

DECEMBER 1958 / 50c

AIR FORCE

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



ON TARGET WITH USAF

ALSO IN THIS ISSUE:

A Look at the New Congress



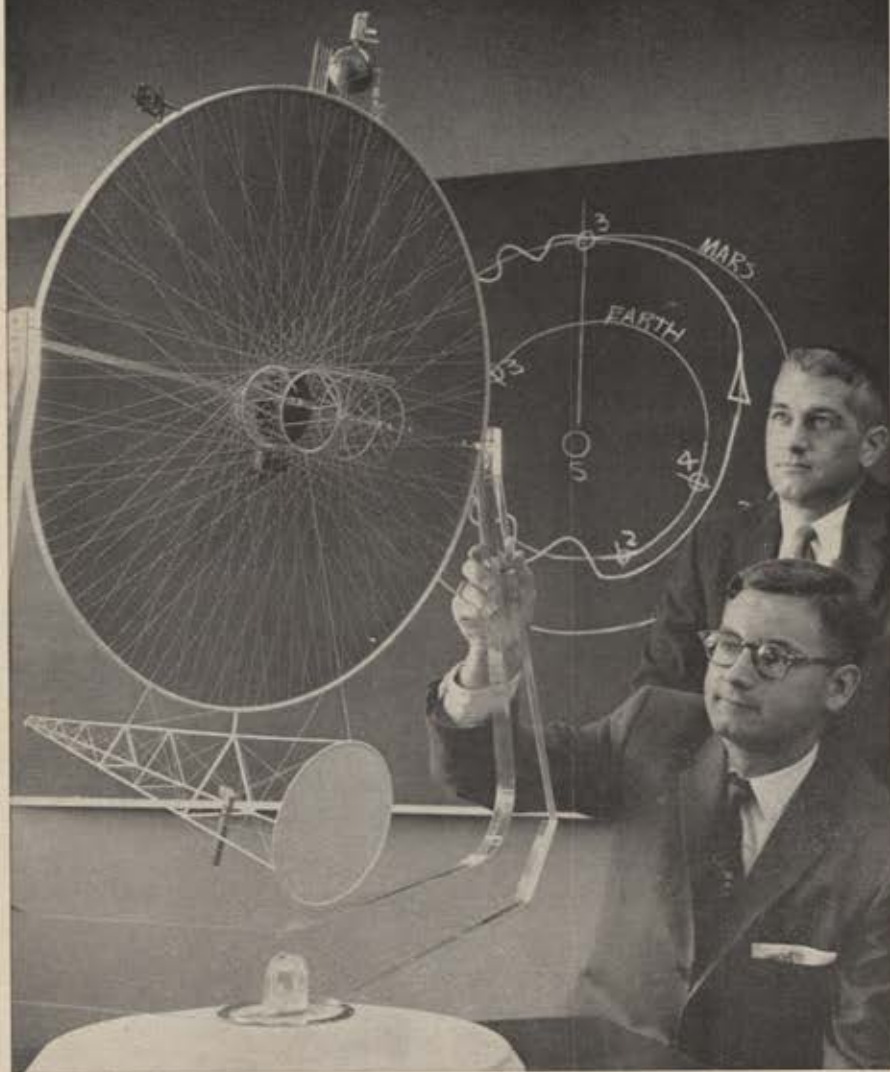


THE U. S. ARMY will use Hamilton Standard Hydromatic propellers for its Grumman AO-1 *Mohawk*, a new turbine-powered observation aircraft. This is another example of Hamilton Standard's leadership in the design, development, and production of propellers or other equipment for more than 50 types of turbine-powered aircraft and missiles.



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BULLETIN FROM **BOEING**



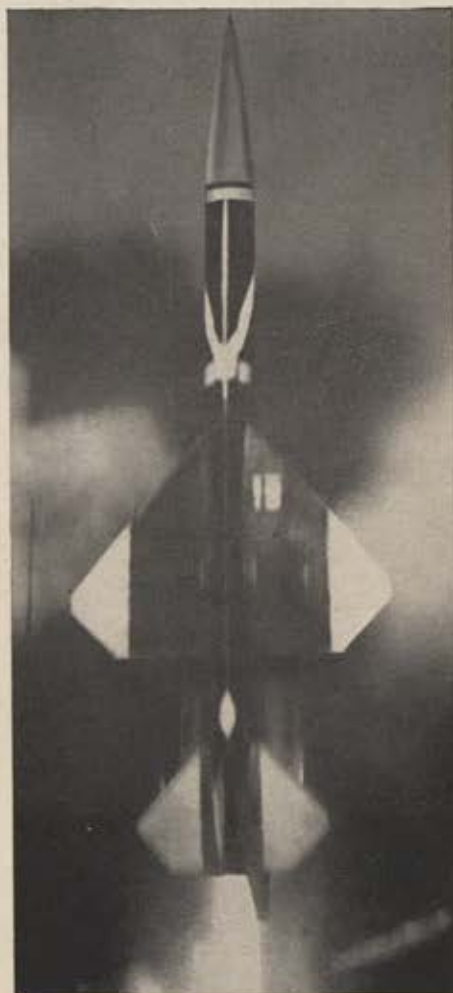
MISSION TO MARS. Scale model, based on an advanced study by Boeing scientists, of a future space vehicle that could make a reconnaissance trip to Mars and return. Launched from a satellite 400 miles above the earth, when such orbital platforms become available, the vehicle would escape to an Earth-Mars transfer orbit, then descend to a Martian orbit to observe the planet. Guidance would be by a "memory" pre-programmed into the vehicle.

Boeing is also at work on advanced projects capable of achieving operational status in the nearer future. One of them is a manned space vehicle which will orbit the earth, then skip in and out of the atmosphere to slow down for re-entry and normal landing.

Boeing is also associate prime contractor for assembly and test of the Air Force's Minuteman, a solid propellant intercontinental ballistic missile under development.



MISSILE-PLATFORM BOMBERS. Boeing B-52Gs roll off the company's Wichita production line. The longest-range jets in the world, global B-52Gs will carry supersonic air-to-ground missiles in addition to their regular bomb loads, combining accurate long-range guidance with supersonic weapons delivery. On a single retaliatory defense mission, Strategic Air Command B-52Gs will be able to strike several targets thousands of miles apart.



AUTOMATIC BLAST-OFF. Supersonic Boeing Bomarcs, Air Defense Command's longest-range missiles, defend entire areas, and in tests have successfully intercepted missiles such as the supersonic X-10 long before they could reach their targets. Bomarcs are tied-in with SAGE system that alerts and coordinates the nation's air defenses.

BOEING

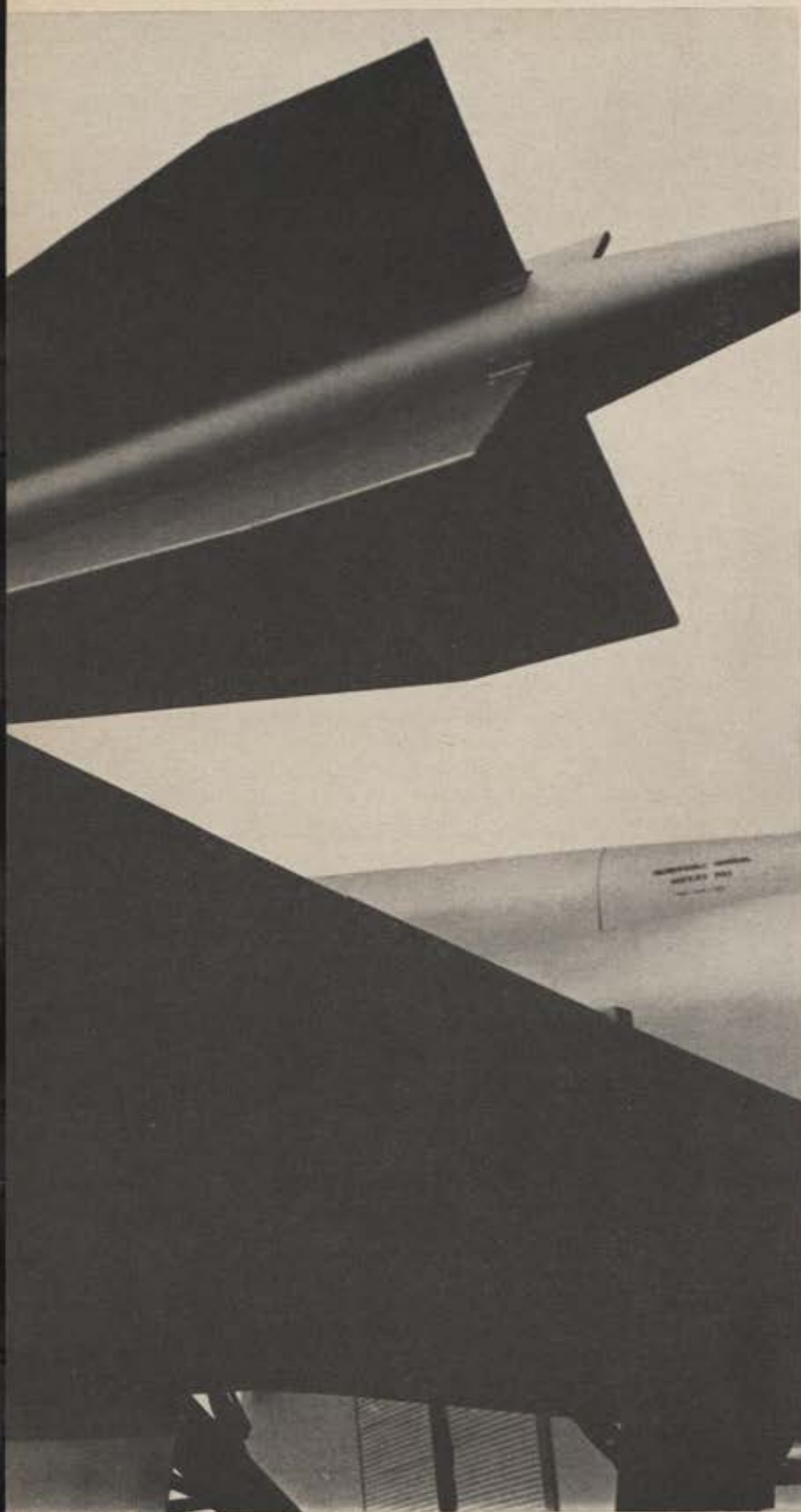
...NEWS IS HAPPENING AT NORTHROP 

Northrop's supersonic twin-jet N-156F counterair fighter is designed to meet the need of NATO and SEATO nations... a high-performance weapon system that delivers more fighting power at less cost.

