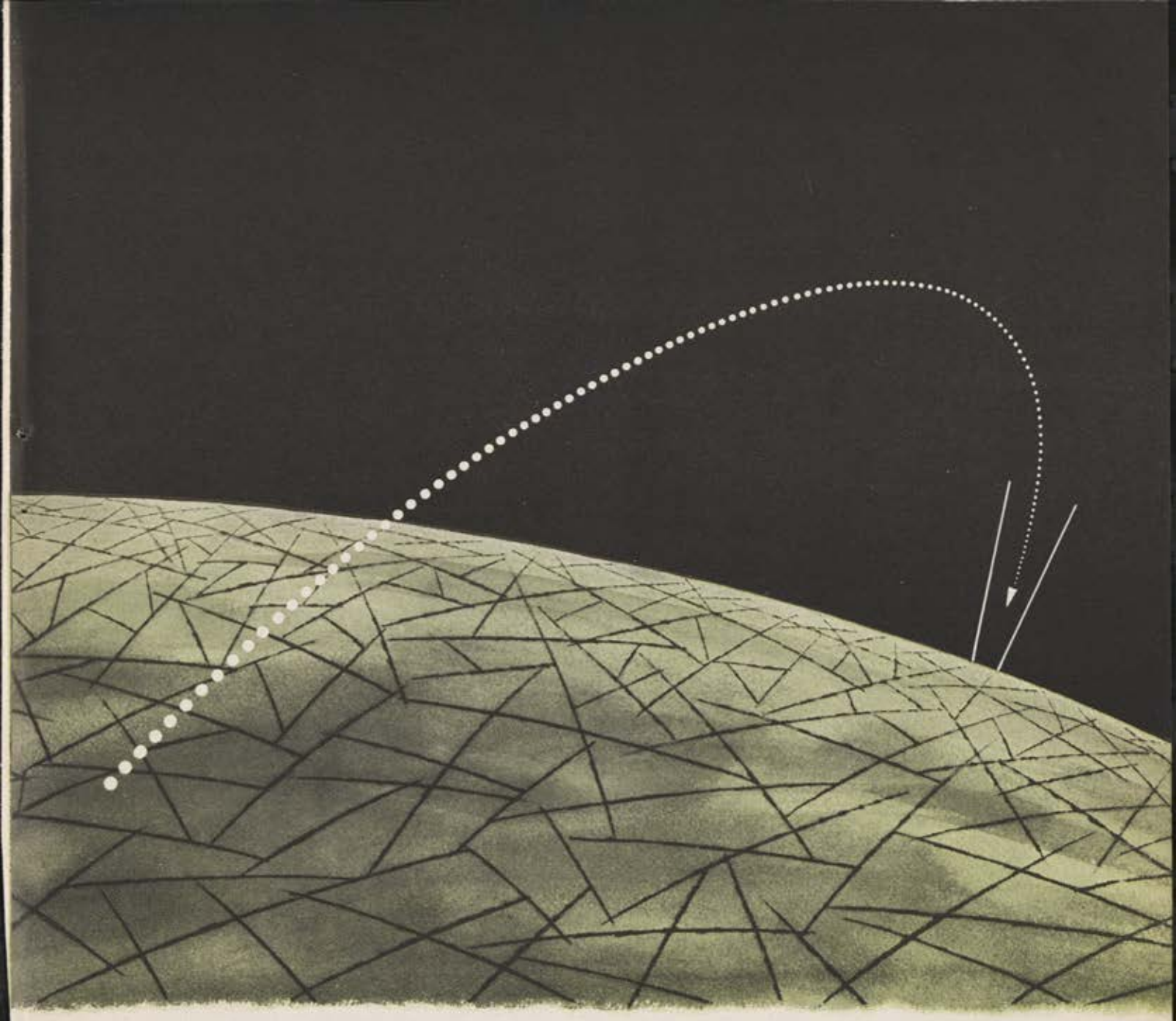

missile equation

DECEPTION . . . Studies in enemy missile detection lead to studies in systems for our own missiles to evade detection . . . Penetration Aids. A ballistic weapon of current configuration cannot take evasive action in the terminal phase. To confuse enemy tracking networks, deception is necessary. What type deception? What systems are they using to detect us? Passive? Active? . . . Radar, IR, UV. One of our fields of research is finding means to combat these detection methods. We are working toward complete micro-miniaturized systems to sense, analyze, interpret, and counter; systems to eliminate as many hazards as possible to insure delivery of the weapon to the target.

If you are a senior scientist or engineer interested in helping to solve both sides of the missile equation, write LORAL Electronics Corporation, New York 72, New York.

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News, Views & Comments

AEROSPACE WORLD

Frederic M. Philips
ASSOCIATE EDITOR, AIR FORCE MAGAZINE

President-Elect Kennedy this month chose a college professor-businessman-Air Force Reservist to head his top defense team. He took under consideration at the same time a major reorganization of the nation's military establishment.

Named Secretary of Defense in the new Administration, succeeding Thomas S. Gates, was Ford Motor Company president and Air Force veteran Robert S. McNamara. Mr. McNamara served in Europe and the China-Burma-India theater during the war. He is presently a colonel in the Air Force Reserve. (*See page 103 for more details.*)

Appointment of Mr. McNamara, associate professor at Harvard Business School before USAF service and a subsequent Ford career, was widely applauded. The Washington *Post* called him "one of the most progressive and resourceful of the nation's younger industrialists," combining "business acumen" with "intellectual curiosity" and "concern" over national defense.

Missouri Senator Stuart Symington, who headed task force that studied national defense organization for President-Elect Kennedy. The group came up with sweeping plan aimed to centralize defense decision-making.

Prime item on the defense agenda as Mr. McNamara takes office will be thorough evaluation of a plan for revamping the Department of Defense put forward by Missouri Senator Symington and a six-man committee (*see page 38 for text and comments*). The committee was appointed by Mr. Kennedy to analyze the defense structure.

The plan would center new responsibility in the office of Secretary of Defense, abolish the separate military service *departments* while maintaining the separate *uniformed* services, and end the Joint Chiefs of Staff system as it now exists. Set up at the same time would be three unified new functional commands to handle strategic, tactical, and defense operations. These were some of the plan's main features:

- The offices of Secretary of the

Mercury man-in-space program took a setback on November 21 when unmanned test launch for manned spaceflight aborted. Above, smoky scene as the Redstone booster ignited, cut off, remained in place on pad at the Cape.

USAF now has staged midair recoveries of three Discoverer capsules released from orbiting satellites. A fourth capsule has been recovered from the sea. Here an Air Force C-119 piloted by Capt. Gene Jones snares Discoverer XVII's capsule over Pacific on November 14. Three weeks later Captain Jones' plane also caught Discoverer XVIII capsule. The capsules contained instruments and biological specimens. Shots, representing technical advances, both went well.

Department of Defense last month released for the first time photos of the two atomic bombs dropped on Hiroshima and Nagasaki, Japan, just before the end of World War II. Left, the "Little Boy" type, used over Hiroshima, twenty-eight inches in diameter, 120 inches long, weighing 9,000 pounds, with a yield equal to about 20,000 tons of high explosive. Right, "Fat Man" type, used at Nagasaki, sixty inches in diameter, 128 inches long, weighing 10,000 pounds, with same yield.

Army, Navy, and Air Force would be eliminated. No longer in existence would be the posts of fifteen secretaries, undersecretaries, and assistant secretaries of the services. Out the window also would go seven Assistant Secretary of Defense jobs.

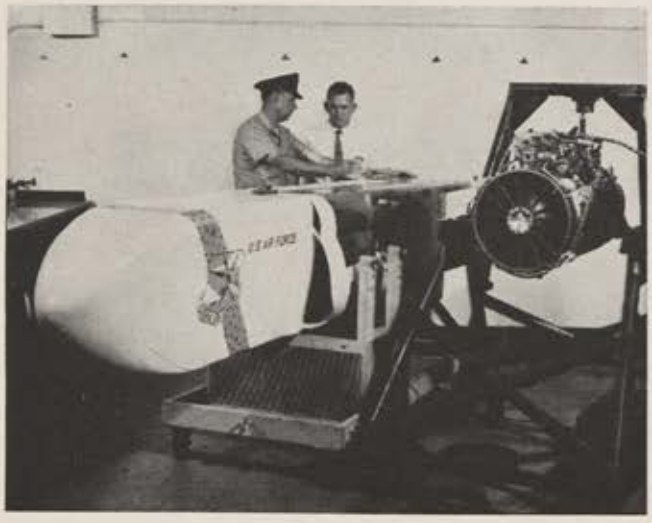
- Each of the services—Army, Navy, and Air Force—would be led by a Chief of Staff directly responsible to the Secretary of Defense.
- Replacing the Joint Chiefs would be a Military Advisory Council made up of senior officers of the three services who would permanently leave their services to sit on the Council. The current Joint Chiefs head their separate services in addition to sitting as Chiefs. A Chairman of the Joint Staff would both chair this advisory group and act as principal military adviser to the President and the Secretary of Defense.
- Two new Undersecretaries of Defense—one for Weapon Systems and one for Administration—would be created in addition to the present Deputy Defense Secretary. Also included in the new setup would be an Assistant Secretary of Defense for Arms Control to work in coordination with other government agencies in the area of disarmament.
- A new unified command in charge of all National Guard and Reserve elements would come into being. This command would also have responsibility for civil defense. It would report directly to the Chairman of the Joint Staff.

Senator Symington, in presenting this plan to Mr. Kennedy on December 5, declared that it would bring greatly increased efficiency to the military establishment, cutting away as it does whole layers of civilian management, and shorten our military reaction time considerably. Centralization of decision-making, Mr. Symington said, would minimize individual "service influence" that currently tends to impede DoD action. Saved by the recommended reorganization, he added, could be as much as $8 billion a year.

Reactions to the Symington group study ran the gamut. The Air Force was reported to judge that a reorganization along the recommended lines would be a long step in the right direction of full unification. The Army and Navy were apparent allies, it was widely observed, in opposition. Outgoing Secretary Gates told newsmen that there had already been "too many" reorganizations of the defense establishment in recent years and the current system was adequate.

Mr. Kennedy, in accepting the group's study, called it "interesting" and said that it would be considered with care. In announcing appointment of his Defense Secretary in mid-December, he said that "Mr. McNamara has no commitment, I believe, to any particular change, but he is going to make his own judgment and then we

(Continued on page 21)



SAC has completed Category I testing on the jet-powered GAM-72A Green Quail decoy missile, designed and built by McDonnell Aircraft. Dropped in coveys by B-52G, it is designed to confuse air defenses by simulating B-52 on radar screens. The missile, shown with wings folded, is powered by a GE J85-7 turbojet engine, with 2,459 pounds of thrust.

Off the line comes first production Bomarc-B air defense missile, center rear, at Boeing's Seattle plant. Other missiles near completion are also shown. Super Bomarc has 400-mile range, is believed capable of protecting half-million square miles of territory. After initial failures, missile has looked good in Eglin AFB testing.

Air Force's T-39 Sabreliner exceeds design specifications

The T-39 Sabreliner, Air Force's first twin-jet utility trainer, bettered its design speed and range by handsome margins in a non-stop test flight over the Western United States. Designed to cruise at 500 mph over a range of 1720 miles, the swept-wing T-39 averaged 540 mph during an 1820-mile flight. Then it loitered for an additional half hour and landed with ample fuel reserves.

The Air Force has ordered 94 of the multi-purpose aircraft for use as radar, navigation, and jet-proficiency trainers—as well as high-priority cargo transports. The T-39 is an aircraft of exceptional all-round utility and economy—a compact workhorse designed especially for jet-age needs. It is being produced by the Los Angeles Division of North American Aviation.

THE LOS ANGELES DIVISION OF **NORTH AMERICAN AVIATION, INC.**

will talk about it after mid-winter."

☆

Service families received a short and bitter course in international economics as the old year closed. The crux of it was this. For the past several years, the United States has been losing money in its dealings with other nations. Each year, this country and its citizens spend, lend, invest, and give away more money abroad than we earn abroad from all sources. In 1959 the deficit, which is toted up in gold, was $3.8 billion. Early in 1960 the deficit rate rode along at about $3 billion. Then the roof fell in so far as the government was concerned. The rate late in the year rose alarmingly to $4.3 billion annually despite the fact that we were exporting an increased amount of goods.

President Eisenhower in a November 16 press conference announced urgent action to right the "gold gap." The boom fell most heavily on the armed forces, which were directed to place a three-part currency-conserving program in effect without delay: cut the number of dependents overseas, prohibit nonessential purchase of foreign goods by BXs, and reduce purchases of goods and services abroad. The dependent feature was the one that really hurt.

Individuals and their families felt that they were being treated unfairly, "like second-class citizens." They asked why they had apparently been singled out to bear the full brunt of sacrifice to combat a national situation. Pentagon officials feared in addition that retention rates would be thrown out of whack by disgruntled folks in uniform.

Specifically, this was what the dependent issue came to. There are 484,000 dependents now abroad with servicemen. The Administration directive orders the number cut to 200,000 by August 1, 1962. The rate of this cut was to be 15,000 a month for all services commencing the first of this year. The Air Force, with 205,000 of the over-all total of dependents overseas, would have to cut at the rate of 6,120 a month.

How will this be done? No details were available by the middle of December. But the Department of Defense, noting that about 180,000 dependents move into and out of the country each year, suggested that most of the total could be met by not sending "replacement" dependents over from now on. The services, on the other hand, feared that dependents already overseas would have to be brought home as well to meet the requirements of the directive. Whichever way you sliced it, large numbers of service families would have to be separated for periods of time.

There was no joy anywhere on this whole matter. The outgoing Administration, which said it was as regretful as anybody, estimated that for each service dependent overseas, an average of $1,000 American passes into foreign hands each year. This figure, the government judged, represented a luxury we no longer could afford—

(Continued on page 23)

Wide World Photos, Inc.

The men and organizations responsible for development of the Atlas ICBM were honored with award of the Collier Aviation Trophy in White House ceremony December 5. President Eisenhower shakes hands with General Dynamics chief Frank Pace Jr., Space Technology Labs' Dr. L. G. Dunn. General LeMay looks on.

AN ACHIEVEMENT IN DEFENSE ELECTRONICS

HIPAR Proves Effective In Hercules Anti-Missile Test

This new General Electric *High Power Acquisition Radar* (HIPAR) more than triples the detection capability of the U. S. Army's Nike-Hercules System. Produced for Western Electric, Nike-Hercules System Prime Contractor, this General Electric radar provides high resolution target data at long range and high altitudes on bomber and fighter aircraft, air-launched missiles and tactical ballistic missiles. The effectiveness of this Improved System was demonstrated at the White Sands Missile Range on June 3, 1960, with the successful intercept and destruction of a Corporal Missile, and in August and September, 1960, when target Nike-Hercules Missiles were destroyed by their defending counterparts at altitudes to almost 100,000 feet and closing speeds near Mach 7.

176-06

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at least so far as 284,000 armed forces wives and children were concerned. (*See also editorial, page 8.*)

☆

A record-setting B-52G and two Discoverer satellites provided the highlights of a busy month over and around this hurtling old planet of ours.

The B-52, of SAC's 5th Bombardment Wing, Travis AFB, Calif., flew 10,000 miles nonstop without refueling, demonstrating once more the strike potential of USAF's manned bomber force and breaking previous propeller and jet closed-circuit distance records. The eight-jet Boeing bomber remained aloft for nineteen hours and forty-five minutes, taking off from Edwards AFB, Calif., and flying a course that took it over Texas, Washington, D. C., Newfoundland, Alaska, and South Dakota before it turned for home. Broken were a B-29 prop record of 8,854 miles set in 1947, and a B-52D mark of 6,233 miles set in 1958. The B-52G's pilot was Lt. Col. Neil D. Van Reenen.

Discoverer XVII, another of USAF's sky-spy developmental series, was placed in orbit from Vandenberg AFB, Calif., on December 12. Two days later a ground signal released its capsule. A C-119 piloted by Capt. Gene Jones caught it in midair over the Pacific. Release of the capsule from the ground marked a significant advance; previous capsules were dropped by timing devices in the satellites. USAF said the capsule dropped "right into the ball park," falling from orbit in among four waiting catch planes. Three weeks later, on December 8, up went Discoverer XVIII, next in the series, with a "souped-up" Thor booster doing the honors. A cargo of human tissue and far-out space surveillance gear went along. Two days after that, Captain Jones's C-119 air recovered this one as well. It was the fourth recovery, the third in the air, of a Discoverer capsule.

Other major missile-and-space news was mixed. This was how it went:

★ Pilot Scott Crossfield flashed over the desert at Edwards AFB three times this month in an **X-15** rocket plane equipped with the new, higher power XLR-99 engine, thus completing his part in the program. Future flights will be by service and NASA flyers.

★ **Atlas** went on a 5,000-mile flight from the Cape on November 16, then failed because of a malfunction in its next launch, on November 29.

MATS added to its honor roll of mercy lifts in mid-November as six C-130s flew in medical and other supplies from Evreux-Fauville Air Base, France, to East Pakistan's Dacca area, hit by cyclone. Aircraft were from 322d Air Division. Locals seem unperturbed as C-130 comes in for landing with supply planeload.

★ The first Navy **Polaris** missile-equipped submarine was deployed at sea on November 15 as testing of a longer-range Polaris got under way.

★ USAF on November 16 announced deployment of its first **Minuteman** mobile missile unit, the 4062d Strategic Missile Wing, at Hill AFB, Utah. Operational date was set for 1962. The first of the Minuteman ICBMs will be emplaced at Malmstrom AFB, Mont.

★ On November 21, a planned NASA test shot of an unmanned **Mercury** man-in-space capsule fizzled on its Canaveral pad when the Army Redstone booster cut off.

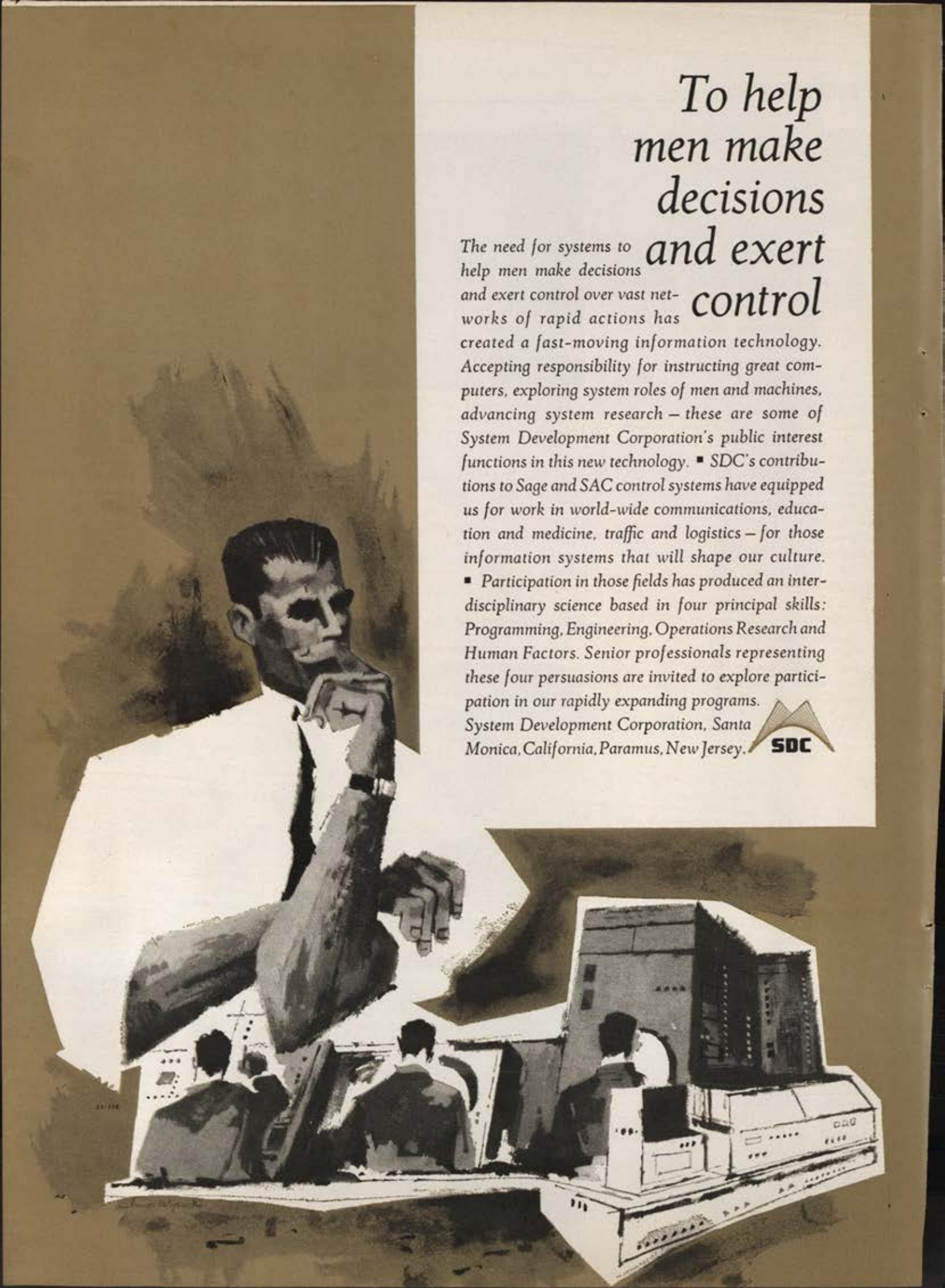
★ Two days later, NASA put up its second weather satellite, **Tiros II,**

(Continued on page 25)

To help men make decisions and exert control

The need for systems to help men make decisions and exert control over vast networks of rapid actions has created a fast-moving information technology. Accepting responsibility for instructing great computers, exploring system roles of men and machines, advancing system research – these are some of System Development Corporation's public interest functions in this new technology. ▪ *SDC's contributions to Sage and SAC control systems have equipped us for work in world-wide communications, education and medicine, traffic and logistics – for those information systems that will shape our culture.* ▪ *Participation in those fields has produced an interdisciplinary science based in four principal skills: Programming, Engineering, Operations Research and Human Factors. Senior professionals representing these four persuasions are invited to explore participation in our rapidly expanding programs. System Development Corporation, Santa Monica, California, Paramus, New Jersey.*

SDC



from the Cape with a modified USAF Thor booster. Photos it sent back were not completely satisfactory, perhaps because, as an Army general put it, "Someone down there moved."

★ December 1, a week later, a USAF Thor-Able-Star booster malfunctioned and had to be blown up in a Cape attempt to put a Navy **Transit III-A** navigation satellite in orbit.

★ Russia's so-called **"Arknik,"** a five-ton space vehicle with two dogs aboard, also joined the space hardware traffic pattern on December 1. It was the third animal-bearing orbital shot by the Russians. The next day, the spaceship-satellite burned up on reentering the denser layers of the earth's atmosphere. Its passengers presumably perished.

★ A **Titan** ICBM blew up in its silo at Vandenberg AFB on December 3 during night fueling operations. The explosion, cause of which was not announced, caused $9 million worth of "terrific" damage to the silo. There were no injuries to personnel conducting the fueling.

★ USAF's **Bomarc-B** advanced air-defense missile began rolling off the Boeing production line in Seattle on December 1 for initial delivery to the service's Bomarc school at Chanute AFB, Ill. Now-successful Bomarc-B testing continued at Eglin AFB, Fla.

★ A NASA attempt to put a vehicle into **orbit around the moon** with a USAF **Atlas-Able** vehicle failed on December 15. The vehicle exploded about a minute up from the Cape. This was the third US attempt, and failure, to achieve moon orbit with the Atlas-Able vehicle.

☆

ELSEWHERE IN THE AEROSPACE WORLD:

Reports in the middle of December said that President Eisenhower's defense budget for FY '62 would be about $42 billion, a billion more than last year, with increased emphasis on Army limited-war capabilities. The new Administration and Congress will act on the outgoing Eisenhower recommendations.

In an extremely important move, France's Assembly on December 6 approved President de Gaulle's plan for an independent French nuclear striking force. It would include development of nuclear bombs and missile, long-range bombers, missile subs and surface ships. The question of a NATO nuclear force still remained

(Continued on page 27)

Daniel P. Morse, center, flew a Spad fighter in the first US air mission in France in World War I. He was then a lieutenant. Here Mr. Morse and wife present an exhaust-streaked American flag cut from the fabric of the plane to Air Force Academy in November ceremony. Maj. Gen. Kenneth P. Bergquist, Commander, Command and Control Development Division, accepted for Academy. The Command is located at Hanscom Field, Mass., near the Morse home.

LIQUID HYDROGEN PROPULSION by Aerojet

The largest known liquid hydrogen rocket engine—delivering well over 100,000 pounds thrust—was fired recently at Aerojet-General's Liquid Rocket Plant near Sacramento and is now under further development.

This important milestone in propulsion progress was attained through Aerojet's development of a large liquid hydrogen pump. It constitutes the last technological breakthrough required for the development of very high thrust liquid rocket engines for astronautical research vehicles and the placement of large payloads in orbit.

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before the Atlantic Pact countries.

USAF Maj. Irving T. McDonald, Assistant US Air Attache in Moscow, was expelled from the Soviet Union on spy charges November 21. He was the second US Air Attache ordered out of the Russian capital in recent months. The first was Col. Edward M. Kirton.

The Air Force announced on November 28 that it will close three major bases as a result of changing requirements and will deactivate other facilities and units. Closed were to be Mitchel AFB, N. Y., Chennault AFB, La., and MacDill AFB, Fla. Donaldson AFB, S. C., was to move from regular to reserve status.

Retired Brig. Gen. Thomas DeWitt Milling, 73 and one of the nation's pioneer military pilots, died in Washington on November 26.

The new hospital at the Air Force Academy, the 7625th USAF Hospital, opened November 21.

The first Airman's Medal ever to be presented has gone to TSgt. Jack N. Barron of the 98th Headquarters Squadron, Lincoln AFB, Neb., for heroism in disarming a deranged airman holding three persons at gunpoint. The Airman's Medal replaced the Soldier's Medal for USAF on October 4.

USAF and the Federal Communications Commission signed an agreement with the Associated Press and United Press International news services on November 21 integrating the facilities of the two concerns into a nationwide communications network for use in national emergency.

US-British-Russian talks in Geneva, Switzerland, on the banning of nuclear tests went into another long recess on December 5. Delegates agreed that there were no "apparent prospects of progress." The talks opened on October 31, 1958, resumed in September of last year after a six-week pause. They were scheduled to get started again on February 7, 1961, a couple of weeks after President-Elect Kennedy takes his oath of office in Washington.

☆

Times flies department. Lester Becker of Oakland, Iowa, may simply be a man who takes his time to decide about things. Or perhaps he's on a one-man crusade to combat creeping inflation and drive prices back to 1947 levels. Anyway Mr. Becker—who'd been a World War II staff sergeant in the CBI-based Fourteenth Air Force—last month sent in his application for membership in the Air Force Association. He used a 1947 application form and enclosed his $3 annual dues (dues have been $6 since 1958) in a 1947 postpaid envelope addressed to Mr. James H. Doolittle (AFA's first president) at the K Street address in Washington where AFA's national headquarters were in 1947. They have since moved several times.

AFA welcomed new member Becker with the hope that he didn't expect his subscription to AIR FORCE to start with the December 1947 issue.

☆

STAFF CHANGES. . . . Maj. Gen. Carl A. Brandt, from Vice Commander, to Assistant to Commander, Hq. ATC, Randolph AFB, Tex. . . . **Brig. Gen. Frederic C. Gray,** from Director of Operations and Training, to Assistant Deputy for Operations, Hq. TAC, Langley AFB, Va. . . . **Maj. Gen. Albert T. Wilson, Jr.,** from Assistant Comptroller, to Acting Comptroller of the Air Force, Washington, D.C.

PROMOTED. . . . Col. Charles R. **Roderick,** to the rank of brigadier general.

RETIRED. . . . Maj. Gen. Alvord V. P. **Anderson,** Brig. Gen. Walter **Graalman,** Lt. Gen. John A. **Samford.**—END

British Royal Air Force aerobatic team, the RAF Hunters, performs a loop against backdrop of Africa's most famous peak, Mount Kilimanjaro. Team flies Hawker Hunter aircraft, has shown its stuff throughout world just as USAF's own Thunderbirds team.

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AIRPOWER in the news

Claude Witze
SENIOR EDITOR, AIR FORCE MAGAZINE

Deterrence on Rails

SEATTLE, WASH.

The Minuteman intercontinental ballistic missile, first USAF weapon system since World War II that will cost less than its predecessors, is ready to go on rails. In early 1963 the entire American rail network will be added to the weapon system. This involves more than 100,000 miles of track and $34 billion worth of locomotives. In a sense, it could be claimed that the rail system itself represents a type of investment in national defense now that the Minuteman is on the way as a cargo.

Lt. Gen. Bernard A. Schriever, chief of USAF's Air Research and Development Command, told the American Association of Railroads that they will become "an essential supporting link in our formation of a modern, flexible, effective ICBM force."

Addressing the Association at the Boeing Airplane Company plant here in mid-December, General Schriever brought their assets into the missile system by pointing out that if he did not have their trackage and yards and sidings and mobile power and personnel, he would have to build them.

"In considering the problems implicit in the fulfillment of the Minuteman mobility concept," he said, "I prefer not to ponder the vastly greater problems that would face us if we did not have a railroad system tailor-made to our requirements. In short, if we had wished the degree of protection afforded by mobility and we did not have the railroads to put our missiles and our launchers on wheels, we would have been forced to develop a special carrier system at tremendous cost."

Dummy upper stages of a development test model of the Minuteman ICBM aboard railroad car at Boeing's Seattle plant.

And low cost, the general reiterates, is the great merit of Minuteman. Not all of the missiles will be on rails. There will be hardened and dispersed fixed sites as well. General Schriever explained the flexibility of the system to the AAR in this way:

Minuteman: "Low cost . . . fast reaction . . . compact size . . . relative simplicity . . . potential effectiveness"—Schriever.

"By positioning large numbers of Minuteman missiles in hardened underground sites, we make it economically feasible to mount an impressive counterforce of tremendous power. We also force the enemy to program a great many weapons toward the single objective of knocking out those strategic targets. We levy maximum demands upon his accuracy, timing, and salvo capabilities.

"By deploying quantities of Minuteman missiles on trains which can move freely in random fashion, we greatly complicate the enemy's targeting problems. We force him to the uneconomical position of having to expend many missiles for every one of ours he hopes to destroy.

"By blending survivability and strike effectiveness into our Minuteman forces, we arrive at a favorable cost-effectiveness ratio.

"We buy, in fact, the most deterrence for the dollar."

From a strategic viewpoint, the mobility of Minuteman will provide another big advantage. This General Schriever defines as the sense of uncertainty an enemy will have because he cannot possibly know where the missile launch cars are located. General Schriever says the foe "cannot launch a salvo blow without being prepared to accept a conclusive counterattack."

At the Boeing plant in Seattle there is a full-scale mockup of the Minuteman train and a model of the Mobile Unit Support Base where the roaming trains will go about every

(*Continued on following page*)

two weeks for a crew change, supplies, and necessary maintenance. The support base will have a special building where the missiles are loaded—five missile cars to a train—and a munitions facility for handling of the warheads. There are warehouses and the necessary equipment for cleaning and stocking the trains.

At the inspection of this display by the railroad executives General Schriever put emphasis on the safety of the operation. Transport of the missile, he told them, is no more hazardous than the movement of gasoline tank cars. The missile is securely capped by a steel jacket while it is on the road, and the cover is not removed until the weapon has been raised to firing position. In addition to protection for the missile, the jacket provides controlled environment, with proper temperature and humidity for all components.

The warheads cannot be activated before flight, and the launch sequences are designed to make an undirected launch impossible. There are two control panels in the command car, independently operated. The two operators must act together to raise and fire the missile yet they are separated from each other by a bullet-proof steel wall. There is no door in that wall, and all other doors are equipped with combination locks with the effect that the men who control the launch are locked in vaults during the operation.

Firings will be made from preselected sidings. The missiles will be located at marked spots on these sidings and receive their guidance intelligence from tapes fed into the control mechanisms aboard the train. The Strategic Air Command will have confided intelligence to the tape that will tell the missile where it is and where it is going. Each missile train, moving from siding to siding on 900 to 1,200 miles of track, will have tapes for every possible launch order.

The emphasis placed on Minuteman's mobility is not intended to detract from the importance of the hard site installations, which will start becoming operational in mid-1962. Construction work on the first site, near Great Falls, Mont., starts this month and will be completed by the Army Corps of Engineers in fifteen to eighteen months.

For this operation, General Schriever has found new economies made possible by use of a highly jam-resistant launch control system. It involves perfection of a radio communications system that utilizes antennas located under the ground where they cannot be damaged by sabotage or blast.

When installed, this radio launch control system will handle all of the underground missiles from launch control centers. Each Minuteman squadron will have fifty missiles and five launch control centers. If necessary, any of the centers can fire all fifty missiles. To tie these centers and missiles together would require hundreds of miles of special cable at an estimated cost of between $20,000 and $25,000 a mile. General Schriever estimates the over-all saving at about $300,000 for each missile.

There are other examples of economies in the Minuteman development program and operational schedule that help this weapon set its record for bucking the trend toward higher bills for our defense effort. The test effort at Edwards AFB in California, where the silo launcher was perfected, did

(*Continued on page 36*)

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its job in eight tests instead of eighteen, cutting $10 million off the bill. Concurrency will be practiced at the Boeing plant and Vandenberg AFB, where testing and training of USAF crews will be merged into a single transition program.

Construction already is under way on a launch complex at the Seattle factory, where work will be done to integrate the systems and ensure proper design and construction of the hardened operational launch sites, first of which will be at Malmstrom AFB, Mont.

At all points there is an effort to cut down on the need for skilled manpower in the field, to reduce the amount of complex checkout equipment burdening operational units and the number of spare parts. Minuteman will be the cheapest ICBM in the inventory.

Another major argument for Minuteman centers around time, which may be the most vital element of the technological war. General Schriever has pointed out that the period between 1960 and 1965 will be the most critical, when US vulnerability to the Russian missile threat will hit a peak. There are skeptics abounding who hold that USAF has neglected the airplane in its search for tools to carry out its mission. The fact remains that Minuteman, considering the complexities of the missile age, has moved at a fast pace. The mobile concept utilizing railroads has been under development for only one year and is ready for production. There is no possible airborne system for meeting the Red threat that could meet such a demanding time schedule.

It is a fact that our survival in mid-decade could depend on our continued ability to deter an enemy some day before 1965. Minuteman, General Schriever says, is a "weapon of great potential." He adds: "Its comparative low cost, its capability for fast reaction, its compact size, its relative simplicity, and its potential force effectiveness have identified Minuteman as an intercontinental ballistic missile eminently qualified to counter the mounting Soviet missile threat—and also to counter it in a fashion the Soviets can fully understand and respect—through numbers."

Supersonic Means Mach 3

WASHINGTON, D. C.

Nobody has said it out loud, but the current program for development of a supersonic commercial transport is almost certainly headed for a vigilant review by Congress. The program is a good one, and it has the blessing of the most experienced and competent people in all arenas, including the Air Force. At the same time it has quietly ignored the sage advice of Congressman Overton Brooks and his House Committee on Science and Astronautics. Last June this group suggested that the National Aeronautics and Space Administration should overcome its reluctance to assume management responsibility for the project and ordered that agency to "submit its detailed proposals . . . together with recommendations for appropriate legislation."

NASA, it now appears, has done no such thing. It is confining itself to the role of its predecessor, the National

Advisory Committee for Aeronautics, in the matter of the supersonic transport and will concern itself with basic research that will contribute to the program. Over-all leadership is being assumed by the Federal Aviation Agency in the sense that it will be the funding organization and that it will defend the project at the White House, on Capitol Hill, and wherever else it comes under scrutiny. Actual management of the program is a job assigned to the Air Force, which has existing talent and machinery in its Air Research and Development Command. The men responsible for this pattern feel strongly that it puts square pegs in square holes and round pegs in round holes. The effort is to ensure application of capabilities where they will do the most good, an approach that many feel should have been applied before this in the technological race with the Russians.

There is unanimity of opinion among the principals that the supersonic transport proposal is sound, a unanimity that is a trifle unbelievable to some observers.

"I feel that an economic Mach 3 transport is inevitable, whether this country or some other develops it," Gen. Thomas D. White, USAF Chief of Staff, told a recent meeting in New York. He continued:

"It does not, however, necessarily follow—and I want to make it very clear that we in the Air Force do not contend—that the first of these commercial aircraft must be a modified B-70.

". . . the Air Force has been working for some time with the Federal Aviation Agency and the National Aeronautics and Space Administration toward the formulation of a national program in the commercial supersonic air transport field.

"Should such a program be initiated the Air Force stands ready, if called upon, to make available its existing capabilities and to contribute to this program in the area of development management or any other way it can. The beneficial effects on the national economy and the aerospace industry in particular, fully warrant such a program. As a matter of fact, there is no alternative if we are to maintain our leadership not only in commercial aviation but in military aerospace power as well."

In this, General White made it clear that USAF has no desire to mix its work on the transport with its military program although ARDC capability is available, if it is needed for a project of this magnitude. USAF's chief made another contribution in the care with which he defined the goal. It is not a supersonic transport alone, it is a Mach 3 transport. The general has made it clear before, in congressional testimony, that he considers this no time to put a big effort in the supersonic ranges below Mach 3.

There are those who disagree with him and it would be well in this case to take an example from abroad. Sir George Edwards, an executive of the British Aircraft Corporation and Vickers Armstrong, has suggested there should be a joint effort by his country and ours to "establish the cruising speed of a supersonic (transport) aircraft at 1,500 miles an hour"—which is just over Mach 2. He says the British know how to build this kind of an airplane, which is the one thing they have in common with all of the people who say it is enough to go supersonic at this stage and never mind Mach 3.

This is not the approach with which history has been made ever since December 17, 1903. It is not the approach the Russians used when they put Sputnik in orbit. Indeed, the Wright brothers knew how to build bicycles, and even the Communists made excellent tanks for World War II. They were not satisfied, in Dayton or Moscow, to stand on already-demonstrated capabilities.—END

REORGANIZATION PLAN

What's Proposed for the Pentagon?

The Democratic Party platform, on which Mr. John F. Kennedy ran and was elected, had this to say about the organization of the Department of Defense:

"A first order of business of a Democratic Administration will be a complete reexamination of the organization of our armed forces.

"A military organizational structure, conceived before the revolution in weapons technology, cannot be suitable for the strategic deterrent, continental defense, limited war, and military alliance requirements of the 1960s.

"We believe that our armed forces should be organized more nearly on the basis of function, not only to produce greater military strength, but also to eliminate duplication and save substantial sums."

As the first step in this "first order of business" Mr. Kennedy asked Senator Stuart Symington to head a committee to examine the problems involved in reorganizing the Pentagon and to come up with a recommended plan. The Symington committee included, as reported in our December issue, the following:

Clark M. Clifford, Thomas K. Finletter, Roswell L. Gilpatric, Fowler Hamilton, and Marx Leva. All these men share a background of expertise in defense administration, Finletter and Gilpatric with the Air Force, Clifford and Leva with the Navy and Department of Defense, Hamilton as general counsel to the Senate Subcommittee on Airpower in 1956.

The report of the Symington Committee, which Mr. Kennedy has accepted but to which he has not, at this writing, reacted, follows.—THE EDITORS

IN ANY appraisal of the US military posture one salient factor stands out above the rest. That is the threefold significance of reaction time at this stage in history:

- First is the unprecedented strategic value of time—the ability to react instantly against aggression in this nuclear-space age.

In World Wars I and II our country had at least eighteen months to build and mobilize its defenses.

If there should ever be a World War III, we would be fortunate to have eighteen minutes to react.

- Second is the crucial time element in the United States vs. Soviet arms race—the need for early selection among alternative weapon systems and for shorter lead times between conception and use.
- Third is the effect of time on defense cost. Regardless of how much the people of this country spend, they cannot buy time. Yet we tend to forget the costly effect of building weapons which have become obsolescent as a result of delay.

Only by giving full recognition to these all-important time factors can the defense establishment of the United States be strengthened in a really meaningful way.

Background of Committee Recommendations

The existing structure of the Department of Defense is still patterned primarily on a design conceived in the light of lessons learned in World War II, which are now largely obsolete.

The piecemeal amendments to the basic legislation effected in 1949 and 1958 and the "reorganization" of 1953 did not alter the essential character of the US military organization, deployed on the basis of whether a military man travels on land, sea, or air. Hence it can be truly said that since 1947 there has been no fundamental change in the scheme of organization of our armed forces.

Yet, during this period of nearly a decade and a half, the whole state of the art in military science has been revolutionized, as epitomized in the transitions to the jet, nuclear, and space ages.

No longer is the prime mission of the military forces of the United States to prevail in a World War II-type of open warfare; now it is to ensure the defense and survival of the nation in the current era of cold war and protracted conflict, with always the possibility of nuclear attack.

Changes of comparable magnitude have taken place in the international political conditions which constantly accentuate the military risks to which the United States is now subject.

Although two partial reorganizations of the Defense Department since 1952 failed to bring the organizational structure of the Department into line with the requirements of today's military conditions, the necessity for modernizing the defense organization has been widely recognized; and both the Administration and the Congress have been repeatedly urged to take further measures.

In 1958 the Rockefeller Brothers Report recommended major changes in the military establishment to remedy those central weaknesses in its structure which have contributed to the lag in US weapon systems development versus that of the Soviets.

In 1959 Senator Cooper proposed a bill designed to make improvements in the administration and control of the Defense Department; and in 1960 Senator

Symington introduced amendments to the National Security Act which would have effected further reorganization of the Defense Department.

It was in the light of such bipartisan moves that the Democratic Platform for 1960 called for a "complete examination of the organization of our armed forces," as a first order of business of the next Administration, and that Senator Kennedy asked this committee to produce for him "a concrete program with specific proposals in the clearly defined field of its responsibility."

Throughout all proposals, past and present, to make more effective the Defense Department organization has run one central theme—the clarification and strengthening of the authority of the Secretary of Defense over the entire United States military establishment.

There are some who believed, even prior to the 1958 amendments to the National Security Act, that existing legislation provided ample basis for the Secretary's authority. Others took a contrary view. It is the conclusion of this committee that the doctrine of civilian control will be compromised as long as any doubts exist on this vital point.