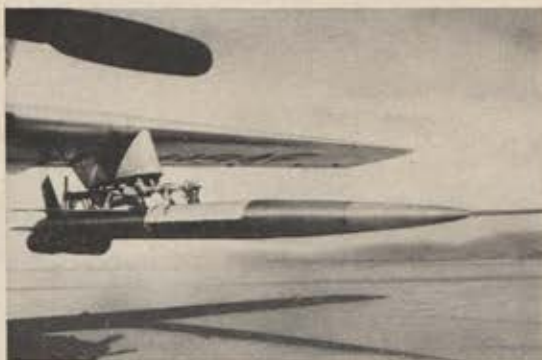


NEW NORTHROP FIGHTER BREAKS COST BARRIER!

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The new N-156F counterair fighter, now being built at Hawthorne, Calif., is proof of Northrop Aircraft's ability to create higher quality weapon systems at lower cost. This and other Northrop contributions to national and international defense are products of the Company's cost-minded management team and of Northrop-developed, years-ahead production techniques.

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Lockheed Aircraft Corporation, GEORGIA DIVISION, Marietta, Georgia

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AIR FORCE

THE MAGAZINE OF AEROSPACE AIRPOWER

Volume 41, Number 12 • December 1958

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Repetition of a Familiar Cycle

FROM A strictly military point of view the new reorganization of the Defense Department (see page 41) makes Mr. Neil McElroy one of the most powerful men in the country, which automatically means he is one of the most powerful men in the world.

Mr. McElroy is a good deal like the centurion in the Scriptures, who said:

"For I also am a man set under authority, having under me soldiers, and I say unto one, Go, and he goeth; and to another, Come, and he cometh; and to my servant, Do this, and he doeth it."

The command power of the Secretary of Defense is spelled out in Public Law 85-599, the Department of Defense Reorganization Act of 1958. And it is considerable power, enough to worry many thoughtful individuals. But Mr. McElroy, like the centurion, is also "a man set under authority." He must obey orders, as well as give them. And those people who fear that the Secretary may run hog-wild with the country's defense dollars just don't realize what kind of orders he is getting and is likely to get.

Number one, it is reliably reported that a ceiling of \$42 billion for defense in the FY 1960 budget has been established by the Bureau of the Budget and the White House. This is one order that can scarcely be disobeyed without a resignation.

Number two, it is equally reliably reported that Mr. McElroy has been told that the defense pie has to be split up in about the same way that it was in the current fiscal year.

Now, if you are told how much you may spend, and what you may spend it on, and you still feel that you are running the show, then you just haven't read the fine print on your *carte blanche*.

By the same token, the power of Congress to appropriate funds is becoming more and more of a negative, rather than a positive power. Ten years ago Congress voted more money for defense than Mr. Truman wanted to spend. So he simply didn't spend it, "it" being \$800 million in Air Force funds. During the current fiscal year about twice that sum is not being spent out of money duly appropriated by Congress for national defense. And, even if the new Congress takes the bit in its teeth and increases the upcoming defense appropriation over what the Administration requests, it has no way in the world to ensure that the money will be spent.

It looks very much as though we might be in for a repetition of a familiar cycle—Congress pushing up, the Administration pushing down, and the Pentagon caught in the squeeze. When one boss says, "Come," and another boss says, "Go," the net result is usually a standstill.

Phase Out of a Great Effort

DOES anyone remember Robert Newman?

Chances are only a handful of history buffs would be able to give an affirmative answer. But in his day Robert Newman was a pretty important fellow. He was the not-so-proper Bostonian who hung the lanterns in Old North Church and started Paul Revere on his ride through Middlesex County. We remember Revere, thanks to Longfellow, but most of us have forgotten the man who, one might say, pulled the trigger on the war of the Revolution.

For the past nine years a sizable group of Robert Newmans have been figuratively perched on today's equivalents of Old North Church, worried not about land or sea but about attack from the skies. They are the men and women of the Ground Observer Corps, the greatest peacetime, civilian, volunteer defense effort in the history of the nation.

Currently the GOC rolls show 280,000 active volunteers, manning 16,000 observation posts and fifty filter centers. All in all, some 600,000 Americans have served in the GOC since its activation.

On January 31, 1959, the Ground Observer Corps will become a victim of technological unemployment, if the term "unemployment" may be applied to one who never has drawn pay for his labors. Secretary of the Air Force James H. Douglas, in announcing the coming demise of GOC, gave three reasons for the discontinuance:

- The increasing scope and efficiency of the air defense radar net.

- The fact that the GOC system of receiving, processing, and transmitting air defense information cannot keep up much longer with the increasing speeds of manned bombers and the new air defense weapon systems.

- The AF responsibility to relieve the volunteers of their burdensome duties when these were no longer needed.

The Air Force announcement urged Ground Observer Corps members to "give their future valuable services to civil defense in order that the wealth of experience gained in GOC can be further utilized." And the service of GOC members is being given tangible recognition in the form of a letter to each participant from President Eisenhower, plus a wallet-card and certificate identifying them as lifetime members of the United States Air Force Defense team.

This, we feel, is the least a grateful nation can do in return for the long hours spent in tedious loneliness, often under the scorn, derision, or just plain apathy of their neighbors.

True, the Ground Observer Corps has yet to spot a real enemy attack—and thank God for that! Like the B-36, the GOC is being phased out without ever having been used in combat. But like the B-36, the very existence of the Ground Observer Corps has played a role in the gigantic drama of deterrence. In a real sense, its members have been part of the Air Force team. We hope and trust that a mutual feeling of interest and devotion will continue long after next January 31.

—JOHN F. LOOSBROEK, Editor



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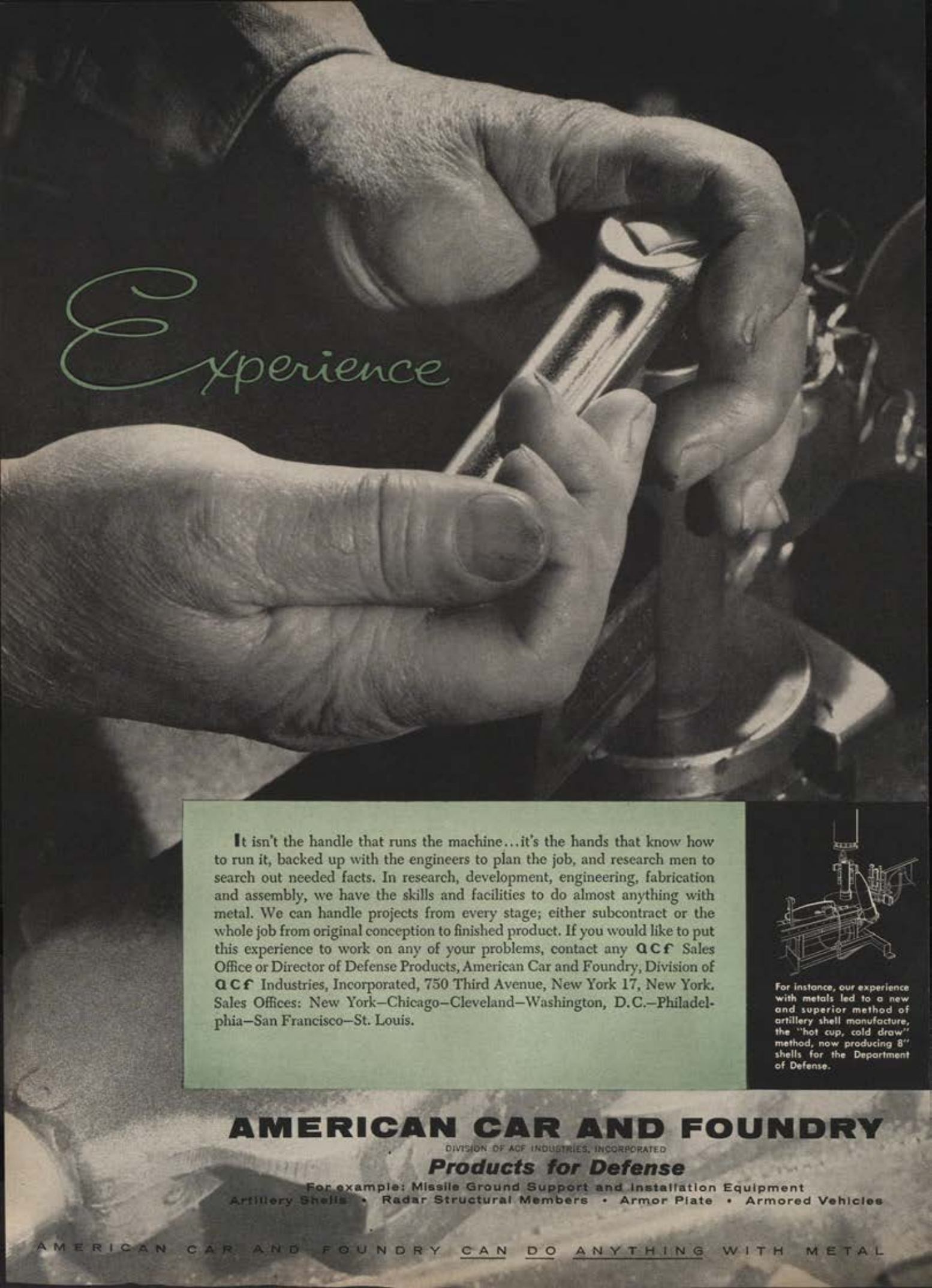
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The Swallow

Gentlemen: I have read the article on Dr. Barnes Wallis' Swallow airplane ["British Polymorphic Design—Swallow Changes Shape in Flight," by Robert R. Rodwell] in your September issue with much interest. As the author of the *Daily Express* report to which it refers, there is one serious misstatement which should be corrected.

The *Daily Express* was never guilty of any breach of security in this connection. Action against the *Daily Express* or against me was never contemplated as my story had been cleared before publication by the competent authority. The Supply Minister eventually admitted this in Parliament.

On the question of the Swallow project itself, Dr. Wallis would not use the varying thrust of the engines for control, as your article suggests. The aerodynamic forces on the outside of the pods and on their supporting fins would give sufficient controlling force, so controllability of the machine would not depend on the continued running of the jet engines.

Chapman Pincher
Science Correspondent
Daily Express
London, England

Gentlemen: Mr. Pincher is unnecessarily offended. Nowhere in the article did I state that the *Daily Express* has been guilty of a breach of security. I merely reported that the manner in which the revelation of Swallow's principles was made "created a furor" in Britain.

At a press conference on May 13, Mr. Aubrey Jones stated that in his opinion there has been a breach of security in the publication of the Swallow's principles, and that "action was being considered." He did not name the *Daily Express*, and possibly I erred in naming this paper in parentheses. However, as at that date the *Daily Express* was the only paper to have made a full revelation of the principles, it was obviously the journal the Minister had in mind. The rumors of action against various journals and individuals were nonetheless real for the statement was made much later, on July 20, by Mr. Jones, that

the *Daily Express* article had, by a misunderstanding, been cleared without his officials being consulted. As his department was the one primarily concerned, one would expect it to be the "competent authority" that Mr. Pincher says cleared the story.