Besides resolving any such remaining doubts, there are three major objectives to be sought in modernizing the present Defense Department structure:

- First, there must be a shortening of the time factor in bringing new weapon systems from conception to utilization without duplication and wasted effort. Under the existing multilayered structure it is only possible to reduce administrative—*i.e.*, decision-making—lead time by crash procedures set up for key programs such as the Special Projects Office of the Navy now in charge of the Polaris program and the Ballistic Missile Division established by the Air Force to expedite the ICBM program. This *ad hoc* streamlining of weapon systems management inevitably slows up progress in other areas.

Furthermore, for today's advanced weapons, such as missiles, and tomorrow's possible new ones, such as space vehicles, there is no longer any validity in separating the development and production cycle into two parts. This has been the practice with World War II-type and other conventional weapons which, when developed, can be manufactured by production-line techniques.

With the present need for concurrency in many stages of weapon systems management, and with the relatively limited number of any given advanced weapon that will be produced, rigid distinctions between research and development and procurement and production organizations are no longer needed, and their performance should be more closely coordinated in the interest of economy in time, money, and motion.

- Second, the predominance of service influence in the formulation of defense planning and the performance of military missions must be corrected. At present, defense planning represents at best a series of compromised positions among the military services. Action by the Joint Chiefs of Staff takes place, if at all, only after prolonged debate, coordination, and negotiation between the staffs of the three service chiefs in preparing them to represent the points of view of their services in the Joint Chiefs of Staff.

No different results can be expected as long as the members of the Joint Chiefs of Staff retain their two-hatted character, with their positions preconditioned by the service environment to which they must return after each session of the Joint Chiefs of Staff. Nor can the Joint Staff become fully effective in developing the basis for clear military judgments unless the present degree of influence exercised by separate service thinking is sharply reduced.

In short, there is a clear need for defense interest rather than particular service interest.

- Third, there must be more effective utilization of human effort and material resources in the defense establishment. This can only be achieved through a flexible organization conforming to the present-day nature of military missions instead of traditional service concepts. Such a change in organization would tend to minimize the duplication and delay growing out of the present multiple layers of control and the overlapping among military programs and operations caused by steadily increasing interservice rivalry in an effort to fulfill common missions.

No longer can this nation afford the luxury of letting each service strive to develop in itself the capability of fighting any future war by itself. The national resources available for our country's defense effort are in limited supply, and we cannot afford such waste of either manpower or funds.

Recommendations for DoD Reorganization

In order to accomplish the objectives mentioned above, the committee recommends the elimination of the present departmental structure of the Army, Navy, and Air Force, but would preserve the military services as separate organic units within a single Defense Department. Such a step would do away with the present departmental service secretaries and their under- and assistant secretaries, fifteen in all.

Certain of the defense reorganization proposals that contemplate this change, such as the bills introduced during recent sessions of Congress by Senator Cooper (S. 2728) and Senator Symington (S. 2957), have made provision for replacing the present service secretaries with three new Undersecretaries of Defense for the Army, Navy, and Air Force. The committee (including its chairman) now believes, however, that, by perpetuating separate service secretariats, it will be more difficult to subordinate service interest to national interest. The committee therefore considers that it would be wise to discontinue what is now a *dual system* of civilian control as a result of interposing between the Secretary of Defense and the services themselves a set of secretaries identified with each of the services.

Vesting directly in the Secretary of Defense the administration of the services would be consistent with the functional scheme of military operations already now reflected in the unified commands, would concentrate civilian control in the Department of Defense *at one level* instead of two, would reduce the delays incident to obtaining separate service department coordination, and would facilitate effective civilian direction of defense policy as distinct from military operations.

(*Continued on following page*)

Since the 1958 amendments of the National Security Act, the chain of command runs from the President to the Secretary of Defense, and, through the Joint Chiefs of Staff, to the commanders of the unified and specified commands. The only change in this operational chain of command contemplated by the recommendations of the committee would be to substitute the Chairman of the Joint Staff for the Joint Chiefs of Staff. Thus, orders to commanders of unified and specified commands would be issued by the Secretary of Defense (or by the Chairman of the Joint Staff by authority and direction of the Secretary of Defense). These commanders, in turn, would continue to have full operational control over the forces assigned to them.

Under the new structure proposed by the committee the military services would retain their existing responsibilities for administrative and logistic support of the military commands. The chain of command for such purposes, as distinguished from operational direction of the military commands, would run from the President to the Secretary of Defense to the chiefs of the services rather than to the military departments through their secretaries as at present. The effect of this one change in the chain of command for nonoperational functions would be to shorten the chain—again, reduce delay—and to place the chiefs of the separate services (who would no longer serve on the Joint Chiefs of Staff) in direct line of command with the Secretary of Defense from whom their orders would issue.

The end result should be to accomplish what the committee believes to be a major objective in any change of the defense structure, namely, to make the Secretary of Defense the civilian official in the Department of Defense with unquestioned authority and control over *all elements* of the Department of Defense at *all levels.*

Specific Recommendations

A. Strengthening Civilian Authority.

1. The military services would be retained, but the present departmental structure of the Army, Navy, and Air Force would be eliminated. This in turn would do away with the present positions of service secretaries, undersecretaries, and assistant secretaries. The services would remain separate organic units, albeit within a single department (as is the case today with the Marines), and subject to the direction, authority, and control of the Secretary of Defense.

2. There would be created two new Undersecretaries of Defense, one for Weapon Systems and one for Administration. Together with the Secretary and the Deputy Secretary, they would comprise the planned statutory appointees in the Department.* In addition, the Secretary of Defense may designate such civilian assistants as he deems necessary.

The seven existing offices of Assistant Secretary of Defense (in addition to the fifteen service secretarial offices) would be abolished. Their functions would be absorbed by Directorates set up under the two new Undersecretaries. This Directorate organization would be subject to change by the Secretary of Defense and should not be frozen into a pattern fixed by legislation.

3. The Undersecretary of Defense for Administration would be responsible for activities such as financial management (comptroller), personnel, legal, transportation and communications, legislative, congressional liaison, public information, and health and medical.

As rapidly as possible all military personnel would be subject to similar recruitment practices, rules for training and length of service, pay for comparable responsibilities, and flexibility of assignment and transfer within and among the services and the service schools and academies.

There would be unified direction and responsibility for all service schools and other military educational institutions.

4. The Undersecretary of Defense for Weapon Systems would be responsible to the Secretary for the complete cycle of weapons development, procurement, and production; and also for construction and installations, including bases, housing, and depots.

These activities would be managed through three Directorates, namely:

a. The Directorate of Research and Engineering, which would take over the functions now carried on by the present Director of Defense Research and Engineering, and in addition would be responsible for the following activities now located in the Office of the Secretary of Defense:

(1) The Science Advisory Board (formerly the Strategic Missiles Evaluation Committee).

(2) The Research and Development Policy Council.

(3) The Defense Science Board.

(4) The OSD Ballistic Missile Committee.

The functions heretofore exercised by the Advanced Research Projects Agency would be absorbed in the new Research and Engineering Directorate.

b. The Directorate of Procurement and Production, which would be responsible for all procurement and production functions.

c. The Directorate of Facilities, which would be responsible for all activities regarding facilities and installations, including responsibility for the planning and construction of facilities for research and testing of weapons, industrial-type facilities for weapons production and maintenance, facilities for weapons operation and use—such as missile and space vehicle launching installations—and noncombatant facilities such as on- and off-base housing.

5. There would be created a Special Assistant to the Secretary of Defense for Arms Control who would serve as the defense liaison in that area with the State Department; and also with other agencies as designated.

*Mr. Leva, while agreeing that there should be a drastic reduction in the number of secretaries, undersecretaries, and assistant secretaries, believes that the Secretary of Defense needs the assistance of several additional Undersecretaries of Defense.

B. Command of Military Operations.

6. The Joint Chiefs of Staff would be reconstituted so the Chairman of the Joint Chiefs (to be redesignated Chairman of the Joint Staff) would be the principal military adviser to the President and the Secretary of Defense.

The Chairman would preside over a group of senior officers from all services to be known as the Military Advisory Council. Each of such senior officers would be appointed by the President and would no longer have any functions or responsibilities in the service from which he came and to which he would not return.

In addition, the Chairman would direct the Joint Staff, enlarged commensurate with the added responsibilities of the Chairman.

7. Each of the services would have a chief who would not serve on the Joint Staff or the Military Advisory Council; and who would report directly to the Secretary of Defense.

8. There would be established the following unified commands, the commanders of which would report directly to the Chairman of the Joint Staff:

a. A Strategic Command, responsible for all strategic missions.

b. A Tactical Command, responsible for all limited and conventional defense missions.

c. A Defense Command, responsible for all continental defense missions.

Each of the above unified commands will include all of the personnel, equipment, and weapon systems required for the performance of its respective missions.

To the extent that any regional or area specific commands would be required in addition to the above-listed unified commands, their commanders would also report directly to the Chairman of the Joint Staff. Such commands would be composed of units assigned from the unified commands.

9. There would be established a unified command in charge of the National Guard and Reserve elements of all of the services. In addition to its other functions, this command would be responsible for civil defense, and would report directly to the Chairman of the Joint Staff.

C. Budgetary Procedures.

10. The Secretary of Defense would be required to present to the appropriate committees of the Congress a detailed explanation of the military requirements for all missions and Defense Department operations prior to the presentation of the defense budget to the Congress.

11. The appropriation of all defense funds would hereafter be made to the Secretary of Defense. Certain categories of the defense budget such as research and development and long lead time procurement would be put on a multiyear instead of a one-year justification and appropriation cycle.—END

FACT OR FANCY?

It would serve little purpose, at this juncture, to go deeply into the detailed pros and cons of the defense reorganization plan proposed by Mr. Kennedy's committee. It remains to be seen how and if the proposed recommendations are to be implemented.

However, historically, the opposition to any proposals leading to more unified and effective direction of our national defense establishment has tended to shy away from fact and logic. Rather it has always been based on tradition, emotion, and self-serving parochialism.

Here are some of the major arguments resorted to in the past and likely to rear their unbeautiful heads again:

Fancy: The German General Staff was unified and lost two World Wars. Why should we imitate it?

Fact: German General Staff was *not*, repeat *not*, a unified staff. It was an Army staff. And the United States has had the same general type of staff organization in *each* of its services throughout most of this century.

Further, no major power has ever had a true inter-service staff with a single chief of staff. So we would not be imitating anyone.

Fancy: The creation of a single Chief of Staff would lead to military domination of the Defense Department and eventually of the country. It would pave the way for a "man on horseback"—for a dictator.

Fact: History's dictators have seldom been generals. Napoleon was a captain of artillery. Hitler was a corporal. Castro, Khrushchev, Mussolini, Stalin, Perón, and a host of others took the civilian road to power. And they, the civilian despots, historically have ruled their military services, not the reverse.

Fancy: The present system is working well. Decisions can be promptly made at present. Why change?

Fact: The Joint Chiefs, at the time of the earthquakes in Chile, debated for five hours as to whether Air Force helicopters or Marine helicopters should be sent in relief.

Fancy: What duplication exists under the present system is healthy and not wasteful.

Fact: When Vice President Nixon was attacked by a mob in Venezuela the Army and Air Force flew paratroopers to Puerto Rico to stand by for a rescue operation, if needed. The Navy shipped a force of Marines to Cuba at the same time and for the same purpose. Would this be the way to run a war?

Fancy: The needs for different kinds of forces for the major physical media of potential combat are so contradictory that the conflict cannot be resolved in a unified establishment.

Fact: At least one service, the Navy, has its own air, ground, sea and space components, which appear to work quite well under unified direction.

In 1903, Secretary of War Elihu Root, after a long and bitter fight, successfully shook up the War Department, combining a jumble of quasi-independent bureaus, branches and geographic departments into one entity called the United States Army under a single General Staff and a single Chief of Staff. The outcries of anguished protest were long and loud.

General Miles, for example, told the Senate Military Affairs Committee:

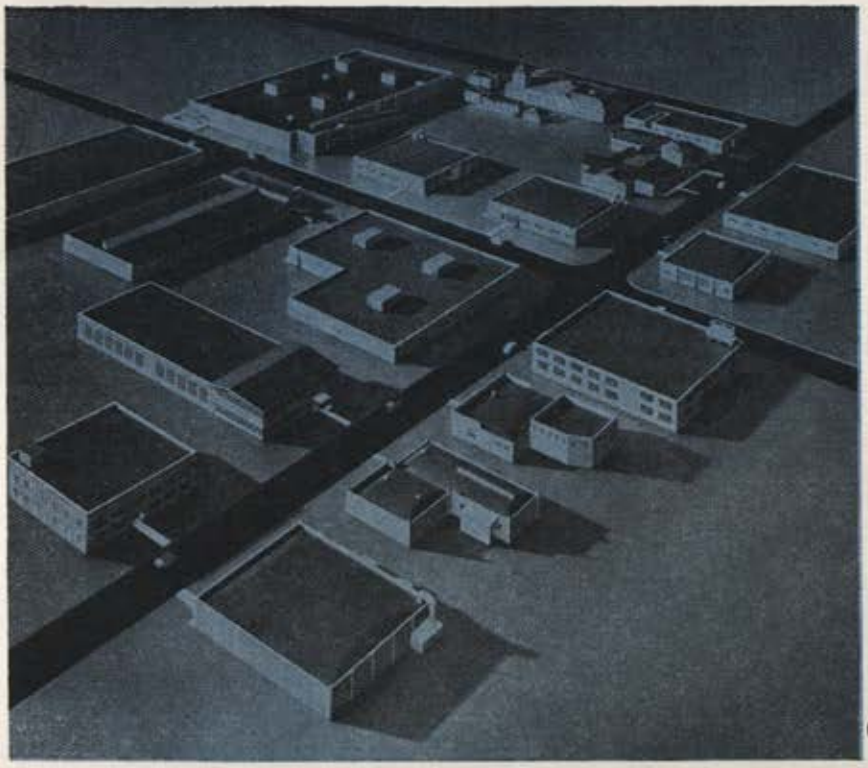
"The scheme is revolutionary, casts to the winds the lessons of experience, and abandons methods which successfully carried us through the most memorable epochs of our history."

And so runs the argument today. It's logic versus emotion, fact versus fancy, tradition versus progress.—END

LIBRASCOPE COMPUTER FACILITIES

Shown below is a composite view of Librascope's facilities where a variety of computer systems are currently in different stages of design and production. Some are strategically involved with national defense...others deal with business and industrial process control. Each is uniquely designed to answer a particular need. The success of these systems illustrates the value of Librascope's engineering philosophy: A decentralized organization of specialized project teams responsible for assignments from concept to delivery...and backed up by excellent research, service, and production facilities. For your computer requirements, call on the company whose breadth of diversification in computer technology is unsurpassed. ■ Librascope Division, General Precision, Inc., 808 Western Avenue, Glendale, Calif. For career opportunities write to John Schmidt, Engineering Employment. ■

computers that pace man's expanding mind



AIR FORCE
JANUARY 1961

With fifty-seven years of aeronautical superiority behind it, the United States now faces a new challenge. Russia has mounted an all-out campaign to outperform and outsell the US aviation industry. A concerted US government-industry effort may be the only answer to this . . .

Irony has marked the helicopter market in India, where the Russians have successfully sold their MI-4 machine to a power that is threatened by the Reds' principal ally, Red China. Red method has been to use price-cutting, long-term credit. US producer, Sikorsky, did manage to sell two S-62s to Indians for Himalayan use, shown above. One of the S-62s crashed; a replacement was provided. Although US copters are superior, the Reds have captured most of the market.

CHALLENGE TO AVIATION IN THE COLD WAR

Claude Witze
SENIOR EDITOR, AIR FORCE MAGAZINE

Sovfoto

Reports from New Delhi indicate that Indians have purchased about a dozen AN-10A versions of the Red AN-10 Ukraina four-engine turboprop transport shown here. The AN-10 can take off in 2,300 feet and land on a 2,000-foot runway, but the US Air Force has a superior aircraft in this category in production. It was shown to Indian representatives in this country and met their requirements, but the manufacturer had no way of beating aggressive Red sales methods.

THE United States, backbone of the free world's defense against communism, has long been deterring the hot war with airpower. Yet, on another air battlefront, that of the cold war, the Soviets remain unchallenged. We are standing passively by while Russia is seizing the initiative on the international aviation front.

This country, the birthplace of aviation, with fifty-seven years of aeronautical superiority behind it, is permitting airplanes from behind the Iron Curtain to roam uncontested on the record range and in the market places of the world.

The Russian sales effort already has begun in the remote regions of India and Africa. There is a strong possibility it will be carried on aggressively in the Middle and Far East and spread, probably from the foothold already established in Cuba, to South and Central America. All of the so-called neutral nations, sensitive as they are to any manifestation of Red prestige in the technological area, are potential battlegrounds.

So far, the Moscow drive has met only spotty and fairly ineffectual resistance from the free world. As in all phases of the conflict with international communism, the prime target is the United States, and it is the United States that should be in the vanguard of the resistance movement.

While this threat is only one of the Kremlin-directed challenges facing the Administration of John F. Kennedy, there probably is no other column of the Moscow march that can be turned aside more easily and more economically.

We have the skills, the industrial know-how, the aeronautical talent to fight back. We have the aircraft —or we can build them. What is needed is the determination to fight back. It is a determination that must originate in the White House with executive recognition of the fact that the cold-war battle is fought on many fronts and that Uncle Sam and his allies must win.

The Russians, in several cases flying an inferior product, today hold nearly twenty-five percent of the aircraft performance records recognized by the Fédération Aéronautique Internationale. There has been a concerted drive by Kremlin-directed aircrews in the past two years to set new records. Emphasis is on demonstration of the speed, endurance, and payload capability of Russian transports and helicopters. In many cases the United States has the hardware—or the design—that can rewrite much of FAI's tabulations of records, but it lacks the national determination to compete. The Reds are winning by default.

It is true that a large percentage of the Russian records are in the more esoteric fringes of aviation—they are the world's greatest balloonists, male and female—but the over-all arithmetic still shows they hold 108 out of 390 records recognized by the FAI. The United States, using its excellent military equipment, has made practically a clean sweep of the straight speed and altitude events where payload is ignored. But the Russians are setting records at a fast clip in events where payload capability is required.

A major reflection of their success—and the most important part of the cold war in aviation—is the mounting Russian export sales curve. They are selling aircraft, particularly transports and helicopters, with increasing frequency in neutral markets.

The US aircraft industry, recognized as an important part of our country's and the free world's national defense machinery as well as the major ally of our armed forces, has been unable to compete. There are a number of reasons for this, any one of which can be corrected by the establishment of a national program and an expressed determination to meet the competition.

"We would like to be in a position to attack early and adequately the Russian cold-war offensive on the international aviation front," a spokesman for the US industry told the Commerce Department recently.

"In fact," he continued with a clear eye on India and a glance over his shoulder at Central and South America, "the Russian attack has already begun."

"The United States industry, singlehanded, will have no possible chance of coping with this competition . . .

and they eventually will be offering products . . . by no means inferior to ours."

Then he warned:

"The United States government will have to be prepared to support our industry in a big way or accept inevitable defeat in this area, having important prestige and national defense aspects."

Even as he spoke, at a conference on aeronautical export trade promotion, India was preparing to buy a substantial number of Russian transports and helicopters.

The Indian sale was an important cold-war victory for Russia. In order to win it the Russians turned to sales techniques that would bring an American drugstore proprietor into court if he used them to peddle tooth paste or toasters. The Reds offer bargain prices on their hardware, twenty years of credit with two percent interest on the money, and payment can be made in any kind of currency. From India, they are accepting rupees. They give free "technical assistance" and sell helicopters, for example, at a price that is more than $100,000 under what the American competitor must ask. And the American firm demands payment in dollars.

US aviation export salesmen say that the Indian deal was a simple case of individual American companies trying to sell in competition with a foreign government. In this particular case the foreign government is fighting a cold war, but the Americans frequently face somewhat similar situations in their effort to outsell such friendly competitors as Great Britain and France. In the New Delhi market place, however, the Americans were handicapped by the fact that their efforts are not recognized in Washington as part of our cold-war strategy. Needed is a change in policy that makes the US aircraft industry as much a part of the cold-war defense team as it is of the existing deterrent effort directed from the Pentagon.

There is a strange contradiction, which cannot be avoided, in the fact that an American aircraft manufacturer, who shoulders major responsibilities in the readiness program for a hot war—or the program to prevent one—is not given comparable responsibilities and support for his role in the fight that is already with us.

This is not a mere commercial battle. It has overtones somewhat parallel to those that come out of the sale by Russia of Cuban sugar in neutral nations at less-than-market prices. In the Indian situation, for example, Russian technical assistance for operation of the planes and helicopters gives Red agents an ideal "front" for penetration of India in its most sensitive areas. The aircraft will be used to supply troops in the remote regions near the Chinese frontier, where there is an actual threat of Communist invasion, and to move men and machinery for a road-building program in the northern part of the country.

If this prospect does not scare us in this distant part of the free world, it should. For the technique can and almost certainly will be exercised in this hemisphere, where shots and shouts from rebel factions already are ringing through much of Latin America. The pregnant uprisings in such nations as Venezuela, Brazil, Argentina, the Dominican Republic, and even Haiti in many cases will create a requirement like the one in India. Will the requirement be met with Russian-built aircraft, sold at bargain-basement prices to give the Reds a Trojan horse entry into our neighboring states?

Reports from New Delhi indicate the Russian sale there provides for about a dozen transports. Generally it is assumed they will be the AN-10A, the standard Aeroflot transport or a military aft-loading version of this airplane. The AN-10 Ukraina has four turboprop engines, can take off in 2,300 feet and land with ease on a 2,000-foot runway. There is a superior US-built aircraft in this category, now in production for the Air Force. It was demonstrated to Indian emissaries both at the factory and at military installations in the United States. The aircraft met their requirements but the American manufacturer had no way of meeting the

(Continued on following page)

Sovfoto

As part of their continuing campaign to impress uncommitted nations, Reds have busily been piling up records with their aircraft, including helicopters such as this MI-4, which have attracted purchasers not only in neutral countries but even in such places as Australia where franchises have been applied for to sell Soviet aircraft of all types. Below, Soviet helicopter pilot, identified as R. Kaprelian, who established a record with the MI-4 by taking the craft, carrying a load of two tons aboard, to an altitude of approximately 19,744 feet.

Sovfoto

challenge of Red sales techniques. He could not offer cut prices, cheap credit, free technical service, and training. He was not free to barter; he must have money in the form of dollars.

The helicopter sold to India presumably is the MI-4, which has been on the international market for more than a year. It first was sold outside the Iron Curtain to some Austrian and Swiss hotel operators. In this case one American manufacturer took his competitive product to India for demonstration and managed to sell two aircraft, one of which later was wrecked in an accident high in the border mountains. A replacement has been shipped. The American product is a superior helicopter, but the Reds captured the lion's share of the market with their more attractive terms. Another American firm, with a helicopter that is notably superior in high-altitude operations, found it impossible to compete. While high-altitude performance requirement is a major factor in northern Indian operations, this firm lacked both a demonstration aircraft and the means of transporting it to the scene.

Other MI-4s have been sold to Indonesia. The government of Ghana, in Africa, has ordered fourteen IL-18 Russian transports for use by its Air Force and the government airlines. The newest evidence of the Red offensive in this area is a report that two Australian companies have obtained franchises to sell Soviet bloc aircraft. Small airplanes, gliders, and helicopters of Polish and Czechoslovakian origin will go on the Australian market.

There is, of course, no way of measuring the overall effect of the Russian effort to capture the maximum number of FAI-recognized world records in aircraft performance. Certainly these records add to Red prestige, particularly among the neutral nations, and they certainly are being used to bolster the sales argument.

In the big effort of the past two years, the Reds have made the most of their monster turboprop, the TU-114, setting two dozen records in speed and payload categories. In almost every case they took the record away from the United States, which had held it since 1946. The airplane that set the marks a decade and a half ago was the Boeing B-29, a military design flown in those days by the Army Air Forces.

This development is the finest example in the record of an area where the United States has lost out to Russia by sheer default. The TU-114, which Americans will remember as the monster that carried Khrushchev

Sovfoto

Red TU-114, four-engine turboprop transport, holds twenty-four recognized records of the sort that used to be held by the B-29, and which might today be held by the Douglas C-132, which because of budgetary restrictions never went into production. Today the C-132 is but the memory of an ironic mockup that marked its demise in Tulsa, Okla. In the record book, beside the Red victory entries, is the frequent empty notation: National US record . . . none established.

In evidence and on hand to impress the Congolese during the crisis in that embattled land was the Russian IL-18 four-engine turboprop transport. The government of Ghana has ordered fourteen for use by its Air Force and government airline, illustrating Red skills in salesmanship.

A closeup view of the Sikorsky S-62 helicopter, two of which have been ordered for use by Los Angeles Airways. First turbine-powered helicopter to enter scheduled passenger service, the craft can operate from land, water, ice, snow, swamps, shows US talent in rotor craft field.

to this country in 1959, does not appear to be in scheduled operation in Russia, but it is a record grabber. The shift of these performance marks direct from the B-29 of 1946 to the Russian aircraft of 1960 was made over the dead body of the Douglas C-132. The C-132 project, a budget calamity, was intended as the US bid for distinction in the high-performance transport area involving unprecedented dimensions and cargo capacity. The economy effort prevented the C-132 from ever becoming more than a mockup at the Douglas plant in Tulsa, Okla.

Here is another instance:

Russian helicopters hold a couple of records that could be smashed by US rotary wings. A manufacturer, who is confident he could recapture the marks, has been rebuffed instead of encouraged. It will be necessary to use a modified government-owned helicopter to attempt a new record. The US Air Force has refused permission, on the grounds that its major mission is concerned with weapon systems that fly high and fast and deliver lethal loads. A helicopter record is of too little interest to deserve USAF support.

The task of meeting the Russian challenge on the international aviation front brings almost as many proposed solutions as there are experts involved in the business of finding foreign markets. At the Commerce Department symposium on the subject last October industry representatives were asked, in effect, what they could suggest to meet the competition not only of Russia, but of Great Britain, France, Western Germany, and other competitors.

There were suggestions made calling for more active help from competent representatives in the foreign service, fewer export restrictions, release of classified data, more rapid and flexible financing, and better information on sales opportunities. All of these will help, but the more experienced men in the field see a need for a new attitude that will recognize that US aviation sales abroad are part of the cold-war effort.

"As it stands," says the executive of one major company, "everybody gets Brownie points for saying no. What we need is the word, handed down from the top, that our policy is to beat the Russians at this game, and everybody—State, Commerce, and Defense Department—is to help. Then they'll get Brownie points for saying yes instead of no."

The Douglas C-132, which never got built but would have had a range of 3,500 miles with a 100,000-pound payload, shown here during the hopeful days at Tulsa when planners built the mockup of the craft that—but for budget-cutting—might have kept the heavy transport lead for the US.

US sales efforts are hampered by government policies. The French bought British engines for their successful Caravelle jet transport, though preferring US engines. US manufacturer was not allowed to release his specifications.

It has been pointed out that Great Britain, for example, does not ask individual manufacturers to go out and compete on the international market. A product is chosen for a foreign requirement and everybody in the Foreign Service, from the Ambassador down to the lowest-ranking attaché, considers himself part of the British sales team. The French operate in a similar way. Not long ago, to meet a requirement in India, the French government selected a transport, a helicopter, and an antitank missile of French manufacture. The government sent them to India and demonstrated their capabilities. It was a government sales effort, designed to meet Russian competition.

In contrast, American sales efforts are handicapped by existing government attitudes and policies. The French bought a British engine for their jet transport, the highly successful Caravelle. Actually they preferred an American product, but the manufacturer, bound to the Defense Department, was not permitted to release specifications of his engine or obtain a schedule under which it could be released for foreign sale.

"The British," said one fairly bitter executive, "can sell a product that they have only on a piece of paper. I can't sell one I have on the production line because somebody has the power to deny release of vital sales information. What we need is a full understanding that these sales are important to this country and the free world. It must be made clear that we give medals for winning races, not for losing them."

There is a general feeling in the industry—and in many places outside—that we are not fighting the cold war on the international aviation front. So far, the problem has not been considered serious enough for implementation from the top level.

What is needed, in the opinion of one aviation export executive, is a determination that it is US policy to fight in this area. After that determination is made, he says, it will not be difficult for American industry and government to plot the lines for battle.—END

A sizable number of aeronautical experts in industry, government research agencies, and the Air Force believe they can achieve the marriage of airplane and space vehicle in the decade ahead. The result would be a gigantic step forward . . .

THE SPACEPLANE

. . . TOWARD A SPACE-AGE KITTY HAWK

J. S. Butz, Jr.
TECHNICAL EDITOR, AIR FORCE MAGAZINE

IF, AS Air Force planners logically contend, the atmosphere and space are a single operating continuum called aerospace, the inexorable pressure of operational requirements on technology must eventually marry the airplane to the space vehicle.

The object of the wedding is to conceive a winged offspring which can *fly* into orbit, rather than being *shot* there with large rocket boosters, and which can take off from and land on conventional airfields. The first successful flight of such a vehicle, into orbit and return, will truly mark the Kitty Hawk milestone of man's conquest of space.

The "Spaceplane" concept has an awesome set of general requirements. It is envisioned as a self-contained, one-stage vehicle which uses air-breathing engines to maneuver in the atmosphere and to accelerate itself to satellite speed of about 18,000 mph. It must either carry enough fuel into orbit to maneuver extensively in space or be able to collect this fuel as it orbits in the upper atmosphere. Finally, the Spaceplane must be able to withstand the heat of reentry, maneuver at very high speeds in the atmosphere as it returns to the earth's surface, and land under power at relatively low speeds at any desired airfield.

Militarily, the attractiveness of Spaceplane is unquestionable. However, the first glance from the technical viewpoint indicates defiance of many of the physical laws which govern the design of aircraft, air-breathing engines, booster rockets, and reentry vehicles. It certainly pushes current technology to its limits, and in many areas the concept cannot be proved or disproved until more research is completed.

As with all vehicles which strain existing knowledge, Spaceplane has both strong proponents and strong critics. The argument is primarily over where Spaceplane fits into the time schedule.

Few people contend that Spaceplane could never be built, but many question whether it could fly in the next ten years, even if it were given the highest national priority in a crash development program.

These critics point to the host of separate vehicles now under development, which considered in the aggregate could accomplish all of the missions Spaceplane can and perhaps better. An example is the fact that large boosters such as Nova can put more weight into orbit in much less time. The reconnaissance and early-warning satellites, such as Samos and Midas, can accomplish these missions as well and perhaps as cheaply as Spaceplane. It is also probable that the Spaceplane, which will need a very large volume to carry its load of hydrogen fuel, will never be able to maneuver as well during reentry as a heavier-for-its-size Dyna-Soar-type hypersonic glider.

In effect, it is the multipurpose aircraft requirement carried over into the space field. It is very difficult to say whether it is better to have a group of high-performance specialized vehicles or a multipur-

(Continued on page 50)

Shown at right is an artist's conception of four possible Spaceplane configurations using hypersonic air-breathing engines which burn hydrogen fuel externally. Technically, the key to the Spaceplane concept—a one-stage aircraft which can fly into orbit after a conventional takeoff from a normal-sized airfield—is to use hydrogen fuel and external-burning engines. The hydrogen fuel contains about three times more energy per pound than gasoline and other hydrocarbon fuels. External burning must be used rather than conventional enclosed engines so that the exposed hot parts can be cooled by radiation to withstand the very high operating temperatures at hypersonic speeds. Several types of aerodynamic configurations are now considered possible for Spaceplane use. The vehicle at top right is a modified cone with its upper half removed and a small wing added. The next is a simple delta wing with a flat bottom with fuselage on top. The next two midwing arrangements might employ submerged canard control surfaces for use at low speeds. Podded external-burning engines are a distinct possibility on the Spaceplane. During hypersonic flight at very high altitudes the exhaust plume from any engine—rocket as well as external burner—balloons to several times its original diameter (much greater than is indicated here), and it might prove necessary to get this plume away from the aircraft.

Drawing by Robert Kirwan

pose vehicle which can do many of the necessary jobs but none of them at top performance. But the increasing cost and complexity of individual weapon systems make the multipurpose approach an attractive one.

The Spaceplane proponents do not suggest that the current space programs be canceled and that all effort be put on the all-purpose vehicle. They do believe emphatically that a single-stage vehicle capable of aircraft-type takeoffs and landings, which can carry men and a sizable payload in between the atmosphere and space almost at will, will be the foundation of the space-vehicle program during the 1970s.

The best indication available today that the Spaceplane is feasible and can be flown before 1970 is that a sizable group of aeronautical experts sprinkled through industry, government research agencies, and the Air Force not only believe that it can be done but are enthusiastic about it.

Several manufacturers have already submitted preliminary type Spaceplane proposals to the USAF. These have been evaluated and considered in the light of proposals from government laboratories and from within the Air Force. The USAF budget for fiscal 1962 contains money for more detailed Spaceplane studies and for state-of-the-art experiments.

Not even the enthusiasts, however, claim that Spaceplane will be an easy technical development. Much of the current US research and development effort, such as Dyna-Soar, the X-15, and state-of-the-art work in high-temperature structures, high-speed stability and control, etc., will feed valuable information into the Spaceplane project. But one field of experimental research vital to the project has been virtually abandoned in recent years, and there can be no sensible hope for a true one-stage Spaceplane unless large-scale research in this area is revived.

The missing technical link in the Spaceplane concept is the air-breathing engines that can operate at hypersonic speeds. Air-breathing propulsion systems theoretically can eliminate the need for high-thrust rocket boosters by drawing their oxidizer supply from the atmosphere. Since the weight of oxygen needed is much larger than the fuel weight, hypersonic air-breathers offer the hope of very light, orbital propulsion systems.

The key to hypersonic air-breathing engines is the ability to burn the fuel externally. In effect, the engines must be turned inside out so that their hot parts will be exposed and can be cooled by radiation. The air entering a conventional enclosed engine at hypersonic speeds would be literally too hot for the engine component to handle. And there would be no way to further raise temperature and therefore produce thrust by adding "fuel to the flame."

External burning has been studied theoretically for many years, but the only extensive experimental research effort was conducted at the Lewis Laboratory of the National Advisory Committee for Aeronautics in the middle 1950s. This research proved conclusively that external burning would work at relatively low Mach numbers. It also cleared up enough theoretical unknowns to convince many thermodynamicists and engine designers that it would work through the high Mach number range right on up to orbital speeds and at very high altitudes.

The external-burning effort was not continued, however, and it was abandoned along with all other air-breathing engine research when the NACA became the National Aeronautics and Space Administration. The decision to drop all other air-breathing work was perhaps the most controversial one yet made by NASA. It raised strong protests from within industry, the military, European aeronautical circles, and within NASA itself. It forced the professional reorientation of the research scientists at Lewis Laboratory who had achieved worldwide eminence for their efforts with air-breathing engines. The decision not only weakened any Spaceplane or air-breathing booster development but limited hypersonic aircraft configurations to the essentially one-shot, rocket-powered, boost-glide type.

During the past couple of years theoretical work with external burning has continued, primarily in industry. Further experimentation is needed immediately, however, to obtain detailed design data and to bring the Spaceplane onto more solid ground technically.

The development problems of a Spaceplane extend far beyond external burning, and they occur in all three of its basic modes of operation, which are: flight into orbit, maneuvering in space, and reentry into the atmosphere.

When the Spaceplane takes off in the conventional manner and accelerates to a speed of around 18,000 mph while climbing to an altitude of 200 miles or more, its flight will resemble much that of a large rocket as of an airplane. An analysis of this flight into orbit must be made from the standpoint of both types of vehicles.

Fundamentally, the rocket vehicle is much easier to analyze than the hypersonic airplane. There are two basic factors which influence the ability of the ICBM-type rocket or a large space booster to accelerate to orbital speed, and they are just as important to the Spaceplane as they are to the rocket. These factors are the vehicle's mass ratio and the specific impulse of its propellants.

The mass ratio is the total takeoff weight of the vehicle divided by its weight after all fuel has been consumed and the engines stop. Mass ratio is an indication of the lightness and efficiency of the vehicle's structure, and it is a dimensionless number.

The specific impulse is a measure of the energy released by each pound of propellant. Its definition is the pounds of thrust produced by each pound of propellant burned each second, so that the specific impulse is given in seconds for each propellant combination of fuel and oxidizer.

In terms of practical numbers the propellants currently used in operational rocket boosters have specific impulse ratings of around 250 seconds or a little more. This means that a single-stage rocket would have to have a mass ratio of around fifteen to achieve orbital speed if it carried very little payload. Adding a large

payload—so that something useful can be done with the rocket after it is in orbit—means that the mass ratio would have to be increased significantly.

Unfortunately, the best mass ratio that can be achieved with any large single-stage vehicle today, using the construction materials which are available, is only about seven or eight. So it is not possible to use single-stage boosters to put even an empty shell into orbit.

The effective mass ratio of large rocket booster systems is increased by using the stage or step principle by which it is possible to discard dead weight in flight. For example, the effective mass ratio of a three-stage rocket is approximately the product of the mass ratios of the separate stages. This powerful design tool makes it possible to take three sturdy, structurally conservative rocket stages with mass ratios of three and connect them with equally sturdy and reliable interstage structures and come up with a complete vehicle that has a mass ratio potential of nearly twenty-seven. Therefore, such a vehicle could carry a sizable payload into orbit using current propellants. Five stages are about the practical limit.

As long as the multistage principle is the only method used to increase performance, the size of the complete booster vehicle goes up rapidly when the payload is increased. The Saturn and Nova vehicles now under development are good examples. While it will be available in several configurations, the Saturn's capability generally is to put approximately 35,000 pounds up into a low orbit with a total vehicle takeoff weight of around 1,350,000 pounds. Preliminary designs on the Nova show that it will be able to put up about 400,000 pounds in a low orbit for a maximum vehicle weight somewhere around 10,000,000 pounds.

The other route to better rocket vehicle performance is to use improved propellants with increased specific impulse. The liquid hydrogen-liquid oxygen high-performance propellant combination now coming into wide use will give an improvement of twenty-five percent or better over liquid oxygen-kerosene, which is the most common operational combination today. Specific impulse of the hydrogen-oxygen system is over 300 seconds in most engines, but this still isn't high enough to get a one-stage vehicle into orbit with any kind of a payload.

Big improvements in specific impulse are in the development mill and undoubtedly will become operational around 1965 or shortly thereafter. The nuclear rocket being pursued in the NASA-Atomic Energy Commission Project Rover will have a specific impulse of around 700 and possibly much better. Thus the Rover rocket will be able to put a one-stage vehicle into orbit if it is possible, from a civil safety point of view, to operate nuclear rockets in the atmosphere. If not, the nuclear rocket will be sent into orbit by chemical boosters where it will be started and used to send large payloads farther out into space.

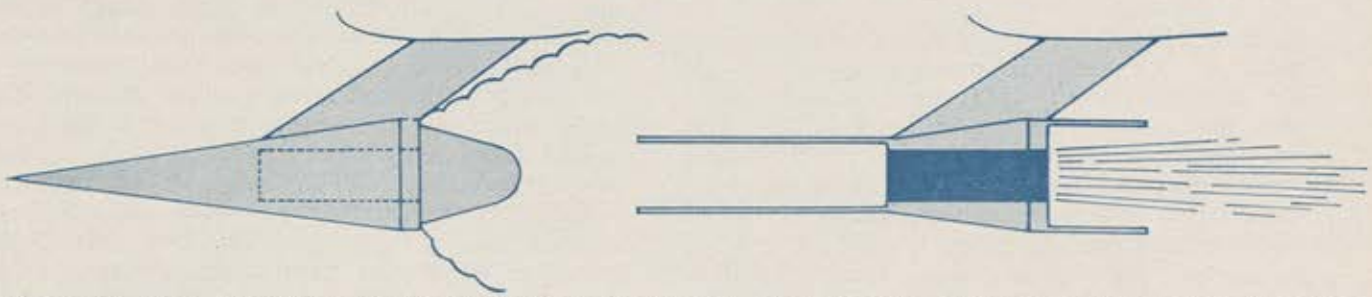
A new chemical rocket (described on page 108), which combines the liquid- and solid-fuel ideas into one engine, has shown the potential of achieving a specific impulse of 500 seconds or so. This hybrid rocket could place a large payload into orbit using a single-stage vehicle, and it is possible that it could be ready for service long before the Rover rocket.

However, strictly from the specific impulse point of view there are no large-thrust engines on the horizon that have the potential of the system planned for the Spaceplane. The Spaceplane propulsion system will burn hydrogen fuel with air, and its fuel specific impulse will be about 6,000 seconds. All air-breathing propulsion systems have much larger fuel specific impulse figures than rocket engines through burning the oxygen in the atmosphere rather than carrying an oxidizer along in the vehicle. Fuel specific impulse of good hydrocarbon-fueled turbojets is about 2,000 sec-

(Continued on following page)

J. S. Butz, Jr.

This article marks the editorial debut with Air Force/Space Digest *of J. S. "Sam" Butz, who has joined our staff as Technical Editor. Mr. Butz is thirty-three, a native of Gainesville, Fla., where his family has been in the newspaper business for years. Immediately following World War II, Mr. Butz served a stint with the Army's airborne troops, with duty as an instructor at the Parachute School, Fort Benning, Ga. In 1952 he obtained his Bachelor of Science degree in Aeronautical Engineering at the University of Florida. He worked on aerodynamic problems for the McDonnell Aircraft Corp. in St. Louis for more than two years, then for engineering-consultant firms whose clients included Canadair and the Martin Company. In 1957 he joined the New York staff of* Aviation Week *as an engineering writer, coming to Washington the following year. He is married, has four children, and lives in Fairfax, Va. He will contribute regular articles on technical subjects and write a monthly column, "Tech Talk"* (see page 108).



Engine pod for a hypersonic aircraft probably would resemble the one shown above in conceptual form. The long needle-nosed plug would compress the air, and the hydrogen fuel would be burned near the point of maximum diameter; then the flow would expand along the plug-type afterbody. During takeoff and for acceleration to a speed of Mach 2 or better the fore and aft plugs would be opened as shown at right so an internally housed turbofan engine could operate. This engine would also be used during landings to give the Spaceplane a wide choice of landing fields.

onds, and the hydrogen is better because its energy per pound is much higher.