In making his second criticism, Mr. Pincher has obviously misunderstood the article. I did not suggest "varying thrust" to be the means of control proposed, but stated that it was "variation of engine thrust direction." Clearly, these are two very different things. I admitted in the article the possibility of aerodynamic forces on the engine pods being a factor in control, but it seems an impossibility that the engine pods can be pivoted without the thrust direction being changed! Can Mr. Pincher suggest how elevation control is obtained, without control surfaces, if not by variation of the thrust line? Whether there would be sufficient aerodynamic forces on the pods to give complete controllability in the event of the engines being stopped, I would not deign to know. I did not mention the case of the Swallow with a total engine stoppage because I do not think it is a realistic consideration. It seems far more likely, as I stated in the article, that there is a separate low-speed control system, employing elevons for lateral and longitudinal control, and the swinging engine pods for the third dimension.

Robert R. Rodwell
London, England

MARS Reserve Nets

Gentlemen: We are building a network of radio stations operated by Air Force Reservists from their homes for the purpose of training and such other special needs as may arise. This is a nonpay activity.

The MARS Reserve Nets of the Tenth Air Force offer a rather interesting means for qualified individuals to contribute to national defense while training or maintaining proficiency in the practical aspects of military communications. These units also provide a means for the Air Force Reservist to obtain point credits for promotion, retention, and retirement.

To qualify, you must be: (a) a member of the Air Force Reserve (not on active duty); (b) a licensed radio amateur; (c) in possession of equipment for transmitting and receiving CW signals. Equipment capable of transmitting on the eighty-meter band will normally cover frequencies used.

The training consists of operating your station on a supervised net for two hours per week and is open to qualified persons in the states of Arkansas, Colorado, Iowa, Indiana, Illinois, Kansas, Louisiana, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Oklahoma, South Dakota, Texas, and Wyoming.

In another vein, we want to say that, in our opinion, the Air Force Association and *Air Force Magazine* are making a most important contribution to national defense. Public misinformation, lack of information, and indifference can be even more destructive than a nuclear weapon in the hands of the enemy.

Lt. Col. Richard E. Marks
MARS Reserve Nets
(Tenth Air Force)
836 North Melborn
Dearborn, Mich.

Things Are Different Now

Gentlemen: Your editorial "The Little World of General Gavin," [October '58] is very constructive and to the point. Of special interest to me is the sentence reading: "General Gavin's arguments for more ground force air-lift would be much more cogent had the thirteen years since World War II been devoted to development of ground weapons that could be reasonably easily toted by air."

I am a World War I veteran—a ground observer for the 148th Field Artillery and was on the firing line for four and a half months. Our guns were 155-mm, long-range mobile rifles, a surprise to the German Army—quite effective and very mobile. We were in four major battles. I thrill today at the effectiveness of our guns.

Years have passed since World War I. . . . Using my hindsight, it is plain that our guns of WWI must take a place in history with the bal-

(Continued on following page)

lista and the battering ram. Just a few short miles from here is Shaw AFB, and the planes there can deliver withering firepower anywhere in the world in the time it took our 155-mm guns to move from one front to the other.

Trying to visualize a fighting force that is up to date brings to mind the Navy-Marine Corps idea. It seems that an air-ground corps is in order for modern warfare—light weapons, fast movement, coordinated command. Of

course, there is a need for mop-up operations. This should be done by the citizen soldier (National Guard). There is also a need for a civil survival operation which must be done by civilians (civil defense). There certainly is a limit to the funds available for a war effort and those of us in civil defense are well aware of that fact. The citizen soldier and the citizen survival organization is the only practical way that taxpayers can provide money for professional soldiers.

I hope you will write more editorials to assist in clarifying the national war effort.

Ewell C. Black, Deputy Director
State of South Carolina
Civil Defense
Columbia, S. C.

Word from a "Lom-Poke" Wife

Gentlemen: The biggest and best bouquet of Lompoc's flowers is on its way to you from the Missile-Missuses of Vandenberg AFB for your "Springboard to the Stars" [October '58].

Lompoc, Santa Maria, and Santa Barbara have gone all-out for us and we love our new home towns.

Housing has been the fly in the ointment, but we are moving into our Capeharts daily and our contractors are dizzy, but they keep building.

Even if our "birds" do make a lot of noise when launched, it will be as nothing compared to the supersonic reverberations already felt here, merely by so many of us arriving at once. SAC's Army of Occupation.

The school boards out here are still fighting ulcers. Official figures told them to plan on one and three-quarters child per family, but we in SAC average out at about three kids per, so the milkmen are happy, anyhow.

We Air Force wives look forward to each issue of AIR FORCE as much as do our husbands, and we know you are one of our very best friends. Our October issue is dog-eared already as I proudly pass it around to all my friends in Lompoc. Biggest hit with them is that you put the proper pronunciation of Lom-poke in!

Mrs. Julie Easton
Lompoc, Calif.

The Elusive DC-5s

Gentlemen: In the preparation of a history of the Douglas "DC" series of aircraft, I have encountered a complete dead-end in attempting to locate information on the three ex-KLM DC-5s, which were impressed into AF service in Australia as the C-110s.

Nowhere can I locate data on their service, where they were used, how they were used, or—most important—what became of them after the war. I do not expect this information to be at your finger tips, but I am hopeful that you may have some suggestions as to possible sources for it.

Tom Baxter
18708 Calvert St.
Reseda, Calif.

● We headed into a blind alley on this one, too. So we're passing it on to our readers.—THE EDITORS.



SIMMONDS RADIO BEACONRY FINDS LOST MEN AND MISSILES

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THE MAN BEHIND THE GREASEGUN... The exploits of the fliers and aircraft that are keeping our nation secure can not be written without proper credit to the unheralded man behind the greasegun. He is a member of a maintenance crew... a crew chief... a plane captain who is content to enjoy the reflected glory of his ship. Something of him flies with every aircraft, and when ship and crew return safely he knows his job has been well done. For he knows that nothing could fly, no pilot could climb aboard without his contribution. Kaman Aircraft recognizes the job these men are doing and gives them a tangible salute by designing helicopters which require minimum maintenance and make the man behind the greasegun whistle while he works.

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AIRCRAFT DIVISION

Bell's X-14, which takes off and lands vertically in a conventional horizontal attitude, has demonstrated in actual flight that the minimum take-off requirements of helicopters can be combined successfully with the high-speed performance of jet aircraft. An operational military airplane embodying this Bell-pioneered VTOL concept now is in advanced stages of development under Navy and Air Force contract. Bell engineers foresee the day when the same principle will be applied to both military and commercial jets of all sizes.



AVIONICS DIVISION

Among the far-reaching accomplishments of this division is the development of an all-weather Automatic Landing System which brings aircraft in to touchdown without pilot control. After hundreds of successful demonstration landings on both airports and carrier decks, a commercial version of Bell's ALS recently has successfully landed a giant Boeing 707 jet transport as illustrated here. The Avionics Division is also among the industry leaders in the development of instrumentation and control systems for missile and aircraft guidance.



SPACE FLIGHT & MISSILES DIVISION

This Bell team had the sole weapon system responsibility for the design, development and production of the GAM-63 Rascal air-to-surface guided missile for the Strategic Air Command (left). It is now energetically engaged in many advanced problems surrounding space flight including development of the Dyna-Soar hypersonic glider for the Air Force. This Bell-conceived space craft is designed to carry man in orbit around the earth at high speeds and high altitudes for reconnaissance or bombardment.



ROCKETS DIVISION

In addition to developing and producing the complete propulsion system for Bell's own Rascal, this division also has been closely associated with the rocket power problems for many other missile and satellite programs. These skilled teams of scientists and engineers are now pursuing the potentials of propellants with even greater energy, and have recently accomplished the first large-scale rocket thrust chamber firing using the ultimate in chemical oxidizers, elemental liquid fluorine.

Bell Aircraft Corporation is a member of the Martin-Bell industry team developing the Dyna-Soar hypersonic glider for the U. S. Air Force. Other team members are the Martin Company, Bendix Aviation Corporation, Minneapolis-Honeywell Regulator Company, Goodyear Aircraft Company and American Machine and Foundry Company.

Niagara Frontier Division

BELL
Aircraft Corp.
BUFFALO 5, N.Y.

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 recent crackup of a Soviet TU-104A jet transport en route from Peking to Moscow points up shortcomings of the craft noted by western observers.

First, it is underpowered. On takeoff several have noted that it is slow leaving the ground, and seems barely able to make it at Moscow's Vnukovo airport as it nears the end of the runway.

Second, its engines are temperature critical on takeoff and must be cut back as soon as the airplane leaves the ground. This indicates a fear of overheating certain critical parts.

Third, the TU-104 is range limited to about 1,800-2,000 miles, and the Russians are inclined to operate close to those limits, compared to western practice. They don't allow for the usual safety margin of extra fuel required by western airlines.

Fourth, the airplane has only two engines, and there is reason to speculate whether such a heavy airplane (140 tons) could fly safely on only one engine delivering about 15,000 pounds thrust.

Fifth, the Russians are having their troubles bringing the TU-104 to a halt on the ground. Braking action is quite severe, and on more than one occasion the airplane has gone off the end of its runway.

But for all of these criticisms, the TU-104 rates a first as a successful jet transport.

Pilotless atomic-powered transports for freight is the latest hot topic in Red technical talk. In an evident attempt to "work around" radiation problems associated with atomic engines, they are suggesting in their newspapers that the first atomic-powered airplane might use an automatic pilot and carry only freight over such distances as Moscow to Antarctica.

Another of the "old-line" Soviet aircraft designers is dead. He was little-known A. M. Cheremukhin, a close associate of A. N. Tupolev, dean of Soviet aircraft designers. He had studied under the "father" of Soviet aviation, Professor Zhukovsky. Cheremukhin was one of Russia's early helicopter designers. He joined Tupolev's design bureau in 1938 and since then had done structural-strength analysis of aircraft.

It is interesting that no well-known Soviet designer other than Tupolev signed the public death notice. This could be an indication of the extreme jealousy known to exist among the various design bureaus headed by Tupolev, Mikoyan, Yakovlev, and others.

Russia and Japan are in a major airlines hassle. The Russians want to fly to Tokyo, but they don't want the Japanese to fly to Moscow via Siberia in return.

Red China's air force has something like 2,200 fighting planes, of which some 700 are jet interceptors—mostly MIG-15s and MIG-17s, and a few MIG-19s. There are also a couple of hundred IL-28 light bombers—but not so

light that they couldn't reach Formosa and Okinawa from the Chinese mainland.

Also, the Chinese have several hundred Russian-made transports that could be used by paratroops, including IL-12s and, reportedly, a few TU-70s.

North Korea's air force now is more closely aligned to Red China's air force than to Russia's. This is in keeping with Red China's growing insistence that it be the dominant Communist partner in the Far East, and that the Russians take somewhat of a back seat in that part of the world. North Korea's air force now has something over 400 military aircraft, most of them MIG-15s.

The list of acknowledged Soviet aircraft designers grows longer—and older. Those mentioned by the Soviet press this year include A. N. Tupolev; S. V. Ilyushin (IL-18 turboprop transport, IL-28 light jet bomber); A. I. Mikoyan (MIG series of interceptors); A. S. Yakovlev (light planes and helicopters); S. A. Lavochkin (LA-17 long-range interceptor and modern, unknown designs); O. K. Antonov (AN-10 Ukraine turboprop); V. M. Myasishchev (Bison and perhaps newest Soviet four-jet, high-speed bomber known to exist for the past year); and P. O. Sukhoi (designer of the delta fighters which showed up in the air show in 1956). Every one of these men is past fifty and several are well into their sixties.

A similar picture prevails in the engine field, where V. Ya. Klimov, A. M. Lyulka, N. D. Kuznetsov, and S. K. Tumansky are the only four names given prominence this year. Klimov is an old-timer, whose name was associated with the Russian adaptation of the British Nene I to Soviet production as the VK-1. Lyulka is the father of the Russian bypass engine, and Kuznetsov is the leading name in turboprops. Apparently retired is A. A. Mikulin, whose AM-3 is used in the TU-104.

S. K. Tumansky has been around a long time, but just exactly what his contribution has been in the engine field is not known. He has had his own design bureau since shortly after World War II. It is located in Serpukhov, in European Russia, and Tumansky has worked on an axial-flow turbojet there that allegedly went into production in 1947. He'd not been heard of since, until this year.

Here's an interesting anomaly and hard fact belying the importance of titles in the Soviet military hierarchy. Russia today has two Chief Marshals of Aviation, P. F. Zhigarev and A. A. Novikov, and several Marshals of Aviation. Yet, the Red air forces are headed not by a Chief Marshal, but by a Marshal of Aviation, K. A. Vershinin. Zhigarev heads Aeroflot, a position of semiretirement for Soviet air officers, and Novikov, who was deposed by Stalin and restored by Khrushchev, is at least semiretired.

Though Vershinin has been in his present post for some time, he has not been elevated to the top title. Why? It could be a sign the Russians aren't putting so much emphasis on their military airpower.—END

military electronics

ASW AND UNDERSEA WARFARE

- SE Submarine communications and detection.
- SE ASW data processing and display aids.
- PP ASW listening and retransmitting devices.

MISSILE AND DRONE CONTROL

- SE Precision inertial-guidance system for short range air-to-surface missile.
- SE Bomber defense missile system.
- DS Homing guidance system for attack and reconnaissance drones.
- DS Air-to-air radar guidance system.
- DS Surface-to-surface radio inertial guidance system.
- DS Drone command guidance system.
- PP Data transmission and processing for surface-to-air missile guidance.
- PP Surface-to-air radar guidance system.

SPECIAL DEVICES

- SE Proximity warning.
- SE Long range electronic surveying equipment with airborne repeater.
- DS Electronic fusing.
- DS Electronic surveying equipment.
- DS Pulsed light range measurement equipments.
- PP Radiosonde transmitter and preamplifier.

SENSORS

- SE Precision location of radars.
- SE High precision and high resolution forward-looking radar.
- DS VHF homing beacon for supply-drop aircraft.
- DS Anti-jam radar transmitter and receiver.
- DS Radar anti-clutter receiver.
- PP Beacons, C-band and X-band.
- PP Strategic bombing radars.

COMMUNICATIONS AND DATA TRANSFER

- SE Obstacle-gain data transmission.
- SE 18-Channel teletype.
- SE Noise-modulated data links.
- DS Integrated battlefield air mobile radio communication system.
- PP High-density FM voice multiplex.
- PP Integrated battlefield ground mobile radio communications system.
- PP High density UHF communication system for air defense.
- PP Coded secure communications.
- PP Pulse code modulated communication equipment.
- PP Multitone and digital selective calling equipment.
- PP Transportable and fixed-station microwave wide-band relay equipment.
- PP AM, FM and SSB voice and data communications equipment.
- PP I.F.F. equipment.
- PP Data link and logic for ground-to-air command guidance of aircraft and missiles.
- PP Miniaturized Transceivers.

Here is an unclassified look at representative Motorola military electronics programs...past and current. Necessarily incomplete, the listing includes only enough projects to demonstrate the breadth of experience at Motorola's Military Electronics Division. For detailed information on how Motorola's capabilities can be applied to your problem...or for data on engineering career opportunities...please write: Motorola, Inc., Military Electronics Division, 8201 East McDowell Road, Phoenix, Arizona.

KEY:

Program
Status
Coding
(Reference
MIL-E-5400B)

- SE Study programs or programs resulting in experimental models.
- DS Programs resulting in developmental and/or service test models.
- PP Programs resulting in pre-production prototypes and/or production models.

experience on file at Motorola

COMPONENTS

- PP Quartz crystal resonators and filters.
- PP Electrical wave filters.
- PP Electromechanical filters.
- PP Precision V.F.O.'s and B.F.O.'s
- PP Electromechanical reed filters and tone generators.
- PP Transistorized power converters.
- PP Transistorized voltage and current regulators.

ELECTRONIC WARFARE

- DS Battlefield electronic warfare.
- DS False target generation system.
- DS Tracking jammer.
- PP Subminiature passive radar illumination detector.

SOLID STATE MATERIALS AND DEVICES

- SE Ferro-electrics.
- SE Ceramics.
- SE Solid state devices.
- PP Ferrites.

NAVIGATION

- SE Doppler personnel navigator.
- SE Inertial sensors.
- SE Supersonic intercontinental bombing-navigation system.
- SE Hyperbolic battlefield navigation system for aircraft, land vehicles and man pack.
- DS Hyperbolic amphibious navigation system.
- PP Aircraft rendezvous and station-keeping systems.

GROUND SUPPORT AND TEST EQUIPMENT

- PP Phase-lock telemetry.
- PP Command destruct receivers.
- PP Guided missile test equipment.
- PP Programmed automatic test system.
- PP Aircraft test equipment.
- PP Militarized precision pulse circuit testers.

COMBAT SURVEILLANCE

- SE Drone guidance, data sensor, and data transmission integrated reconnaissance system.
- SE Aircraft data sensor, and data transmission reconnaissance system.
- PP High resolution side-looking radars for aircraft and drones.

DATA PROCESSING AND DISPLAY

- SE Automatic data processing for electronic countermeasures.
- SE Data processor for electromagnetic intercept.
- SE Threat evaluator for air defense.
- PP Shipborne electronic data system for air defense.
- PP Large-scope bombing radar indicator.



MOTOROLA

Military Electronics Division

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CHICAGO



PHOENIX



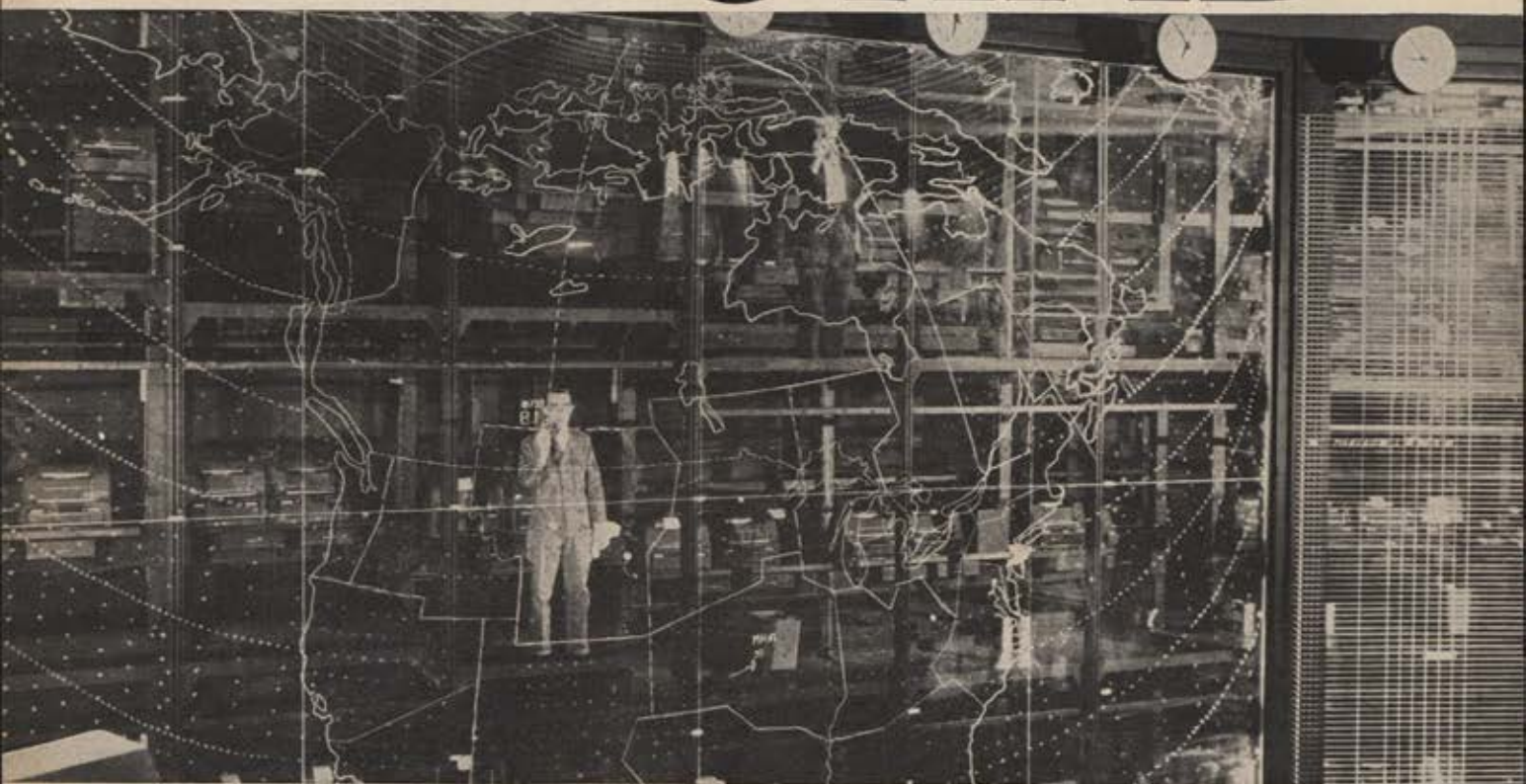
RIVERSIDE

Five Military Electronics Division plants in three locations. Over 500,000 square feet of engineering and production space, devoted exclusively to the design, development and manufacture of advanced military equipment.