The very high specific impulse of air-breathing engines does not automatically mean that they have the potential of propelling a single-stage vehicle into orbit. There is the major problem of keeping the air-breathers operating at all of the necessary speeds and altitudes. However, even if this were no problem, hydrocarbon engines probably would not be able to send a one-stage airplane into orbit because the requirements for mass ratio and aerodynamic efficiency would get too high.

Several factors combine to make the hydrogen engines proposed for the Spaceplane marginal for their task of sending the one-stage airplane into orbit. These are the factors which have always plagued aircraft designers when they were trying to reach higher speeds or provide more range. The factors are the airplane's lift/drag ratio and the excess power available under all flight conditions.

The lift/drag ratio depends upon the total aerodynamic efficiency of the airplane, its wings, fuselage, tail surfaces, etc. If the lift/drag ratio is high, then the power required is low. The dramatic effect of improving lift/drag ratio was evidenced with the B-70 supersonic bomber. When the design was first studied it was predicted that a lift/drag ratio of four would be available at the Mach 3 cruise speed. This meant that the engine thrust must be one-fourth of the weight of the airplane. It was impossible to carry enough fuel to achieve long range with this sort of aerodynamic efficiency. Through an extensive research effort the lift/drag ratio was raised to eight so that the power required for the B-70 was cut in half, as was the fuel consumption.

The other vital factor to a constantly accelerating airplane is the excess thrust available at all flight speeds and altitudes. If the thrust available is just equal to the total drag in pounds, the aircraft can maintain level flight, but it cannot accelerate or climb. If only a ten percent margin of power is available, then the aircraft will accelerate so slowly that it probably will consume its fuel long before it reaches orbital speed. Modern supersonic aircraft need at least a thirty percent power margin over most of their speed range to accelerate efficiently to their top speeds. It is probable that the Spaceplane will need a substantially higher margin of excess power to reach orbital speed.

In many ways the rocket is the ideal engine for acceleration and climb. Its performance gets better as the altitude increases, and it consumes fuel rapidly so that the vehicle weight goes down quickly. The excess power margin therefore goes up rapidly during a rocket flight. Also the rocket leaves the atmosphere so rapidly that its aerodynamic efficiency can be disregarded in a general discussion.

In contrast, the airplane's climb and acceleration performance is extremely critical because the thrust of air-breathing engines decreases at the higher altitudes and the lift/drag ratio decreases at the higher speeds. Therefore, the power available decreases as the power required increases. In this situation the thrust margin for acceleration and climb can quickly get too small for efficient flight or can disappear altogether so that a definite limit is placed on maximum speed and altitude performance.

The Spaceplane proponents believe that they will be able to maintain a satisfactory power margin over the entire range of the Spaceplane flight speeds. At subsonic speeds, for takeoff and acceleration through the very high drag region near Mach 1, the Spaceplane undoubtedly will have some sort of turbofan engine. Somewhere near Mach 2 the external burning will be initiated, with the turbofans probably shut down and the ducts closed off somewhere around Mach 3. In theory, it now appears possible for the external-burning engines to maintain an adequate margin of excess power on up to orbital speeds.

It is certainly conceivable that the excess power available will go to zero sometime during the Spaceplane flight either because the engine thrust drops off in a certain speed range or the lift/drag ratio gets very low. If this is impossible to correct, then consideration probably will be given to carrying rocket engines along to provide the power necessary to pass through the critical speed range.

Proper operation of the external-burning engines is keyed to one main question. The hydrogen fuel must be burned in a supersonic flow when the Spaceplane is flying at high hypersonic speeds, and it has not been positively established that supersonic combustion is possible. In the external-burning experiments conducted to date the free stream Mach number has been around 2 to 6 so that the flow on the after portions of the wing has been slowed down through a couple of strong shock waves and is still subsonic. If supersonic combustion proves possible, then the efficiency of conventional enclosed ramjets can also be increased significantly in the Mach number region of about 4 to 8.

External-burning systems must also be integrated into an aircraft configuration with more care than conventional engines. It apparently will be possible with external burning to improve the pressure distribution around a hypersonic airplane and improve its lift/drag ratio considerably.

Once the Spaceplane has achieved an orbit, there are many missions possible for it to perform. These missions include: rendezvous with other space vehicles to either join or inspect them; launch of both offensive and defensive weapons; provide long-term observation and reconnaissance and maintain an advantageous position from which it may launch a glide attack into the atmosphere. All of these missions have one requirement in common, and that is a need for maneuverability. The most effective space vehicles will undoubtedly be those which have the greatest maneuvering capability. Two general categories of engine are now being developed or are available to maneuver in space. First, there is the chemical rocket which will provide high thrust and rapid maneuverability but needs a large supply of propellant. Second, there are the electric engines, the

ion and plasma rockets, which provide low thrust and slow maneuvers. These engines do not need a large supply of propellant, but they require a large fixed weight in the electrical-generating machinery, which supplies them power.

It is probable that the Spaceplane and other military vehicles operating in space near the earth will need to maneuver rapidly and will use chemical engines to do this. Most of the Spaceplane ideas being studied today incorporate a novel idea which will provide the Spaceplane with a good maneuvering capability even though it doesn't carry a large propellant load into orbit. This idea is to carry some light machinery which can liquify the atmospheric oxygen available at an orbital altitude of sixty to seventy miles. The machinery would be run by liquid hydrogen.

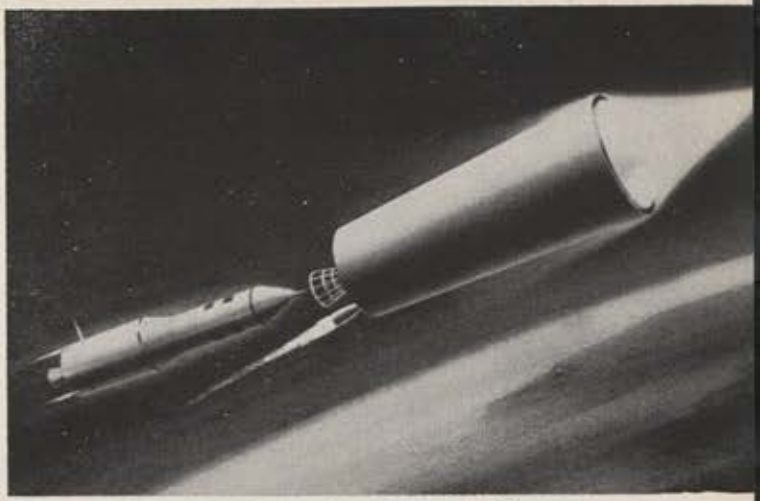
Studies of this system show that a Spaceplane with a takeoff weight of about 500,000 pounds can climb into orbit with the necessary machinery and hydrogen fuel load to store about 500,000 pounds of liquid oxygen taken from the atmosphere. There will still be enough hydrogen aboard to burn with the 500,000 pounds of liquid oxygen in a rocket and provide a large maneuvering capability near the earth. Eight times more weight of oxygen than of hydrogen is required in the chemical rockets so that less than 50,000 pounds of hydrogen fuel needed by the rockets plus a much smaller weight of hydrogen fuel for the oxygen collector must be carried into orbit to provide the maneuvering potential. The drag of the Spaceplane while it is collecting the oxygen will be overcome by external burning or possibly by a small rocket.

From the military point of view there is still one major drawback to the oxygen-collection system, which has been studied extensively by Antonio Ferri of the Polytechnic Institute of Brooklyn and Sterge T. Demetriades of the Northrop Corporation. With the presently proposed systems the oxygen cannot be collected quickly, and it will take in the neighborhood of 100 days to store 500,000 pounds of liquid oxygen with a system that can be carried in the Spaceplane.

Fundamentally there are two basic space maneuvers. One is to change orbital altitude while staying in the same orbital plane, and the other is to change planes while holding altitude. There are an infinite number of powered maneuvers which are combinations of these two.

Changing orbital planes requires considerably more energy than changing altitude so that the plane of the original orbit of a Spaceplane will have a strong influence as to whether it can accomplish any given task. To illustrate the comparative energy requirements, it takes a velocity change of around 14,000 feet per second to change the orbital plane forty degrees at an altitude of 1,000 nautical miles, and it requires a velocity change of about 1,400 feet per second to change from a circular orbit 500 miles high to one 1,000 miles from the earth.

The Spaceplane will make a glider-type reentry, probably similar to what is now planned for the Dyna-Soar. Initially, the angle of attack will be very high, close to ninety degrees, and this will be held during the very high heating period. Consequently,



Maneuverability in orbit is planned for the Spaceplane by incorporating an oxygen-collection system into its configuration. A Northrop proposal for the basic system is shown above refueling a space vehicle. Current designs would require 100 days to collect oxygen for Spaceplane.

the bottom of the Spaceplane will be of heavier, more heat-resistant construction than the top surfaces. Somewhere below Mach 15 the angle of attack will be reduced, and the Spaceplane will fly more like an airplane.

There is one major design difference between the Spaceplane and the Dyna-Soar. The Spaceplane will be a very large vehicle, probably well over 150 feet long, and it will have a very large tank space for the liquid hydrogen it must carry. Liquid hydrogen weighs only about four pounds per cubic foot as compared to kerosene and liquid oxygen, both of which weigh around sixty pounds per cubic foot. Since a Spaceplane weighing 500,000 pounds at takeoff would have to carry in the neighborhood of 200,000 pounds of liquid-hydrogen fuel, its tank space would be something like 50,000 cubic feet just for the hydrogen, which results in a very large vehicle.

During the reentry, however, this almost empty tank volume aids the Spaceplane considerably. The Spaceplane will essentially be a large empty shell on the way to the ground, and its wing loading will be very low. The low wing loading results in a low heating rate, and it is presently believed that the heating rate is so low that the Spaceplane structure can be cooled completely by radiation. If complete radiation cooling is possible, then the skin can be very thin; very little insulation and no cooling system will be required under it. In other words, the Spaceplane can be built with much the same structural concepts used on current Mach 2 aircraft because essentially all of the heat generated by air friction will be radiated away by the skin. Therefore, the main structural problem is to get skin materials which have slightly better radiation efficiency than those available today. It is believed that this will be possible in the next four or five years.

The Dyna-Soar heating problem is more severe because it is a small dense vehicle with a relatively heavy wing loading. The higher wing loading raises the heating rate and requires the heavy use of insulation and cooling equipment for certain types of reentry along with radiation cooling.

The Spaceplane's very light wing loading will make its landing a relatively simple matter regardless of the configuration that is finally chosen for it. Its landing speed and sink rate will be well below those experienced with the X-15 and the Dyna-Soar.—End

It is a stubborn fact of human nature that—despite the rush of events which clearly suggests the need to prepare through change for the future—we cling to the past. This is particularly true of many military planners whose approach to tomorrow's war is in terms of yesterday's weapon systems. Out of history, and symbolic of this lack of vision, is the story of . . .

THE HORSE CAVALRY: MONUMENT TO

Dr. Edward L. Katzenbach, Jr.

THE MILITARY history of the past half century is studded with institutions that have managed to dodge the challenge of the obvious. The Coast Artillery continued until the middle of World War II, at least in the United States. Other such institutional anomalies spring to mind. But the most curious of all was the Horse Cavalry, whose capacity for survival borders on the miraculous. Like the mollusk, the Horse Cavalry made those minor adjustments that time dictated absolutely. Then it continued to live out an expensive and decorous existence with splendor and some spirit straight into an age which thought it a memory. In times such as these, when today's weapons are already out of date and there is therefore a daily need for reassessing our military institutions' response to them, the strange and wonderful survival of the Horse Cavalry represents something more than a curiously alarming anachronism.

The Weapons Problem

By the year 1900 or thereabouts, the clip-fed breech-loading repeating rifle was in the hands of the troops of all the major powers. Self-firing automatic weapons were also on the assembly lines of the world's armament makers. At roughly the same time it had been found that use of glycerine in the recoil mechanism of artillery pieces enabled these to remain aimed after being fired. This in turn meant that the artillery piece itself became a rapid-fire (twenty rounds per minute) weapon. The French "Seventy-five" was shortly to be in production. Firepower, in short, had a new meaning.

For the cavalry, each of these developments would seem to have been nothing short of disaster. For the horse has a thin skin and a high silhouette, and its maximum rate of speed on the attack is only thirty mph. It is difficult to imagine a target more susceptible to rapid fire.

It was clear that the introduction of the automatic and the semiautomatic weapon would make some cavalry missions more difficult. But there was no doubt in any cavalryman's mind, and there was little doubt in the minds of most others, that cavalry missions would have to continue simply because there was no viable substitute. The horse was transport, the horse was mobility, and the horse was reasonably amphibious. A group of horsemen could cover 100 miles in twenty-four hours with a load of around 225-250 pounds.

The cavalry was the good eye of the infantry. It was taught to collect, and if necessary to fight for, information about the enemy. The cavalry protected friendly troops and harried enemy flanks and rear. It covered withdrawals. It pursued a defeated enemy. And above and beyond all else, the cavalry was used to charge the faltering, the weary, or the unwary, to deliver the *coup de grâce* with the *armes blanches:* with cold steel, with saber or lance, to "crown victory," as the proud phrase went.

To scout, to patrol, to cover flank, rear, and withdrawal, to raid—these missions remained untouched.

There remained, however, one really great problem. Did automatic fire relegate the horse to a transport role or should it be considered as part of a weapon system? At the time the problem was never stated quite this simply. Indeed it was never stated at all, but in essence this was the issue. The reason why the question so divided men was this: Cavalry as an arm was an integrated weapon made up of horse, man, and cold steel fighting as one. If horses were to be separated for the fire fight, then the cavalry as an arm would no longer exist. Only mounted infantry would remain.

On the issue of the relationship between horse and man hung a number of subsidiary issues. Should the horseman be armed with the new automatic weapons? If so, he would have to be dismounted in action, for the horse, as differentiated from the elephant, is a most unsatisfactory gun platform. Yet to deprive cavalry of the new weapons would be to deprive the weapons of mobility. And if the horse could no longer be used to charge the new guns, then of what possible use was honed steel, *e.g.*, lance and sword, even if one took into serious account the last-ditch defense of it, to wit that it was "always loaded"? Finally, and here one comes to the most burning question in any issue of military policy—the effect of change on morale. If the cavalry were deprived of its cold steel, would it lose that fine edge of morale, that *élan* without which it would not be "cavalry," no matter what its mission?

(Continued on following page)

PUBLIC IRRESPONSIBILITY

To devote the pages of a magazine called Air Force *to a historical dissertation on the horse cavalry may seem an anachronistic anomaly. But this story of the tenacity of an outmoded weapon system is especially pertinent in these days of overnight obsolescence. Each reader will interpret its significance in his own way, depending on his point of view, his background, his traditions, his prejudices. This, we feel, is part of the charm, as well as of the usefulness, of the article. You pays your money and you takes your choice. The text is condensed with permission from a longer article which appeared as "The Horse Cavalry in the Twentieth Century: A Study of Policy Response," in* Public Policy: Yearbook of the Graduate School of Public Administration, *Volume VIII, 1958, published by Harvard University.*

The Bettmann Archive

But before the problem of the cavalry armament could even be tackled, the difficult question had to be answered as to what the rapid-fire weapons could do and should be doing.

There was agreement that a given weapon, *if* kept supplied with ammunition, could be fired for a given period of time, *if* it could be kept in action, *i.e.*, was *not* knocked out by, say, long-range artillery fire, at a certain rate of fire, and that the firing might or might not be worthwhile depending on the availability of targets, *i.e.*, enemy tactical doctrine. If an offensive weapon, then the machine gun could well be designated a cavalry weapon. If defensive, then was it not an infantry, or even an artillery weapon? In short, for each demonstrable fact there was an awkwardly intangible *if* which could neither be properly accounted for nor possibly forgotten.

Within the military staffs of all nations, the machine gun raised many more problems than it solved—as can be expected of any new weapon system. These problems were, furthermore, broadly intellectual rather than narrowly technical. Indeed, the mechanical improvement of a given weapon system is usually less urgent and almost always less baffling than deciding a proper and fitting target for it, and then solving the galaxy of problems of organization and control which hinge on this basic decision.

Perhaps the fact that there are such agonizing reappraisals of organization and doctrine in the light of new invention only after what seems in retrospect the most reprehensible time lag, whether it be a matter of horse cavalry or ballistic missiles, may best be explained as being due to the enormous difficulty of predicting the future. For the future of war can only be constructed on the basis of enemy capabilities in unstable combination with a "guesstimate" as to his intentions. This also explains why each nation maneuvered against itself each fall, dividing itself into Red Forces and Blue Forces, each of which was endowed with the same characteristics as the other, instead of trying another nation's tactics against itself. The latter was simply too difficult. For the cavalry to have to think about automatic weapons was understandably tortuous and time-consuming.

So the immediate problem was to conceptualize the mission or missions of the machine gun and the tactics of the new clip-fed, bolt-action rifle and the automatic gun. The second problem was to decide the future tactics and armament of cavalry in view of the concept arrived at. What actually happened was that the new was absorbed into old organizational and tactical concepts, and nothing of the old was rejected.

Weapon System Evaluation

Looking back now, and attempting to distill historic lessons from the past, it seems unreasonable to believe that means could not have been found to test the Horse Cavalry in a framework of new technology. One feels that a conclusive study could have been made of cavalry charges in a variety of formations, with a variety of weapons, against a variety of simulated enemy formations equipped with modern weapons. But the truth is that nothing is more difficult to test than a weapon's effectiveness. This should be patently obvious to anyone who, during the late 1950s, troubled himself to inquire into the missile development claims of the several US armed services. Maneuvers, like wars, take place, after all, under certain sets of conditions, and who is to say, therefore, what they have shown?

For example, during the summer of 1936 the US Infantry maneuvered against the US Cavalry at Fort Benning, Ga. As the problem started, the cavalry rode and the infantry trucked to the given maneuver area. The motor vehicles being rather faster than the horses, the infantry had ample time to get into position first. This proved a most frightening advantage. The infantry, well camouflaged, waited with some excitement while the cavalry was allowed to pass concealed forward infantry units. Only when the advance units of cavalry hit the main units of infantry did the infantry's strategem become apparent. It was at that moment that the infantrymen rose shouting from entrenched positions waving bed sheets. The horses thought their Day of Judgment had arrived as ghosts rose over the battlefield, and what followed is best left to the imagination.

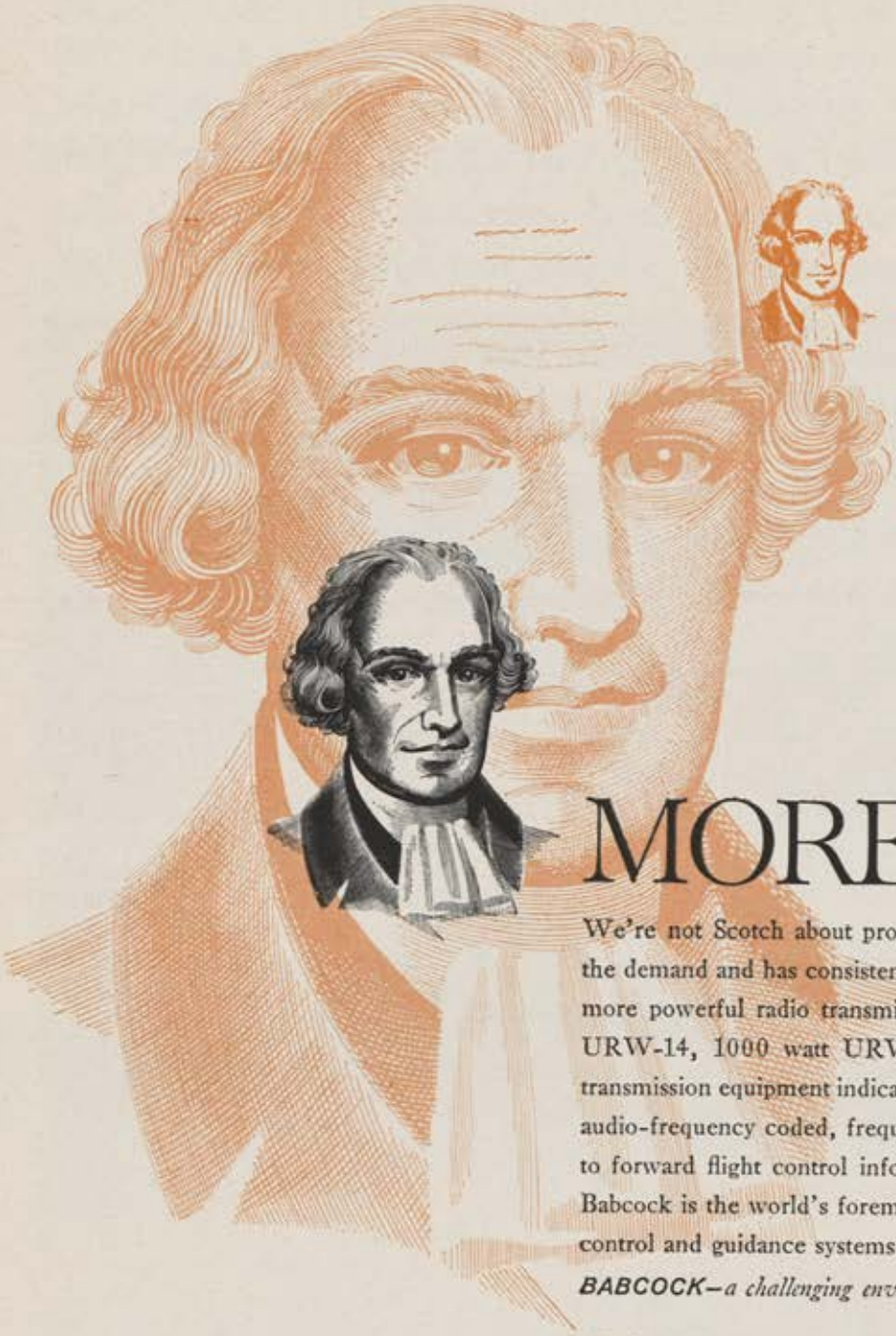
To infantrymen the maneuver proved conclusively that trucks gave the infantry a mobility with which the cavalry could not hope to compete, and that when minus multicolored uniforms and not drawn up in drill formation the infantry made unsatisfactory cavalry targets. Yet to the cavalrymen—and this raised a furor that still stays in men's minds—the whole exercise proved only that infantrymen were practical jokers. The problem of "proving out" doctrine in the field of maneuver is distressingly difficult. Operations analysts are never called upon to solve crucial problems.

Mission Justification

The simple fact is that experience, the most revered of teachers, couches the lessons of war in ambiguity. And with the introduction of each new weapon into the arsenal of any power, the future is more difficult to see than it was previously. Each of the revolutions in warfare that have occurred in this century has made policy determination that much more difficult. One of the reasons for this is that each new weapon system is so quickly idealized by those who control it. Those situations which frustrate its usefulness are left for those out of control to exaggerate. The bomber pilot thinks of Germany rather than of China. The tankman remembers the plains cut by roads and forgets the jungles cut by rivers. The anti-whatever-it-is man—the antitank, the antiair—thinks of the power of the defense over that of the offense. The crystal ball has been shattered by technology. It was fractured by 1900, but this only became quite evident after the first World War.

The basic argument of the cavalrymen in their journals and in their manuals in the period between the great wars was an absolutely sound one. They argued in essence that new weapons obviated only those with

(Continued on page 59)



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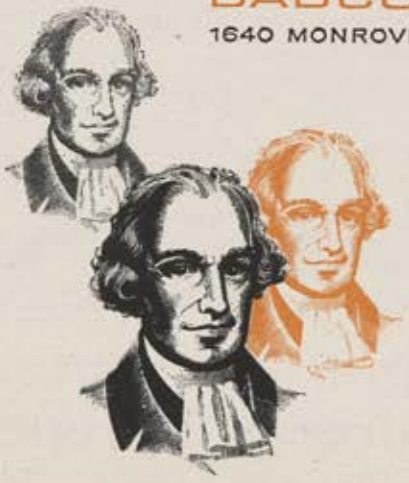

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like characteristics. They argued that while a better tank scrapped a worse one, the tank as a weapon system could not replace the horse until such time as it could perform *all* the missions of a horse. Whether these missions were worthwhile was seldom considered.

For the man on the horse there was much greater difficulty in understanding the tank than in understanding the rapid-fire weapon. Perhaps this could be expected since tank and horse were competitors for the same missions. Certainly the limpid eye and high spirit of the one and the crass impersonal power of the other was enough to render partisans of the one quite helpless when it came to understanding the military views of the other, quite as helpless indeed as the sea-based fighter is to understand the land-based or the air-based and their view of world geography. To speak even more immediately, does a ground-to-ground mission outmode a bomber? Will a man in the hole be able to do what a man in a bomber will?

One finds the Horse Cavalryman making the same points over and over again. He stressed the tanks' need for spare parts, without taking into consideration that one of the greatest difficulties of the cavalry was that horses do not have spare parts. He stressed the lack of mobility of the tank along mountain trails without mention of the appalling problem of getting horses overseas—they have a tendency to pneumonia, together with a soft breast which becomes raw and infected with the roll and pitch of the ship. Whereas the point was occasionally made that nature took care of the resupply of horses—*i.e.*, that while factories could be bombed out, sex could not—no mention was ever made that in wartime as in peace it still took four or five years to produce each mature animal. And, finally, although the horse was claimed to have certain immunities to gas warfare, the peculiar problems of getting gas masks on the poor beasts were omitted.

Yet whether partisans were ankle deep in the sands of prejudice or not, there were certain aspects of the relationship between horses and planes and horses and tanks which were so obvious that they could hardly be missed. However low and slow it flew, the plane would not be a substitute for a still lower and still slower man on a horse. And the plane could not penetrate forests and neither, within limits, could tanks. So there was, and indeed there still is, a gap between what the horse can do and what the plane and the tank can do. Just as there is between what the missile and what the bomber can do.

In retrospect, the US Cavalry was as retrogressive in 1940 as it had been progressive in the years before World War I. It had never crossed the sea during World War I due to transportation difficulties, and spent its war chasing bandits along the Mexican border. But it shared every confidence that its future role would be everything it had not been in the recent past. As of 1940 it labored under the most embarrassing of illusions. The US Cavalry believed that it had modernized itself. And it defended its Horse Cavalry on the sacred ground of "balanced force."

"Each arm has powers and limitations," explained Maj. Gen. John K. Herr, Chief of Cavalry, before the Subcommittee on Military Affairs of the House Committee on Appropriations on March 11, 1940. "The proper combination is that which arranges the whole so that the powers of each offset the limitations of the others."

The Price of Change

The ultimate conclusion of all this today is that the military profession, dealing as it does with life and death, must become utterly realistic, ruthless in discarding the old for the new, forward-thinking in the adoption of new means of violence. But equally needed is a romanticism which, while perhaps stultifying realistic thought, gives a man that belief in the value of the weapon system he is operating that is so necessary to his willingness to use it in battle. Whether a man rides a horse, a plane, or a battleship into war, he cannot be expected to operate without faith in his weapon system. But faith breeds distrust of change.

Furthermore, there is need for discipline, for hierarchy, for standardization within the military structure. These things create pressures for conformity, and conformity, too, is the enemy of change. Nor is there generally the pressure for the adoption of the new that is found in other walks of life. There is no profit motive, and the challenge of actual practice, in the ultimate sense of war, is very intermittent. Finally, change is expensive, and some part of the civilian population has to agree that the change is worth the expense before it can take place. What factors then make for change in situations short of war?

Surely the greatest instigation of new weapon development has in the past come from civilian interest plus industrial pressure. The civilian governors get the weapon systems they want. Hitler gets his tanks, the French public their line of forts, Khrushchev his rockets. When society shows an interest in things military, weapons are adopted—apparently in great part because of the appeal they make to a set of social values and economic necessities.

The abolition of the Horse Cavalry came about first in those countries which could not afford to raise the horses and in which there were those with a hungry intellectual interest in the ways of war. When there was no interest in the military, as in the United States, there was no pressure for change and the professional was given tacit leave to romanticize an untenable situation. Thus the US Horse Cavalry remained a sort of monument to public irresponsibility in this, the most mechanized nation on earth.—End

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A longtime observer of and commentator on questions of strategy and defense, Edward Katzenbach, Jr., was from 1955 to 1958, consecutively, Associate Director and Director of Harvard University's Defense Studies Program. Later associated with Brandeis University and the National Academy of Sciences, he is presently an analyst at the Air Force Cambridge Laboratory in Massachusetts, and will soon join the Institute of Defense Analysis as a consultant. He holds a doctorate of philosophy in history from Princeton University, received in 1953.

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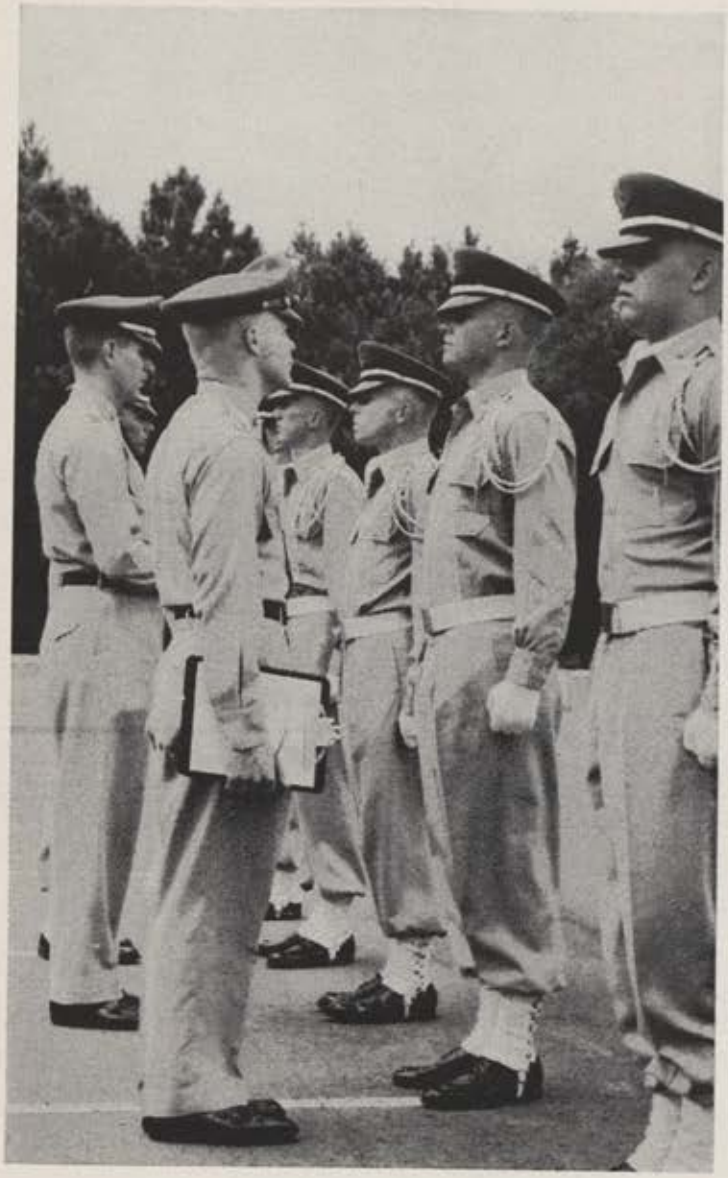
The Air Force plans a major overhaul for its campus Reserve Officers Training Corps. Under a proposal now off the drawing board, campus officer education would be built around a merit scholarship program, become smaller, more selective, and less expensive . . .

'New Look' in the Quadrangle

Frederic M. Philips
ASSOCIATE EDITOR, AIR FORCE MAGAZINE



Chin in, chest out! Campus unit undergoes inspection during recent Air Force Reserve Officers Training Corps drill competition. Officer Education Program, which would supplant present AFROTC, might shift most such activities from school year to summertime tours.

IF THE Air Force has its way, its ROTC program is in for a major overhaul. Off the drawing board late in 1960 came a plan for a streamlined new jet-age version of campus officer education. The hope was that it would be enacted by the newly elected Congress in the coming months.

The new plan, revamping USAF's largest means of career officer procurement from concept to course material, would:

- Replace the current four-year AFROTC organization with a two-year merit scholarship program for college juniors and seniors. College students would be chosen for it by competitive examination after completing two years of college. All college students, including junior college students, would be permitted to compete.
- Provide an $1,100-a-year stipend to Cadets during the junior and senior years in college, in which they would take a modernized program of officer education courses in addition to other college course work. They would be commissioned on graduation.
- Mark finis to the compulsory feature now in force in Air Force units at many schools throughout the country. The new program would be entirely voluntary and selective.
- Cut the size of the program to 5,000 high-caliber Cadets per year in line with the needs of the Air Force. The current setup includes 107,000 Cadets, basic and advanced, and the number is rising with booming school enrollments. But USAF's yearly requirement of junior officers from ROTC stands in sharp contrast at a steady 3,500. The 5,000 a year, or 10,000 in the two-year program at any one time, takes into account the required 3,500 output and likely attrition rates.
- Change the name Air Force Reserve Officers Training Corps to Air Force Officer Education Program, placing emphasis on the fact that the primary aim would be education of career officers rather than a pool of reserves.
- Save $2 to $4 million a year. The current program costs $26.25 million annually. The Officer Education Program would run at $22 to $24 million.

Deputy Secretary of Defense James H. Douglas, then Secretary of the Air Force, first brought the OEP plan in its general aspects to public attention in Decem-

(Continued on following page)

An AFROTC Cadet sits at the controls of USAF plane. The Air Force is concerned at present that it is not bringing into its campus program enough highly motivated, highly qualified young men. The proposed new program, featuring merit scholarships, may solve the problem.

Classroom instruction during summer training period at Air Force base. At present, AFROTC Cadets receive one summer of training between junior and senior years of college. OEP proposal adds second summer, between the sophomore and junior years, providing needed instruction.

'NEW LOOK' IN THE QUADRANGLE

ber 1959 at an Air University conference of AFROTC college presidents and USAF officers. The civilian educators' group expressed enthusiastic support. The Air Council, composed of top Air Force generals, voted unanimous approval last November 14. Then on December 8 the Air Force ROTC Advisory Panel, made up of representatives of the nation's nine major university-level educational associations, added a strong endorsement. The panel, meeting in Washington, declared the proposal "excellent" for both the schools and the Air Force.

At this writing, the Air Force proposal requires final Defense Department approval and then congressional enactment. Should it pass these hurdles by the end of the new congressional session, it would go into effect in either the 1962 or 1963 school year.

OEP appears on the scene at a time when the nature and mission of ROTC programs have come under searching examination at colleges and universities and within the military. Charles C. Finucane, the outgoing Assistant Secretary of Defense for Manpower, Personnel, and Reserve Forces, has taken the position that ROTC enrollments might well be cut on grounds of economy and efficiency. The Officer Education Program would appear to fit his view.

Behind this blueprint for a fresh approach to undergraduate air education is the Air Force belief that AFROTC as it stands no longer suits the needs of today's changing Air Force. Basic philosophy of the AFROTC was laid down in the National Defense Act of 1916. The primary mission set then for ROTC was to turn out large numbers of college-trained Reserve officers to man an inactive Reserve force ready for call in the event of national emergency. Today, USAF no longer is committed to massive Reserve forces. It was so committed in the past, in a different technological era, along with the ground forces.

The Air Force today, however, requires high-quality professional career officers, regular and Reserve, for the active establishment. It was with this in mind that the OEP proposal was put forth. The aim is to attract and select high-quality, highly motivated youths, train them as professionals, and make every effort to encourage them to continue in uniform after completion of obligated service. This would remain four years for nonrated officers, five for rated.

AFROTC now is the largest single means of officer procurement for USAF and is expected to remain so. Its almost 110,000 Cadets are in units at 173 universities and colleges. More than ninety percent of these take only the initial two-year basic course with no intent of going on into the advanced course and obtaining commissions. A large proportion of this number take basic AFROTC under state or university compulsory requirements. Thus the Air Force is saddled with running a program for a great mass of students, most of whom will not and do not wish to enter the Air Force after graduation.

USAF retains over eighteen percent of nonrated officers commissioned through ROTC beyond the required four years. It considers this number much too low. Sixty-four percent of current ROTC-commissioned rated officers have indicated they will stay.

Under the current USAF proposal, the mass-operation AFROTC as it has existed heretofore, with a compulsory feature in many places, would become a thing of the past. The four-year Air Force program, with two years of basic and two of advanced, would no longer exist at most schools. The service does envision, however, continuing a four-year program at four military colleges—Texas A&M, The Citadel, Virginia Military Institute, and Virginia Polytechnic Institute—where military training is integral to the four-year program. These schools have long records of producing outstanding officers.

Thorough revisions would be made also in course work. Subject matter covered in AFROTC courses would undergo review, be cut, beefed-up, improved

A major feature of summer tours is taking part in and observing the active Air Force at work. With additional accent on these summer training tours, new officer education plan would also revamp school year courses in interest of modernization, revitalization of training.

Cadets airborne in navigation trainer aircraft. Past experience has shown that rated junior officers tend to remain in the service after completion of obligated tour of duty at much greater rate than nonrated. One of USAF's aims is to try to raise retention rate of latter.

CONTINUED

where required. Today, advanced AFROTC students take five classes a week. This in many cases makes it impossible for students carrying heavy college workloads to take ROTC. Among those eliminated are a great many science and engineering students, the types most in demand in the modern military climate. OEP would include three course hours a week.

In addition, two summer training periods would supplement college course work. Currently there is only one summer training period. But, with OEP reducing course pressure during the two school years, more summer time was judged necessary for instruction. The Air Force Academy also fully utilizes summers. Under OEP, the Cadet would receive 720 hours of military and classroom instruction, equaling the total now given in four years.

The new, two-year Air Science curriculum would consist of four phases. Detailed course planning is still to be accomplished, but this is the outline:

First, the basic summer training tour of four weeks' duration between the sophomore and junior years, introducing the newly chosen Cadet to USAF organization, military life, aircraft and aircrew indoctrination, air base function, military drill and ceremonies, customs and courtesies, code of conduct, weapons familiarization, physical conditioning, survival training.

Second, the college junior year to include one three-hour-a-week course on organization and missions, duties and responsibilities of Air Force officers with particular emphasis on leadership development, and the Air Force commander and his staff. The material, according to the Air Force general plan, would be presented in an integrated course rather than "the present compartmentation into short and frequently disparate blocks of instruction."

Third, the second summer training tour between the junior and senior college years. Here the Cadets would learn by doing as officers-under-supervision in charge of the junior-year Cadets in summer training. Curriculum here would include the military justice system, orientation to active duty including service overseas, introduction to base personnel and logistics operations, survival training, physical conditioning, simulator trainer operations, and formations and ceremonies.

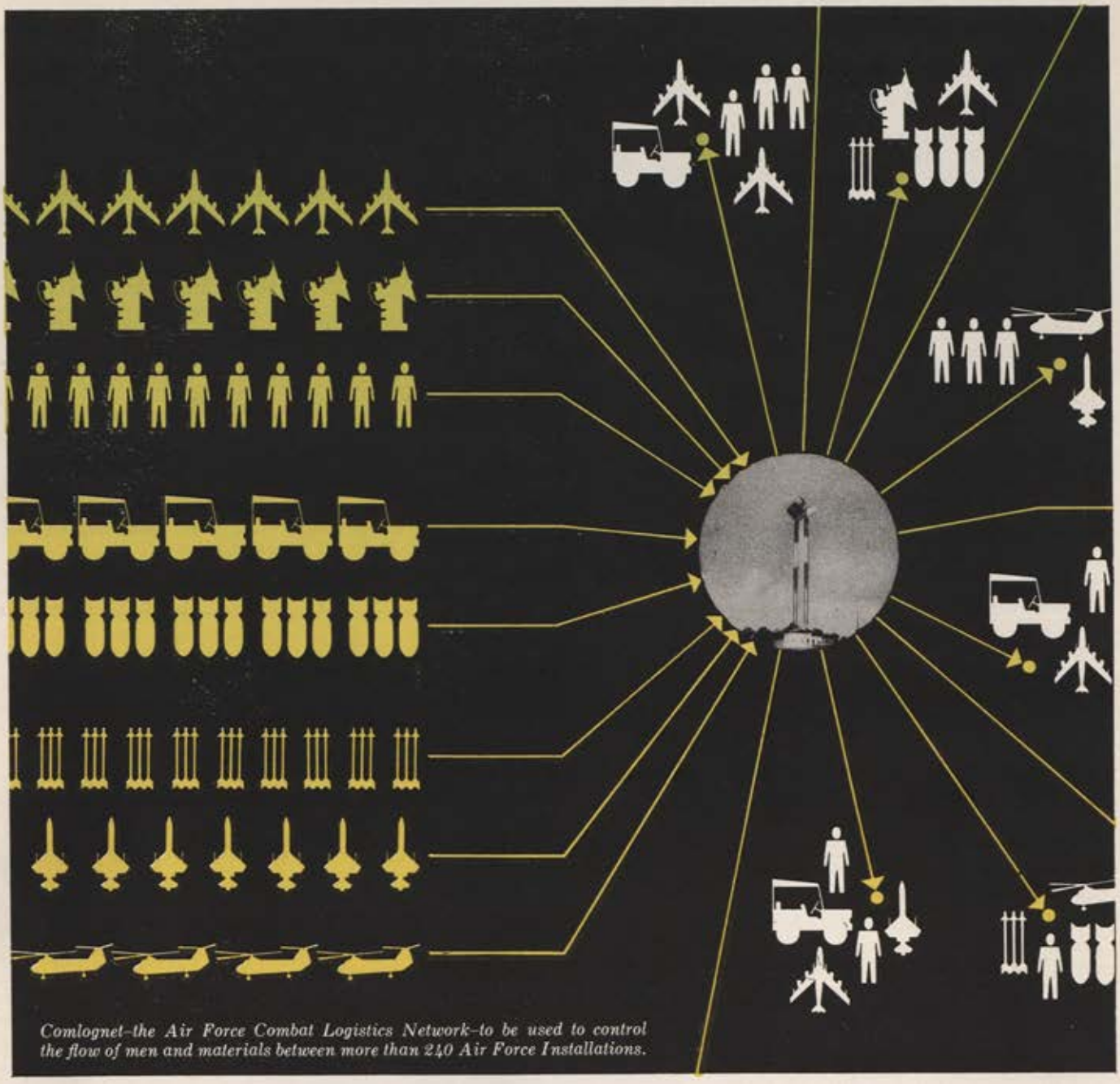
Fourth, a three-time-a-week senior college year course covering the whole range of modern aerospace operations.

Since campus units of AFOEP would be small, containing between twenty and 200 Cadets, school-year parades or drills might prove impractical. The burden of military instruction and leadership training may fall, therefore, to the summer tours at air bases. Here, in a military atmosphere, advanced Cadets would work with large groups of junior-year Cadets in these areas. There would probably also be some form of strictly military activity on campus, but perhaps not the traditional drill.

The OEP is similar in nature to the Naval ROTC Holloway Plan, which has been in existence for fourteen years. The Navy plan provides four-year scholarships to high school seniors, after which they serve for four years. It was named for Rear Adm. James L. Holloway, former Chief of Naval Personnel. Twenty-four percent of junior officers commissioned through the Holloway Plan choose to remain in the Navy after completion of obligated service.

The Air Force, which has taken a look at the Holloway Plan, is confident that its two-year program can better this retention figure. The reasoning is that young men applying for the Officer Education Program, after two years of college, will be more likely to feel mature career motivation than the high school lad taking his examination for the Naval ROTC. USAF believes that its program will bring into the fold many high-quality students ready, as they start their junior years in college, to make serious career decisions. OEP would be Johnny-on-the-spot at that critical juncture

(Continued on page 65)



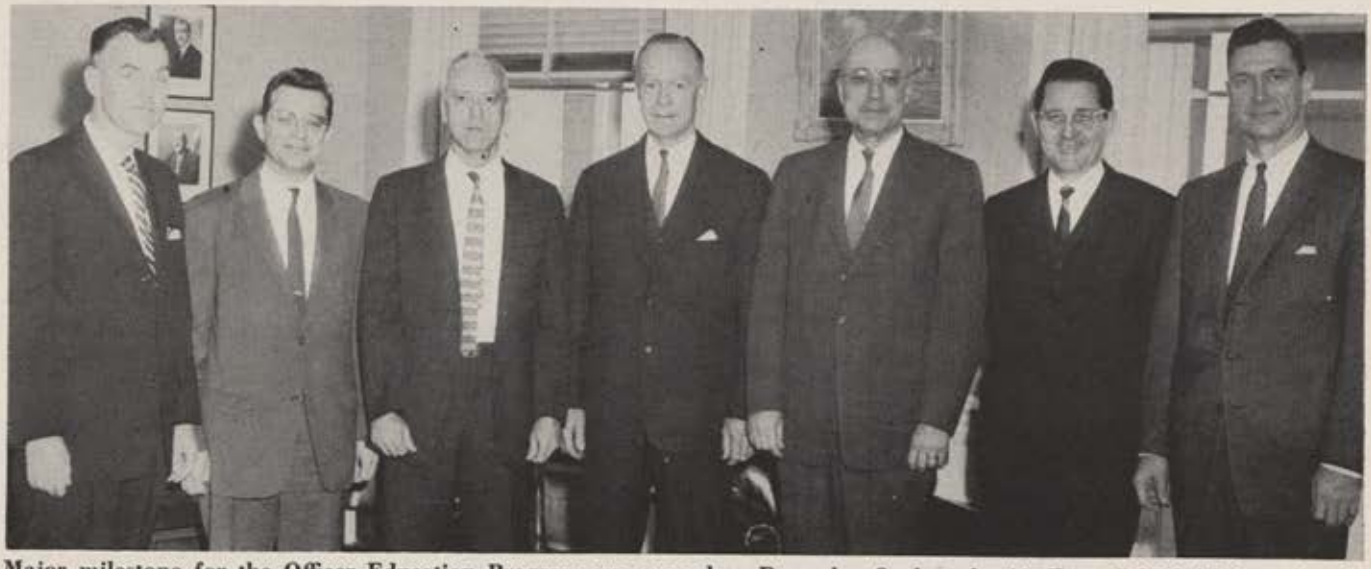
Comlognet–the Air Force Combat Logistics Network–to be used to control the flow of men and materials between more than 240 Air Force Installations.

COMLOGNET:
world's most advanced data communications system designed for the Air Force by Western Union.

This instantaneous communications and data network has the capability of handling every known form of electronic communications swiftly, accurately, and automatically. Upon completion in 1961, Comlognet will have a daily capacity of seven million punched cards in its five U.S. centers, making it the world's largest data processing system. Future expansion, including the handling of data from overseas installations, will be readily accommodated.

Modernization of Comlognet is another first for the U.S. Air Force and Western Union. Acting as prime contractor, Western Union designed and engineered this electronic network in participation with other companies.

WESTERN UNION...*finds better ways to speed it electronically*



Major milestone for the Officer Education Program was passed on December 8 when the Air Force ROTC Advisory Panel, made up of representatives of the nation's nine major university-level educational associations, expressed their strong support. Panel members shown here with Air Force Secretary Dudley Sharp, center, are: President Joseph E. McCabe, Coe College, Iowa; Provost John W. Masland, Dartmouth; Dean Lloyd J. Davidson, Virginia Military Institute; President C. Clement French, Washington State University; President William C. Friday, University of North Carolina, chairman; President Edgar F. Shannon, Jr., University of Virginia. Panel members absent from the photo are Msgr. James P. Shannon, President of the College of St. Thomas, St. Paul, Minn.; President Norman P. Auburn of the University of Akron; President John T. Wahlquist of San Jose State College, California. Required following this major step were final Defense Department approval and congressional enactment. Then new USAF plan would go into effect.

to provide a worthy and dedicated professional career.

If the Navy's ROTC provides a convenient tentative yardstick for where AFROTC may be going, the Army's is where it has been. The Army, with its heavy Reserve officer requirements, has traditionally operated a large ROTC establishment founded on the rock of compulsory training at institutions built on federally granted land. The Army requires about 14,000 officers annually from its ROTC. They must remain on active duty from six months to two years, then go into the inactive Reserve.

USAF recognizes that Army manpower requirements are very different from its own. It has no bone to pick with the Army approach to ROTC. The Air Force recognizes, however, that a new problem may fall to its khaki-clad comrades-in-arms. At present, USAF and the Army share out the many thousands of students in basic ROTC at schools where it is compulsory. If USAF departs from the compulsory ROTC scene with the establishment of OEP, the Army may be asked to assume most of this burden. Problems of manning, expense, facilities, and program efficiency, already being felt by the Army ROTC in its own right, would increase.

Actually, many Army decision-makers feel that their service ROTC plan, regardless of Air Force action, is at a crossroads of its own. The specifics of manpower requirements and weapon needs vary from service to service, but many of the same general considerations apply. There have, to date, been some revisions in Army ROTC programing. A recent article in the magazine *Army*, publication of the Association of the US Army, in fact recommended sweeping changes in the ground ROTC. The author was thinking along much the same lines as Air Force planners who brought forth the Officer Education Program.

Also in this regard, it is generally expected that when the Air Force program went through, with its scholarship provision, the Army would then set about seeking similar benefits for some of its students. Otherwise, with USAF and the Navy offering sizable financial assistance, the Army would fear being out-recruited in the young-man market.

On another tack, some Army leaders along with some prominent educators feel that compulsory ROTC programs along traditional lines serve to provide excellent citizenship training for American youths. The students receive leadership training and discipline, the point is made, that is available in no other way at a critical point in their formative years.

The Air Force strives to do its part in this connection along with the other services. But, at the same time, it feels that its primary job on campuses must be the recruitment and professional training of badly needed junior officers—and this within restricted resources of money and service manpower. If it must continue to train large masses of students in compulsory programs, USAF fears, its officer training will suffer increasingly, to the detriment of the over-all aerospace mission.

One major factor in Air Force thinking is that, apart from USAF's own requirements, changing conditions at colleges and universities are almost certain to throw new obstacles in the way of traditional AFROTC.

Skyrocketing college enrollment, for one thing, is expected to have an increasingly major impact. In colleges with two years of compulsory AFROTC, enrollment in the program could be expected to shoot up, bringing manning and cost problems to the Air Force at a time when there appeared no likelihood of an increased requirement for new junior officers. Abandonment of compulsory AFROTC by the institutions at their prerogative would alleviate this problem. But,

(Continued on following page)

first, some of these schools prefer not to drop compulsory training of their own volition in this way. Second, the Air Force would not like the idea of pressing for such abandonment under present conditions. The Air Force does not want to "disband" AFROTC until there is a superior substitute for it—such as the Officer Education Program.

Rising pressure on campus facilities would be another result of the enrollment situation. It could be expected that institutions might demand increased financial assistance to house ROTC activities. Classroom space in particular comes at a greater and greater premium. Further, increasingly stern academic requirements at institutions of learning have nurtured a growing wariness toward the requirements of large campus military training units.

On the basis of these factors, primarily, Mr. Finucane, the Defense Department manpower chief, formed his expressed view that ROTC needed at least modest revamping.

His concern has centered on two points. First has been the magnitude of current ROTC enrollment in relation to the number of new officers actually needed. Second has been the fact that a considerable number of youths, perhaps most notably junior college students and many transfer students, are excluded from eligibility for ROTC at present.

The OEP, while much smaller than today's AFROTC, would be available to those now-excluded students.

At present, a student is required by law to complete basic ROTC before going on to advanced. A student who attends a school where AFROTC is voluntary but does not enter it in his freshman year cannot join later. If he attends a school that does not have AFROTC and transfers to one that does, he cannot then join because he "came in at the middle." If he attended a junior college for his first two years—and these institutions are growing in number—he finds on entering a college with an AFROTC unit that he has missed basic and cannot enter the USAF training. For USAF to establish units at junior colleges to meet this problem would be inordinately expensive.

Creation of this new program would open Air Force college training to all of these groups, thus increasing to an important degree the pool of young men eligible to apply. This is an interesting line of thought since it reveals the Air Force to be thinking in terms of bodies while, at the same time, it advocates cutting some 90,000 basic AFROTC Cadets from the rolls. "If you want more people," USAF might be asked, "why don't you try doing something more with those you've got?"

The answer is, again, that the Air Force feels the issue is not one of numbers alone, but of the numbers of qualified, motivated young men who apply for officer training. The majority of Cadets in basic training, says the Air Force, are there under compulsion, with only the small number in advanced training motivated toward Air Force careers. By making this a program that begins later in college, provides a scholarship, and is open to those who would have taken the basic course *plus* many others, the service hopes to attract at least 60,000 applicants annually to compete for 5,000 OEP places. With 60,000 to pick from, USAF believes it would each year come up with 5,000 outstanding youths.

With a smaller program, also, fewer instructors would be required. Here once more, says the Air Force, selectivity would be the keynote. Present authorization for AFROTC detachment manning is 1,038 officers and 747 airmen. With the new OEP in effect, the requirement would be cut roughly in half. The number of officers needed would range between 438 and 582 and, similarly, the number of airmen between 417 and 561.

The number of colleges and universities involved was, likewise, still uncertain. USAF feels that the Officer Education Program could function successfully if it had units at as few as 129 institutions, compared to the 173 AFROTC institutions. Fewer than this, it is felt, would tend to diminish the quality of the program accordingly. Figures and tentative plans have been set down for a nationwide OEP organization including 129 units, one with 150 units, and one with 173 units pending final determinations along these lines as time moves along.

Secretary Douglas introduced the Officer Education Program in broad outline, as noted, in December 1959 at Air University. A California educators' study and a major conference on ROTC at Ohio State indicated their approval in theory in ensuing months. With considerable progress thus having been achieved on the conceptual side, Brig. Gen. William J. Bell's AFROTC headquarters at Air University prepared a draft plan last August for consideration at Headquarters USAF. Col. William C. Lindley, director of the education division of Maj. Gen. James V. Edmundson's Personnel Procurement and Training shop, laid the matter before the Air Council. The OEP program received strong impetus under General Edmundson's predecessor, Maj. Gen. Lloyd P. Hopwood, who now commands ATC's Chanute Technical Training Center, Chanute AFB, Ill. Colonel Lindley, Lt. Col. James L. Jackson, and Maj. Joe F. Tarpley have been prime movers of the proposal at the working level. Then, in early December, the AFROTC Advisory Panel, carrying considerable weight as representatives of national educational associations, met at the Pentagon and strongly supported the draft plan.

Required now to get the Officer Education Program on the road—or into the quadrangle—are two further steps. First, the Department of Defense must formally approve legislation encompassing the plan that was being prepared late in the year by USAF. This legislation is required because of a number of provisions in the National Defense Act of 1916—including requirements that ROTC students take four consecutive years of training for a commission and five hours of ROTC course work a week during the final two years of schooling. Then the legislation goes before the young Congress.

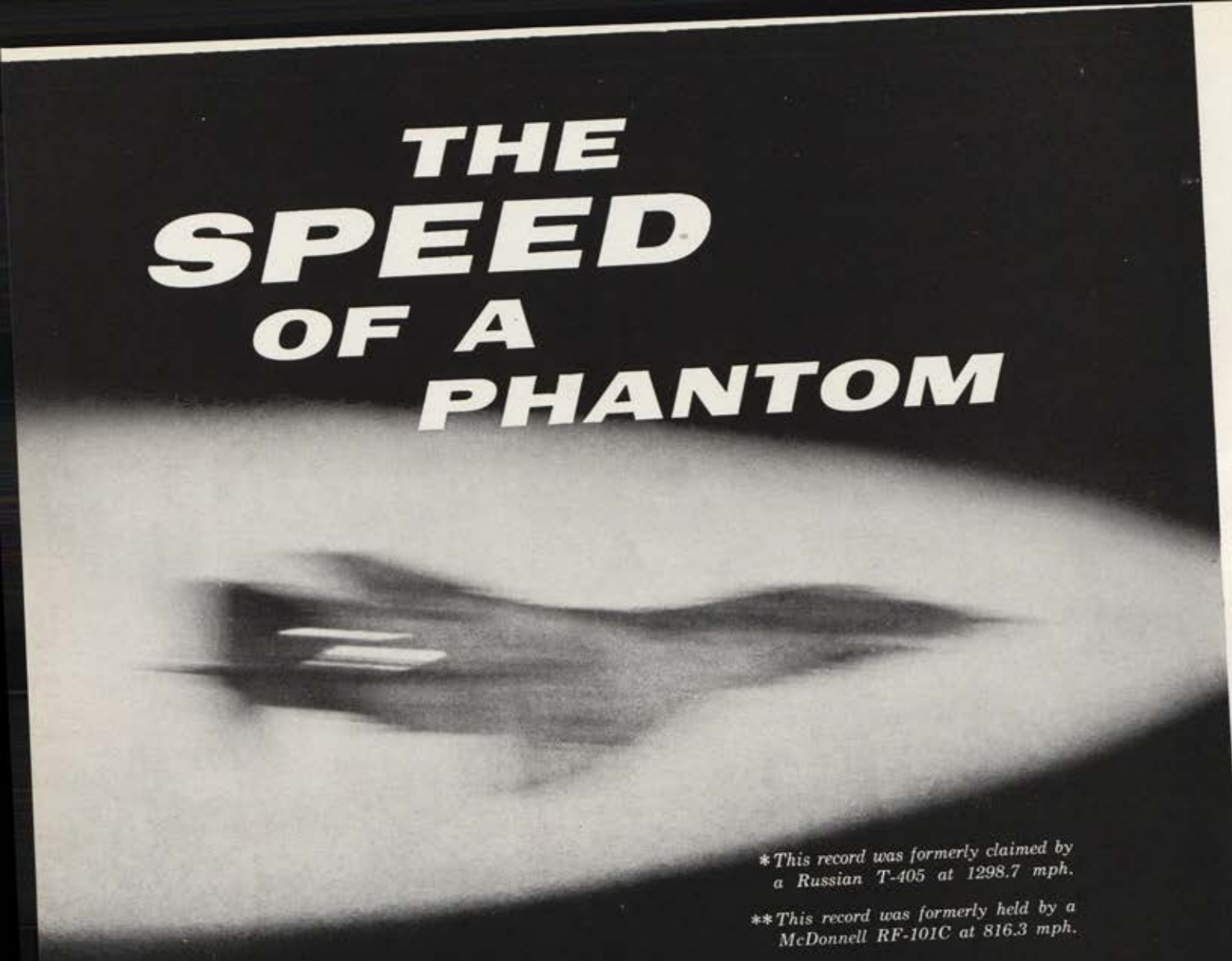
Passage of this legislation, the Air Force strongly feels, would mark an important milestone on the road to a wholly professional air arm to protect the free world now and through the years ahead.—END

THE SPACE AGE IN PERSPECTIVE

SPACE DIGEST

VOLUME 4, NUMBER 1 • *JANUARY 1961*

THE SPEED OF A PHANTOM



**This record was formerly claimed by a Russian T-405 at 1298.7 mph.*

***This record was formerly held by a McDonnell RF-101C at 816.3 mph.*

The true value of a *combat* aircraft lies in the ability to *maneuver* at high speeds. On September 25 a Phantom II, piloted by Navy Commander John F. Davis, set a 100 km world closed-course record of 1390 mph * flying a circular path less than 20 miles in diameter. On September 5 a Phantom II, piloted by Marine Lt. Col. Thomas H. Miller, set a 500 km closed-course record of 1216 mph ** flying a triangular course 310 miles in length.

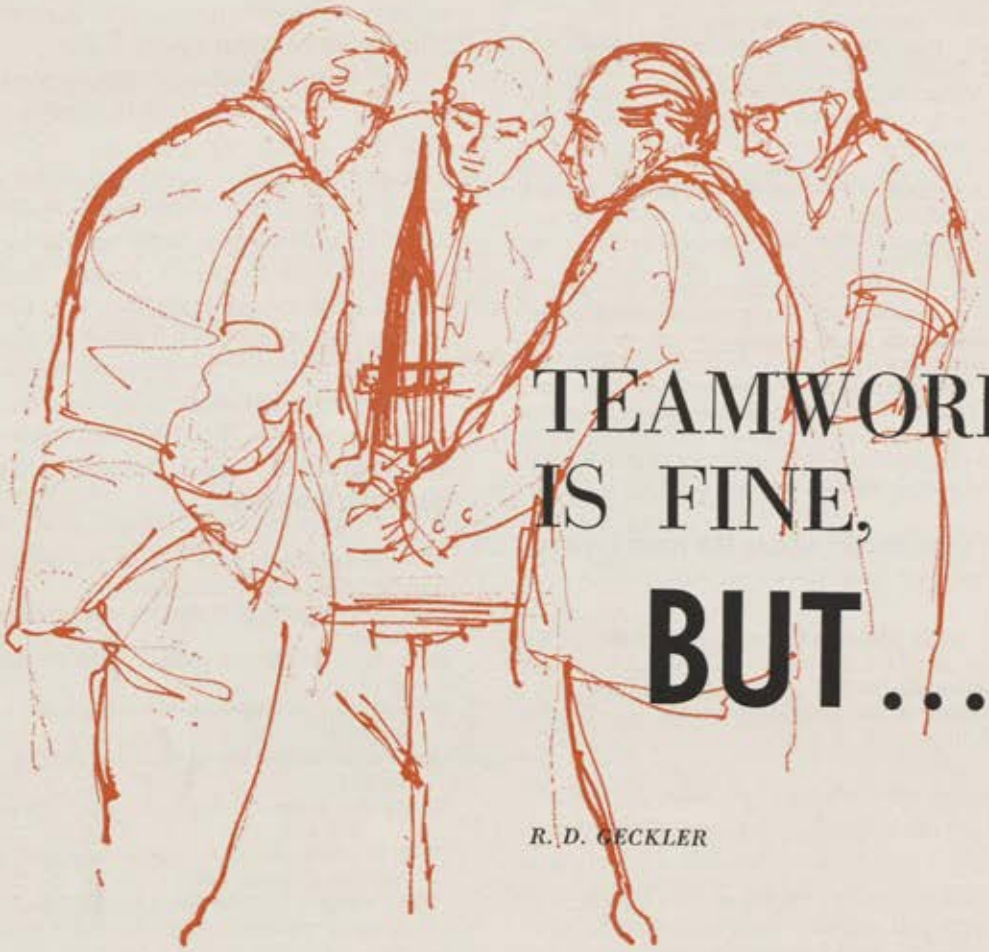
Setting these records requires a much higher straight-line speed capability. Military security permits only the statement that maximum speed for the Phantom II is "in excess of 1500 mph."

MCDONNELL

PHANTOM II AND F-101 FIGHTER AND ATTACK AIRCRAFT • ROTORCRAFT • QUAIL DECOY MISSILES • TALOS AIRFRAMES AND PROPULSION SYSTEMS • PROJECT MERCURY SPACE CAPSULES • ELECTRONICS SYSTEMS • AUTOMATION

MCDONNELL AIRCRAFT • ST. LOUIS

Research and development projects today are often so grandiose and expensive that only a team approach, harnessing the talents of large groups of men, can achieve progress. The day of the individual is far from past, however . . .



TEAMWORK IS FINE, BUT...

R. D. GECKLER

A DISTINGUISHING feature of a large portion of the research and development work being conducted in this country today is that it is carried out by a team. The lone investigator has not lost his importance, in my opinion, but the objectives aimed for today are frequently so grandiose and so expensive that only the combined and cooperative efforts of a large group of men can make progress on the time scale called for.

If we do not recognize the problems that may arise from the continued use of the team approach and take corrective action, I fear a growing belief in the unimportance of the individual. If this belief should continue to develop, it seems to me that any appearance of progress would be only an illusion. To explain what I mean, I should like to quote as follows from Robert Lindner's book, which is entitled *Prescription for Rebellion:*

"Human beings are enclosed by an iron triangle that forms for their race a veritable prison cell. One side of this triangle is the medium in which they must live; the second is the equipment they have or can fashion with which to live; the third is the fact of their mortality. . . . If there is purpose to life, that purpose must be to break through the triangle that thus imprisons humanity into a new order of existence where such a triad of limitations no longer obtains. This is the end toward which both individual and species function; this is the end toward which the race strives; this is the end which gives meaning and substance to life. . . . What we call progress is nothing more than the small victories every man of every age wins over any or all of the sides of the imprisoning triangle. . . . Anything—thought or deed—which enables

man to pierce the three-sided cage described by the triad of limitations is good, anything which prevents him from so doing is bad."

Lindner goes on to say:

"I believe that the science and practice of psychology has fallen upon an evil day, that somewhere it became lost, diverted, and forgetful of its high and significant purpose. I believe that it has come to grief on the shoals of the regretful hypothesis of adjustment.

"Essentially, this concept [of adjustment] enjoins men to conform, to adopt an attitude of passivity and a philosophy of resignation. It requires that each of us make such efforts as he can to align his thinking, feeling, and acting with situations as they are presented to him; . . . that he make peace with things as they are; that he perform such actions and engage in such behavior as will result in the adaptation of his self to conditions; and finally, that he abjure all protest not only as vanity but also as harmful.

" 'You must adjust' . . . is repeated over and over at all levels of our society and for every conceivable purpose. It is offered to us as medicine when we are sick, as hope when we are unhappy, as faith when we are perplexed. . . . The average man must walk in fear, must tremble in his daily life, lest somehow—by oversight or bad luck . . . found guilty of use—or maladjustment, he tremble into a pit demon inhabited, no doubt, by psychiatrists and social workers."

Lindner's purpose in writing the book *Prescription for Rebellion* was to—

"reveal the truth about adjustment, to show it for what it is—a mendacious idea, biologically false, philosophically untenable, and psychologically harmful. . . . opposed to progress and freedom from the . . . triad of limitations."

The concept of the team approach to research and development will make it easy for the investigator to adjust and to abandon any conviction of his importance as an individual. If this should happen, research and development will wander aimlessly in a labyrinth of paperwork and red tape—endless approvals and endless reports, but no progress. Useful results from a research team arise from the initiative of individuals on the team. I believe that the greatest service that our universities can perform is to instill in the student an understanding that individual initiative can be compatible with cooperation. That a man's identity need not be lost when he is associated with a large team—in fact, that the team will be nonproductive if the personality of the individuals is obliterated.

To express a belief about what the universities should do is one thing—to give helpful suggestions as to how they should do it is quite another. Here I cannot be sure of having any useful suggestions. However, it seems likely that close attention to the humanities will be of value if the objective is to see not only what we should learn from human experience but also what we should not learn. Through observation of human history we can better understand what motivates mankind; we can better appreciate the misery that has been caused by prejudice, superstition, and custom, and we can grow to a respect for the great value of our intellectual resources. It is on our intellect that we must rely for progress, and it is essential for the universities to foster this reliance.

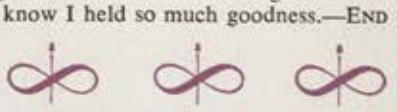
One of the traditional and important methods of doing this, of course, is to require of the Ph.D. candidate a successful piece of individual research. I believe that this is especially important and that the requirements for technical work in today's technology demand a larger and larger proportion of people with the Ph.D. degree. Whatever other means exist to inculcate the individual with the feeling and habit of self-reliance should be encouraged.

The person emerging from the university would be as described in Walt Whitman's poem "Song of the Open Road," and I should like to conclude by quoting a few lines:

Afoot and lighthearted I take to the open road.
Healthy, free, the world before me,
The long brown path before me leading wherever I choose.
Henceforth I ask not good fortune, I myself am good fortune,
Henceforth I whimper no more, postpone no more, need nothing,
Done with indoor complaints, libraries, querulous criticisms,
Strong and content I travel the open road.

From this hour I ordain my self loos'd of limits and imaginary lines
Going where I list, my own master total and absolute
Listening to others, considering well what they say,
Pausing, searching, receiving, contemplating,
Gently, but with undeniable will, divesting myself of the holds that would hold me

I inhale great draughts of space,
The east and west are mine, and the north and the south are mine.
I am larger and better than I thought
I did not know I held so much goodness.—END



The author, R. D. Geckler, is Vice President, Solid Power Plant, Aerojet-General Corporation, and is also a member of that concern's Technical Directorate. The above article first appeared in a longer form in the National Science Foundation's publication, Scientific Manpower 1959, *this past summer, and is reprinted here with permission.*

1st Lt. Robert M. L. Baker, Ph.D., discusses a trajectory problem with his boss, Lt. Col. W. E. Bjornson, in Command Satellite Plotting Room of the Air Force Ballistic Missile Division. Lieutenant Baker does research, lectures at UCLA.

Young Air Force 1st Lt. Robert M. L. Baker is representative of a new type of junior officer, the doctor-lieutenant. Holder of a rare doctorate in astronautics, he has written widely, occupied important industrial research posts before becoming a . . .

PROFESSOR IN A BLUE SUIT

LOIS PHILMUS

THE world's greatest space scientists convene in Stockholm for the September 1960 meeting of the International Astronautical Federation. Quietly on hand . . . US Air Force 1st Lt. Robert M. L. Baker.

A top Defense Department official cancels an appointment with three quite senior officers to make time for a briefing on space technology . . . by Lieutenant Baker.

Students at UCLA thumb through a bright new tome on astrodynamics, the science of the motion of natural and artificial satellites. The students know the author—Lieutenant Baker—who is

Air Force scholars with some "far-out" hardware. Maj. G. S. Halvorsen of BMD, Colonel Bjornson, Lieutenant Baker talk over aspects of NASA Project Mercury man-in-space capsule. At left, a model of the NASA's Explorer VI Paddlewheel satellite. Scientists in uniform play vital role today.

also their instructor in astronautics. He is, moreover, something of an academic celebrity at UCLA —as holder of the first Ph.D. in astronautics, awarded in 1958.

This space-age versatility is housed in the six-foot frame of a brilliant, twenty-nine-year-old scientist who camouflages his "egghead" with sandy-colored, crew-cut hair and a sense of humor that is reflected in the comment: "I'm only an egghead sixty hours a week. The rest of the time I play volleyball and paddle tennis."

But during those sixty hours Lieutenant Baker is helping to lay down the theoretical foundations on which man can build his roads into space.

When Dr. Baker donned the blue suit with the single bars in October 1959 to fulfill his ROTC obligations, the assignment people had this happy dilemma:

What do you do with a Ph.D. with a first lieutenant's commission, an assistant professorship at UCLA, thirty-five published technical papers, and industry experience in managing research contracts on lunar guidance, interplanetary exploration, and trajectory studies for Project Mercury?

Answer: Assign him to the Air Force Ballistic Missile Division. After a couple of months as assistant project officer for Dyna-Soar boosters, Lieutenant Baker was moved into fundamental research and encouraged to continue his academic career while he fulfilled his Air Force tour.

Not only have BMD and its commanders encouraged Lieutenant Baker to continue his Tuesday and Thursday lectures at UCLA—where he has held a seat as an assistant professor of astronomy for three years—but they have *expanded* his teaching responsibilities. He lectures on astrodynamics to key senior officers and civilians in the Ballistic Missile complex one night a week, and is frequently asked to deliver high-level briefings to familiarize the top defense hierarchy on his subject.

The transition from Doctor to Lieutenant-Doctor has been thus eased, with vital civilian extracurricular pursuits kept virtually intact. Bob was able to complete his textbook during his tour, and with the blessings of superior officers has continued on his committee assignments with scientific organizations, and presently serves as acting editor of the *Journal of the Astronautical Sciences.*

Lieutenant Baker demonstrates, lectures before university class on subject of rectilinear lunar orbits. Youthful Air Force officer holds a rare doctorate in astronautics earned in ROTC days. He holds UCLA's first astronautics doctorate.

Desk piled with books and papers, plus bookcase loaded with technical books, are focal points in Baker home. Wife Janet, at Lieutenant Baker's side, was student of his, helps him in his work. They met while he was Douglas Aircraft consultant.

One of Bob's BMD "think" assignments is determination of the technical feasibility of advanced industry study proposals on lunar observatories. He is sanguine on the idea of utilizing our nearest celestial neighbor as a site for clearer observation of the cosmos.

"Some of the proposals are quite reasonable," he says. "We'll be able to put men on the moon within a decade. Propulsion is no problem. We could reach the moon right now with a booster like Saturn. But keeping a man alive is a problem."

Pure astrodynamics research can be a big life insurance policy here, as it deeply influences space navigation in determination of orbits.

"Very accurate, reliable orbit computation," Baker explains, "can mean the difference between a successful, economical mission or the opposite. You want to know where you are, where you are going. In space if you miss a landing point or just don't approach it properly, it might be your last attempt to do anything."

"I sit at my desk and think," he says. "Then I get what I think programed on a high-speed digital computer—when I can get near one."

Right now he is thinking about orbit determination—how to tell where a space vehicle will be in the future by observing where it is today.

"Exact orbit determination," Bob Baker says, "will give the Air Force the ability to design cheaper, simpler, and more accurate space systems. The exact orbit of earth satellites can be projected a few weeks or a month ahead. However, planetary orbits around the sun can be projected tens, maybe hundreds, of years ahead."

The Air Force has already gotten its first data back from Baker's trip into cerebral orbit. His studies have proven out a theory of his directly applicable to Air Force missions.

"Through the use of purely electronic observations—exclusive of visual or optical observations—it is possible to accurately determine orbits of space vehicles both from the ground and from other space vehicles in orbit, using pulse, doppler, and/or inferometer observations," he sums up, as nontechnically as possible.

His theory is immediately applicable to Able-series moon shoots and to other space programs, and it will have far-reaching effects on all space

tracking for the national surveillance system. Applications could include tracking the Project Mercury Astronaut or projections of such programs.

Lieutenant Baker is, of course, intensely following Project Mercury (his doctorate thesis dealt with recovery of objects from space, partially applicable to Mercury).

"It's coming to grips with some very important problems," he says. "We'll know how a man can function in free-fall condition, and it will give us the ability to deal with the heat encountered in the reentry of vehicles, plus knowledge on how to use the atmosphere to control the landing point of returning space vehicles. It will demonstrate the feasibility of placing man in space missions and bringing him back—alive."

Dr. Samuel Herrick, UCLA professor of astronomy, Baker's teacher, and one of the world's leading authorities on rocket navigation, makes a final adjustment on instrumentation at the UCLA observatory as his former student looks on.

Here Dr. Baker shows Air Force Maj. Donald J. Wolfe some equipment in UCLA planetarium. Major Wolfe is working toward a masters degree in meteorology on the UCLA campus under an educational program that is sponsored by USAF.

But to Bob Baker, who has followed space technology from science fiction to reality, the most exciting prospect is that life may not be unique to our planet.

A dream?

He says: "If one assumes the acceleration in our technology will continue, it won't be too many decades before it will be feasible to embark on such exceedingly deep exploration or, alternatively, we may develop very sensitive observation devices that may perceive other intelligence in the universe."

Bob Baker has been preparing since at least the eighth grade to help turn the dream to reality. Under the influence of a family friend studying meteorology under the Navy V-12 program, he became intensely interested in space and wrote his first paper on the subject for school.

His high-school yearbook from Harvard Military School pictured him riding a rocket to Mars. He began his preparation when he enrolled as a physics and math major at UCLA.

"My father, an attorney, tried to discourage me back in 1947," Baker explains. "He didn't think space was going anywhere, but I think he's changed his mind now."

Bob racked up a distinguished scholastic record at UCLA. He won the UCLA Physics Prize in 1953, graduated as a Phi Beta Kappa in 1954, earned a master's in physics in 1956, and gained the status of protégé of Dr. Samuel Herrick, UCLA professor of astronomy and one of the world's leading authorities on rocket navigation. It was under Dr. Herrick's guidance and counsel that he earned the historic first Ph.D. in astronautics from UCLA in 1958.

Home life of an astrodynamicist? The living room of his Brentwood, Calif., apartment has as its most prominent feature a gigantic desk, piled high with books and space notes. Directly adjacent is a much-used electric typewriter for Mrs. Baker.

"She's tried to keep aloof," Bob muses. "But I keep her busy. She typed my whole book and most of my papers."

Attractive Jan Baker—the woman in the case—was wooed and won by the crew-cut egghead when he was a consultant at Douglas Air-

craft Company and she was the secretary to a vice president.

"She can understand some of what I'm talking about," he says with a combination of tease and praise. "She took my class at UCLA about two years ago. I didn't grade her though—didn't want to break up the home."

Whether at home, at his BMD office, or at the university Bob Baker lives and breathes space technology. His interest and drive are directed toward his own field of astrodynamics, his own research, and the recruiting of new scientists into the fold.

Teaching he views as one of his most overpowering responsibilities, reinforced even more strongly after his trip to Stockholm.

Explaining orbiting problem to Major Wolfe and young lady students after university class, AFBMD has encouraged brilliant Baker to continue with teaching along with Air Force research duties. He leads active life both in and out of Air Force blue.

"I overheard a discussion with Dr. Sedov of the Soviet Academy of Sciences," he recalls. "Apparently the Russians are behind us in astrodynamics now. But it was very clear from Sedov that they are embarking on an intensive program in astrodynamics, particularly in education, to prepare for a massive capture of the field."

Lieutenant Baker is sure we are ahead now but is deeply concerned by the fact that there are fewer than 100 people in the US qualified to do research in his field.

"The Air Force," the young scientist declared, "has bent over backwards to accommodate my specialty." He singled out for appreciation Lt. Col. Wallace E. Bjornson, Deputy Chief of the Space Booster Division, as being instrumental in getting his projects onto the Air Force agenda, and he is grateful to Brig. Gen. Richard D. Curtin, then Space Program Director, and Col. Harry Evans, Deputy Director, Space Programs, for their deep interest.

However, Lieutenant Baker is quietly emphatic about his "no" to remaining in uniform when his tour is up in the fall of 1961.

"It's not only rank—although my experience outside qualifies me for authority equal to that of a major or lieutenant colonel," he said. "I believe I can contribute more outside the Air Force than inside."

Though he has not studied the Cordiner report, he deeply echoes its findings.

"Continuity is vital in my specialty, mainly because of my teaching, but secondly—in building up theoretical research I can't move around the country. In uniform, men like myself would need a ten- or even a fifteen-year tour of duty to pursue our activities."

Recognizing the difficulties involved, he threw out the following thought—that well might warrant some second thoughts, particularly in light of the emphasis on scientific education:

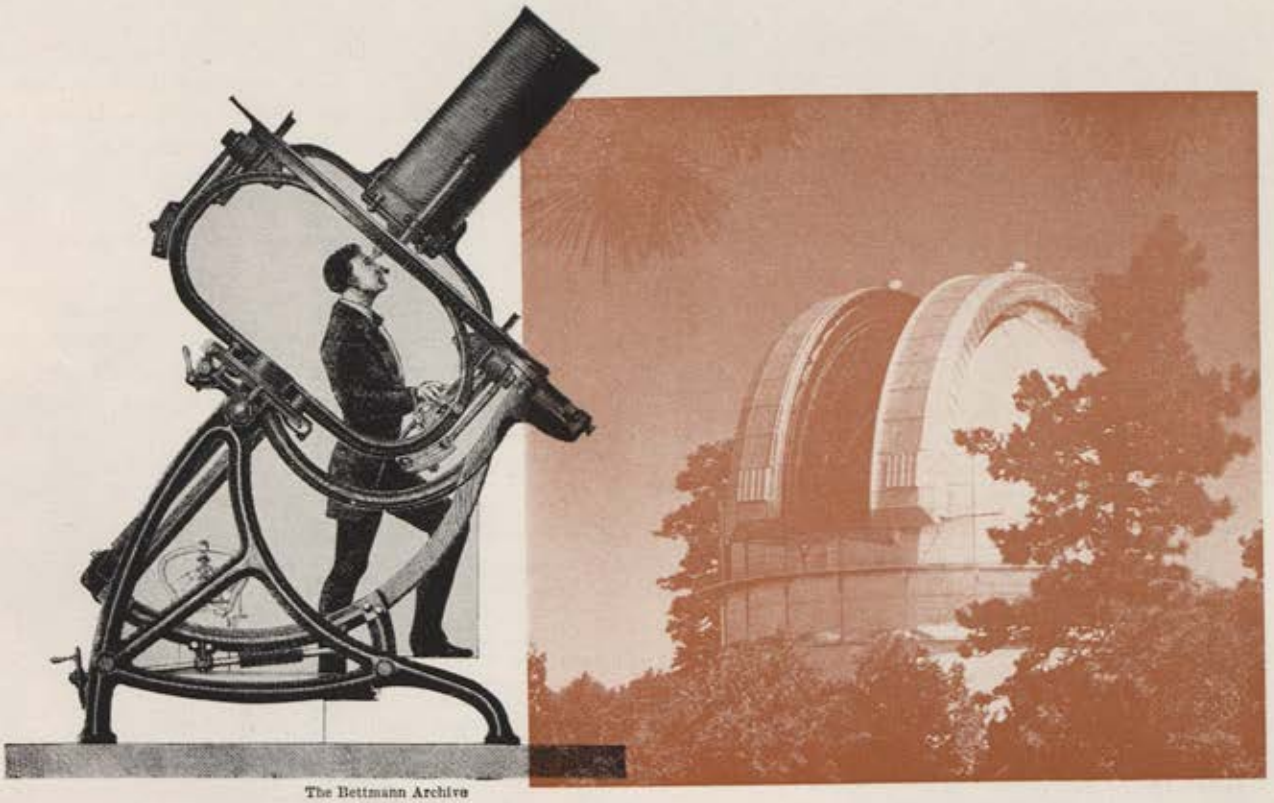
"All ROTC Ph.D.s," he proposed, "would better serve the country as civilian Air Force consultants on active duty. Rather than being assigned to a military installation, we should serve our two years with nonprofit corporations, such as Aerospace, with the option to continue when our obligatory duty is fulfilled."

Dr. Baker's achievements and contributions to the Air Force in just one year—with more to come in his final year—will be felt for many years to come.

But it is his hope—now that he has gotten into the military phase of his work—that he can continue to serve his country.

"I am convinced that the role of an Air Force officer is to manage the R&D part of the Air Force mission," he says, "with civilians like myself giving counsel with special technical fields. That's the role I see myself in after I go back to civilian life.—END

The author, Lois Philmus, is a former Pentagon reporter turned free-lance writer who now reports from the West Coast on aviation and space topics. Miss Philmus contributed "Discoverer's Man in the Blockhouse," an article on another young Air Force space specialist, to our July issue.



The Bettmann Archive

The telescope, a monument to human genius, literally brings new worlds within man's intellectual reach. Dating back only to 1608, its development through the years has steadily extended man's sight and his knowledge of the universe around him. Above, a study in contrasts. At left, an astronomer of the past probing the heavens. Right, Mount Wilson Observatory, California, in use for the past half-century.

NO REALLY great strides were made in either observational or theoretical astronomy until the invention of the telescope. The ancients were able to map the stars, record their proper places in the heavens, and give them names which usually had some reference to mythology. Once in a while acute observations gave some clue to the nature of a star. The old observers could distinguish between the "wandering stars" (planets) and fixed stars. They could record eclipses and the coming of a comet. Beyond that, without the telescope, they could not go.

The telescope as an instrument is relatively modern, dating back only to 1608, but the lenses necessary for its invention were in use 300 years earlier. A Florentine manuscript of 1289 refers to "those glasses [lenses] they call spectacles, lately invented, to the great advantage of poor old men when their sight grows weak." Of course, lenses were impossible until the development of glass. Specimens of Egyptian glass are in existence which can be dated back to about 2400 B. C. In Egyptian sculptures of 4000 B. C. glass bottles are undoubtedly represented.

A telescope is an optical instrument for enlarging the image of a distant object on the retina of the eye, or if the object is a point of light, for increasing its brilliancy. The telescope consists of essentially two parts: an objective glass or mirror for forming an image of the object, and an ocular, or eyepiece, for viewing this image. The word "telescope" is derived from the Greek words *tele,* which means far, and *skopein,* to see.

The telescope appears to have been invented by Jan Lippershey, a spectacle maker of Middleburg, in Zeeland, in 1608. Galileo, hearing of the invention, constructed an instrument for himself and was the first to use the telescope as a research instrument. With an instrument magnifying thirty-two times, he began in 1610 the notable succession of discoveries that laid the foundation of observational astronomy. A serious fault of the Galilean telescope was its very small field of view at any considerable power. Galileo's largest instrument had a field of but seven minutes, fifteen seconds—less than a quarter of the moon's diameter. This fault was remedied by Johann Kepler who substituted a convex lens in the eyepiece for the concave lens that Galileo used.

There are two classes of telescopes, the refractors and the reflectors. The *refractor* transmits the

Without the telescope, the space around us would be a dark sea of mystery. A roll call of the men who devised and developed the early telescopes contains some of the most illustrious names in the history of science . . .