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a continent***

NORAD



Headquarters—NORAD—Colorado Springs

Like a huge "bumper" wrapped around the North American continent and reaching down along both the Atlantic and Pacific shores, the North American Air Defense Command (NORAD) has been created for operational control of air defense units of the Army, Navy and Air Force of the U.S. and the RCAF Air Defense Command of Canada. Its field includes the vast area between the southern border of the United States and the

northernmost limits of Canada and Alaska. Under the functional control of NORAD will be BMEWS (Ballistic Missile Early Warning System) and SAGE (Semi-Automatic Ground Control Environment) for the defense of specified sectors. In addition to its responsibility as prime contractor for BMEWS, the Radio Corporation of America is working on other important electronic assignments for NORAD.



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FLIGHT LINES

ARPA has authorized the Army, Navy, and Air Force to initiate negotiations with four chemical companies for research contracts in solid propellants. The companies are American Cyanamid, Dow Chemical, Esso Research and Engineering, and Minnesota Mining and Manufacturing. About thirty companies in the chemical industry took part in the competitive bidding that preceded authorization of the contracts.

In announcing this important step in the advancement of solid-propellant technology for across-the-board military purposes, Roy W. Johnson, ARPA Director, said:

"We are looking for even more energetic solids to vastly increase our present capability. The long-range importance of these research contracts to our ballistic missiles program for all ranges and to our AICBM program cannot be overstated."

ARPA is also reported to have let contracts for development of a manned satellite weighing several thousand pounds. The Pratt & Whitney Division of United Aircraft Corp. has received a contract for the development of a liquid-hydrogen-fueled rocket engine to be used as the second stage of the manned satellite vehicle.

Lt. Gen. Donald L. Putt, USAF (Ret.), President of United Research Corp. of United Aircraft Corp., will replace Dr. James H. Doolittle as chairman of the Air Force Scientific Advisory Board. Dr. Doolittle, a member of the board of directors of Shell Oil Co. and chairman of the board of Space Technology Laboratories, will continue to be a member of the Scientific Advisory Board, although relinquishing the chairmanship.

General Putt, who recently retired as Deputy Chief of Staff, Development, Hq. USAF, was military director of the SAB from 1954 to 1958.

Mrs. Iven C. Kincheloe, Jr., widow of the Air Force test pilot who flew the Bell X-2 experimental rocket plane to a 126,200-foot record altitude in 1956, received a copy of a letter from President Dwight D. Eisenhower to the President of the United States in 1972-1976. The letter asked the future president to consider appointing Iven Kincheloe III, now 19½ months old, to the Air Force Academy. Captain Kincheloe, who was scheduled to fly the North American X-15 research plane, was killed last July in the crash of a F-104 Starfighter.

In the letter addressed to his successor, the President said: "The recent untimely death of a fine young American . . . brought a real sense of loss to our nation. In recognition of his many exemplary deeds as a pioneer in advanced aeronautic research . . . I request that you consider the merits of his young son for appointment as a cadet in the United States Air Force Academy. . . . His rich inheritance stems from a father whose superb technical skill and selfless dedication to country were demonstrated in outstanding fashion in his perilous duties as a test pilot.

"Because of the debt of the nation to a fine American, I ask that you consider giving this opportunity for his son to follow his father's chosen profession. . . ."



Gen. Curtis E. LeMay, AF Vice Chief of Staff, and Navy Commander Jack R. Hunt received the 1958 Harmon International Trophies from President Eisenhower on November 12. LeMay was cited for his nonstop KC-135 Westover AFB to Buenos Aires, Argentina, flight on November 11, 1957.

Dr. Joseph V. Charyk has been appointed Chief Scientist of the Air Force, to succeed Dr. George E. Valley. Dr. Charyk, General Manager of the Space Technology Division of Aeronutronic Systems, Inc., a subsidiary of the Ford Motor Co., has been granted a year's leave of absence, effective January 1, 1959. Dr. Charyk has been a member of the subcommittee on fluid mechanics of the National Advisory Committee for Aeronautics, and is a member of the Technical Advisory Committee on Aeronautics of the Assistant Secretary of Defense for Research and Engineering. He is a member of the AF Scientific Advisory Board and served as chairman of the AF Committee on Aeronautics and Space Vehicles, which con-

(Continued on following page)



Dr. Joseph V. Charyk, who has been appointed by Gen. Thomas D. White to succeed Dr. George Valley as Chief Scientist of the Air Force, will be on leave from his job as General Manager of the Space Technology Division of Aeronutronic Systems, Inc., after the first of the year.



A rocket sled used to test windblast effects on a dummy clothed in a protective suit hurtled to almost Mach 2, 1,200 mph, at ARDC's Holloman AFB, N.M. The AF later revealed that the rocket vehicle has reached 2,853 mph.

ducted a long-range planning study under the auspices of the National Academy of Sciences.

As an authority on aerodynamics and missile technology, Dr. Charyk has directed a number of important programs in the fields of reentry of ballistic missiles, aeronautics, propulsion, and space technology. As Air Force Chief Scientist, he will have responsibility for providing technical advice to the Chief of Staff on Air Force plans, programs, and requirements.

A new photographic mapping technique capable of charting an area the size of West Virginia in twelve hours has been developed by the Air Research and Development Command's Wright Air Development Center at Dayton, Ohio. The airborne surveying equipment uses an improved version of USAF high-precision, short-range navigation radar (HIRAN), and can accurately photograph areas that would otherwise take many months to survey with ground teams.

The system, currently being tested in C-130 aircraft, was designed primarily to ensure accurate aerial maps and charts for use with modern and future weapons, and will also span oceans to provide true distances and relative locations of the major land masses of the world.

A closed-circuit television system is used on the C-130



The JetStar, Lockheed's UCX jet utility transport now going into production, has reached speeds of 685 mph, altitudes of 52,000 feet, and ranges up to 3,105 miles.

to guide it along parallel photographic flight lines. The television camera transmits a picture to a seven-inch scope used by the photo-navigator. An airborne profile recorder verifies true altitude with a radar altimeter which determines the shape and height of terrain features by measuring the time of return of a radar beam from the plane to the ground. Atmospheric data are also collected and coordinated with the photos.

The new system, including the refinement of HIRAN, was developed by WADC's Aerial Reconnaissance Laboratory for use by the Military Air Transport Service world charting service.

Two Boeing IM-99 Bomarcs were successfully launched on October 21, 1958, against QB-17 drones from Cape Canaveral, Fla. The missiles were alerted, fired, and guided from the SAGE system control center in Kingston, N.Y. The Bomarc, a 250-mile, long-range interceptor missile, is being developed to be fired in multiples from a single installation.

General Aircraft and Leasing Company, Inc., with offices in Washington, D. C., has been organized to buy, sell, lease, and deal in used and new aircraft and engines and equipment. Brig. Gen. Milton W. Arnold, USAF (Ret.), who has been vice president for operations and engineering of the Air Transport Association for the past twelve years, has retired from ATA to become president of General Aircraft.

Maj. Gen. Hugh J. Knerr, USAF (Ret.), former Air Force Inspector General, who is aviation consultant to the city of Coral Gables, Fla., has been elected board chairman of Southeastern Airways, Inc. A new feeder line that circles south and central Florida daily, Southeastern flies out of International Airport, Miami, Fla.

Brig. Gen. Hollingsworth F. Gregory, USAF (Ret.), who recently retired from command of the Office of Scientific Research, Air Research and Development Command, Andrews AFB, Md., has joined **Midwestern Instruments, Inc.**, Tulsa, Okla., as vice president and assistant to the president. Midwestern Instrument products are in use in almost every missile- and rocket-testing center in the United States, and the company is pursuing the development of industrial automation devices.

STAFF CHANGES . . . Brig. Gen. Jack N. Donohew, who was Deputy Director of Programs, DCS/Plans and Programs, has been assigned as Director for Programs, The Joint Staff, Wash., D.C. . . . Brig. Gen. David A. Burchinal has been reassigned from duty as Chief of Staff, Eighth AF, SAC, Westover AFB, Mass., to become Deputy Director, J-3, The Joint Staff, Wash., D.C. . . . Brig. Gen. Austin J. Russell, formerly Comdr, 4080th Strategic Reconnaissance Wing (Light), SAC, Laughlin AFB, Tex., has been made Comdr, 822d Air Division, SAC, Turner AFB, Ga.

Brig. Gen. John M. Breit has been relieved from assignment as Deputy Director, J-3 (Plans), US European Command, to assume duty as Director of Special Investigations, Office of The Inspector General, Hq. USAF, Wash., D.C. . . . Brig. Gen. Christian F. Dreyer, who was Deputy Director for Real Property, DCS/Operations, Hq. USAF, has been reassigned as Deputy Director of Installations with additional duty as Deputy Director for Real Property, in the same office.