Reflecting Telescopes: The Long View

MEARL F. CARSON

rays to a focus through a combination of lenses called the objective glass; the *reflector* brings the rays to a focus by reflection from a concave mirror. In both kinds the real image thus formed is viewed through a magnifying eyepiece.

Reflecting telescopes are superior to refracting instruments in that they are easier and less expensive to construct, they can be made larger in size, and they do not suffer the fault of "chromatism" of the refractor. This latter fault is a failure of the lens to bring all colors of light to a focus at the same point. A mirror does not produce this error. The glass for a mirror need not be perfect all the way through since only its front surface is used. This greatly reduces the difficulty of casting the mirror blank and lowers the cost as well. Further savings result from the fact that only one surface of the mirror must be ground and polished, while a lens consisting of two pieces of glass has four surfaces that must be ground and figured.

The size of a lens is limited because it can only be supported around the edges so that light may pass through. A large lens may sag under its own weight and become distorted. A mirror can be supported over its entire back, so flexing is prevented. A newly aluminized mirror reflects more light than is transmitted by an air-spaced doublet lens of the same area. A nonreflecting coating would shift the advantage back to the lens in this respect, but no one would think of coating a lens the size used in the thirty-six-inch refractor at the Lick Observatory in California.

In 1663, James Gregory, a famous Scottish mathematician, published his *Optica Promota,* in which he described the rather elegant construction which bears his name. This telescope had a perforated parabolic mirror with an elliptical mirror

The Bettmann Archive

Galileo was the first man known to have used the telescope as a research instrument. He achieved a notable series of astronomical discoveries in early 1600s. Above, a scene in his laboratory.

The Bettmann Archive

Johann Kepler refined Galilean telescope, which had an extremely small field of view at higher powers. Kepler substituted a convex lens in the eyepiece for the concave lens used by Galileo.

J.M. WILLIAMS The Bettmann Archive

Sir Isaac Newton invented reflecting telescope in 1671. It was acclaimed, then forgotten for fifty years. Newtonian study of light led to invention, which centered about use of highly polished metal alloy in mirror. Right, Portrait of Sir Isaac. Left, Newtonian reflecting telescope, now in possession of Britain's Science Museum in London.

The Bettmann Archive

forward of the focus returning an image to the ocular through the perforation. It was convenient in that it gave an erect image, and it was sound theoretically. The future proved it sound practically, but its curves were quite too much for its contemporary opticians.

The Bettmann Archive

Sir William Herschel, an organist turned pioneer astronomer, discovered planet Uranus in 1781 with a telescope he made at home because he was too poor to buy one. The discovery led to his appointment as private astronomer to King George III and knighthood. Years later he discovered two new Saturn satellites. Above, at work. At left, Sir William.

The Bettmann Archive

A great influence on the art of telescope making attended the next attempt at a reflector, by Isaac Newton. This was an early outcome of his notable discovery of the dispersion of light by prisms, which led him to despair of improving refracting telescopes and turned his mind to reflectors. In 1671 he presented to the Royal Society a small model of his device which was received with acclamation and then lay forgotten on the shelf for half a century. In making the mirror of his telescope Newton had to obtain a metal of suitable hardness and reflectivity. His choice was an alloy well known to the alchemist of his time, a mixture of six parts copper, two parts tin, that had a brightness similar to silver. The high copper content caused it to tarnish rapidly, and he had to repolish his mirrors from time to time to restore their original luster. This problem continued to plague telescope makers until a way to silver glass was discovered 200 years later.

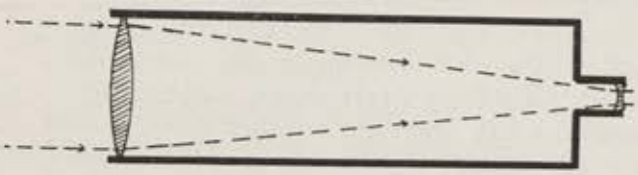
About the beginning of the year 1672, M. Cassegrain communicated to M. de Berce a design for a reflecting telescope which eventually found its way into the *Philosophical Transactions* of May, in that year, after previous publication in the *Journal des Sçavans*. It differed from Gregory's construction in that the latter's elliptical concave mirror placed outside the main focus was replaced by a convex mirror placed inside the focus; the image was therefore inverted.

In the face of the seemingly impossible task of figuring a parabolic mirror surface, nothing further was done, and the instruments of Gregory, Newton, and Cassegrain fell into disuse for about fifty years.

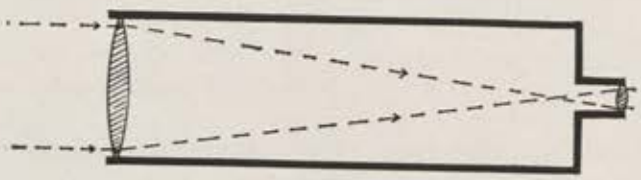
In due time the new order came, and with astounding suddenness. In 1722 John Hadley presented to the Royal Society the first reflecting telescope worthy of the name. He took the essential step at which Gregory, Newton, and the others had stumbled. He parabolized his mirror. The instrument he presented was of the Newtonian type and with magnification up to 230 power.

The chief link between the old and new in instrumental as well as observational astronomy was Sir William Herschel. In the first place, he carried the figuring of his mirrors to a point not approached by his predecessors, and secondly, he taught by example the immense value of aperture in definition and light-gathering power. William Herschel was a poor German organist living in England who had a passion for astronomy. In order to make some sort of living he gave concerts, then hurried home to study the stars. Unable to purchase a telescope of the size and perfection he desired, he began making his own instruments. A dedicated and persistent worker, he once toiled sixteen hours polishing a mirror while his sister from time to time fed him hot soup with a spoon. It was with this telescope he discovered the planet Uranus in 1781, and became private astronomer to King George III. Years later he was knighted for his achievements in astronomy. His greatest mirror was forty-eight inches clear aperture, and of forty-foot focal length. The completion of this instrument, which would rank as large even today, was rewarded by the immediate discovery of two new satellites of Saturn, Enceladus and Mimas.

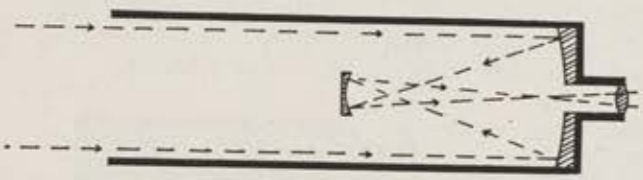
The last great reflector of the nineteenth century



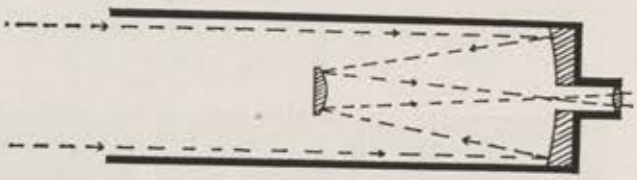
Galilean telescope, in which starlight passes in through a converging, or convex, lens. The image is viewed through a double concave eyepiece that is inside the instrument's principal focus. First Galilean telescope magnified thirty-two times.



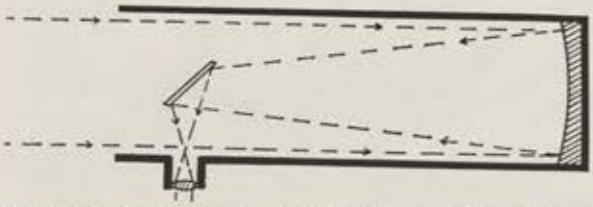
The Keplerian telescope, in which the starlight comes through a converging, or convex, lens. The image is then viewed through a double convex eyepiece outside the instrument's principal focus. Kepler's telescope had much larger field of view.



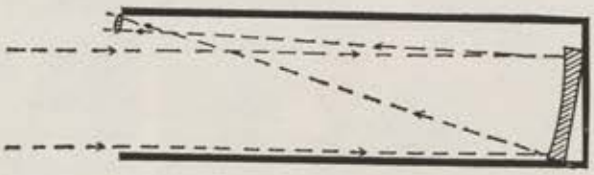
Gregorian telescope, a sophisticated development for its time. Starlight reflects back along axis of telescope from small, concave secondary mirror. It is viewed through an eyepiece at a hole in the center of the large, also concave, primary mirror.



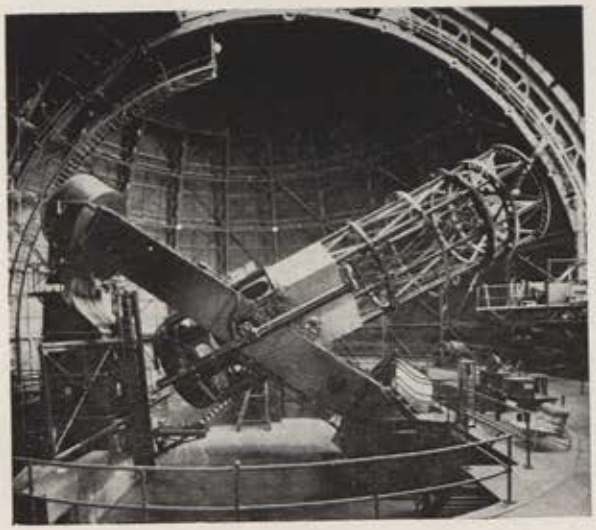
Cassegrainian telescope, a refinement of version developed by Gregory. In it, starlight reflects back along axis from small, convex second mirror. Viewing is done through an eyepiece at a hole in the center of the large, concave primary mirror.



Newtonian telescope, which had a great influence on the art of telescope making. In it concave primary mirror is perpendicular to axis, reflects starlight to inclined flat secondary mirror, from which it is turned out to eyepiece at tube's side.



Herschelian telescope, marking transition between old and new in telescopes. Starlight is reflected toward the front of the instrument by a concave primary mirror placed at a slight tilt. Viewing is done through an eyepiece at the edge of tube.



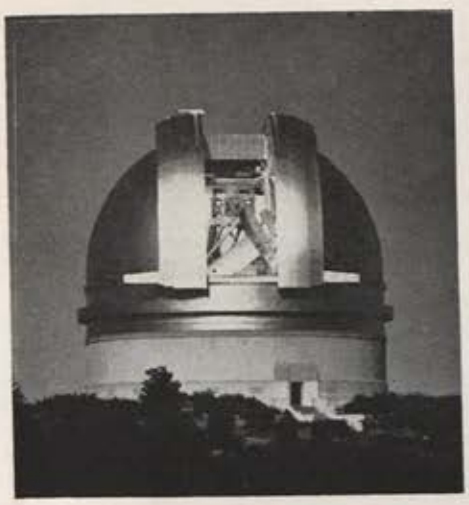
Above, 100-inch Hooker telescope at Mount Wilson Observatory. Massive telescope joined the array of equipment at Mount Wilson in 1917. Nine years earlier, first large reflector telescope in use in the US, sixty inches, was installed here.

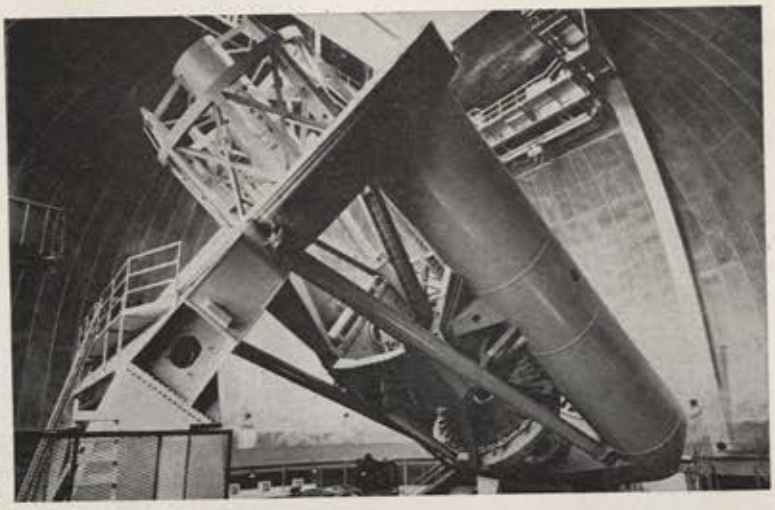
was constructed by the Earl of Rosse. This remarkable and mighty instrument had a mirror six feet in diameter with a total reflecting surface of 4,071 square inches and weighed over three tons. Its focal length was fifty-two feet, but the tube, made of wood, was fifty-six feet long, including the mirror cell. The whole instrument weighed over fifteen tons. It was fixed to a large universal joint imbedded in masonry about six feet below the surface of the ground. Raising or lowering it to sweep the sky was done by a chain and windlass. On each side of the tube, in line with the meridian, was erected a stone wall seventy-two feet long and forty-eight feet high allowing lateral movement of the telescope.

The next great step in the development of the telescope was the discovery of a simple chemical process for silvering glass. Up to this time all telescope mirrors had been made of metal. This had the disadvantage of weight, and the polished surface tarnished rapidly. The first silver-on-glass reflector was constructed in 1856 by Dr. Karl August Steinheil. Early the next year Jean Bernard Leon Foucault made public his methods of grinding and testing parabolic glass mirrors. The Foucault test is a simple but delicate test capable of revealing irregularities in the curve of a mirror of less than a millionth of an inch. His method of testing is now universally employed.

Until about fifteen years ago mirrors were coated with silver which was chemically deposited on the surface. Since World War II, most telescope mirrors are coated with aluminum deposited by evaporation and recondensation in a vacuum. When such a surface is first exposed to the air a transparent coating of aluminum oxide is formed which protects the surface from tarnishing for a considerably longer period of time than silver coating.

Until the close of the nineteenth century all large reflecting telescopes were constructed in Europe. Since 1900, aided by public-spirited citizens, the United States has taken the initiative in the development of these huge instruments of research.





Left above, the Mount Palomar Observatory, which is conveniently close to Mount Wilson in vicinity of Pasadena in southern California. The greatest of all telescopes, the 200-inch Hale reflector, right, is located at Mount Palomar. Novel feature of this instrument is that astronomer rides inside it as he observes at the prime focus. The observing cage is at the upper end of tube fifty feet from the mirror.

The first large reflector put into use in America was the sixty-inch telescope at the Mount Wilson Observatory near Pasadena, Calif. This instrument was completed in 1908 and has been in continuous service for half a century. Nine years later the 100-inch Hooker reflector was added to the array of astronomical equipment at Mount Wilson. It is a massive instrument; the parts which move when it is set to follow an object across the sky weigh 100 tons. To move the quantity of glass and steel with precision a great driving clock actuated by a weight of three-fourths of a ton is set below the level of the floor. By means of a worm gear seventeen feet in diameter the slow and precise motion of the driving shaft of the clock is transmitted to the telescope.

In 1939 an eighty-two-inch telescope of unique design was completed at the McDonald Observatory on Mount Locke in western Texas. On photographs taken in 1948 with this instrument an additional moon of the planet Uranus was discovered.

The greatest of all telescopes, the 200-inch Hale reflector, was officially dedicated in 1948. Located at a favorable site on Mount Palomar, it is within convenient distance of Mount Wilson. The seventeen-foot mirror, weighing sixteen tons, is of Pyrex glass. Because it is subject to less distortion by temperature variations and bends less under its own weight Pyrex was used in place of plate glass. During the grinding and figuring process thirty-one tons of abrasives were used to remove five tons of glass from the mirror blank. A novel feature of this instrument is that the astronomer rides inside the telescope when observing at the prime focus. The observing cage is located at the upper end of the tube, about fifty feet above the mirror.

In 1959 the 120-inch telescope at Lick Observatory on Mount Hamilton in California began scanning the further depths of space. The mirror of this instrument was made from a Pyrex blank that was originally intended to be used in testing the 200-inch mirror.

By way of comparison, the two largest refracting telescopes in the world are the thirty-six inch at Lick Observatory, completed in 1888, and the forty inch at the Yerkes Observatory, Williams Bay, Wis., finished in 1897.

No story of the development of large telescopes in America is complete without the mention of George Ellery Hale. A natural leader of men, he succeeded four times in raising funds for the construction of large telescopes. The forty-inch Yerkes refractor, the sixty-inch and 100-inch Mount Wilson reflectors, and the 200-inch Mount Palomar reflector were made realities through his leadership. Although Hale died before its completion, the great 200-inch telescope was named in his honor.

Hale telescope uses Pyrex glass instead of plate glass because it is subject to less distortion by temperature variations and bends less under its own weight. Here the 200-inch Pyrex disk being machine polished in optical shop, Mount Palomar.

The telescope is certainly one of the noblest monuments to human genius, and its invention will always be considered among the most remarkable in the circle of human knowledge. It is a work in which, by following unconsciously the plan of nature in the formation of the eye, we have come the nearest to the construction of a new organ of sense. By means of it we have extended our views and researches far beyond the limits of our own globe, enabling us to penetrate into the immensity of space and to become familiar with other worlds placed at almost incomprehensible distances from us. The telescope has revealed an infinitude of celestial bodies, whose existences must forever have remained unknown to us but for its invention.—END

The author, Mearl F. Carson, is Preparator of Exhibits at the California Academy of Sciences in San Francisco and associated with the Morrison Planetarium there. He served with the Army Air Forces in Europe in World War II. This article first appeared in Pacific Discovery, *bimonthly journal of the California Academy of Sciences, and is reprinted here with permission.*

BUCK ROGERS

From the comic strips to the law reviews, questions of space law are receiving increasing attention. Scholarly articles generally dwell on issues of state sovereignty in the upper atmosphere. Comic writers often get a bit "farther out" . . .

COMICS, COMMON

EVERYONE who reads the Sunday newspaper has seen the colorful "Buck Rogers" comic strip with its story plots built around spaceflight situations. Aside from the entertainment value of these tales of space adventure, Buck and the other space comic heroes sometimes deal with problems of interplanetary law and order.

> "Hecuban law requires that invaders from outer space be shot when captured," declares Buzz Corry, Commander of the Space Patrol.

The "invaders from outer space" in this case were earthmen seeking to land on Hecuba, a newly discovered planet of the sun.

> "Sure, I saw their flag," explains Alley Oop, "but that doesn't make the moon Russian property, even if they did plant it there first!"

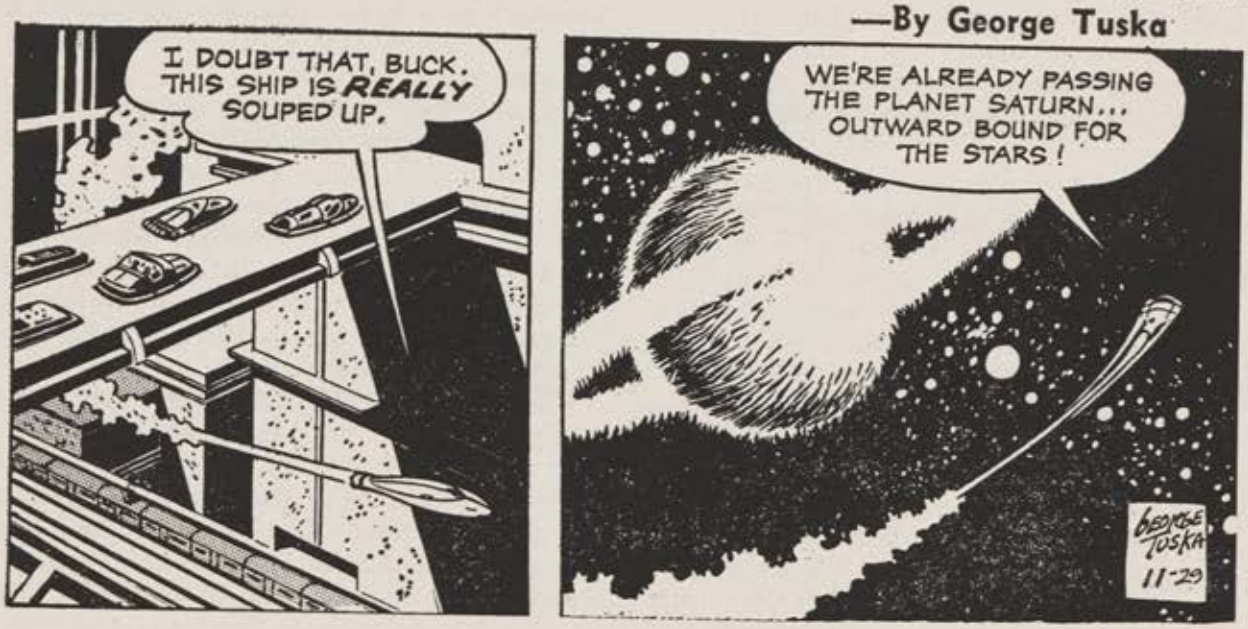
Alley and the Russians compromise by agreeing to split the moon into quarters—the first and last quarters going to the USSR and the rest of the moon to the United States.

> Arrested for flying with a revoked space pilot's license, Gregg is told by IPPY: "You'll be lucky to get off with twenty years suspended animation!"

Note that a suspended sentence in space does not mean the same thing as a suspended sentence on earth!

"Buck Rogers" reprinted with permission, courtesy National Newspaper Syndicate.

—By George Tuska



LAW, and the COSMOS

MORTIMER D. SCHWARTZ AND JOHN C. HOGAN

(Incidentally, the IPPY is comic-book slang for "Interplanetary Police.")

Years ago, before lawyers had very much interest in space, the writers and artists for the comics were predicting many of today's technological developments in space. They also had something to say about juridical developments in space.

What are some of the legal problems that the comic-book writers say are likely to arise in interplanetary space forty to fifty years in the future?

A favorite legal theme of those who write for the space comics is "criminology." But the crimes they dramatize are not always the violent or the gruesome kind. Good is made to triumph over evil, and the offender of the law generally receives just punishment for his misdeeds.

Interplanetary politics is another theme. It is associated with a superpolitical body that maintains law and order throughout the universe. The leaders of this political body are dedicated to the achievement of justice, whether through a court of law or by some extrajudicial means.

The space comic writers have a long list of law enforcement situations which they tell us are possible within the lifetime of our own children:

- Escape-proof prisons and reform schools for criminals, located on isolated satellites that orbit eternally in interplanetary space.
- An Interplanetary Police Force that cooperates with a Military Solar Guard to maintain law and order throughout the universe.
- An outlaw colony, located on a lonely planet,

where men "wanted" by the law may hide out, and where the Interplanetary Police may not enter.

- A "hermit" planet that refuses to associate with the rest of the universe, and that defies the legal authority of the superpolitical body.
- Legal contests between earth powers and space powers over ownership of planets.
- A "circuit" court (with a judge and jury) located on a satellite that orbits from planet to planet handling cases involving interplanetary crimes.

The science of criminology, apparently, will occupy much of the time of the people who live in space, if we can believe what we read in the comic books.

Space law has in it both an element of fantasy and an element of fact. Factually we are confronted with the vital problem of, how will man control space? Will it be by a struggle for political power among nations, or will it be by cooperation and by lawful means?

Since the end of World War II, some lawyers have had a serious interest in the legal problems of space. Scholarly articles on this subject have been published in law journals both in this country and abroad. The immediate problem is state sovereignty in the upper atmosphere. But some attention has also been given to a system of jurisprudence for all activities in space.

The surface of the earth is merely one guide to the extent of a state's sovereignty. The territory of a state is three dimensional, including not only the surface of the earth, but the area below the surface—sometimes divided into "horizontal strata," especially in mining districts—and the area above the surface, commonly referred to as the "airspace" and anciently believed by lawyers and judges to extend upwards ad infinitum.

The projection of state sovereignty to some point in the upper atmosphere is necessary. Yet any projection beyond the atmosphere itself is inconsistent with basic astronomical facts.

"The revolution of the earth on its own axis, its rotation around the sun, and the motions of the sun and the planets through the galaxy, all require that the relationship of particular sovereignties on the surface of the earth to space beyond the atmosphere is never constant for the smallest conceivable fraction of time," declares Sir C. Wilfred Jenks, British international law scholar, and he adds: "Such a projection into space of sovereignties based on particular areas of the earth's surface would give us a series of adjacent, irregularly shaped cones, with a constantly changing content. Celestial bodies would move in and out of these cones all the time."

Several theories have been proposed by lawyers for defining and delimiting state sovereignty in the upper atmosphere:

- The "cone" concept of sovereignty (just described), projects state boundaries upwards—like a giant ice cream cone, either all the way or up to a predetermined height.
- The "zone" theory divides the upper atmosphere into compartments at, say, 150, 300, or 500 miles. Everything below a certain zone is under the control of the subjacent state. Everything above and beyond the zone is "free" space.
- The "gravitational" theory extends state sovereignty upwards to the farthest point where an object, if dropped free in space, would fall *to* earth, not *away* from earth.
- The "air" theory gives a state absolute sovereignty over the "airspace" above its territory, but that sovereignty terminates where there is no longer any measurable molecule of air present.
- In the "parallel lines" theory, instead of a cone with ever-widening lines projected into space, parallel lines are drawn upwards from each state's borders. The area between these lines is free space.
- Finally, the "Kármán line" terminates state sovereignty at that point where aerodynamic lift ceases and centrifugal force takes over in the course of a flight into outer space.

Lawyers have struggled with the sovereignty question for over five years now, and they still are not able to agree on its solution.

The limitation of state sovereignty, however, is only one of many questions to be answered. Who is responsible for damage caused by the accidental falling of a satellite? How do we regulate radio frequencies and signals emitted by missiles launched into space? Has anyone the exclusive right to radio signals and weather forecasts made possible by satellites? How do we regulate movements in space in order to avoid collisions of satellites? What are the rights of states that have first reached the surface of the moon or other space bodies?

Fortunately, at the moment, only unmanned machines are whirling through space—Sputniks, satellites, and rockets. But men will come later, and then the legal problems will increase.

After the moon has been reached and other worlds have been discovered, questions involving real property will arise. And still later, with the introduction of private property into space, will come some interesting legal situations:

• For purposes of taxation, is a privately owned space platform a "chattel" or is it "real property"? A difference in taxation rates will depend upon the answer to this question. And by that time the tax collectors will be with us out in space, too!

• To transfer title to "Moonacre" (a privately owned space platform) from A to B, would a lawyer use a "bill of sale" or would he prepare a "deed?"

• Will the governments some day recognize squatter's rights in unoccupied and less desirable areas of space?

From the point of view of people who live on earth, the operation of such devices as rocket ships and space platforms must be viewed as an extra-hazardous activity for which there is strict liability for harm to person or damage to property. From the point of view of people who live in space, however, these will be normal everyday activities, and spacemen will be presumed to have "assumed the risk" in law.

Perhaps the concept of the "reasonable spaceman" will come to be applied to cases of negligence in the "law of space-torts."

You should know that these are not legal problems suggested by the comic books. These are actual situations discussed in the serious law review literature.

The question of the ownership of the airspace above land has frequently been litigated in cases involving airplanes. (There has not yet been a case involving a missile or satellite, either American or Russian.) The courts are not agreed on how to decide airspace disputes, with some states subscribing to one theory of space ownership, other states to another theory. But all the theories seem to have this in common—namely, that public aviation is beneficial and that it will be curtailed only when it unduly interferes with the landowner's use of the land.

When you purchased that lot on which your house is built, you had the surface boundaries surveyed and marked out, and perhaps you were careful to acquire the rights to the minerals beneath the land. But what did you do about title to the airspace above the land?

When the moon is high and directly over your property, get out your "grant deed" and read what it says about ownership of the airspace above your land, and ask yourself who has title to the heavenly objects in *your* airspace? Who knows, if you had a smart lawyer draft this document, it may be you who have legal title up to the moon.

Already, we have some very real "space" laws on the books. They are not generally recognized as such. For example, there are provisions of the Atomic Energy Act and the National Aeronautics and Space Act concerning inventions and discoveries useful in space.

Moreover, it is a fact that "customary" law applicable to space is developing, before our eyes, when one country allows—or permits without objection—another country to do some new act in space in order that the nonobjecting country may itself at some later date do the same or similar act in space. Much of the common law of England evolved in this manner.

With many people from the different countries of the world living and traveling in space—some in spaceships, others in spacesuits—some special rules for traffic regulation may be required—legal space codes—such as standard measurements (time zones, directional standards, etc.), granting of passports, import-export licenses, landing and takeoff rules, traffic control, allocation of radio and television frequencies, identification marks on spacecraft, citizenship of a child born in space, right of discovery and occupation, pollution of space by improper discharge of waste, and exploitation and preservation of natural resources found in space.

All this is not as far in the future as it seems and sounds. In the not-too-distant future, lawyers can expect clients to appear at their offices with problems involving some aspect of space law.

Will the law in these cases be any diflerent if the client is a spaceman from Pluto, rather than an earthman from Oklahoma City? Where will the lawyer look for authority in advising this man as to his legal rights and duties in space? In the absence of a good legal text on space law—which is yet to be written—he might begin by consulting the comic pages of the Sunday newspaper.—END

The authors, Mortimer D. Schwartz and John C. Hogan, are both experts in the young field of space law. Mr. Schwartz is a University of Oklahoma law professor and one of the founders of the International Institute of Space Law. Mr. Hogan is employed by the RAND Corporation, Santa Monica, Calif. *This article appeared first in the October 1960 issue of the University of Oklahoma's alumni magazine,* The Sooner, *from which it is reprinted with permission.*

Dr. Teller and Allen Brown list several important reasons why the United States should review and liberalize its policies on classified material. We must come to realize, he declares, that . . .

SECRECY IS NOT SECURITY

DR. EDWARD TELLER AND ALLEN BROWN

SECRECY in government research, particularly in the field of nuclear explosives, has become widely and even eagerly accepted. It is now labeled "security," and many people, I suspect, cling to secrecy as if it really were security.

This situation is new. Before World War II, there was much less secrecy in government-sponsored research and, when it *was* imposed, it was limited to specialized applications. But in 1939, alarmed that Nazi Germany might develop an atomic bomb before we did, we voluntarily departed from our traditional openness, and secrecy in the atomic energy field was adopted as policy.

At the end of World War II, the reasons for continuing this secrecy were still substantial. We had an atomic monopoly but at the same time we had reason to worry that the bomb might fall into unfriendly hands. Some hoped that if we kept our atomic secret, no other nation could develop a nuclear explosive for decades.

But the secret was not kept. Even before we knew that Klaus Fuchs had given the Russians detailed information about our atomic bombs, we had proof that Russia had produced a nuclear explosion. With that proof, the practical value of secrecy was greatly diminished.

I believe that Russian scientists could have produced an atomic explosion without information from spies. The Russians are fully capable of unraveling the secrets of nature and putting them to effective use; there is probably no major scientific development of which the Russians are ignorant. This also decreases the value of secrecy.

There remain two popular and powerful arguments for continued secrecy. One is that without secrecy, more and more nations would produce nuclear weapons. But other nations have exploded atomic bombs as soon as they had sufficient amounts of the proper fissionable materials.

Further, the reactors which produce these materials can be constructed by many nations. Not

only were the relevant principles published in the Smyth Report as early as 1945, but at the 1955 Conference on the Peaceful Uses of Atomic Energy in Geneva, we ourselves took the initiative in revealing essential portions of reactor technology. Thus, there is little reason to believe that even a small nation willing to spend the time and money would be unable to trigger a nuclear explosion.

In the long run, the safety of the world must be ensured by enforceable international law, not by the perishable advantage of some specialized knowledge or development.

The other argument for the continuation of secrecy is this: If we tell the world our secrets and the Russians keep theirs, it seems logical and obvious that they will always be ahead of us.

This is an extremely powerful argument. If we open up our technical work we *will* give the Russians an advantage. It is clear, therefore, that here secrecy does have a value. But the other side of

Our national overcommitment to secrecy, declares Dr. Teller in the accompanying article, often results in a "waste of time and waste of money" or a situation in which "we are fooling only ourselves."

US handling of Project Argus, the high-altitude explosion of three atomic bombs over the South Atlantic in 1958, appears to provide a case in point.

The Argus tests, aimed at obtaining data on the earth's magnetic field, were not announced in this country until months after they took place. Even today, many details of the tests are considered highly classified by the US government.

Last fall, however, authoritative and detailed data on the Argus operation was published in geophysical bulletins of the Soviet Academy of Sciences. A Soviet scientist analyzed the Argus findings with use of material still judged secret in the United States. Russian scientific stations had detected the Argus explosions and "read" the tests' results seemingly as well or better than we did.

So who in the name of secrecy was kidding whom?
—The Editors

the question also must be considered: What is the cost of secrecy to ourselves?

Immediately after World War II, Niels Bohr, who had worked with us on the atom bomb, made a characteristically clear-cut and courageous proposal. He urged that the free countries return to their proper and natural state of complete openness, arguing that continued secrecy in technical matters would not be advantageous to our society.

Now, in totalitarian Russia, secrecy is accepted as a way of life. Scientists whose work is outside the nuclear and military fields are as restricted and as regimented as those who are engaged in high-priority nuclear and space projects. Scientists and technicians are not tempted to abandon military projects for personal freedom, because personal freedom simply does not exist.

In free America, people do not like to work in secret. This is as true of scientists and technicians as of anyone else. Secrecy has tended to shunt away some of our best men and best minds from work which is badly needed for our defense. Most of us prefer to work in a field where the free interchange of ideas is encouraged, and where we can become known to our colleagues.

The United States no longer enjoys a monopoly in the nuclear field, and our competitors are doing extremely well. Our safety no longer lies in keeping all we know to ourselves, but rather in the speedy production of new and useful ideas. Since free discussion is the lifeblood of progress, less secrecy would result in more speed. And we need more speed in a race which vitally concerns our freedom and survival.

For the greatest possible scientific and technological advance, the United States and the other nations of the free world should pool their efforts and information. Our secrecy in nuclear weapons has erected a barrier between ourselves and our allies, resulting in a duplication of effort, waste of time, and waste of money.

Our mutual defenses suffer seriously when we are barred from discussing with our allies all of our weapons—both those that exist in fact and those that exist on drawing boards.

Creating a military organization and adapting it to the advances in weaponry often requires more time than the development of the weapons themselves. Unless we are allowed to communicate with our NATO allies, we cannot hope that our common defense forces will be able to make effective use of the advanced weapons now being developed.

A liberalization of the Atomic Energy Act in 1958 did allow more discussion with our allies. This has alleviated the problem, but it has not eliminated it.

Unhampered discussion would strengthen both the military defense and the moral unity of the free world. To the extent that secrecy isolates the free nations from one another, it certainly must be considered harmful.

Moreover, an informed public opinion is a danger to a dictatorship but a cornerstone of democracy. The government often cannot act without public support; it frequently cannot act wisely unless the public is informed.

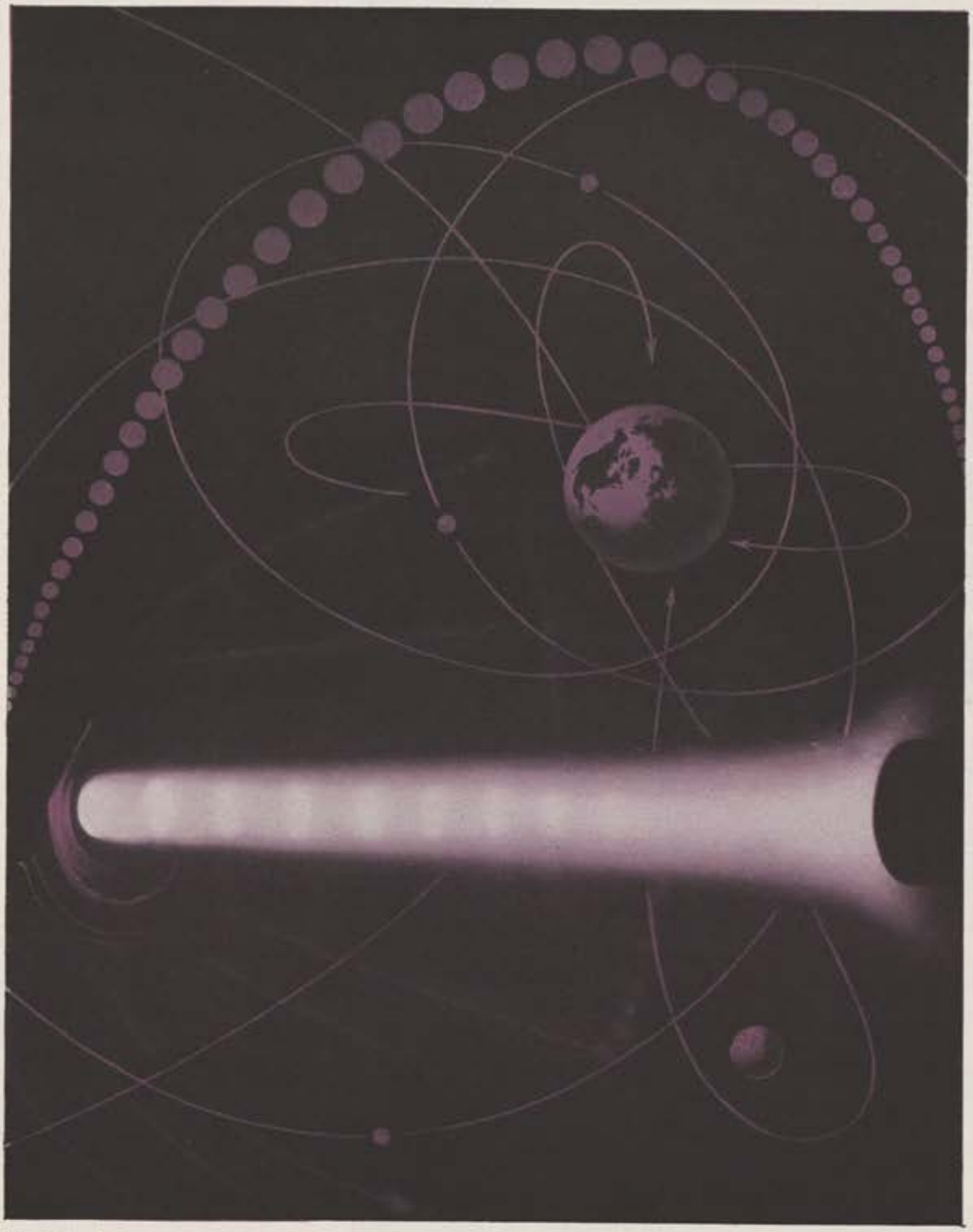
The Atomic Energy Act recognized the dangers of entrusting the atomic program to a single agency functioning in complete secrecy. Lack of information could result in a lack of informed criticism, in too much centralized power, and in arbitrary and often wrong decisions. To avoid these dangers, the Joint Congressional Committee for Atomic Energy was established. This committee has continued to represent the public and the long-range national interest. The commission and the committee form a team which often has been harmonious and almost always effective.

But in the broader field of public participation, the situation is less fortunate. For instance, lack of public information has dangerously distorted our view of possible future uses of nuclear explosives. It is generally believed that any nuclear war will result in the end of civilization and in the possible extermination of the human race. It is also believed that further development of nuclear explosives will hasten these ends and is, in any case, futile.

In my opinion, these views are mistaken. They prevent us from developing powerful defensive weapons and may, indeed, lead to world domination by Russia. Yet, the beliefs held by the public are plausible. The misunderstandings might be cleared up more easily if all relevant facts could be put before the public.

This is our dilemma: If we abandon secrecy, we give the Communists an advantage; if we retain secrecy, we slow down our progress, separate ourselves from our allies, and impede the formation of a well founded public opinion.

Recognizing this dilemma, the Atomic Energy Commission has taken a number of effective steps. Since the early disclosures of the Smyth Report, more information has been made available. Classification is under constant review. Virtually all facts relating to peaceful applications of atomic energy have now been published. Finally, some



Tailoring new re-entry materials with a white-hot needle. This is a 10-megawatt arc jet "needle." Avco uses it to test heat-shield materials under simulated re-entry conditions. Avco has capabilities for developing new materials to meet whatever thermal environmental conditions may be encountered by a re-entering nose cone, satellite or space probe. Examples: Avcoite, reinforced-quartz protector of the first ICBM nose cone recovered after flight . . . Avcoat, special all-plastic formulation which can be cast, sprayed or painted on. Other exotic materials are on the way as Avco tailors new ceramic-plastic composites to surmount re-entry obstacles.

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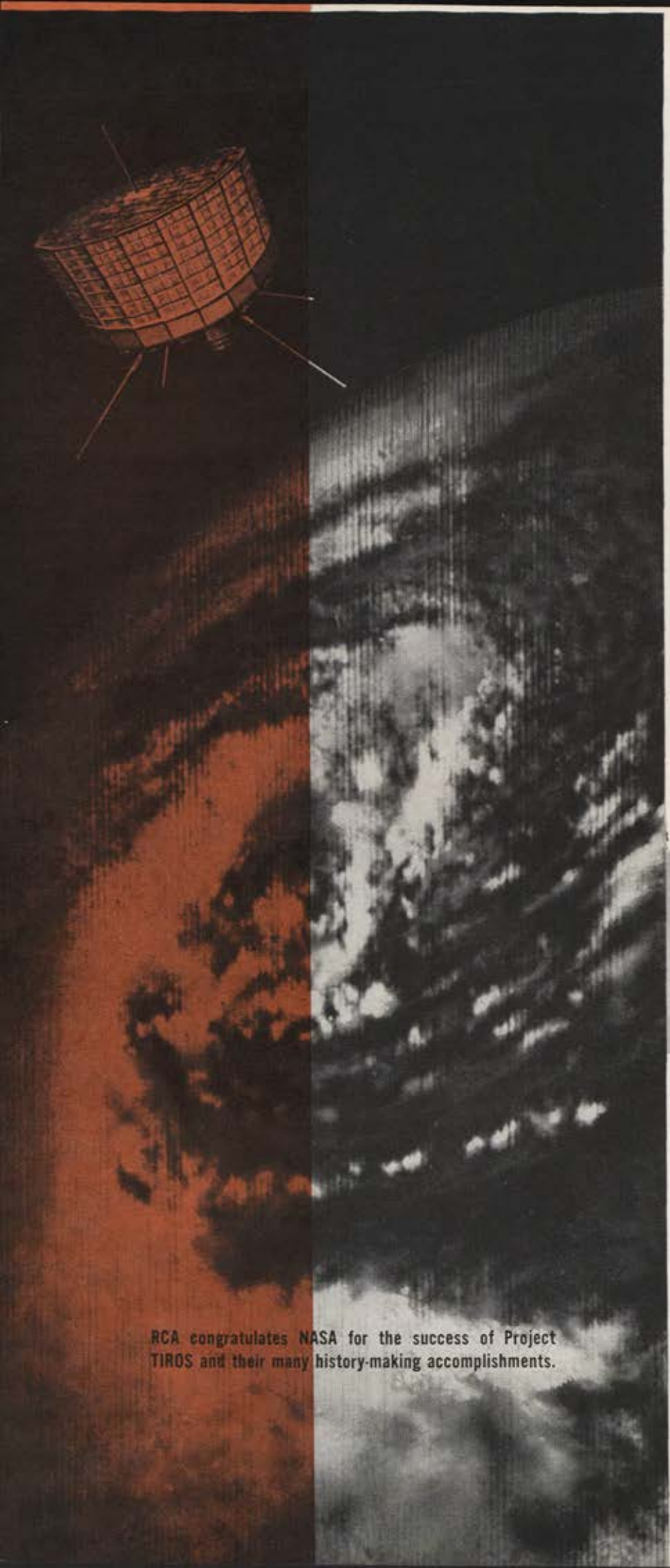

RCA congratulates NASA for the success of Project TIROS and their many history-making accomplishments.