RETIRED: Brig. Gen. Kurt M. Landon.—END



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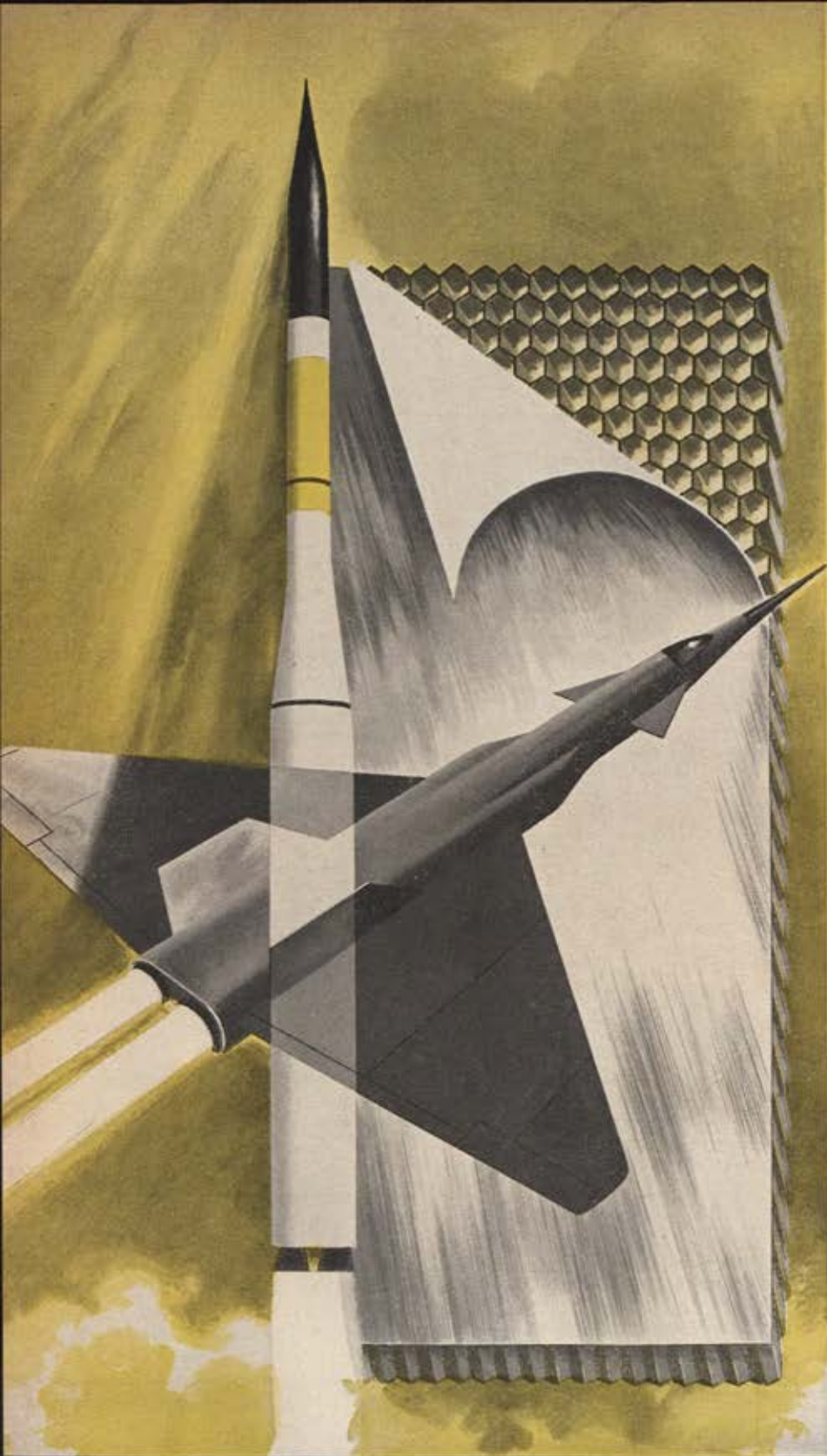
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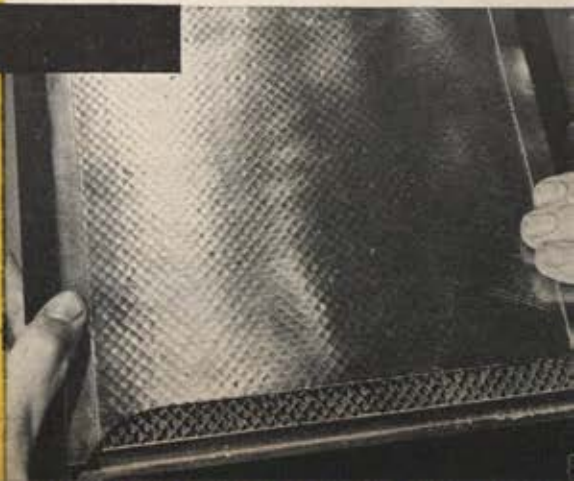
Avcomb has already passed the very rigid tests required of it for the high-speed bombers and fighters to be produced in the 1960's. Crosley is proud that its stainless steel honeycomb panels were the *first to win such approval . . .* and stands ready to mass produce *Avcomb* for our nation's aircraft and missile manufacturers.

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A Way to Peace . . . via Outer Space

On November 17, Sen. Lyndon Johnson, Democratic majority leader, outlined the US objectives in space exploration to the United Nations. In his speech, he stressed America's hope for international cooperation, in a strong statement of the good that could accrue from such cooperation. Significant excerpts follow:

THE FULL dimensions of the promise of space are now beyond the scope of our knowledge and our imagination. To presume that we have more now than merely a glimpse of those dimensions would be both a vain and, perhaps ultimately, a fatally limiting error.

At this moment the nations of the earth are explorers in space, not colonizers. Hence, it is proper that this assembly should provide—first—the means for the United Nations to encourage and inspire that exploration.

That is contemplated in the form of this resolution, which would create an exploratory *ad hoc* committee of representatives of member nations to carry out the following tasks:

First, to inventory the activities and resources of the United Nations, its specialized agencies, and other international bodies relating to peaceful uses of outer space;

Second, to determine areas of international cooperation and programs which could be undertaken under auspices of this organization by member nations without regard to their present stage of economic or scientific advancement;

Third, to consider the future form of internal organization in the United Nations which would best facilitate full international cooperation in this field; and

Fourth, to survey the nature of the legal problems which may arise in implementation of this joint adventure among the nations of the earth.

These are essential first steps. Until these explorations are conducted, orderly procedure to the broader horizons beyond will not be possible. Thus, to impede this first step is to impede all progress toward the goals of peace which men of faith believe exist in the realms of space.

While these are first steps, they are decisive steps, and we cannot be unmindful of the precedents which, if established now, may influence or even control the longer steps ahead.

We of the United States have recognized and do recognize, as must all men, that the penetration into outer space is the concern of all mankind. All nations and all men—without regard to their roles on earth—are affected alike by what is accomplished over their heads in outer space.

If nations proceed unilaterally, then their penetrations into space become only extensions of their national policies on earth. What their policies on earth inspire—whether trust or fear—so their accomplishments in outer space will inspire also.

For nations given to aggression and war and tyranny on earth, unilateral success in space technology would only multiply many times over their threat to peace.

Thus, it is the interest of nations dedicated to peace and freedom that the opportunity of space not be perverted to the end of aggression and control over earth by the aggressors.

Recognizing this as true, men of peace will recognize fully the necessity to proceed without delay on the first step which is here proposed.

Today outer space is free. It is unscarred by conflict. No nation holds a concession there.

It must remain this way.

We of the United States do not acknowledge that there are landlords of outer space who can presume to bargain with the nations of the earth on the price of access to this new domain.

We must not—and need not—corrupt this great opportunity by bringing to it the very antagonisms which we may, by courage, overcome and leave behind forever through a joint adventure into this new realm.

What man has done, thus far, has been the result directly of international cooperation on an informal basis by men of science through the years.

The success, further, of the formal cooperation undertaken in observance of the International Geophysical Year foretells the high promise offered by enlargement of our goals and intensification of our support and efforts.

We know the gains of cooperation. We know the losses of failure to cooperate.

If we fail now to apply the lessons we have learned, or even if we delay their application, we know that the advances into space may only mean adding a new dimension to warfare.

If, however, we proceed along the orderly course of full cooperation, we shall by the very fact of cooperation make the most substantial contribution yet made toward perfecting peace.

Men who have worked together to reach the stars are not likely to descend together into the depths of war and desolation.

It is the American vision, I believe, that out of this fresh start for humankind which space affords man may, at last, free himself of the waste of guarding himself against his ignorance of his neighbors.

Barriers between us will fall as our sights rise to space.

Secrecy will cease to be. Man will come to understand his fellow man—and himself—as never he has been able to do. In the infinity of the space adventure, man can find growing richness of mind, of spirit, and of liberty.

The promise of this moment . . . is great.

(More Views and Comments on following page)

No Service Has a Monopoly

Chairman of the Joint Chiefs of Staff, Gen. Nathan F. Twining, had some significant things to say on the subject of limited and general war to the meeting of the Association of the US Army, recently held in Washington, D. C. A vital point he made was that no single service had a monopoly on limited war roles. Excerpts follow:

WITHIN our over-all military structure we must have the means of dealing with the entire spectrum of possible forms of conflict. We must be able to apply these means with degrees of power. Our national policy calls for the use of nuclear weapons in any case where such use would be advantageous to us. This, of course, does not mean we will use them in every case. It does mean that we should be prepared to use them. . . .

How do we get this flexibility? We get it by being able to apply the necessary degree of force at the point of tension quickly and decisively. Our overseas bases are important for this. Our naval fleets at sea with embarked marines are important. Our tactical combat aircraft and transport aircraft are important. Our Army divisions and other units both overseas and in this country are very important. And I would not want to forget our atomic retaliatory forces which certainly can contribute, if necessary, in situations less than all-out war. We must be able to meet a local war situation with forces varying from a single warship or marine battalion to several Army divisions and Air Force wings.

As in the case of general war, no one service has a monopoly on fighting limited war.—END

The USAF Limited War Capability

Expanding on General Twining's theme, a few days later, USAF Chief of Staff, Gen. Thomas D. White, spelled out USAF capabilities in limited war, facts often forgotten in the more frequent discussion of general war potential. His speech, from which excerpts follow, was given in Puerto Rico to Military Order of the World Wars convention. It points up the adaptability of the worldwide AF.

LET US take a look at our general war capability and examine its application to the limited war problem. Approximately \$7 billion of the current Air Force budget is directly programmed for the Strategic Air Command, the primary deterrent to general war. This is considerably less than half of the total USAF budget. Since SAC is on call for its rapid long-range, all-weather response to limited aggression also, not all of this expenditure can be attributed solely to the general war category. At the same time, it should be recognized that this general war capability represents almost the entire free world force of its kind. There are related capabilities—but no identical capability and no true substitute in type, effectiveness, or import.

Slightly less than \$2 billion of our current budget is programmed for tactical air forces, worldwide. These, too, are dual capability forces, with a particular adaptability to limited conflict. Of the 105-wing force, planned for the end of the current fiscal year, thirty-five wings will be in the tactical category. These wings and their supporting units comprise over 125 squadrons of various types, including tactical fighters and bombers, reconnaissance aircraft, tactical missiles, and transport and tanker aircraft. If directed, these units can, either from in-place overseas bases, or after rapid deployment from domestic bases, engage in limited war without detracting from the backbone of our general war strength. . . .

Whenever one looks at the limited war capabilities of the free world, all services and all free-world countries

must be taken into account. All of the United States Marines, most of the Army and Navy, and much of the Air Force have a particular adaptability to limited war. Most of our allies have forces suitable for just this type of warfare. In 1957 these allied forces consisted of 5,000,000 men, 2,500 combat vessels, and 13,000 jet aircraft. It can be seen from this that the free world has substantial forces with a particular aptitude for limited war. And yet the charge is sometimes made that too much effort is being put into general war nuclear deterrence—and that our limited war capability is too small.

Despite the recent activity in the Middle East and Far East, we cannot underrate the possibility of general war. The Soviets have often expressed their intent to dominate the world. Who can say that the Soviets will not choose to coldly evaluate and contemplate their gains versus their losses in a nuclear holocaust? We must maintain a general war force which will present the enemy with the prospect of an absolutely unacceptable exchange should he initiate hostilities. A vital part of this force is the nuclear striking power of the United States Air Force. This force cannot be reduced if it is to remain strong and effective. We cannot and must not look to it for resources to apply to other projects with lesser precedence. There is no higher priority than the requirement to provide a deterrent to general war.

An essential aspect of our total general war force is its inherent limited war capacity. The Air Force has, within its resources, designed its structure to provide the desired general war strength plus a capacity to fight successfully in limited war. Composite air strike forces represent a long stride in the direction of fast response to limited war situations. I agree that they are not the whole answer, but I feel that these forces in concert with our overseas airpower and the substantial military might of our sister services and our allies pose military power which an enemy cannot ignore.—END



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Control Unit For Type 210

THE 360 CHANNEL TRANSMITTER-RECEIVER TYPE 210

As air traffic increases in volume, the question of safe and efficient control becomes more and more important. A vast increase in the number of assigned radio frequencies has been required in order to facilitate air-ground communications.