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TIROS II—Improved experimental weather observer—follows TIROS I to provide man with new and more comprehensive views of earth's ever changing weather patterns from its vantage point some 400 miles in space. The new, more definitive pictures and data it gathers and returns to earth are providing a ground work for new giant strides in meteorology and long range weather forecasts.

Tiros II satellite, like Tiros I, was designed, developed and built by RCA's Astro-Electronics Division for the National Aeronautics and Space Administration. It includes all of the equipment of TIROS I—TV cameras, tape recorders, TV transmitters, command receivers, timing mechanisms, beacons and telemetry equipment—plus many new and improved devices. Chief among these are:

New scanning and non-scanning Infra-Red Sensing Devices—Developed by NASA to measure and record the heat radiation of the earth and its cloud cover adding new dimensions to existing weather data.

New Magnetic Orientation Device—a revolutionary advance to capitalize on the effects of the earth's magnetic field on TIROS II and maintain favorable orientation of the sensors over an extended period of time.

New noise suppressor circuits—to help eliminate extraneous noise from TV pictures TIROS II returns to earth.

New miniaturized RF Diplexer—to provide important savings in payload space and weight.

Improved horizon scanners and sun angle sensors—to give better orientation information for more efficient use of satellite photography and data.

Ground stations for TIROS II were designed and developed by RCA. This includes the primary stations at Fort Monmouth, N. J., at the Pacific Missile Range and the back-up stations at Princeton, N. J. and Cape Canaveral, Florida.

Many of these outstanding improvements were designed, developed, tested and incorporated in TIROS II within the short period of time since TIROS I was launched. It is an example of the kind of dynamic capability that is available to you at RCA's Space Center by simply contacting the Marketing Manager, RCA Astro-Electronics Division, Princeton, N. J.

If you are interested in participating in this challenging team effort, contact the Employment Manager, Astro-Electronics Division, Defense Electronic Products, Princeton, New Jersey.

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information which remains secret to the public actually has been discussed with our allies. This is a particularly important step.

But in my opinion we could, and should, go much further in the direction of openness. Niels Bohr's suggestion has lost none of its force or validity; secrecy and our way of life do not harmonize.

It would be foolish to pretend that the problems of secrecy are easily solved, but I shall make a few tentative suggestions:

In some fields of atomic energy all new results are considered secret or confidential until it is proved that disclosure will not endanger our country. In other technical fields, the burden of proof is on the party arguing for secrecy. This latter procedure, I think, should apply in the atomic field as well. We should not classify anything as secret or continue a secret classification unless it is absolutely necessary for our defense. Whenever possible we should encourage publication of scientific results.

General principles can be kept secret for only a short time. Secrecy does not prevent the spread of ideas or their rediscovery by the scientists of other nations. Effective secrecy rarely survives for more than a couple of years; in attempting to keep secret such principles after they have been discovered by others, we are fooling only ourselves.

Technical and engineering details can be guarded with greater success. The accumulation of these details may give us an important advantage. So we should consider carefully which details are to be kept secret and for how long.

There is some military and operational information which, at present, cannot be revealed. The location of our strategic nuclear weapons, for example, should be secret. As long as the Russians do not know where our hydrogen bombs are, they dare not attack us, nor can they blackmail us in an effective manner. Operational secrecy is both normal and necessary as long as our military forces must be on the alert.

A liberal policy—scientific openness and operational secrecy—would reestablish the situation that prevailed before World War II, reducing secrecy to its normal state within our democracy. To achieve this goal, I believe we should initiate a careful and detailed investigation of secrecy during the next two or three years. This, hopefully, might lead to radical progress toward openness in the field of science.

The advantages of openness and the dangers of secrecy become particularly obvious if we make an attempt to look into developments of the future.

The safety and prosperity of an interrelated world depend upon international cooperation. This cooperation must, in the end, embrace all nations, but it is urgent that it be established soon between the free and friendly countries.

Secrecy is contagious. It erects barriers between friends. It causes suspicion between strangers. And it obscures needed public discussion on the national and worldwide scene. Openness will certainly help the free world to obtain the initiative in the great task of world organization.

Our eventual goal, as a democracy, should be the elimination of secrecy. The facts of the cold war prevent us from adopting complete openness. Still, I believe that it would be to our advantage to make rapid progress toward openness even under present conditions.

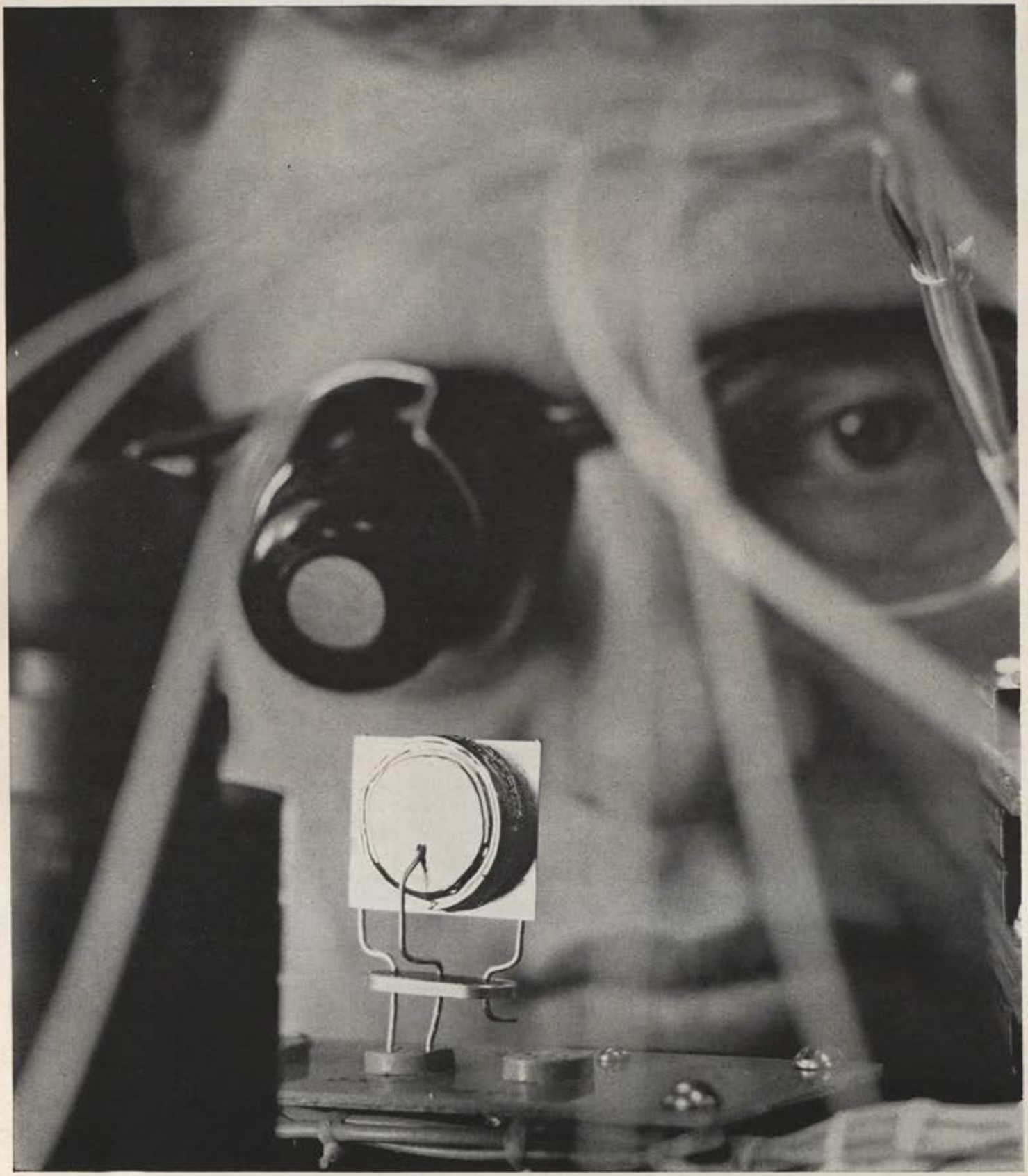
It would be unrealistic to believe that Russia would follow suit immediately. But our revelations at the Atoms for Peace Conference did produce an opening in the Iron Curtain.

If we were to share with other nations atomic explosives for peaceful purposes, the Russians would be faced with a difficult choice: Either they would have to appear less advanced than ourselves or they would have to disclose new information.

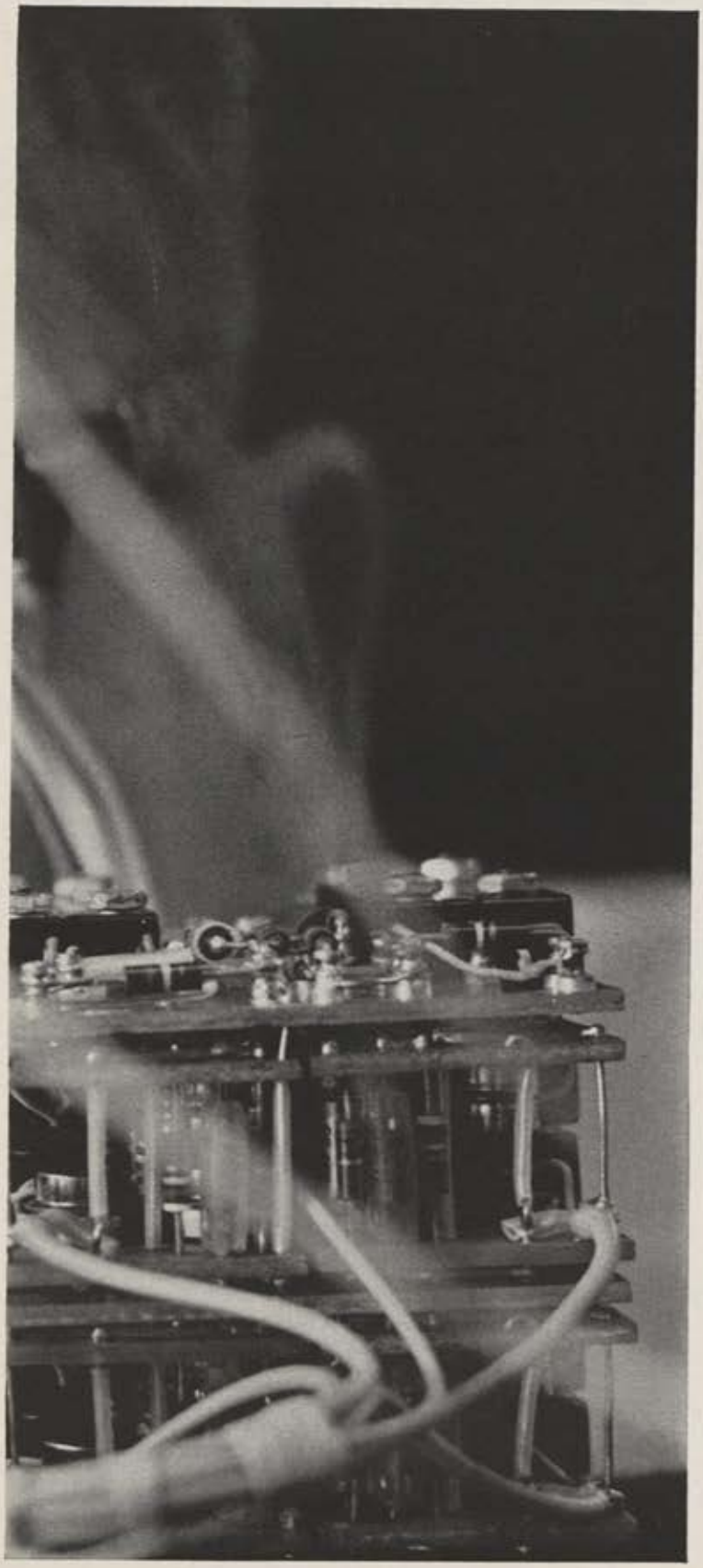
The Communist countries interact and must continue to interact with the rest of the world. The Russian scientists will sympathize with a free exchange of ideas. In the long run, their influence on the Russian political leaders will be felt.

We believe in the virtues of openness and freedom not only because these principles promote human happiness, but also because they are conditions for human dignity, for effective progress, and for international cooperation. Secrecy has become a relatively unimportant weapon in our military arsenal. Increasing openness, on the other hand, could be a great source of strength in our battle for the minds and hearts of people on both sides of the Iron Curtain.—END

Currently Professor at Large at the University of California, Dr. Teller is one of the world's most noted nuclear physicists. Mr. Brown, formerly with the San Francisco Chronicle, *is currently collaborating with Dr. Teller on a book,* After Hiroshima, *to be published by Doubleday. The above is reprinted with permission from the New York* Times Magazine, *issue of November 13.*



The mystery of radiation in space



Before man can safely travel into space, we must know more about the radiation he will encounter there. What kind it is. How much there is. Where it is.

A tiny Hughes radiation detector, housed in this electronics assembly, answers these questions. It is the most advanced detector yet developed—a thousand times faster reacting, smaller, more rugged than any other.

Hughes detectors such as this, reporting back from outer space, have already provided information vital to our Man in Space programs. Because of their small size and high sensitivity, Hughes detectors can do *many* scientific, industrial and medical jobs impossible for other devices.

They can give foot soldiers an instant means of warning against harmful radiation. They will find many uses in medical research and cancer treatment. They are invaluble for controlling atomic reactors—as well as for process applications such as flow measurement, thickness gauging, liquid level measurement, oil well logging and others.

Hughes radiation detectors are a product of the Hughes Nuclear Electronics Laboratory—specialists in the generation, detection, handling and analysis of radiation.

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Speaking of SPACE

WILLIAM LEAVITT
Associate Editor, SPACE DIGEST

1961—New Year for New Look at the Space Program

An important truth that needs telling, if this country is to recoup the prestige that became such a stern issue during the recent presidential campaign, has a good chance this new year of getting the hearing it deserves on both executive and congressional levels. This is the hard fact that space technology, as a new and dramatic focus of national power in an uncertain world, demands a maximum national effort with spelled-out objectives, using existing capabilities and strengthening them wherever necessary.

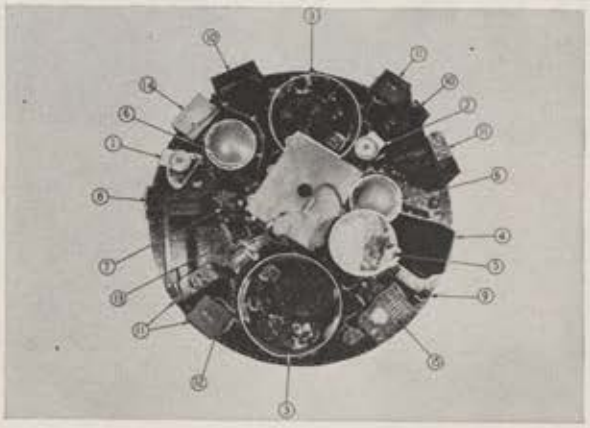
It is probably too early to predict with any certainty the mood of a new Congress, which at this writing is still buckling down for the new session. But it is evident that a new air of sophistication has developed among legislators who since Sputnik have been patiently listening to the parade of scientific and military witnesses who have testified on the plusses and minuses of the US national space effort. The lawmakers and their staffs have done much homework on the organization and facilities involved in the space program, and there is a good chance that both the Senate and House space committees will, in the coming months, be taking a long and hard look at the space effort from the standpoints of objective, pace, and organization.

There is much for them to examine, for the history of the national space effort since Sputnik, and even farther back into time, of the dim days before Sputnik, is a muddy flow of ironies which has managed to dampen today's motion in a manner that can only be reversed by vigorous action on both legislative and executive levels.

Tomorrow's historians will truly find it difficult to fathom, for example, as they describe the beginnings of America's venture into the space arena, that the country's first official man-in-space program—the Mercury Astronaut project of the National Aeronautics and Space Administration—was announced to the public as a bright new plan when it was, in fact, almost entirely an on-going program of the Air Force, denuded of its military uniform and put in mufti for what really were the most naïve of political reasons. The same historians will wonder at proposals—circa 1960—that new facilities were needed at which the necessary medical research to facilitate safe manned spaceflight could be done, in view of the demonstrable fact that in military and naval laboratories across the country Air Force, Navy, and Army researchers, backed up by a highly competent group of civilian specialists, had been doing just that job for a number of years.

This writer, a few weeks ago, toured several such laboratories, at the Air Force's Wright Aerospace Medical Laboratory, Wright-Patterson AFB, Ohio; the Aero Medical Field Laboratory, Holloman AFB, N. M.; the Physiological Training Flight, Edwards AFB, Calif.; the Air Force Ballistic Missile Division's bioastronautics unit at Vandenberg AFB, Calif.; and the Aerospace Medical Center at Brooks AFB, Tex.

The activity was varied, ranging from continuing zero-gravity flight studies at Wright-Patterson to design of satellite-borne biological experiments at Brooks, plus such exciting prospects as a hoped-for addition of a Space Pilot's Training Course at Edwards. But the unity of purpose was clear: Whether you talked with blue-uniformed Air Force research and development officers or their civilian counterparts, the anxiety was to get on with the job of ensuring US space capability. You could see the pride of achievement when an advance was made, as symbolized at a press conference we attended at Brooks AFB, where a team of civilian and military scientists working at the School of Aviation Medicine announced the surprisingly low radiation damage suffered by a SAM-prepared "biopak" safely recovered from Discoverer XVII, which passed by fortuitous acci-



Left, Tiros II, NASA weather satellite, blasts off from Cape Canaveral November 23. Above, payload — 1. wide-angle TV camera, which hasn't worked well; 2. narrow-angle TV camera; 3. TV tape recorders; 4. radiometer; 5. infrared system electronics; 6. electronic timers; 7. relays for altitude control; 8. control box for electronic systems; 9. infrared horizon scanner; 10. camera circuits; 11. tape recorder circuitry; 12. telemetry switches; 13. antenna diplexer; 14. generator.

dent through the radiation of an intense solar flare.

Or the same sense of pride of two scientists at Wright-Patterson who believe that they may be able to develop a method of eliminating the need for a circulation fan in space capsules, hence saving some of the weight that is still so critical a factor in US space operations. Or the shy smile of a bespectacled young Air Force lieutenant who, by inventing a machine usable for physiological testing of X-15 pilots, saved the Air Force the time and cost of having to farm out the project.

These comments are put down not to glorify the military capability but to underscore the fact that, hampered though it was by the former Administration's obsession with "space for peace," the military has quietly proceeded with its duty of trying to provide the country with an extension of its strength into the space arena.

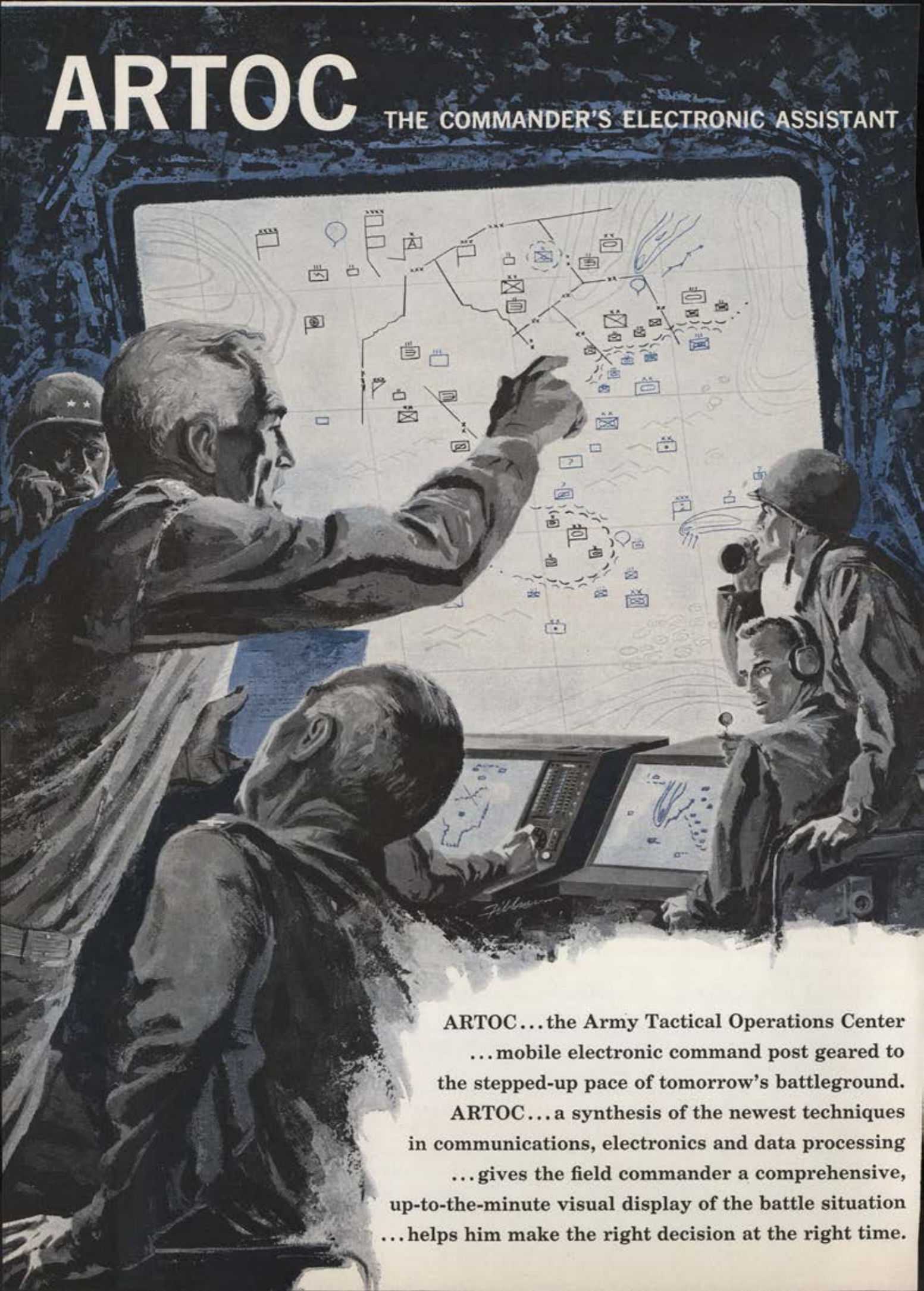
There is likely to be a more hard-headed approach to the military space mission, as well as the over-all space program, in a new Administration which was elected on an "all-is-*not*-well" platform. And in Congress, although there will probably be a lengthy period of watchful waiting to see how President-Elect Kennedy approaches space policies, interest in organization and objectives will continue strong.

In the last Congress, the House and Senate differed on proposed amendments to the Space Act. The House passed a bill abolishing the National Aeronautics and Space Council, which had been set up in the Space Act to advise the President on astronautical policy, and the Civilian-Military Liaison Committee, which had been designed to provide a link between NASA and DoD, as well as approving a semantic change in the law which strengthened the military role in astronautics. The Senate did not act on these proposed amendments last session, taking the view that the original Space Act machinery had never had a proper trial during the Eisenhower Administration. Similar amendments may again be considered by the House this

USAF School of Aviation Medicine's Dr. George Crawford, physicist, reported December 7 at Brooks AFB, Tex., press meeting that biological specimens recovered from Discoverer XVII suffered surprisingly light solar-flare damage.

ARTOC

THE COMMANDER'S ELECTRONIC ASSISTANT



ARTOC...the Army Tactical Operations Center ...mobile electronic command post geared to the stepped-up pace of tomorrow's battleground. ARTOC...a synthesis of the newest techniques in communications, electronics and data processing ...gives the field commander a comprehensive, up-to-the-minute visual display of the battle situation ...helps him make the right decision at the right time.

SPEAKING OF SPACE

Space mail, one of eight letters sent by USAF Chief of Staff, Gen. Thomas D. White, and carried in recovered Discoverer XVII capsule, is delivered to AF Secretary Sharp.

new session, although the Senate is expected to stick to its view that the original machinery should be tried out by the new Administration before any changes are made.

So, although the outlook for early *specific* congressional action on space effort organization is slight, there is a good chance that by indirection there will be considerable congressional study of the NASA-DoD relationship, particularly during the NASA 1962 authorization hearings.

There are second thoughts in at least some congressional circles on the question of whether it is really advisable, in terms of both economy and concentration of effort, to have *two* large complexes, military and civilian, operation as foci for sizable hardware and medical developments, competing for funds and technical talent. This observation is in no way meant to reflect on the NASA stockpile of technical competence. It is only to point out that perhaps the old way—as representated by the predecessor organization, the National Advisory Committee for Aeronautics, serving as a basic and applied research fount for both military and industry—might have been the best way for the emerging space age, too.

For the advocates of a strong military space capability, there is, in a somewhat reverse twist manner,

a bright aspect to the below-the-surface controversy that has for months smoldered between the military and the civilian agencies. For it has stimulated military people, particularly in the Air Force, which has an obviously viable mission in space, to greater courage in proclaiming that mission, and to setting its own house in order so as to most efficiently perform that mission.

A case in point is the current Air Force study as to how best to organize its considerable aerospace medical capability, the need for review of which was discussed in this space in November 1960.

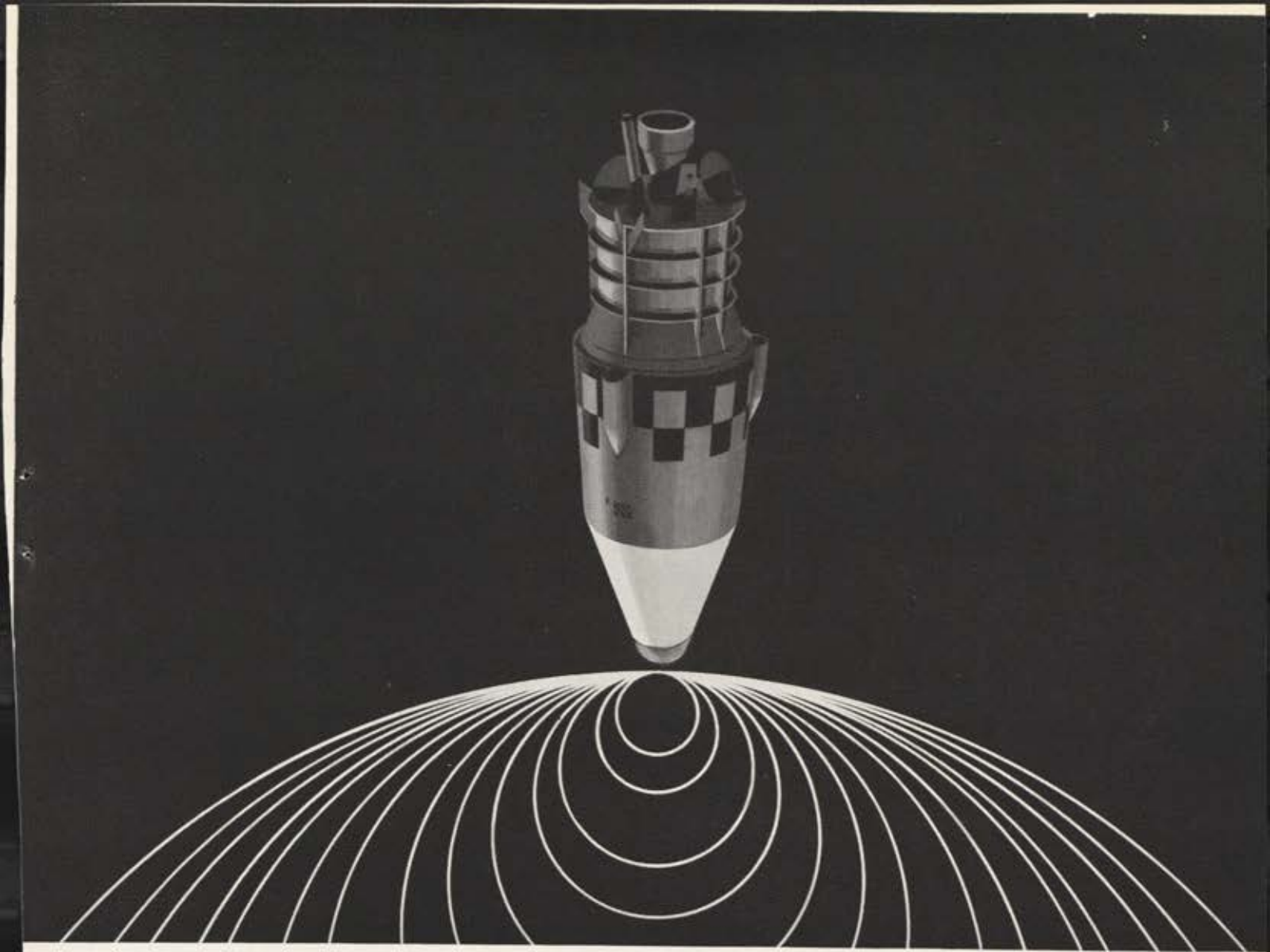
Recently Brig. Gen. Don Flickinger, Special Assistant for Bioastronautics to the Commander, Air Research and Development Command, and a flight surgeon who back in 1958, before NASA and the Mercury program, had nearly buttoned down an Air Force orbital training program to be headquartered at Edwards AFB, Calif. (*See "Blueprint for Tomorrow's Spacecrews,"* AIR FORCE, *May '58*), was in effect named Chief of ARDC's aerospace medical program. All such ARDC programs are now reported on directly to him rather than through the regular command channels.

By Joseph G. Farris, reprinted with permission from "Saturday Review"

And discussion is under way as to where the Aerospace Medical Center, with its School of Aviation Medicine and space-medical talent, at Brooks AFB, ought to be assigned. Currently, it is a part of the Air Training Command, where its important flight surgeon teaching function fits nicely enough, but where the research program really doesn't. ASM might, in a reorganization, come into ARDC. Or—another possibility—all of the Air Force aerospace medical research programs, those, presently, in and out of ARDC may come under over-all charge of the Surgeon General. In any case, a long look is being taken at a problem which has long needed review—all part of the longer look Congress and the Kennedy Administration will be taking at roles and missions in an increasingly complex space-age world.

Space Capsules

Last month's comments on the controversy in Great Britain over whether the English ought to plan an independent space program is followed up by reports that the RAF SCHOOL OF AVIATION MEDICINE at Farnborough has been assigned to investigate the bioastronautical aspects of the feasibility of a British man-in-space program. . . . A space-age nightmare is suggested by reports from US medical visitors to the Soviet Union that the Russians are pushing ahead with a boarding-school child-training program, the intent of which is—through encouragement of childish probing into motivations for *all* their behavior—to establish completely predictable behavior patterns for the total society. The child, separated from parents, and raised by "up-bringers," does not lose his individuality, but by contributing to the behavior pattern pool, so to speak, strengthens the state as the supreme entity to which he owes his loyalty and best efforts. . . . A project that received much attention in Europe during last summer's Stockholm meeting of the INTERNATIONAL ASTRONAUTICAL FEDERATION but little in this country was LIL—Lunar International Laboratory. A study group of the newly formed International Academy of Astronautics, including Russian's DR. LEONID SEDOV, current IAS president, is to pool ideas on this hopeful project. . . . DR. HUBERTUS STRUGHOLD, noted Air Force space medico, suggests that the recovery of biological specimens from Discoverer XVII may revive interest in the "panspermatic" theory of the origin of life, propounded by SVANTE ARRHENIUS, Swedish scientist in the early 1900s. Arrhenius believed that life was carried through space from celestial body to celestial body in the form of microscopic spores. Dr. Strughold noted that the genus of spores which survived solar flare radiation aboard the Discoverer is among the oldest known types. . . . The NATIONAL AVIATION EDUCATION COUNCIL has reprinted and now has available at a low cost of $1 per copy the *Teacher's Guide—Earth and Space Science,* outline of an excellent new course being offered in the Pennsylvania public school system. For copies, write to National Aviation Education Council, 1025 Connecticut Ave., N.W., Washington 6, D. C.—END



"MIDAS" REPORTS

through communications equipment by Philco

MIDAS II, the experimental "sentry in space," is the forerunner of a series of satellites that will detect the launching of ballistic missiles anywhere on earth and instantly relay the warning. Its entire communications system was designed and produced by Philco's Western Development Laboratories for the U.S. Air Force, as associate contractor with Lockheed.

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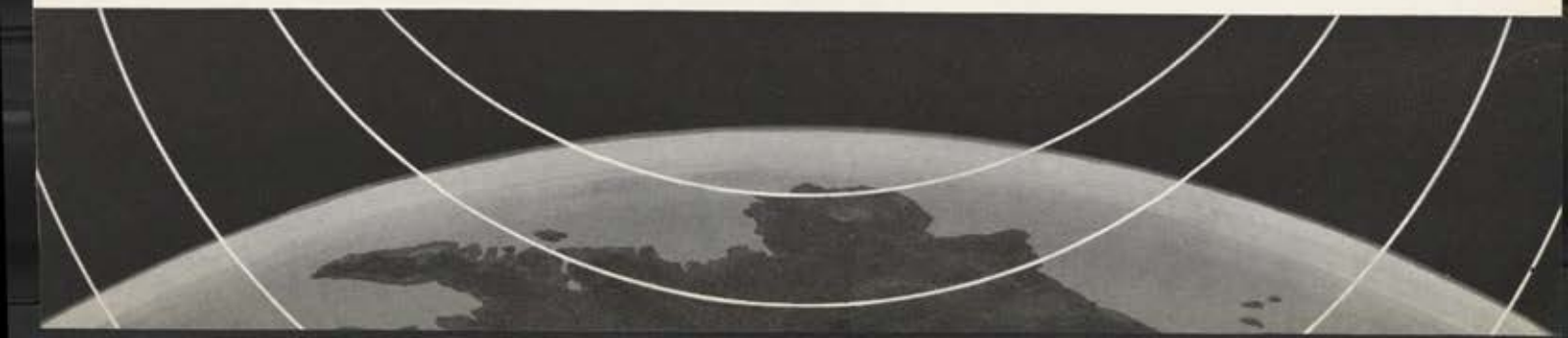

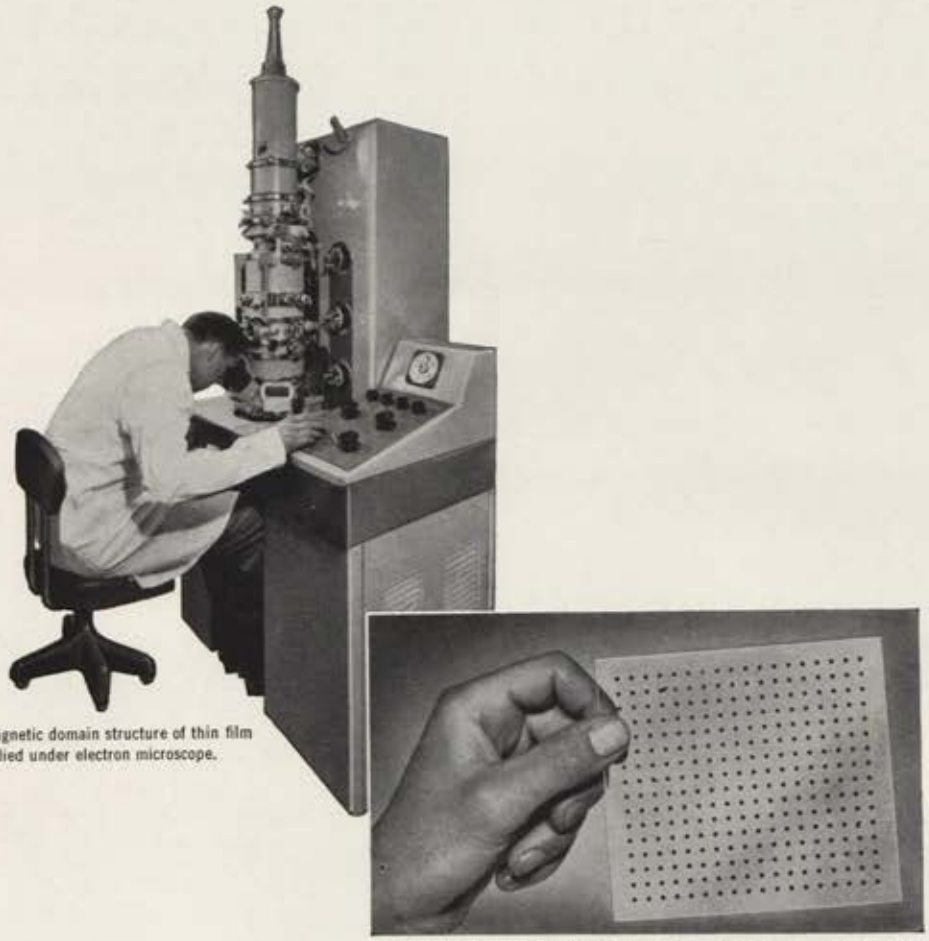

Ferro-magnetic domain structure of thin film studied under electron microscope.

Experimental memory array produced by deposition of evaporated metal.

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AIR FORCE
JANUARY 1961

A tough-minded businessman with an intellectual bent girds himself for what has become one of the most complex jobs in the world. Here's a profile of . . .

ROBERT S. McNAMARA

New Secretary of Defense

ROBERT Strange McNamara, the businessman and Air Force Reservist who will serve as Secretary of Defense in President-Elect John F. Kennedy's Cabinet, is described, by associates in the automotive world he left to accept his new job, as a tough-minded intellectual with an awesome ability to keep facts, figures, and ideas neatly stored in his mind.

Mr. McNamara, forty-four years old, had—not many weeks before being offered the Defense post—accepted the presidency of the Ford Motor Company. He was the first nonmember of the Ford family to hold that job. His record at Ford had been somewhat of a legend. With no background in the automobile business, he joined Ford in 1946 as a member of a ten-man group of ex-Air Force officers who sold themselves as a package to the motor company after turning in a smooth performance revolutionizing Army Air Corps procurement and supply with new systems of statistical control. At Ford, they became known as the "whiz kids."

Shunning the usual social circles of the Motor City, and residing in the university town of Ann Arbor where he spent his spare time plowing through tomes by such unfrivolous commentators on modern civilization as Arnold Toynbee and Oswald Spengler, the Secretary-designate served in planning and financial posts at Ford until 1949, when he became controller. In 1953, he became assistant general manager of Ford Division. In 1955 he was elected a vice president and named general manager of the division. In 1957 he was made vice president and group executive for the car and truck divisions, the post he held prior to his being named company president in November 1960.

A native of San Francisco and father of two children, Mr. McNamara is a graduate of the University of California, where he majored in economics and philosophy and was elected to Phi Beta Kappa as a sophomore.

From California, he went to the Harvard Business School, then spent a year with Price Waterhouse & Company accounting firm. In 1940, he returned to the Harvard Business School as an assistant professor of business administration.

During his Harvard stint, he was borrowed by the War Department as a consultant in development and installation of an Army Air Corps statistical control system, serving in the US and overseas in England. He entered active service as a captain in the Army Air Corps in 1943, was promoted to major and lieutenant colonel in 1944, and served in Europe and the Pacific. Toward the end of the war, he and the nine other "whiz kids" mentioned above worked as a team at Wright Field. He earned the Legion of Merit during service, and holds a colonelcy in the Air Force Reserve.

Considered personally shy, he is an enthusiastic skier and mountain climber as well as an avid reader. Although a registered Republican, he supported the candidacy of John Kennedy. He and his new boss had never met until the meetings which convinced the President-Elect that Mr. McNamara was the man he wanted for the job.—END

the Ready Room

RESERVE AND AIR GUARD NEWS

Reserves Into Space

The **Reserve Forces have moved into space.**

The Air Force Reserve's **434th Troop Carrier Wing,** Bakalar AFB, Ind., was assigned a **space capsule-catching mission** in November.

Seventeen **Air National Guard communications and electronics squadrons** are now scheduled to assist in developing communications facilities at USAF ballistic missile and space test sites throughout the country next summer.

The 434th, the **Department of Defense** has announced, will begin training shortly in specially equipped C-119s for aerial space capsule recovery duties. The Wing, commanded by **Brig. Gen. John O. Bradshaw,** is comprised of two squadrons at **Bakalar** and one at **Scott AFB, Ill.** All fly C-119s at present.

Training of 434th aircrews is to be conducted by USAF's **6594th Recovery Control Group** in the area of the **Hawaiian Islands.** The 6594th is the recovery unit that has performed so nobly in Discoverer satellite recovery. The 434th

Capt. Gene Jones, right, USAF C-119 pilot who caught Discoverer XVII and XVIII capsules, briefs 434th Troop Carrier Wing on new mission. With Jones is Col. John W. Hoff, Deputy Commander of the now space-oriented Reserve group.

was also slated to receive recovery C-119s from the 6594th when the active duty group is given larger and faster C-130s.

The **434th Troop Carrier Wing** will continue in its present mission roles, with wartime assignment to the **Tactical Air Command,** in addition to assuming the new space mission.

The seventeen ANG squadrons will perform their communications duties in support of satellite and missile programs directly under the **Air Materiel Command.**

Dr. Joseph V. Charyk, Undersecretary of the Air Force, announced some months ago that the capabilities of the Reserve Forces would be used in the space program. He listed three missions that might go to the Reserves—capsule recovery, radar space surveillance, and airlift support of missile site activations.

The assignments to the **434th Troop Carrier Wing** and the Guardsmen marked the first actions taken in this regard. Further such assignments may be on the way in coming months.

Globemasters for the Reserve

The first five Air Force Reserve troop carrier squadrons to be equipped with four-engine **Douglas C-124 Globemasters** have been designated by CONAC.

Scheduled to receive C-124s this spring are the 77th Troop Carrier Squadron, **Donaldson AFB, S. C.;** the 305th, **Tinker AFB, Okla.;** and the 706th, **Barksdale AFB, La.** Next in line as additional aircraft become available are the 303d and 304th Squadrons at **Richards-Gebaur AFB, Mo.**

Each squadron will operate eight Globemasters in place of the sixteen Fairchild C-119 Boxcars it has now. While personnel strength and operating costs will be virtually unchanged, the transition greatly increases each squadron's capacity for airlifting troops or cargo.

The C-124 carries a maximum payload of 74,000 pounds or 200 troops. Its maximum range is in excess of 4,000 miles and its speed 300 mph or more. In comparison, the C-119's top payload is 27,500 pounds, its range 2,280 miles, and speed about 200 mph.

First aircrews are being checked out at **Tinker AFB, Okla.** Airman specialists from the five squadrons are attending tech school at **Chanute AFB, Ill.**

Awards for Flying Safety

Two Reserve wings and two Air Guard squadrons have been awarded USAF flying safety plaques for the first six months of 1960.

Air Force Reserve units honored are the 459th Troop Carrier Wing, **Andrews AFB, Md.,** commanded during the award period by **Brig. Gen. Ramsey O. Potts, Jr.,** and the 514th TC Wing, **Mitchel AFB, N. Y.,** led by **Col. Campbell Y. Jackson.**

Air Guard units receiving the award are the 134th Fighter-Interceptor Squadron, **Burlington, Vt.,** commanded by **Maj. Rolfe L. Chickering,** and the 183d Aeromedical Transport Squadron, **Jackson, Miss.,** commanded by **Maj. Thomas F. Brown.**

The **459th and 514th Wings,** equipped with C-119s, each flew nearly 5,000 accident-free hours during the first six months of 1960. The citations also noted that each operates in highly congested air traffic areas.

Vermont's 134th Squadron, operating F-89s, flew more than 2,800 hours without accident during the period, and has accumulated more than 15,000 jet hours since its last accident in November 1956. The 183d, flying C-119s, logged 1,600 accident-free hours in the award period, and some 15,000 hours since its last mishap in March 1956.

CONAC Move to Close Mitchel

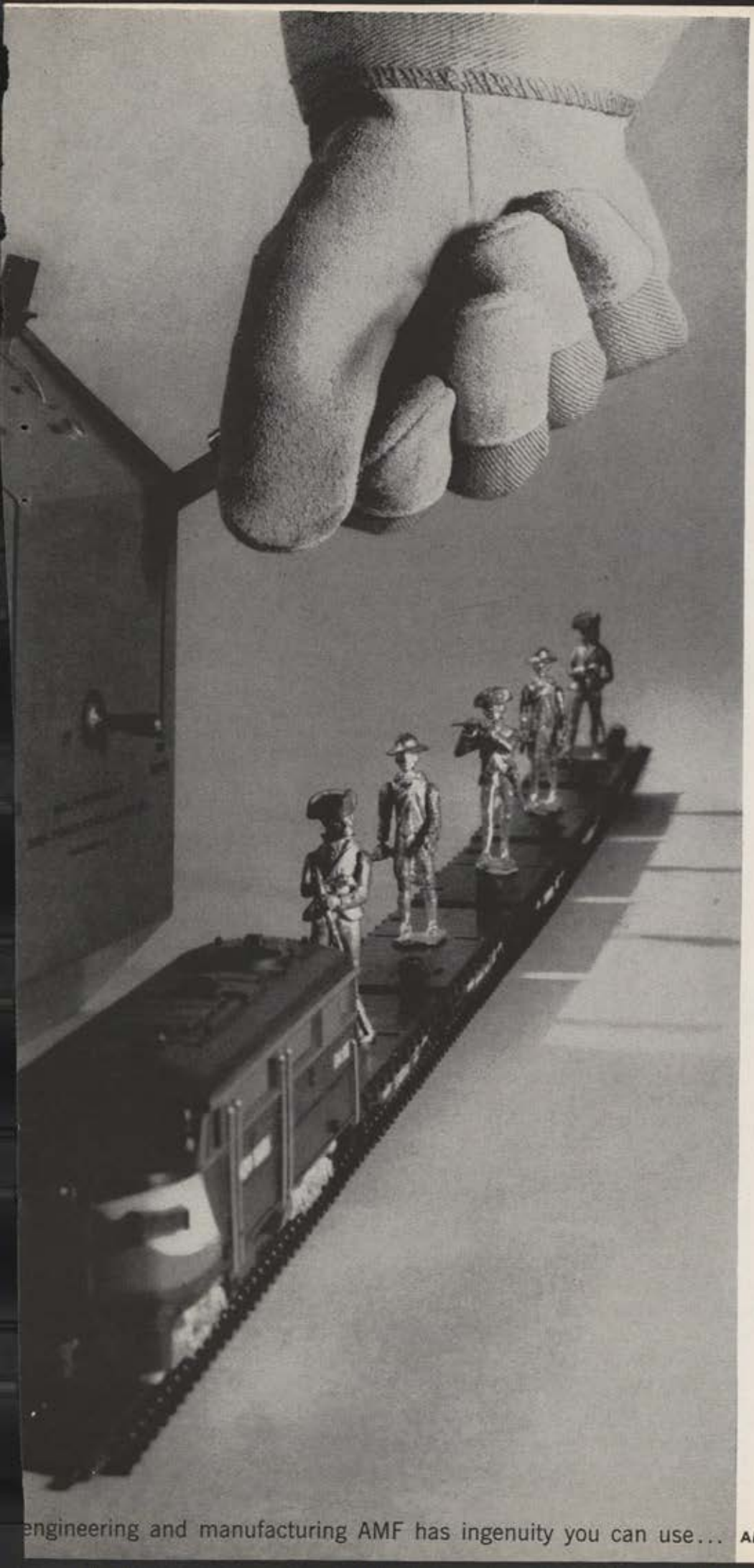
Continental Air Command Headquarters will move from **Mitchel AFB, N. Y.,** to **Robins AFB, Macon, Ga.,** by June, USAF announced early last month. With its departure, historic Mitchel will be closed as an Air Force installation.

To make room at Robins AFB for CONAC's headquarters staff, the **3d Air Reserve Region** will move from Robins to **Dobbins AFB,** near Atlanta.

Several other relocations announced at the same time by Hq. USAF affect elements of the Air Reserve Forces:

- When SAC vacates **MacDill AFB, Fla.,** early in 1962,

(*Continued on page 107*)



He's got Minutemen "working on the railroad"

Hard basing is one way to protect America's force of retaliatory ICBM's. The problem was to find an alternate means of accomplishing the same mission. The Air Force solution was a new ICBM mobility concept—railroad car-mounted Minutemen, utilizing the nation's vast track mileage for numerical and geographical dispersion, creating a difficult target for enemy attack.

To put the Minuteman, its support systems and associated equipment on rails was a completely new problem in missile handling. The first requirement assigned by Boeing to American Machine & Foundry Company and ACF Industries, Inc., was a feasibility study of the existing limitations of roadbeds, rails, railroad operations and right-of-way. Unique tactical cars are being designed within these limitations to carry the Minuteman—cars that can handle the missile and its operating equipment, safely isolated from roadbed shock and ready for immediate retaliatory launching.

Single Command Concept

Whether for conceptual problems such as this one, or for challenges in design or manufacturing, AMF has ingenuity you can use. AMF people are organized in a single operational unit offering a wide range of engineering and production capability. Its purpose—to accept assignments at any stage from concept through development, to production, and service training...and to complete them faster in

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This "midget with a punch" requires a minimum envelope since it measures only 4.6" dia. x 8" long. It comes with round, square, or QAD flange and includes a fan to supply its own cooling air up to 20,000 feet.

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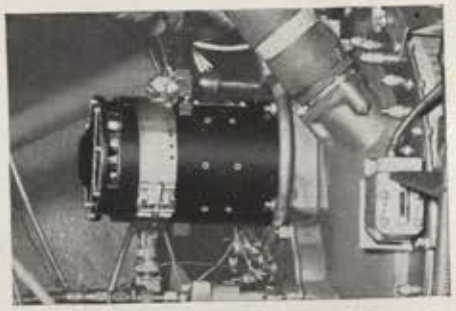

Its small size makes the 30B56 Starter Generator ideal for use on the new small gas-turbine engines.

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USAF will close the major portion of that base, leaving only the Air Reserve Center and a radar station.

- **ADC's 32d Air Division,** which works with ANG air defense units in the southeast, will move from Dobbins to **Oklahoma City, Okla.,** in July. The 3d Air Reserve Region will absorb some of the 32d's facilities at Dobbins in line with the move.
- **ADC's 29th Air Division** at **Malmstrom AFB, Mont.,** which exercises operational control of ANG air defense units in the northwest, will be inactivated in July. At that time, the **33d Air Division** at **Richards-Gebaur AFB, Mo.,** will be redesignated the 29th. SAC will acquire facilities at Malmstrom to house three Minuteman squadrons, with the missile scheduled to become **operational in 1962.**
- SAC is moving out of **Clinton County AFB, Ohio.** ANG will transfer its **145th Aeromedical Evacuation Squadron** there from **Akron-Canton Municipal Airport,** and later will convert the squadron to a tanker mission, employing KC-97s.
- MATS will move its **63d Troop Carrier Wing** from **Donaldson AFB, S. C.,** to **Hunter AFB, Ga.,** in the spring of 1962, at which time Donaldson will be turned over to CONAC for reserve missions.

Air Guard's Readiest

Nine Air Guard units compiling top readiness ratings in their aircraft category were named last month. The units, and their commanders, are:

RF-84F—174th Tactical Reconnaissance Squadron, Sioux City, Iowa, **Lt. Col. Donald W. Forney.**

F-84F—121st Tactical Fighter Wing, Columbus, Ohio, **Col. Dale E. Shafer, Jr.**

F-86H—107th TF Group, Syracuse, N. Y., **Lt. Col. Curtis J. Irwin.**

F-86D/L—127th Fighter-Interceptor Squadron, Wichita, Kan., **Lt. Col. Donald W. Coulson.**

F-89—115th Air Defense Group, Madison, Wis., **Lt. Col. Oliver S. Ryerson.**

F-100—188th FI Squadron, Albuquerque, N. M., **Maj. Clay O. Keen.**

C-119—140th Aeromedical Transport Squadron, Reading, Pa., **Capt. Nicholas J. Bereschak.**

SA-16—129th Troop Carrier Squadron (Medium), Hayward, Calif., **Lt. Col. Charles W. Koenig.**

RB-57—123d TR Wing, Louisville, Ky., **Brig. Gen. Philip P. Ardery.**

These units were leaders in an over-all campaign which by September had qualified two-thirds of the Air Guard's flying and support personnel as "operationally ready" under Air Force standards. When more than one command echelon is stationed on the same base, the rating applies to all combat and support units on the base.

New Faces, New Jobs

New commanders have been named for the First and the Third Air Force Reserve Regions.

Col. J. H. Starbuck now commands the First, with headquarters at **Mitchel AFB, N. Y.** He succeeded **Col. Charles W. Bicking,** who has been appointed chief of the USAF mission to **Bolivia.**

In the Third Region, **Col. J. S. Bishop** has succeeded **Maj. Gen. Chester E. McCarty,** who is now Deputy for Air Force Reserve under the Assistant Chief of Staff for Reserve Forces at Hq. USAF.

Col. Nicholas E. Allen, former associate general counsel of the Air Force, has been named deputy commander of the Second Air Reserve Region at **Andrews AFB, Md.,** under **Brig. Gen. Felix L. Vidal,** Second Air Reserve Region commander.

Col. Allen succeeds a fellow Washington attorney, **Brig. Gen. Ramsay O. Potts, Jr.,** who has accepted an assignment as mobilization assistant to **Maj. Gen. Brook Allen,** Commander of Headquarters Command, **Bolling AFB, D. C.**

Before occupying the Second Region deputy slot, General Potts was Commander of the 459th Troop Carrier Wing at Andrews. He was succeeded as Wing commander by **Col. William T. Smith.**

Meanwhile, an Air Guardsman, **Brig. Gen. Philip P. Ardery,** who commanded the 123d Tactical Reconnaissance Wing at **Louisville, Ky.,** has switched to the Reserve to accept a mobilization assignment in the office of the Secretary of the Air Force in Washington. In civilian life, General Ardery is an attorney.

Brig. Gen. William D. Ott, Kentucky's Assistant Adjutant General for Air, has been designated acting commander of the 123d.

AFA Guard, Reserve Councils to Meet

AFA's Air Guard and Air Reserve Councils will meet in Washington on February 3 under new chairmen recently named by **AFA President Thos. F. Stack.**

Brig. Gen. Frank A. Bailey of Arkansas succeeds **Col. Robert D. Campbell** of California as chairman of the ANG council. **Col. James McPartlin** of Michigan is the new Air Reserve Council chairman, succeeding **Brig. Gen. Roy Sessums** of Louisiana.

Each council is being **increased to eleven members,** four more than before. One new member on each council is to be an airman. **Rosters of the councils** will be published next month.

The agenda for the February meeting includes briefings by **Air Force officials on long-range Air Reserve Forces roles and missions.** The councils also will discuss AFA's recommendations for presentation at forthcoming congressional reserve posture hearings.

No More Lost Vacations?

Information on a new law which provides more job protection to Reserve Forces personnel in connection with absences for military training has been disseminated to all services by the **Department of Defense.** Similar guidance has been furnished employers by the **Department of Labor.** This is an **important and gratifying action** so far as the Reserves are concerned.

The law, **P.L. 86-632,** says that employers must grant leave of absence to an employee when he applies for it to participate in military training—whether the leave is for a night or week-end drill or for extended periods.

Upon completion of training, says P.L. 86-632, the employee must be reinstated with the same pay, seniority, and vacation privileges as if he had not been absent.

Normally, the employee must apply for leave each time he expects to be away, but in **the case of regularly scheduled training sessions he may submit the training schedule with one request to cover it all.**

Actually, the new law extends the scope of legislation previously on the books. It now assures members of the Reserve Forces time off to attend all scheduled training sessions, whatever their normal working hours, and guarantees a regular vacation period in addition to time off for field training.—END

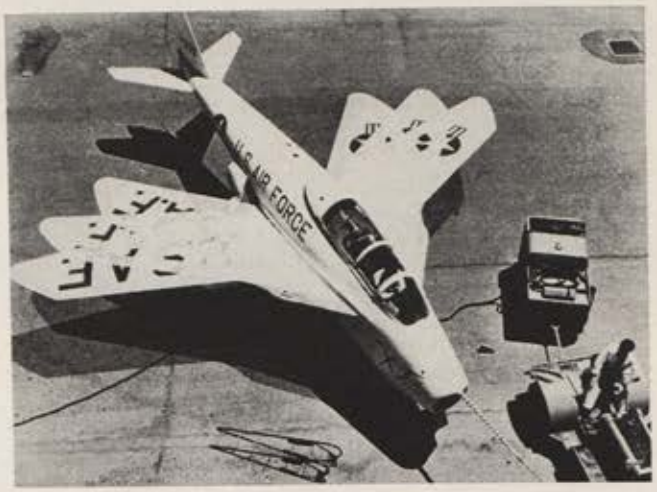
TECH TALK

J. S. BUTZ, JR.

Wings which **change their sweep angle in flight** have quietly but quickly become a **major design tool** of the US airframe industry even though they have never been used on an operational aircraft. **General acceptance** of the variable-sweep wing today marks one of the major about-faces in aircraft design history because it has been a little more than a year since the major manufacturers still nursed a **ten-year-old adverse opinion** of variable-sweep wings which had been created largely by the **Bell X-5** (*see cut*) **and the Grumman XF10F** project for the Navy. Now the same companies have **hundreds of hours of wind-tunnel data** on models of variable-sweep aircraft, and the majority of their current proposals from ground-support aircraft to supersonic transports feature **large changes in wing-sweep angle.**

The transformation of opinion grew out of new variable-sweep design ideas generated at the **Langley Research Center of the National Aeronautics and Space Administration** and the ever-deepening problem of combining good supersonic and subsonic flight characteristics into one airframe. One military aircraft requirement, which proved **absolutely impossible to meet using generally accepted wing design,** was instrumental in causing the manufacturers to experiment with variable-sweep wings along the lines suggested at Langley Field. This USAF requirement, **SDR-1?,** for a **Tactical Air Command fighter** calls for a maximum weight takeoff distance of **3,000 feet,** a range approaching **1,000 miles** when flying **above Mach 1 at sea level,** and a **transoceanic ferry range** during subsonic flight at altitude with a significant payload.

The variable-sweep wing theoretically offers a **strong possibility of meeting these conflicting requirements** by giving excellent performance at altitude and during takeoff with its wings **stretched to their maximum span** and excellent performance at supersonic speeds at sea level when they are **swept back eighty degrees or more.** However, such aircraft generally have been **too stable** and therefore **uncontrollable** with an **ordinary-size tail** when the wings are in the sharply swept position.



First US aircraft with a variable-sweep wing was the experimental Bell X-5, above. Mechanism which varied the sweep was heavy on the X-5 because it had to move the wing forward as it changed the sweep angle so the aircraft would remain controllable. New research shows a light mechanism can be used which simply changes the sweep angle.

The Langley research showed that it is possible to **solve the stability problem** and to build a light mechanism to move the wings. While most manufacturers still were not convinced last summer, most of them now appear to regard variable sweep as a **sure bet to become as common a form of variable geometry as flaps and slats.**

° ° °

Hybrid rockets, using both liquid and solid fuels in the same engine, have been shown in recent tests to have **performance potential rivaling the Rover-type nuclear rocket.** Several manufacturers are running **chemical engines,** which basically operate in the same way as the Rover rocket and achieve specific impulse values approaching **500 sec.** while the Rover is predicted to be **700 sec.** The best conventional chemical engines provide **only about 350 sec.**

In principle the Rover rocket operates simply by passing **liquid hydrogen through a solid-fuel heat-exchanger-type reactor** and then **exhausting it out of a nozzle.** The new hybrid rocket operates in the same way except that a **solid-fuel motor replaces the reactor.** Hydrogen is fed into the top of this solid-fuel unit and mixes with its combustion gases so that the **molecular weight of the exhaust is significantly reduced** and a major **increase in specific impulse is achieved.** Solid-rocket manufacturers have been trying to get **more hydrogen and other light elements** into their propellant mixtures for years, and the general reaction to the hybrid work is wonder at **why it wasn't tried before.** The specific impulse of hybrids is high enough so that with proper structural design **they, like the Rover,** will be capable of putting a **one-stage rocket into orbit.** It is possible that the performance of the hybrid system will be good enough and the **Rover radiation problems** bad

First flight tests of the NASA-Rocketdyne F-1, 1,500,000-pound-thrust, single-chamber, rocket engine are scheduled for 1963. Several types of F-1 engine clusters are being considered similar to the ones that are shown above.

enough for the hybrid engine to **replace Rover** as a ground-launched booster and restrict Rover to operation in space.

° ° °

First flight date for a **Nova** 1,-500,000-pound-thrust single-chamber rocket engine, will be **early in 1963** according to **David E. Aldrich,** manager of the project at Rocketdyne, at the American Rocket Society meeting last month. The **first complete Nova engine is scheduled to run early this year** on a development schedule which is much more rapid than previously announced by NASA, the sponsoring agency.

The formal program is little more than **two years old,** but it has drawn on considerable state-of-the-art work in developing **such components as a turbopump** which will deliver three tons of propellants per second.

Clusters of **up to eight Nova engines** are being planned for first-stage propulsion units which will produce more than **12,000,000 pounds of thrust.** Multistage rockets powered by such units will be able to put **B-52-size satellites into orbit** or send a heavy fighter-size vehicle to the moon and back. The rapid development schedule of the Nova makes it appear certain that by the middle 1960s the US will have **broken through the space-payload resrictions** imposed by the limited size of available boosters. The **Rover** high-performance nuclear rocket and the **Saturn** vehicle with 1,-500,000-pound thrust in the first stage both are due for flight in this time period, with the first Saturn flight tests scheduled for this year.

° ° °

Triservice program is being instituted to develop a **large VTOL transport** which can be used for completely realistic operational testing. Very limited operational data on **downwash debris clouds, flying under service conditions, etc.,** have been gathered with the many VTOL research aircraft sponsored by the separate services. This data is considered absolutely necessary before **sound specifications** can be written for operational VTOL aircraft.

Navy's Bureau of Weapons will manage the joint program, which now calls for the production of **five of the test-bed aircraft.** Specifications for it are now being written by a **joint service group** and are scheduled to be **let out to industry early this year.** It is probable that a **two-month period** will be allowed for manufacturers to prepare proposals to meet the specs, and a similar period will be required for **evaluation of the proposals** and the **selection of a contractor** to build the aircraft. Allowing for normal slippage, DoD sources predict that the VTOL test-bed contract will be awarded **about July 1.**

Several VTOL aircraft designs which have been proven by flight testing during roughly the past five years **will be in contention** for the tri-service VTOL transport award. These designs include the **compound or unloaded rotor helicopter,** and **tilt-wing, tilt-rotor,** and **vectored slipstream aircraft.**

° ° °

The free world's **largest sonic test chamber,** to check effects of **noise and vibrations** on aerospace vehicles and components, is under construction by ARDC at **Wright-Patterson AFB,** Ohio.—END

airman's bookshelf

Thermonuclear War

On Thermonuclear War, by Herman Kahn (Princeton University Press, 1960, 653 pp., $10)

Reviewed by Lt. Col. Donald F. Martin, USAF

This book examines thermonuclear war. It compares the major alternatives that seem available and examines some of the implications in these choices.

Herman Kahn, who studied at the University of California at Los Angeles and the California Institute of Technology, has been a member of the physics division of the RAND Corporation since 1948. He has served as a consultant to the Gaither Committee, the Atomic Energy Commission, and the Office of Civil and Defense Mobilization.

Here he examines the whole range of current thinking on national strategy in an era of thermonuclear weaponry. Both sides of competing theses are analyzed objectively and in detail. A prime example of Mr. Kahn's approach is the handling of the strategic theory of minimum deterrence. He is, first, as persuasive as an ardent minimum deterrent advocate in its behalf. Then he lists what he judges its inherent inadequacies and outright dangers.

On total world disarmament, Mr. Kahn believes that "neither our own emotional desires" for total world disarmament nor the fact that there are "many earnest proponents" for disarmament should sway us toward a position which ignores basic realities. With a proliferation of nuclear weapons in the possession of the United States, Russia, and Great Britain, he says, it would be "child's play for one of these nations to hide completely hundreds of these bombs."

If the agreement ever broke down, the nation which had even a small supply of nuclear weapons would have a tremendous advantage. Because it would be such an overwhelming advantage, it must be assumed that there would be some hiding of nuclear weapons or components.

The author proceeds to evaluate the usefulness of varying types and amounts of military force. The first is minimum deterrence. "The notion is dramatic," he says. "It is that no nation whose decision-makers are sane would attack another nation which was armed with a sufficiently large number of thermonuclear bombs. Thus all a nation that is so armed has to worry about is insanity, irresponsibility, accident, and miscalculation."

There appear to be at least three major inadequacies in minimum deterrence, in his view. First, we could not strike first with such a force even under severe provocation because it would mean our suicide as a nation. Second, if the Soviets struck first at our military force, it is entirely possible that only a rather small percentage of our population would die; we would then be faced with the frightening prospect of sacrificing the balance of our people in a militarily futile act of revenge. Third, it is incredible to ourselves, our allies, and the enemy that we would resort to our own suicide to protect our allies—previous commitments notwithstanding.

One chapter of this book is entitled "Will the Survivors Envy the Dead?" Here, and elsewhere throughout the book, the author argues that we can survive thermonuclear war as a nation and as a people. How successfully we survive will depend on how much effort and resources we put into advance preparations for survival, Mr. Kahn declares. He emphasizes the vast importance of an adequate civil defense program.

The author spends considerable time on "Counterforce as Insurance." He judges that we require a force that can: (1) create widespread thermonuclear devastation *to discourage an enemy from using his nuclear force against our cities and people*, and (2) can survive a surprise attack and go on to win a war against the enemy's military force.

Mr. Kahn's principal thesis is that if we come to understand thermonuclear war better, there is a chance it can be avoided, and that if it is not avoided our thorough understanding of it could undoubtedly save millions of lives.

This book will unquestionably evoke much interest. It may justly be said that no military man's library, regardless of his branch of service, will be complete without it.

About the reviewer: *Lt. Col. Donald F. Martin is currently assigned to the Office of the Assistant for Coordination, Deputy Chief of Staff, Plans and Programs, Headquarters USAF.*

Toward the Stars

***Always Another Dawn: The Story of a Rocket Test Pilot*, by A. Scott Crossfield with Clay Blair, Jr. (The World Publishing Co., Cleveland, Ohio, 1960, 413 pp., $4.95)**

Reviewed by Lt. Col. F. X. Kane, USAF

Always Another Dawn is a unique account of the era of the rocket test pilot and particularly of the X-15. It is a story no one else could tell, a notable insight into the nature of a pilot's pilot. Often in life the people who go the farthest in their professions have the most difficulties to overcome. By all odds, the childhood illnesses of Scott Crossfield should have ruled out any thought of being a pilot, let alone a rocket test pilot. Perhaps the fight to survive gave him the stamina, the desire to succeed which made him the first X-15 pilot.

As Crossfield says, there is no penalty for being late. He joined the stable of notables in research aircraft flying after Yeager had already passed the sound barrier. His apprenticeship in civilian flying and as a Navy pilot, his graduate education as an engineer, paved the way for joining the old National Advisory Committee for Aeronautics. Typical of his spirit was his first flight in the X-1 test ship, made when he had three broken ribs. Crossfield entered into the competition with Yeager to be the first to fly Mach 2. His first claim to fame was that he was the first man to fly twice the speed of sound. Later Yeager was to exceed this speed.

As one of the NACA pilots at Edwards AFB in California, Crossfield flew the early versions of the experimental research aircraft such as the Skyrocket, the X-4, and the X-5. Also, he conducted many of the tests on the Century series and other high-performance aircraft. However, the desire to be the first X-15 pilot led him to leave the NACA, now the NASA, and to ask North American to take him on the engineering staff in the early stages of the design of this new rocket research craft. Thus, Crossfield lived with the new aircraft from its earliest stages. His extensive experience provided an excellent background for advice and recommendations on the design of the X-15, in particular on the escape system. The design of the pressure suit was influenced by some

(Continued on page 113)

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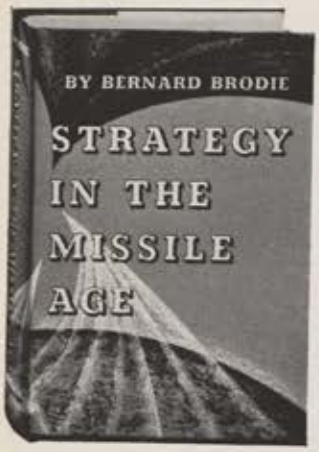

Strategy in the Missile Age. Bernard Brodie. Retail $6.50. Member's price $4.90.

Dick Bong: Ace of Aces. Gen. George C. Kenney. Retail $2.95. Member's price $2.45.

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

Man High. Lt. Col. David Simons, USAF. Retail $4.50. Member's price $3.95.

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of his recommendations. In short, he made a unique contribution to rocket aircraft flying by participating in the program from design through first flight and up to acceptance by the NASA and the Air Force.

This is a highly personal account told in the first person but without dramatics or heroics. The action-packed, demanding flights of short duration but great importance to the test program are recounted in a matter-of-fact way. The net effect is the underplaying of incidents which in themselves could be expanded into full stories. At times the glimpses are almost episodic. No butterflies in the stomach, no palm sweating, no introspection about danger are found in the telling of even the most potentially explosive situations. Crossfield goes on record early in the book in ruling out fear as part of the makeup of a rocket test pilot. He merely recalls uncertainty with a plan for being jettisoned in case of trouble.

The reader will learn also that even the most experienced rocket aircraft pilot makes mistakes. Crossfield acknowledges that he makes pilot errors. But he leaves it to the reader to reconstruct the tremendous pressure created by urgency, by the press of the clock, by the need to succeed. No flamboyant extrovert, Crossfield is a pro, tops in his business, but he is human. He is a man, and the style in which his story is told makes the reader understand him—as well as this whole crazy business of rocket test piloting and shooting for the stars—all the more.

About the reviewer: *Lt. Col. Francis X. Kane is Special Assistant to Lt. Gen. Roscoe C. Wilson, DCS/Development, Hq. USAF.*

Crisis By Distortion

***The Crisis We Face*, by George Steele and Paul Kircher (McGraw-Hill, 1960, 220 pp., $4.95)**

Reviewed by Col. Paul S. Deems, USAF

The Crisis We Face is another "Doomsday USA" book. The authors have taken a long, unhappy look at our defense establishment—and the best they can say is that, in their opinion, we're in bad shape and things will get worse before they get better.

Since they have been extremely critical, one would have expected some reaction. The most immediate was that of the Navy's Chief Scientist, Dr. John P. Craven, whose angry letter to Morton Reicheck, military correspondent for McGraw-Hill Publishing Co., was widely reported by the newspapers. Those who have bothered to read the book—and the number in the military community seems small—are generally enraged by what Dr. Craven characterized as "the totality of half-truths, distortions, innuendoes which are employed throughout the text to imply the existence of a morally and scientifically bankrupt defense community."

Messrs. Steele and Kircher quite plainly overstated their case, and did so on the basis of a completely erroneous concept of the relationship between the weapons they condemn as "hypercomplex and inoperable" and US national strategy.

The authors are collaborating in their first book. *The Crisis We Face* is the second for Paul Kircher, who also wrote *Electronic Computers and Management Control* with George Kozmetsky for McGraw-Hill in 1956. Mr. Kircher is a graduate of the University of New Mexico, with a doctorate from the University of Michigan. He is a Certified Public Accountant, a member of the Research Society of America, and presently an Associate Professor of Business Administration at UCLA.

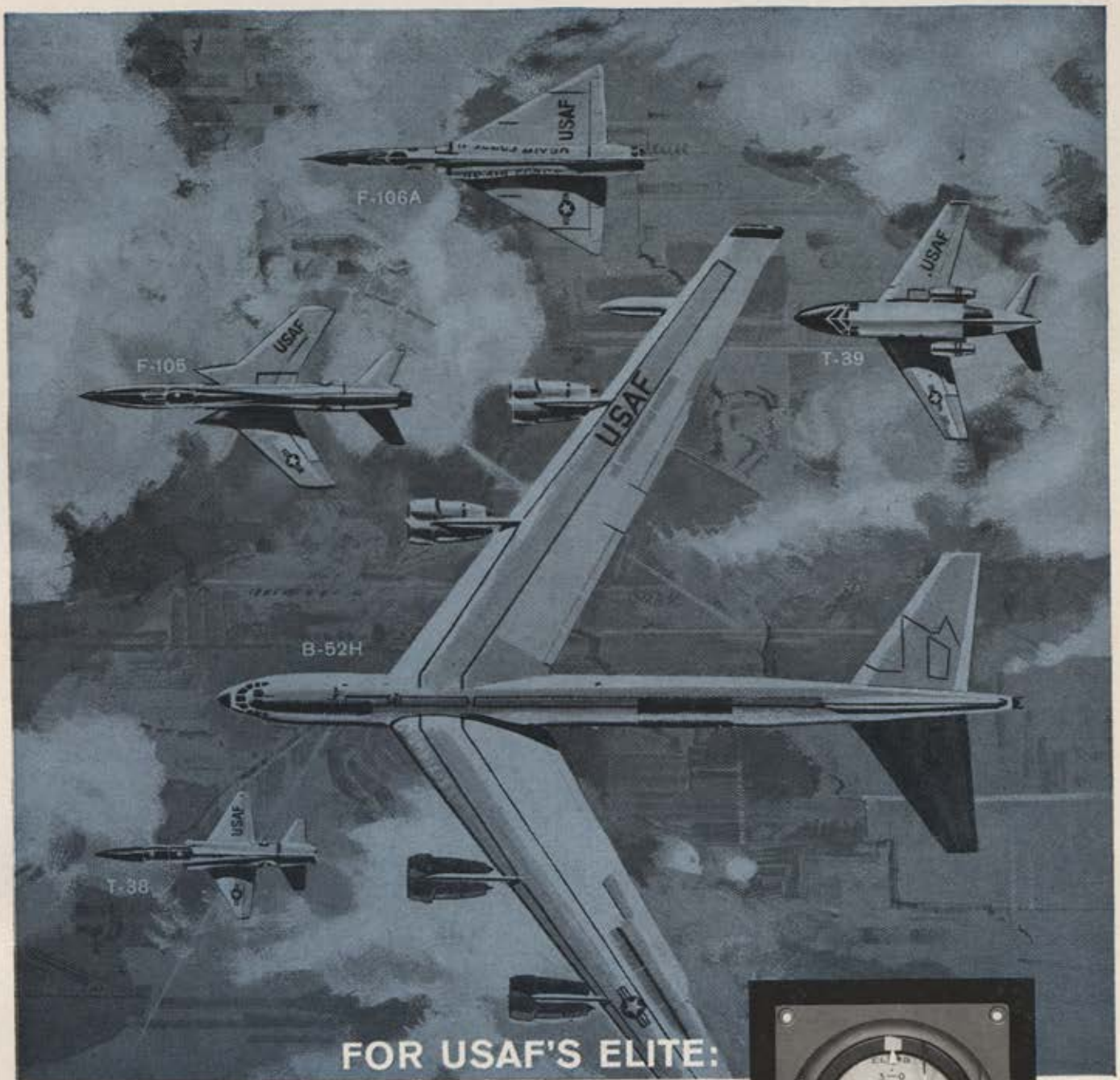
Floyd George Steele, the senior author, has been described as "a unique national resource" for his many original contributions to computer design and production. His experience goes at least back to Snark and Northrop in 1948. He has founded several computer production companies and at present operates as an independent consultant on computer design and development.

In a nutshell, the authors blame inept management for producing complex and unreliable weapons which won't do the job required of them. Since the authors patently don't know what the job is, their solutions are as totally erroneous as their analysis of the problem. And the analysis isn't altogether honest, by a long shot. They ignore—one almost has to conclude, deliberately—the significant management improvements effected in ARDC by General Schriever, and Navy's PERT.

The clue to what the book is about appears on page 11. The authors state, ". . . The crisis is characterized by the following conditions:

"1. We depend for survival upon *automatic* weapons.

(Continued on page 115)



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SPERRY

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AQU-2/A HSI

"2. Our *automatic weapons have become too complex,* in number of parts, *to be reliable.*

"3. At the same time *these weapons have not enough automatic response* to satisfy immediate, much less future, needs.

"4. The fact that our automatic weapons seldom work, without preparations and delays that would not be permissible in wartime, remains generally unrecognized.

"5. Most of the complexity is unnecessary. *It is due to organization failure.* The failure to correct it is also due to organization failure."

The italics are mine. It is easy—as I did at first—to get ensnared in the discussions on organization and automation design, and to miss the real fallacy: that we depend for our survival on "*automatic* weapons." All weapons (except the M-14 rifle) are criticized on the basis of their reliability: the B-52, Atlas, Titan, Sky Bolt, Polaris. The real whipping boy is Minuteman. Minuteman was supposed to be simple. As it turns out, Minuteman will be worse—according to the authors' gloomy but refutable forecast—than Atlas on almost every score.

It is more complex, they state, than first-generation missiles, by several layers of automation. Automation in a missile, by the way, consists not only of the integrated guidance and control mechanism of the missile itself, but the "layers" of additional automation required to check the missile systems out, to check and recalibrate themselves, and to launch "automatically."

This unnecessary complexity results, they say, from defense contracting procedures, an improperly automated industrial base still operating with linear assembly-line methods under an archaic division of labor organizational concept, and ineffective DoD planning and control.

There have been many proposals for reorganization of the Defense Department, but none like Steele's and Kircher's. Suffice to say that they would charge RAND, or a similarly objective study group, with all war planning at the DoD level. It would be called the Operations Analysis Group of the Secretary's War Strategy Staff and would work in coordination with the Weapon System Analysis Group (monitors system changes), the Automation (design and contract supervision) and the Time and Cost Group. A separate Information Control Center would report on programs by purpose, dollars, schedule, and "physical achievement," whatever is meant by the latter.

Industry (or business: the terms seem to be interchangeable) would be similarly reorganized. This (somehow) would enable the hotbed greaser boy to bypass the shop foreman, the foreman's boss, and the boss's boss, to tell the Chairman of the Board (who is an old maintenance man himself and not a malassigned scientist) how to redesign the cannon so it can be loaded from the muzzle. This would be simpler and more reliable than loading from the breech. The reorganization keeps Sales, Comptroller, Advertising, and Styling from lousing up good, simple ideas.

After you have a simple missile, what?

The authors reveal themselves further on page 125, while discussing long-range technical problems. They say, "The fact that Atlas has so much more range than the V-2 does not mean its guidance is necessarily more difficult. Suppose the Atlas had merely copied the German V-2 guidance, with practically no changes, but a little 'polishing.' We would find that this gives accuracy of about one-half percent. With a 3,500-mile range to Russian bases and a five-megaton warhead, this would mean that a single missile would be accurate within about seventeen miles and would destroy most of a city.

"Today this would provide a very effective deterrent, indeed, if we had many dispersed sites with such missiles."

Now that we know why accuracy is unimportant, why the additional accent on reliability?

". . . There is a great difference, in atomic warfare, between the immediate response and the hesitant reaction. Pressures and blandishments can be effective only in the latter case."

"It must be clearly understood," continue the authors, "that the important consideration is not whether the President will actually decide one way or another [to retaliate or recall forces after an attack] but whether the Russians think they can use such a tactic as part of a war scheme, once they have decided on a strategy of risking conflict. Any kind of apparent weakness in our position, real or not, weakens our deterrent posture. If the Russian planners see us as weaker

(Continued on page 117)

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they will act accordingly. A deterrent defense must remain plausible to the enemy—not to ourselves."

Reliability is necessary to the *automatic* response, and what the authors have finally constructed is a Doomsday Machine. You blow me up and I'll blow you up, too. Reliably and automatically.

The last chapter, the most sensational of all, is devoted to proving why our present retaliatory system can't work. If we persist in doing things our way, instead of the more sensible Russian ways that have been indicated here and there, we will probably lose both the Ruble War and the Real War. But, they intone on the last page, "If we lose and die, we are still much better off than the Communists. Forlorn atheists, the world is all they have. We have eternity."

So far as I am concerned, I think there is too much irresponsible writing about defense as it is, and this ranks near the top for irresponsibility, not to mention misinformation, faulty reasoning, and improper assumptions.

Incidentally, there are only five "commands" that can be given Minuteman, and less than a dozen responses—and two of the latter have to do with trespassing. Does this sound very complex?

About the reviewer: *Col. Paul S. Deems is currently assigned to the Office of the Assistant for Coordination, DCS/Plans & Programs, Hq. USAF. He is the author of the primer, "Strategy from A to Z," which appeared in last month's* AIR FORCE/SPACE DIGEST.

Aerospace Books

Wind on My Wings, by Percy Knauth (Doubleday, $3.95), adds another to the many recent books by private flyers describing the newly found, exhilarating world of the air, and passing on to "fledglings" and fellow amateurs advice and tips in form of personal experiences. As a piece of flying literature, this one ranks them all, for Knauth's prose is descriptive, flowing, and in spots poetical. He covers experiences from his first solo to his small-plane flight across the Atlantic.

Now available in handy, pocketbook form is the encyclopedic second edition of the *Air Force Blue Book*, 1961, edited by Tom Compere and William P. Vogel, Jr. (Military Publishing Institute, $1.50, paperback; Bobbs-Merrill, $4.95, hard back). Similar in format to last year's model, this handy reader-reference contains thirty-four articles on various facets of AF operations from recruiting through the B-70. In addition, more than half the book comprises an almanac fact section containing ready source to a multitude of AF facts, historical and current. The recently published *Army Blue Book* and *Navy Blue Book*, similar in format and design, complete a trilogy which makes a practical military reference shelf.

Drew Middleton, New York *Times* London Bureau Chief, recreates the turbulent summer and winter of 1940 in *The Sky Suspended: The Story of the Battle of Britain* (Longmans, Green, $4.50). His narrative reflects detailed research. Middleton was an Associated Press correspondent in Europe during this period.

A deep dip into air history is taken by Henry R. Palmer in *This Was Air Travel* (Superior Publishing, $11.95). It is a picture story of aviation, from the days of early ballooning to the commercial jets today. Emphasis throughout is on civil aviation transportation. Few aspects of military air are covered. Scores of unique early air photos trace commercial air development in Europe and America. Captions and introductory text carry the narrative account. An appendix contains design and operational specifications of all craft featured.

More than 400 photographs, many rare prints, illustrate Martin Caidin's ambitious and distinguished *Golden Wings* (Random House, $10), a 232-page pictorial history of the United States Navy and Marine Corps in the air. This 60,000-word narrative picture history is a counterpart to his 1957 *Air Force: A Pictorial History of American Airpower*.