Only a few years ago pilots could operate with 10 or 20 channels. Later frequencies were increased to 80 or 90. Plans now call for 360 frequencies — enough to meet the need for years to come. In view of this channel increase, ARC now offers an all-channel, flight proven transmitter-receiver (Type 210 Transceiver) covering all 360 channels. The powerful 15 watts guarantees optimum distance

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WILLGOOS TURBINE-ENGINE TEST FACILITY—(top picture). Here tomorrow's power plants are "flown" under conditions of simulated altitude, speed, and temperature often impossible to attain in actual flight. It is the most complete privately-owned turbine-engine test facility in the world.

FLORIDA RESEARCH AND DEVELOPMENT CENTER, a completely air-conditioned plant with 17 acres under roof, is specially equipped for development of new propulsion systems of almost any type. This facility supplements Pratt & Whitney Aircraft's research and development installations in Connecticut.

PROVING A PAIR OF THOROUGHbred JETS

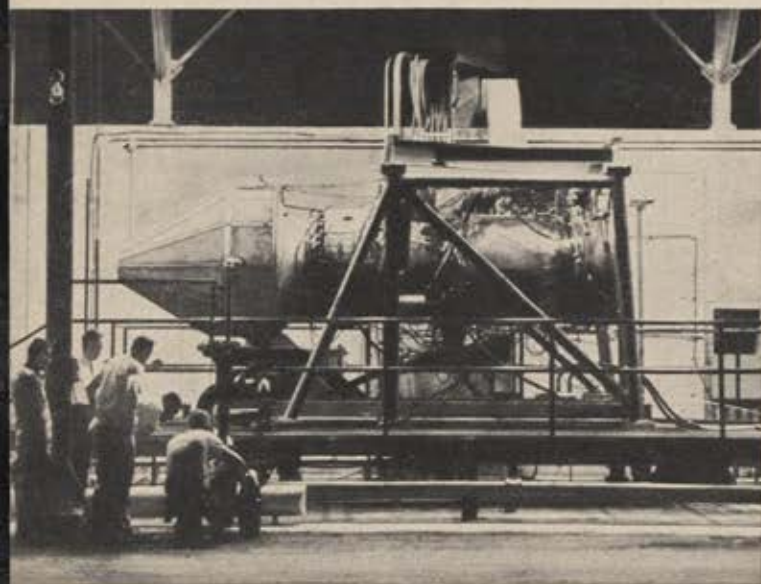
Whether the 30,000-pound thrust class J-58 . . . or the small, highly efficient JT12, aviation people know these newest power plants by Pratt & Whitney Aircraft are thoroughbreds.

Aviation people know, as well, that these new members of the "first family" of aircraft engines will be thoroughly proved in performance before ever taking to the air.

Beginning with matured design, and backed by unequalled experience, Pratt & Whitney engines are tested and re-tested, developed and refined in facilities

second to none. Principal among them are the Willgoos Turbine-Engine Test Facility, heart of Pratt & Whitney's complex of research and development installations in Connecticut, and the new Florida Research and Development Center. The Florida center is specially equipped to develop and test advanced propulsion systems, and here the J-58 first roared into life.

Born thoroughbreds, Pratt & Whitney Aircraft's new J-58 and JT12 engines before long will take their place as dependable power plants for new generations of American aircraft.



J-58 JET ENGINE, the most powerful yet built by Pratt & Whitney Aircraft, is shown on a test stand in Florida. It is designed for operation at very high Mach numbers.



JT12 JET ENGINE, the smallest built by Pratt & Whitney Aircraft, produces 2900 pounds of thrust for a total weight of only 430 lbs. With a single spool and fixed geometry, the JT12 promises outstanding performance, reliability and ease of maintenance for many possible applications.



Pratt & Whitney Aircraft

Division of United Aircraft Corporation, East Hartford, Connecticut

CONNECTICUT OPERATIONS—East Hartford, North Haven, Southington, Meriden, Middletown
FLORIDA RESEARCH AND DEVELOPMENT CENTER, United, Florida



AIRPOWER in the news



Claude Witze

SENIOR EDITOR

We Still Can Afford What We Need

WASHINGTON, D. C.

There is no doubt about it, this politically blasé town was shaken by the election. We cannot report that the makeup of key congressional committees faces many shifts worthy of mention. But the complexion of things has changed, mightily, and the Eighty-sixth Congress is going to reflect this new glow when it convenes next month. Outside of the White House, it is hard to find anyone who believes there are not going to be some new policies and, more important to airpower, some new approaches to vital questions involving the nation's security.

It is unfortunate that the President displayed so much bitterness at his press conference the day after the people spoke. He said he could not see what the voters who abandoned the GOP "consciously want the Administration to do differently. And if I am wrong, I'd like to know what it is."

Well, there are a lot of reports attributing the shift in political sentiment to a wide variety of causes. Offhand, it is not difficult to trace at least some of the change to people who agree with the Rockefeller Report and the Committee for Economic Development and the Air Force Association in their conviction that we can afford what we need in the field of national defense. Only last month the editor of this magazine called our wealth and productivity the strongest weapons in our arsenal. This column provided a rundown on the CED report, which said we cannot afford to gamble for the sake of economy. All of this talk apparently was lumped in the political campaign under the general heading of what the Administration chooses to call "radical spending."

AFA and AIR FORCE Magazine believe that our military requirements must be realistically calculated and the cost of that requirement related to our ability to pay. We do not look upon spending as an effluvium of the political arena or its endorsement, in this case, as the mark of a radical. Our interest in an adequate defense budget is the interest of preserving our freedom, not that of promoting a left-wing philosophy. It is interesting, and we believe significant, that the father of the Rockefeller Report, whose first name is Nelson, is one Republican who reversed the trend and was elected governor of New York.

Mr. Eisenhower indicated at his press conference that he was ready for a two-year fight against the spenders. He then took off for Toledo, where he went duck shooting with George M. Humphrey, his former Secretary of the Treasury and real patron saint of the economy-at-any-cost school. Back on Pennsylvania Avenue he left the Democratic leaders of Congress, armed with new power and facing a whole bevy of new spending proposals, some of them coming out of agencies that are bossed by Eisenhower appointees.

Formation of policy on Capitol Hill now is unequivocally in the hands of two competent Texans: Sen. Lyndon B. Johnson and House Speaker Sam Rayburn. Both are politicians who command considerable respect. They are perhaps

"What Do I Do Now, George?"



HERBLOCK in the Washington Post, reprinted with permission

the most important two people in Washington today, and they will not find it difficult to get in step with a more liberal Congress than they led last year. At this writing it is generally accepted that they will not be walking on eggs except over the issue of civil rights. Fully aware of this peril, Johnson and Rayburn are not expected to test the fragile shells any more than necessary. But on such questions as the Soviet threat and the necessity for a deterrent power in being, as well as adequate research and development, it is not likely that there will be any wide difference of opinion among those who have read the election returns.

After all, the Democrats are on record for the most part as critics of the Eisenhower Administration's policy of putting concern for the budget ahead of concern for the nation's defense. Senator Johnson has announced a twelve-point legislative program, including increased activity in the field of astronautics and space exploration. Remember, in addition to being majority leader he is boss of the Senate Space Committee and the Preparedness Investigating Subcommittee. He has a vested interest, politically, in the National Aeronautics and Space Administration, which is a product, in large part, of his own labors. It is significant

(Continued on page 31)

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		Input Voltage (400~)	Input Current (Amps.)	Input Power (Watts)	Output Voltage (Volts)	Sensitivity (MV/deg.)	Phase Shift (deg. lead)	Rotor (Ohms)	Stator (Ohms)	Zre (Ohms)			Zso (Ohms)	Zrs (Ohms)
Torque Transmitter	CDC-8-A-7	26	.100	.54	11.8	206	8.5	37	12	54 + j260	12 + j45	80 + j20	30	7
Control Transformer	CTC-8-A-1	11.8	.087	.21	23.5	411	9	143	24	210 + j690	28 + j114	250 + j73	30	7
Control Transformer	CTC-8-A-4	11.8	.030	.073	22.5	393	8.5	365	64	470 + j1770	81 + j330	590 + j190	30	7
Torque Receiver	CRC-8-A-1	26	.100	.54	11.8	206	8.5	37	12	54 + j260	12 + j45	80 + j20	30	30 sp.
Electrical Resolver	CSC-8-A-1	26	.038	.39	10.8	189	20	230	27	270 + j630	39 + j142	340 + j67	30	7
Electrical Resolver	CSC-8-A-4	26	.038	.39	26	454	20	230	170	270 + j630	250 + j830	340 + j67	30	7
Control Differential	CDC-8-A-1	11.8	.087	.21	11.5	204	9	36	24	38 + j122	28 + j114	47 + j13	30	7
Vector Resolver	CVC-8-A-1	26	.100	.54	11.8	206	8.5	37	16.5	54 + j260	19 + j60	80 + j20	30	7

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Senator Lyndon B. Johnson, Democratic majority leader.

Sam Rayburn, Democrat from Texas, Speaker of the House.



that he was selected by the Administration to carry the national viewpoint—that is, the Eisenhower viewpoint—on space exploitation to the United Nations (see page 23).

In the new Senate, Mr. Johnson will be in command of sixty-two Democrats and facing only thirty-four Republicans. This is a sharp improvement, for his party, over the close forty-nine to forty-seven margin in the Eighty-fifth Congress. In the powerful Senate Armed Services Committee the top Democrats, such as Harry F. Byrd of Virginia, Henry M. Jackson of Washington, John Stennis of Mississippi, and Stuart Symington of Missouri, stand unmoved. Richard B. Russell of Georgia remains as Chairman. Two Republicans are gone and probably won't be replaced. They are Ralph E. Flanders of Vermont, who quit, and Frank A. Barrett of Wyoming, who was dropped by his electorate.

The Appropriations Committee looks much the same. The Democrats stand firm. Republican William F. Knowland of California walked out into something that looks like political suicide, Flanders did not run, and Edward J. Thye of Minnesota was defeated. Democrat Dennis Chavez of New Mexico will continue as Chairman of the Defense Subcommittee. The Interstate and Foreign Commerce Committee has an Aviation Subcommittee that deals with matters of vital concern to both civil and military aviation, such as the airport aid program (see page 62). This remains basically unchanged with A. S. Mike Monroney of Oklahoma as Chairman. Republican member Frederick G. Payne of Maine went down in the upset in that state, and he leaves a subcommittee vacancy.