—MAJ. JAMES F. SUNDERMAN

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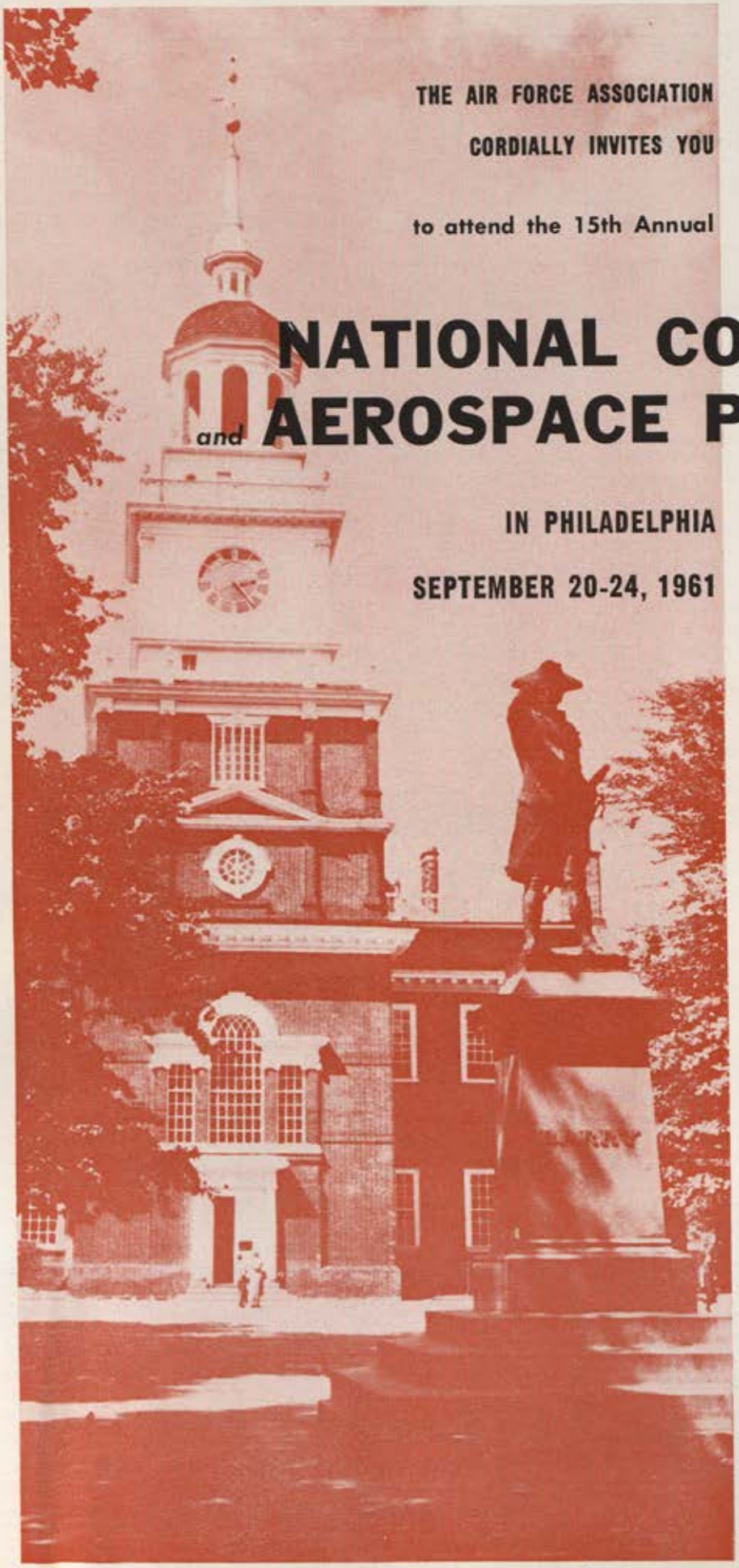

Make your plans now to attend AFA's 1961 Annual National Convention and Aerospace Panorama which will be held in Philadelphia, the birthplace of our nation. Philadelphia, without doubt, is the richest city in the United States from the standpoint of historic colonial lore and the establishment of liberty and freedom. Independence Hall, located in the heart of Philadelphia, is the most historic structure in America. Here in 1775 the Second Continental Congress met and decided to resist England. Here George Washington accepted the role of Commander in Chief of the Continental Army. The Declaration of Independence and the Constitution of the United States were both signed here.

Just as Philadelphia was the pioneer in the establishment of liberty, so today this city is one of the most progressive in America. You will be impressed with the new, modern Philadelphia that is constantly building for the future. This is evidenced by the expansive urban redevelopment, expanding transportation systems, ribbons of expressways leading quickly to center-city hotels, Convention Hall, and the International Airport. Newly developed Independence Mall is in the center of old Philadelphia. Philadelphia is also known to be one of the most diversified industrial cities in the United States and a center of aerospace industries.

The AFA Housing Office will open in Philadelphia February 1 and will begin confirming requests for hotel accommodations soon after. The next issue of AIR FORCE Magazine will contain full information of hotels and rates and a tear-out reservation request form.

AFA NEWS

SQUADRON OF THE MONTH

Boise Valley, Idaho, Squadron, Cited for

effective support of AFA objectives in planning and sponsoring an outstandingly successful aerospace education program for the community.

Boise's fine AFA Squadron sponsored a **two-day aerospace education** conference in Boise High School auditorium **November 4 and 5.** It featured a trio of speakers covering the **full spectrum of the aerospace age.** Speakers and their subjects included **Miss Laurel Van Der Wal,** Space Technology Laboratories scientist, who spoke on **"Man in Space"; Dr. Donald F. Kline,** F. E. Compton Company Research Director, who discussed **"The Aerospace Education Mission"**; and **Brig. Gen. Cecil E. Combs,** AF Institute of Technology, Wright-Patterson AFB, Ohio, covering **"Current and Future Technological Requirements."**

The program, successful in every aspect, was **cosponsored by the Idaho Wing of AFA and the Boise public school system.** It included presentations to the student bodies of **Boise Junior College and Boise and Borah High Schools** and a banquet in Boise High School at which awards were presented by the Wing to individuals selected for their contributions to aerospace education. Among these were **Dr. Delbert Engelking,** State Superintendent of Public Instruction; **Dr. Donald Mammen,** Director of Secondary Education in Boise; and **Mrs. Ted Wilson,** a first-grade teacher in Nampa, Idaho.

We're proud of the fine effort of the Idaho Wing and the Boise Squadron, which acted as host, and are pleased to recognize this group as our **Squadron of the Month.**

• • •

AFA's Organizational Advisory Council met in Washington on December 2 to consider **organizational problems** brought to its attention by units and individual members across the nation. A **full report of its deliberations will be sent to all units** in the near future. But it can be reported at this time that the council discussed a wide range of problem areas and made **several specific recommendations** to be acted on in the immediate future.

Subjects discussed included **membership and programing in units.** The council recommended that a **supplement to the Commander's Handbook** be prepared to assist in developing effective community programs. It was also revealed that **AFA's fifteenth anniversary,** February 4, 1961, will be the occasion for a **nationwide series of programs** observing the anniversary. The week of February 4 through 11 will be **"AFA Anniversary Week."** Details and suggested types of programs will be sent to all units soon in the form of an **Anniversary Kit.**

(Continued on following page)

Squadron Commander Tom Mason greets Jimmy Doolittle at anniversary lunch of Chico, Calif., Squadron. First AFA President and his wife spoke to Chico Squadron assembled at luncheon.

Boise Squadron education program participants Dr. Donald Kline, Miss Laurel Van Der Wal, and James M. Trail (*see text*). Trail, Squadron Commander Chuck Roundtree, and former Wing CO Dale Hendry headed the AFA group.

Bill Claiborne, left, Wing Vice Commander, presents an award to Carl Warner for Dr. Delbert Engelking, State's Commissioner of Education, in Idaho program. Engelking was instrumental in sponsorship of the major function.

Air Force Academy's Capt. R. A. Stevens told Academy story in Syracuse with AFA sponsorship. Here he stands with, from left, State Commander Gordon E. Thiel, AFA National Director Alden A. West, the Commander of the 26th Air Division, Maj. Gen. Henry Viccellio, and Syracuse Commander Douglas L. Deal.

Under the direction of **Wing Vice Commander Ed Gagliardi,** Pennsylvania's **Beaver Valley Squadron** sponsored a **"Meet Your Air Force Day"** in Ambridge on November 9. It still has the local citizenry talking.

Taking its cue from a **Pittsburgh Squadron** program last year, the Squadron invited officers representing several facets of USAF to come to **Ambridge** for a day-long program featuring conducted local tours, radio and television interviews, and finally a **panel program** at which the individual Air Force officers detailed their specific responsibilities and answered questions directed to them from a large audience. An added touch was the distribution by the Squadron of banners reading "Welcome Air Force" to all **merchants along the main street.** They lent a festive air to the occasion.

Speakers included **Brig. Gen. Henry Thorne,** Commander, 3500th USAF Recruiting Wing; **Lt. Col. Edwin Balch,** USAF Reserve Training representative; **Lt. Col. Francis Kane,** ballistic missile expert from the Pentagon; **Maj. J. W. Hassard** and **Maj. Frank Russo** of Information Office, Headquarters USAF. Panel moderator was **Lt. Thomas Cindric,** USAF, past National Commander of the **Arnold Air Society** and now stationed in Pittsburgh. These programs designed to acquaint communities with the USAF mission are excellent. The **Beaver Valley Squadron** deserves much credit for the sponsorship of this event. We congratulate the officers and members on an outstanding function.

* * *

For the fourth consecutive year, the **Syracuse Squadron** has sponsored a series of community programs designed to acquaint **area high-school students** with the advantages of matriculating at the **USAF Academy.** Their efforts have proved most successful. From November 16 through 18, through Squadron sponsorship, USAF **Capt. Randolph E. Stevens** of the Academy met with interested students in twelve area schools. He discussed admission requirements and procedures, and the Academy in general. To date the Squadron has been directly responsible, through this program, for the **appointment of seven Cadets.** All are currently enrolled.

On the last night of his visit, Captain Stevens spoke to Squadron members on the Academy. **Maj. Gen. Henry Viccellio,** Commander, 26th Air Division, whose son is a Cadet at the Academy, discussed some of his experiences there.

Programs such as this, emphasizing the **advantages of an Air Force career,** are also excellent events for our Squadrons to sponsor. We urge interested outfits to contact the **Syracuse Squadron** for particulars.

* * *

A majority of the **Squadrons in California** were well represented at the **Ambassador Hotel in Los Angeles on November 11 and 12** for the annual **Wing Mid-Year Conference.** Hosting the meeting was the **L. A. Group,** under the able direction of **Commander Ronald McDonald. Bill Gilson,** Chairman of the Wing Executive Committee, was in charge of the program, along with **Wing Commander John Beringer.**

Feature of the week end was a "Pre-Victory" dinner dance on Friday evening, prior to the Saturday **football game between the USAF Academy and UCLA.** It proved to be a fine program, but the theme turned out to be a bit overoptimistic. The Falcons lost the game the next day.

Maj. Gen. William E. Stone, Academy Superintendent, was guest speaker at the banquet. He was introduced by **Joe E. Brown,** an old friend of AFA (*see cut*).

During the business sessions of the conference, the Wing **approved plans for the 1961 combined Western States Conference** in Las Vegas to be held April 7 through 9. This program will **replace the Wing Conventions** of the three states comprising the Far West Region. It will feature an **aerospace education symposium, a seminar on the present and future mission of the USAF, and business sessions** for AFA units in the Region. **Barney Rawlings,** a member of the Board of Directors, is Chairman of the event, assisted by **John R. Alison,** former National President of AFA.

(Continued on page 123)

Maj. Gen. William E. Stone, USAF Academy Superintendent, is introduced to California Wing Mid-Year Banquet by Joe E. Brown at the Hotel Ambassador, Los Angeles. Also shown at table are Mrs. George Sanchez, wife of Wing's Treasurer, and Mrs. Stone. Stone spoke on life at the Air Force Academy.

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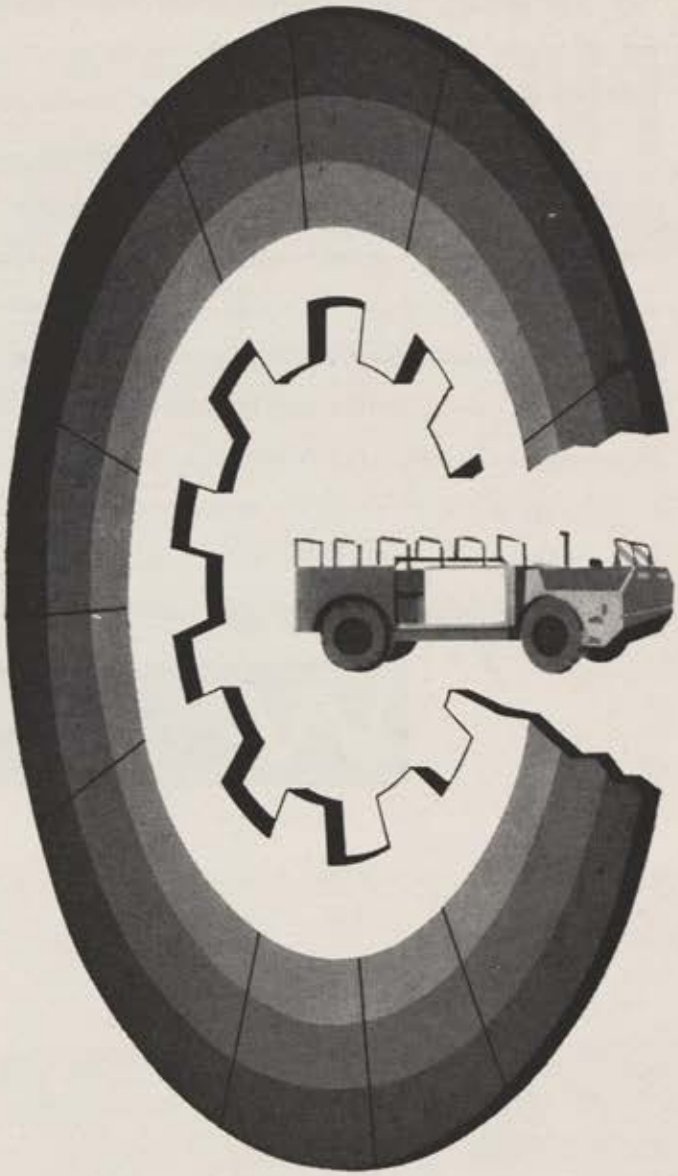

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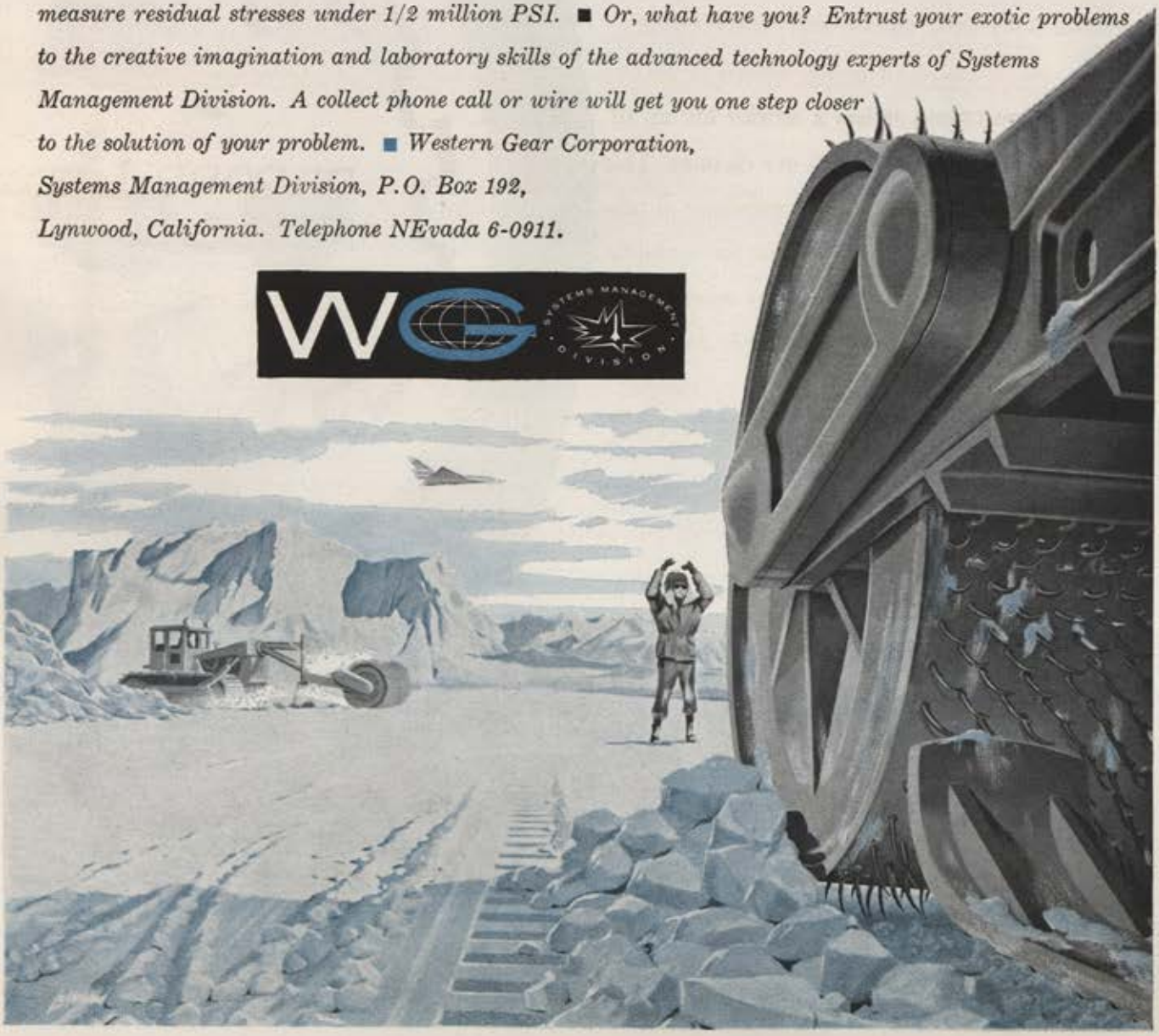

AFA NEWS——CONTINUED

Under the **inspired leadership of Edward "Bo" Barber,** Commander, the **Miami Squadron** on November 11 and 12 sponsored a fine briefing at **Cape Canaveral** for over **200 civic leaders** from throughout the Sunshine State. The program included briefings on the **operation and the mission** of facilities at Cape Canaveral, **presentations** by several officers assigned to the operation, and a **banquet** at which the principal speakers were **State Senator Fred O. Dickinson, Jr.,** West Palm Beach, and **Col. George M. Knauf,** Staff Surgeon and Assistant for Bio-Astronautics on **Project Mercury,** the national man-in-space program.

General Barber had discovered previously that **Patrick AFB,** named after the late **Gen. Mason M. Patrick,** owned no portrait of the General. So Barber, on behalf of the Squadron, commissioned **Mrs. Nancy Evans,** wife of **former Miami City Manager E. A. Evans,** to paint an oil portrait. It was **presented to the Base during the dinner,** an added highlight of the occasion. Barber made the presentation. The painting was accepted by **Maj. Gen. Leighton I. Davis,** Commander, Patrick AFB.

° ° °

CROSS COUNTRY . . . Jerome Boxer, 59 Franklin Road, Scarsdale, N. Y., asked us to help him in lining up a roster of **former members of the 462d Bomb Group,** 20th AF, with an aim to arranging a reunion. If you know of any former personnel of this Group, please ask them to contact him. . . . **Chico, Calif., Squadron** advises us that **F. H. Raymond,** head of the State Forestry System, was its guest speaker at a luncheon on November 18 at the Hotel Oaks. His topic of discussion was **"Uses of Military-Type Aircraft in Control of Forest Fires."** . . .Although the Housing Office for the handling of hotel requests for the **1961 National Convention at Philadelphia** does not open for the general public until next month, AFA leaders will receive **detailed information in a couple of weeks.** Seems like long lead time, but experience has shown that the best hotels fill up fast. . . . The state **Department of Education, Arnold Air Society, and Massachusetts AFA** units plan to cosponsor an **aerospace education program** in Boston, February 11. . . . January 28 has been announced by the **Colorado Springs Squadron** as the date for its annual dinner honoring the USAF Academy football team. **Board member and former South Dakota Governor Joe Foss** has been invited to speak.

—Gus Duda

USAF's 1110th Balloon Activities Squadron, located at Goodfellow AFB, Tex., is a unique organization. Building on a tradition stretching back to the eighteenth century, it performs functions no other Air Force unit can in gathering information about the upper air . . .

GOING UP UP . . . UP

MAJ. Keith Swisher strode vigorously into his squadron operations office at Goodfellow AFB, Tex. The operations sergeant looked up from his desk.

"Another high flight today, Major?" he asked.

"Looks like it, Sergeant," Swisher answered. "If we don't get cloud cover over eastern Oklahoma, we'll be able to get to 120,000 feet before we have to bring her down."

The sergeant nodded matter of factly and handed the major some flight-plan forms. "Taking the Gooney and the chopper on this one?" he asked.

The major nodded affirmatively and filled out the forms. He put down takeoff time as 0530 hours and forecasted landing time as 1245. The destination was listed in longitude and latitude instead of by place name.

"Think the weather will hold, Major?" the sergeant asked.

The major nodded again. "It's scheduled to start kicking up some dust around 0500 this morning, though. If the surface wind gets over twelve knots, we'll have to call it off."

An odd conversation for the space age? Not at Goodfellow, home of the Air Force's 1110th Balloon Activities Squadron.

Maj. Keith D. Swisher is Squadron Commander of the 1110th. The unit he commands is made up of nine officers and forty-two airmen, each with unique qualifications. Their job: launch balloons for the Air Force for scientific purposes. Their balloons are contributing to the Air Force of tomorrow in a way no other unit can.

Typical launching of an Air Force balloon shortly after dawn at USAF facility in California. Balloons perform important high-altitude scientific data-collection for USAF throughout the world. There is no cheaper way for man to explore the unknown.

Ever since the first manned balloon flight in 1783, military men have been interested in balloons as research vehicles and a means to reconnoiter enemy forces. During the Civil War, Yankee forces used balloons to observe deployment of Confederate forces. During World War I, they were again used as observation vehicles, but with only limited success because they could be shot down fairly easily—as "balloon-buster" Frank Luke proved. In World War II, balloons were widely used for gathering upper-air data.

And today they are still used for this purpose; for even in the space age there is no cheaper way to explore the unknown above than with the faithful balloon. It can get up to altitudes above 100,000 feet, travel slowly, stay up for significantly long periods of time, and come back with valuable data for the use of later high-flying aerospace explorers. Knowledge on cosmic and other radiation temperatures, air composition, pressures, and other phenomena which was collected by balloons months and years before will help X-15 pilots

Lt. Col. Carroll V. Glines, USAF

IN THE SKY

Here balloon in launch arm is being inflated prior to launch. "Bags" are made of polyethylene, are filled with helium. Balloons cost between $750 and $3,500, the helium used in one flight in the neighborhood of $500.

and their successors on the road to space.

It has been estimated that more than 4,000 balloons are released daily in the United States—almost all of them to obtain information about the upper air. The US Weather Bureau accounts for most of them, with its balloon soundings for routine data on winds aloft traveling to 60,000 or 70,000 feet. Also, many balloons are launched by research organizations seeking knowledge about the still relatively unknown air at 100,000 feet and above, where the X-15 and other experimental vehicles will operate. The balloon, far from being a relic of the past, has become one of the most useful helpmates to the burgeoning aero and astronautical sciences.

I asked Major Swisher what kind of data the 1110th gathers on its balloon missions.

"Scientists want to know everything possible about the upper atmosphere," he answered. "They want information about ozone content, infrared transmissibility, cosmic rays, water vapor, temperature, pressure, and the distribution of the elements. They want actual samples of the atmosphere and the 'particulate debris' that is floating around, so they'll know exactly what's up there and how it varies from day to day, week to week, and season to season."

Does the 1110th have any special problems in flying the balloons that other Air Force units don't have?

"You bet we do," replied Capt. M. E. Johnson, operations officer for this unique Air Force unit. "We have to plan each flight to avoid penetrating areas of high-density air traffic or highly populated regions. This problem alone can be a tough one when you consider how crowded our airways are today. There are very strict regulations concerning balloon flights—regulations that are necessary for the protection of all aircraft.

"But our biggest problem is predicting the point of landing of a balloon that goes up to 120,000 feet or more. We've got to figure our upper-air trajectories so that we can tell as accurately as possible where it is going to land. This requires quite a bit of mission preplanning, as you can imagine."

Predicting balloon trajectories is a specialized science. For that reason a weather officer and two full-time airman assistants are assigned to the 1110th. They must make a continual analysis of the upper air, sky cover, and surface-wind velocities both at the launch site and en route to and at the predicted recovery site.

"Let's review an actual mission to see what must be done by the balloon crews to gather some routine data," Major Swisher suggested. "As with any other Air Force unit, our missions are laid on by our headquarters, which is Headquarters Command at Bolling AFB, near Washington. Let's say we are to gather some air samples at 120,000 feet during daylight hours over Texas. Capt. Jim Taylor, our weather officer, is usually the first member of the unit to get in the act. He studies the general weather picture and comes up with a probable launch date.

"He must try to choose a day when the cloud cover will not be over five-tenths, ground winds not over twelve knots, and upper winds such as not to take the balloon over a populous area, through a heavily traveled airway, or out of the country. When he announces probable launch date, the rest of the unit's sections begin a series of preplanned actions.

"Captain Johnson works up his operations order. He figures a flight profile, decides the kind of plastic bag to be used, the type of payload to be carried, amount of gas needed, and the crews to be alerted for the mission. He must then coordinate the mission with the FAA, giving them location of the launch, estimated launch date and time, forecast time of penetration of the 44,000-foot level, and the predicted airspace involved in the ascent and descent.

(Continued on following page)

"When the mission is firm," Major Swisher continued, "each section coordinates with each other and works out the respective plans. Instrumentation personnel get the electronic brain of the payload together; launch crews gather their equipment and rig the packages. When everything is assembled, thorough checks are made of the entire assembly separately and then together to make sure there will be no malfunctions.

"When the day comes, if the weather is as forecast the crews are called out at 0200, eat their breakfast, and report to the launch site about 0300, ready for a long day. The gas trailer, launch truck, tugs, and other vehicles are placed in position. The polyethylene bag is carefully laid out on a ground cloth to protect it from abrasions. No watches may be worn, and all men wear gloves to keep from snagging the delicate plastic. The various pieces of the 'balloon train' such as the twenty-eight-foot parachute, separation blocks, safety timer, suspension bar, and ballast hopper, the 'grab bag' with its collection blower, and the instrumentation package with its radio transmitter are all attached. The helium trailer is driven up, and the inflation hose is hooked to the manifold. The helium then is passed into the main bag through a ninety-foot sleeve, and the bag starts to inflate. Slowly but surely the lifeless plastic takes shape and rises. Meanwhile, the weathermen watch the surface wind because launches are not usually made if the ground wind gets over twelve knots.

"If the weather is OK, if the balloon doesn't tear, if the instrumentation package passes the final check, if the FAA doesn't have aircraft traffic in the area, if all equipment functions, then we're ready to launch. In fact, there are more *ifs* in balloon operations than in almost any other kind.

"At the launch officer's signal, the release man holding the launch arm down snaps the lever, and the balloon snaps upward. The driver of the truck holding the instrumentation package and other gear slowly drives under the bag and in the direction it's drifting. At the precise moment the bag and all its load are fully stretched out overhead, the balloon is released from the truck and begins its ascent," Major Swisher said.

"But takeoff is not the end of our responsibilities," he added. "In fact, it's only the beginning of a long and sometimes exciting day because we've got to follow that balloon through its entire flight. We do this by using theodolites, helicopters, a C-47, and radio-compass equipment. As soon as a balloon takes off, we have a helicopter follow it usually as long as it is in sight. Sometimes we use the C-47 on long missions to keep following while the chopper is refueling at some intermediate stop. When it gets too high to see easily with the naked eye, we use our radio-compasses tuned to the balloon's transmitter while the theodolite men watch it through their telescopes back at the takeoff point.

"When it reaches the planned altitude, a multicam control unit with extremely accurate synchronous motors starts the blower, and air is drawn into the collection bag. When the mission is complete, an electronic signal opens a gas-escape port, and the balloon begins its descent. As the load descends, the air in the collection bag is transferred to a 'grab bag' where it is sealed off automatically.

"According to regulation, we must make track notifications to the FAA Air Traffic Control Center. When cut-down time comes, we'll tell the FAA of the balloon's track, ground speed, position, forecast position when penetrating the 44,000-foot level, and the expected time and location of impact. So, again, you can see how many variables can creep into a seemingly simple balloon flight and can imagine how meticulous our flight planning and flight following must be."

Instrument load to be borne aloft under balloon. Instrumentation can vary widely according to object of the particular high-altitude mission.

When the balloon nears a landing, the recovery crews go into action. They follow it to its impact point and land nearby to stop the balloon train from dragging across the ground and causing damage to private property or the delicate instruments. If air samples have been gathered, the recovery crew must immediately hook up a compressor and force the air into a small container at prescribed temperatures and pressures to be sent to the laboratory for analysis. By this time, at least eight hours may have gone by from launch time to recovery time, depending on the mission. Occasionally, two or three days may have passed before the balloon is brought down. The flying crews may have been in the air much of that time and are anywhere from 2,000 to 3,000 miles from the launch point.

Do the crews ever have any unusual experiences?

Some of the landings have been extremely interesting. The hope is that a balloon will come down in a nice, wide pasture. But they often do not. Crewmen have picked them from trees, lakes, swamps, snowdrifts and, once, right off a busy Los Angeles freeway. They have been chased by bulls, irate farmers, and school kids asking for autographs. In South American operations, they have had to fight the Brazilian jungle, snakes, ants, dust, heat, and language barrier to recover their gear. On occasion natives have ripped balloons to pieces.

Once a crew recovers the all-important payload, the plastic bag is generally destroyed or given away. One flight is all each bag can take. Each contains enough plastic to cover half an acre. They

(Continued on page 129)

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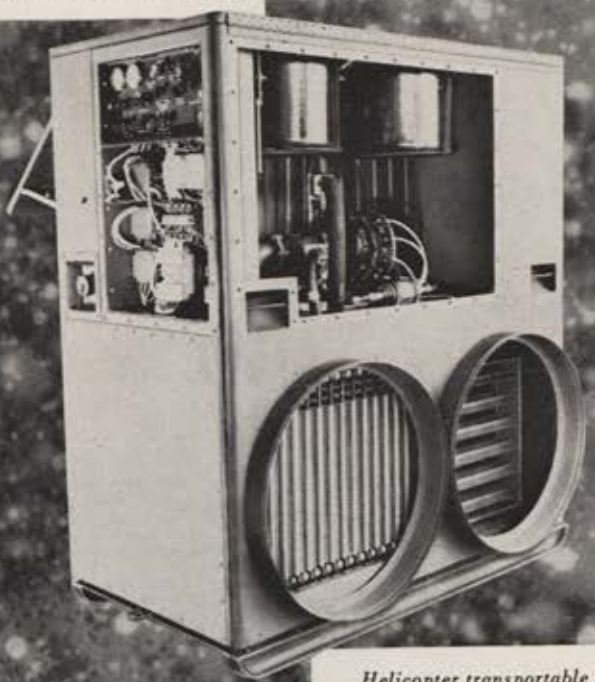

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The cost of ballooning depends on the mission. A large balloon with a highly instrumented load required to go to very high altitudes for a long time may cost $10,000 per flight. Helium, which costs $6,000 per tank-car load, is used exclusively. About 15,000 cubic feet fill the average balloon; there are about 200,000 cubic feet to a car. The polyethylene bags cost about $3,500 each for large ones with prices scaling downward to about a $750 minimum. Collection devices and the delicate instruments, many of them expensive, are used many times before they have to be replaced.

The chances of anyone being hit by a descending balloon, incidentally, are one in 8,000,000. Since 1950, when the squadron was first formed, no one has ever been injured by a balloon.

There have been minor claims against the squadron for such things as flowers being trampled or tree limbs broken. In one case, a farmer put in a claim for a cow. He said that his cow ate some of a polyethylene bag and died. A veterinarian checked the cow's stomach and found some "poly" inside. The government paid the bill.

Over the past ten years, the 1110th Balloon Activities Squadron has made several thousand flights from many parts of the world. Its contribution in this dawning space age has been immense, perhaps fittingly so since balloons were the vehicles that got men off the ground in the first place.—END

The author, Lt. Col. Carroll V. Glines, is Chief, Planning Team, Monitoring System Group, Directorate of Operational Requirements, Hq. USAF. He was formerly Chief, Plans and Analysis Branch, Quality Control, at Headquarters of the AMC. Colonel Glines is the coauthor of the recent book on the Douglas DC-3, Grand Old Lady, *as well as the author of two earlier books and a regular contributor to the pages of this magazine.*

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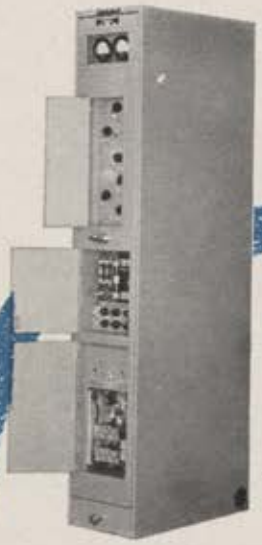

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RF channel with 1000 watts P.E.P. provides highly dependable service at any frequency from 2 to 32 mc. for matchless point-to-point and ground-to-air communications. Precise frequency control is maintained by temperature controlled crystals located in the SSB exciter. Like the 96SSB unit, the transmitter can be used in practically any type of transmission service.

TECHNICAL CHARACTERISTICS

Frequency Range: 2 to 32 mc. continuous.

Frequency Stability: 1 part 10^7; Aging, less than 1 part 10^8 per day.

Output Power: 1,000 watts P.E.P. (Class AB_1).

wilcox models 99 and 96 transmitters

which are in service with governmental agencies and private firms throughout the world, can be updated with Wilcox Interchange equipment to provide SSB capabilities at minimum trouble and expense.

the *wilcox* 605A SSB "STRIP" RECEIVER

is a highly sensitive and stable equipment consisting of separate IF/AUDIO unit used with one or more RF units. The IF/AUDIO unit is also an SSB converter when used in conjunction with a tunable HF Receiver. Use of a single IF/AUDIO unit and one or more RF units makes it possible to create a system capable of instantaneously selecting any predetermined exact frequency. By combining at IF frequency, space and/or frequency diversity is possible without the usual duplicate receiver cost. Also, USB and LSB IF channels can be used separately with two RF sections operating on different frequencies.

TECHNICAL CHARACTERISTICS

Frequency Range: 2-32 mcs.
Frequency Stability: 1 part 10^7 per day.
Sensitivity: SSB ½ uv for 100 milliwatt at better than 10 db SN/N.
Selectivity: SSB: ±3 db 300-3000 cycles. Unused SB Rejection —60 db minimum.
Output: 100 milliwatt min. into line. 1 watt min. into speaker.

***If 96 AM equipment is available for interchange, the cost of an SSB transmitter replacement is approximately $1.00 per watt.**

Write, wire or phone for more Technical Data on Factory New or Interchange Single Sideband Equipment . . .

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Fourteenth & Chestnut
Kansas City 27, Missouri, U.S.A.

Now GUARANTEED Flight Pay Insurance!

An extra AFA benefit at no extra cost . . .

Now AFA Flight Pay Insurance is a better investment than ever, because it offers *guaranteed protection*, even against preexisting illnesses, after the first year's coverage.

There's no extra charge for this new, liberal provision and no change in the regular benefits of the policy—

- *Coverage for* both *illnesses and accidents.*
- *Payments for up to 24 months if your grounding is the result of an aviation accident — up to 12 months if for illness or ordinary accident.*

Remember, payment for a single 90-day grounding reimburses you for the whole cost of 10 years' protection.

NOTE:

All policies are dated on the last day of the month in which the application is postmarked, and protection against accidents begins as of that date; protection against groundings due to illnesses begins 30 days later. Of course, coverage cannot be immediately extended to include illnesses which existed prior to the time at which you insured your flight pay, but after 12 months you are fully covered against all illnesses.

To be eligible for protection, you must have passed your last annual physical . . . be presently in flying status . . . and be a member of the Air Force Association.

Most claims are routine. Where a difference of opinion exists, the Air Force Association has the right to request a review of medical records and other claim evidence by appropriate medical authorities—normally the office of the Surgeon General, USAF.

There are also some exclusions that affect your coverage under the Flight Pay Protection Plan. They are designed primarily to protect your investment in the Plan—restrictions that you'd normally expect, such as groundings due to insanity, court-martial, attempted suicide, etc. Here they are in detail:

EXCLUSIONS:

The insurance under the policy shall not cover loss to any Member resulting in whole or in part from or due to any of the following:

1. Criminal act of the Member or from injuries occasioned or occurring while in a state of insanity (temporary or otherwise).
2. "Fear of flying," as officially certified by responsible authority of the Member's Service and approved by the head of the Service in accordance with applicable regulations.
3. Caused by intentional self-injury, attempted suicide, criminal assault committed by the Member, or fighting, except in self-defense.
4. Directly or indirectly caused by war, whether declared or not, if act of an enemy in such war is the direct cause of loss insured hereunder, hostile action, civil war, invasion, or the resulting civil commotions or riots.
5. Failure to meet flying proficiency standards as established by the Member's Service unless caused by or aggravated by or attributed to disease or injuries.
6. Inability of a member to continue to meet physical standards for Hazardous Flight Duty because of a revision in those standards, rather than because of preceding injury or disease causing a change in the physical condition of such member.
7. Mental or nervous disorders.
8. Alcohol, drugs, venereal disease, arrest, or confinement.
9. Willful violation of flying regulations resulting in suspension from flying as a punitive measure, or as adjudged by responsible authority of the Member's Service.
10. Suspension from flying for administrative reasons not due to injuries or disease, even though the Member may have been eligible for or was being reimbursed at the time of the administrative grounding because of a previously established disability.
11. Loss of life shall not be deemed as loss for purposes of this insurance.
12. Primary duty requiring parachute jumping.
13. Voluntary suspension from flying.
14. A disease or disability preexisting the effective date of coverage, or a recurrence of such a disease or disability, whether or not a waiver has been authorized by appropriate medical authority in accordance with regulations or directive of the service concerned, *unless the Member was insured under the master policy issued to the Air Force Association for 12 continuous months immediately prior to the date disability (grounding) commenced.*

Underwritten by Mutual Benefit Health & Accident Association (Mutual of Omaha).

CHOOSE EITHER CONVENIENT PAYMENT PLAN. MAIL THE APPLICATION TODAY!

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Send me my Flight Pay Protection Policy.

BILL ME FOR:

$_____ semiannual premium (1% of annual flight pay, plus $1 service charge)

$_____ for full payment of annual premium (2% of annual flight pay)

I ENCLOSE:

$_____ semiannual premium (1% of annual flight pay, plus $1 service charge). Bill me every 6 months

$_____ in full payment of annual premium (2% of annual flight pay)

This insurance is available for AFA Members only ☐ I am an AFA Member ☐ I enclose $6 for annual AFA membership

Rank (please print) Name Address

City Zone State $ Annual Flight Pay Years Service for pay purposes

I understand the conditions and exclusions governing AFA's Flight Pay Protection Plan, and I certify that I am currently on flying status and entitled to receive incentive pay and that to the best of my knowledge I am in good health, and no action is pending to remove me from flying status for failure to meet physical standards. I authorize AFA, or AFA representatives, to examine all medical records pertinent to any claim I may submit.

Signature of Applicant Date

Underwritten by Mutual of Omaha 1-61

USAF ON FILM

Recent USAF film releases of special interest to readers of AIR FORCE Magazine and SPACE DIGEST

These and other selected USAF films are available for loan from the Air Force Film Library Center, 8900 S. Broadway, St. Louis 25, Mo. Requests, which are welcomed from both military and civilian groups, should contain Air Force serial numbers and correct titles to avoid delay in processing. Because of heavy demands for certain films, particularly those on missiles and space, the Film Library Center recommends that requests indicate alternate films and showing dates.

SFP 1010—Photographic Highlights of USAF Activities 1959—Some aerospace achievements of that year, from training aircraft to missile shots, recorded on film in all their color and excitement.

TF 1-5293—Space Orbits—Basic facts on orbital patterns and the forces which produce them in relation to space missions of missiles, artificial earth satellites, lunar probes, space travelers.

TF 1-5296—Space Communications—Basic communications principles and techniques, stressing factors that relate directly to space. Shows how unmanned satellites may be used to establish reliable communication links in space to ensure man's survival in spaceflights and improve communications on earth.

WA 10—The New Africa—Assistant Secretary of State for African Affairs Joseph C. Satterthwaite and Ernest K. Lindley, news commentator, discuss basic problems facing many new nations on the continent of Africa.

SFP 693—June Week—Records stirring, colorful events of the Air Force Academy's first graduation week. Also presents highlights of the Cadets' four years at Academy.

SFP 650—Moments of Decision—Film examines the AFROTC through the experiences of three Cadets.

SFP 1027—Minuteman—Missile and Mission—Science and industry join with the Air Force to conquer the complex problems involved in the development of a solid propellant for the Minuteman ICBM.

AFNR 55—Air Force News Review No. 55—SAC Crews Vie with RAF; Tunnels Explore Aerospace Problems; Scientist Spends Week in Capsule; "Excelsior" Studies High-Altitude Escape; Radio Links Planes to SAC Headquarters; AF Pugilists Try for Ring Crown; Atlas Blasts 9,000 Miles in Cape Canaveral Launch.

AFNR 56—Air Force News Review No. 56—USAFE Shows Tactical Strength; Air Force Runs Big Ocean Terminal; USAF Planes Aid Quake Victims; Colonel Gets Award on Polar Ice Cap; B-52s Perform Low-Level Missions; Air Force Opens Communications Center; USAF Celebrates Armed Forces Day.

AFNR 57—Air Force News Review No. 57—F-105s Deployed; Mace Stars on TV; Airmen Learn New ATC Methods; Missiles Boost B-52 Effectiveness; Tactical Hospital Proves Mobility; DEW Line Sites Get Supplies; Avrocar Unveiled.

AFNR 58—Air Force News Review No. 58—Cape Activity at High Pace; Airlift Aids Congo Refugees; QB-47 Flies Target Mission; USAF Teaching Goes Automatic; Atlas Added to Smithsonian; SAC Has Headquarters Command Post Airborne; Discoverers Recovered.

AFNR 59—Air Force News Review No. 59—Hurricane Donna Plagues AF Bases and Lashes Florida Keys; AFA Cadets Get Jump Training; Feature Flashes Show Armed Forces Day Activities, ECI Progress, and New Technique in Driver Training; Minuteman Uses Mobile Launch Pad; Exercise Bright Star/Pine Cone Produces Efficient Results; USAF Emphasizes Survival; Skyshield Proves a Success.—END

This Is AFA

The Air Force Association is an independent, nonprofit airpower organization with no personal, political, or commercial axes to grind; established January 26, 1946; incorporated February 4, 1946.

Objectives

• To assist in obtaining and maintaining adequate airpower for national security and world peace. • To keep the AFA members and the public abreast of developments in the field of aviation. • To preserve and foster the spirit of fellowship among former and present personnel of the United States Air Force.

Membership

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