One of the smartest politicians in town is Sam Rayburn. Now armed with 282 Democrats in the House as opposed to 153 Republicans who are following a lame-duck President in the White House, Mr. Rayburn is in a powerful position. At the same time, he is far from a left-winger and is known as a thoroughly reasonable person. He will get support from some equally competent veterans in top committee posts.

The House Armed Services Committee will continue under the chairmanship of Carl Vinson of Georgia, a doughty and experienced gentleman who has served forty-four years on the Hill. All Democrats on the committee won reelection; there are three Republicans who will not come back—James T. Patterson of Connecticut, James P. Devereux of Maryland, and Paul Cunningham of Iowa.

There will be alterations in the House Appropriations Committee because one Democrat and nine Republicans will not return, most of them because they were defeated. But the two most important subcommittees, those most

interested in USAF affairs, will be almost unchanged. George H. Mahon of Texas will continue to head the subcommittee on defense, and Harry R. Sheppard of California will not move from his chairmanship of the subcommittee on military construction.

Of some import to USAF is the makeup of the committees that deal with space and atomic energy. House Majority Leader John W. McCormack of Massachusetts heads the House Select Committee on Astronautics and Space Exploration, and he won a lot of praise for his handling of the job earlier this year. But there is a rumor that Overton Brooks of Louisiana, ranking right after McCormack, may be offered the chairmanship of the permanent space committee. The price would be his willing departure from the number-two Democratic slot on the Armed Services Committee. If this begins to look unduly obtuse, recall that Carl Vinson has served as boss of Armed Services for a long time and undoubtedly will be retiring one of these years. Paul J. Kilday of Texas would be in line for Vinson's job if Brooks moves over to the space committee. Republicans on the space committee include: Minority Leader Joseph W. Martin, Jr., of Massachusetts, and the party whip, Leslie Arends of Illinois.

On the Senate Aeronautical and Space Science Committee there is a new vacancy created by the defeat of John Bricker of Ohio. His defeat is also a factor on the key Joint Committee on Atomic Energy, where four vacancies have been created by Republicans. Representatives James T. Patterson of Connecticut and Thomas A. Jenkins of Ohio went down with Bricker. Senator Knowland, of course, resigned. This committee is important because of its responsibilities in the areas of production and utilization of our nuclear resources. As things stand now, the ranking House minority member will be James E. Van Zandt of Pennsylvania, who is a member of the House Armed Services Committee and is an active Navy Reserve officer.

The new Congress inevitably will come up with the usual rash of investigations, which are not evil if they are honestly and fairly conducted. Items surely on the calendar or likely to be there include further probing into the Military Air Transport Service, defense procurement practices, and the Air Force Academy. The General Accounting Office probably will be followed by Congress in taking a long, hard look at the missile program, including USAF's Ballistic Missile Division.

With the kind of serious and competent leadership expected from Johnson and Rayburn, there is a good deal of optimism at the moment. True, there is some talk that the President has been acting tough and promising to put up a fight. If he does, he will be out of character. A White House aide has been quoted in the *Wall Street Journal* as pretty confident that the GOP and conservative Democrats will be able to keep the less cautious elements from over-riding vetoes. And he says Mr. Eisenhower will wield the veto with a vengeance. On the other hand, it is hard to deny that the President and his party have lost the election.

Let's Stick to the Issue

It is a common practice in the worlds of both business and government to settle disagreements over principle or basic concept by means of a legal or legislative "test case." A simple example we recall from our days on the police beat was that of an automobile owner who challenged the right of a patrolman to summon him by tying a tag on his parked car. The motorist, in this case, did not deny that he had parked overtime. Nor did he maintain that he should

(Continued on following page)

escape the penalty for that violation. He did argue, with considerable effectiveness, that a cop can't serve a summons on an automobile. It has to be served on a person. He made a test case out of this particular incident and forced a change in the procedure and the wording on the tag, at least in Albany, N. Y.

That little tea party came to mind last month when James H. Douglas, Secretary of the Air Force, appeared before the House Subcommittee on Government Information to defend his stand in a current donnybrook with the Comptroller General and the General Accounting Office.

Mr. Douglas has refused to give GAO the full text of a report on the management of the ballistic missiles program, prepared by USAF's Inspector General. In doing this, he has the full support of the Secretary of Defense and the President of the United States. He is following a Defense Department directive issued last July 9. Back of this, there is a long-standing precedent for his refusal to pass along the Inspector General's in-house study.

The General Accounting Office and its boss, Comptroller General Joseph Campbell, are challenging the right of the executive department of the government to withhold reports of military Inspectors General. That is the simple



Lt. Gen. Elmer J. Rogers (right), Inspector General of the Air Force, talks with Congressman John E. Moss, Democrat from California, Chairman of the House Government Information Subcommittee, during the November hearings.

issue. Mr. Campbell's argument is that his office is an agency of Congress and is supposed to be independent of any control by the Executive branch of the government. He contends that he cannot properly carry out his assignment if he is denied access to studies by the Inspectors General.

So far the House Subcommittee, headed by John Moss, California Democrat, has based its case for the most part on a contention that Mr. Douglas is violating the law. The Air Force argument, which is that of the Defense Department and the White House, says that withholding an Inspector General report is an executive prerogative. USAF's Inspector General, Lt. Gen. Elmer J. Rogers, expressed the reasoning behind the custom:

"The concept that I function as a confidential agent of the Chief of Staff and of the Secretary [of the Air Force] should be adhered to in order that the Air Force may continue to have an inspection service which is capable of stern, impartial, and objective analysis of the effectiveness and efficiency with which it carries out its operations."

Under questioning by the Moss Committee, General Rogers was more explicit: Both Air Force personnel and

outside sources of investigative information will be reluctant to cooperate with his agents if they are not assured that the report is for USAF eyes only. Put in blunt terms by a GI veteran, this means, "The IG is a guy you can spill your guts to and know there won't be any bounces."

It is unfortunate that the Air Force and its survey of the management of the ballistic missile program have been selected by the Comptroller General as a test case. Counsel for the Moss Subcommittee says he has no interest whatever in the contents of the survey. Yet the newspaper headlines have not been able to avoid the suggestion that there is skulduggery afoot and that missile procurement is lax. Even an editorial page of usual soundness, in the *Washington Post*, says the basic question is the right of Congress and the people to know how defense funds are being spent. It sees further implications that the report is being hidden from Army and Navy eyes.

We would be less than honest if we did not accept the fact that USAF's ballistic missile program is a fit subject for investigation by the Comptroller General or some other congressional committee properly concerned with its efficiency. Indeed, there is little doubt that the subject will be aired to some extent by the new Congress. There is equally little doubt that a major effort such as this, carried out at great speed and with a top national priority, has involved some mistakes.

None of these things, however, is an issue in the current imbroglio. The House Government Information Subcommittee could carry out this fight over an Army report on how long an infantryman can wear a pair of shoes or how Navy procurement officers buy little white hats for sailors. The broad issue is the question of whether the release of Inspector General reports to outsiders is conducive to orderly conduct of business inside the armed forces.

Q.E.D.

Back from a six-week world tour, which he described as a survey of what our forces are doing and what our allies need, Defense Secretary McElroy almost immediately crossed wires with the State Department. Outlining what some of the press called a revised approach to global strategy, he said there will be a deemphasis on intermediate-range ballistic missiles at foreign bases and more emphasis on intercontinental missile bases. He also said the armed forces will be cut. A few days later he ordered the slash. USAF is to trim 13,800 men by next June 30.

The next day we were treated to the rare sight of a State Department announcement to clarify a Defense Department announcement. Clearly, Mr. McElroy's program, or the headline interpretation of it, was rocking some diplomatic boats. State made it clear we still are supporting the IRBM setup abroad. After all, the idea was adopted by the North Atlantic Treaty Organization and constitutes an obligation.

Back of it all, it seems clear, is the Pentagon's unswerving insistence on trimming defense to fit the budget. There is something approaching a contradiction in these assertions that now is the time to cut. Any schoolboy can find a flaw in this syllogism: Limited and unlimited war both are possibilities and a continuing threat. We delayed cutting the armed forces in this fiscal year because of the situation in Lebanon and Formosa. Therefore, now is the time to carry out the programmed reduction.

This is not to argue that numbers of men are the final criterion in measuring defense capability. But it is to argue that we are not being candid in our evaluation of the need.—END

Air Force Association's

1959 CONVENTION and **AEROSPACE** **PANORAMA**

Miami Beach, Florida • September 2-3-4-5-6

New Exhibition Hall . . .

Last month Miami Beach officials dedicated a new, ultra-modern exhibition hall, the finest in the south. This will be headquarters for Air Force Association's 1959 National Convention and Aerospace Panorama. The new structure offers 105,000 square feet of exhibit space and connects with the auditorium, where many Convention events will be held. The proximity of the auditorium and exhibition hall assures maximum attendance at both the meetings and the Panorama by leaders of government, industry, and defense. Exhibit floor plans and space reservation forms were recently distributed to AFA's Industrial Associate companies and 1958 Panorama exhibitors.

Finest Hotels to Serve AFA . . .

Thirteen of Miami Beach's finest hotels have been selected to house those attending AFA's 1959 Convention and Panorama. All AFA hotels are located between the auditorium and the Eden Roc and Fontainebleau Hotels at 45th Street. Biggest problem facing those attending the Convention and Panorama will be making a decision as to which hotel to use—they are all excellent. Every AFA hotel is on the ocean side of Collins Avenue and each has its own beach. The Convention Housing Office will not open until January 1959. Everyone planning to attend the Convention is requested not to write for hotel reservations until opening of the Housing Office is announced.



Miami Beach's new exhibition hall and auditorium appear in the foreground of the photo. The Eden Roc and Fontainebleau Hotels, farthest from the Auditorium, are shown at upper left. Other AFA hotels are located in between.

SHOOTING THE BREEZE

WITH THE EDITORS OF AIR FORCE MAGAZINE



Newest member of AFA's national headquarters staff is William A. Belanger, who joined the Washington, D. C., office November 1 as AFA Convention Manager, a title previously held by Ralph V. Whitener, who assumed the post of Convention and Exhibit Director. A native of Winchendon, Mass., Mr. Belanger was Convention and Exhibit Manager for Washington's Sheraton-Park Hotel and was associated with the Sheraton-Carlton Hotel prior to joining AFA. He is a naval veteran of World War II and was educated in Canada and at the American University in Washington where he received his degree. Mr. Belanger is a member of the Hotel Sales Managers Association and the Washington, D. C., Board of Trade.



Newly settled in North Springfield, Va., he is married and the father of two sons, Craig and Bruce, and a daughter, Jane.

AFA's 1959 National Convention and Airpower Panorama will be held in Miami Beach, Fla.



What with winter here, the lass is better-covered, but this is how Mary Ann Craven looked last summer as she delivered Air Reserve Recruiting posters to US Mail people in the Macon, Ga., area. Mary was chosen by the Fourteenth Air Force to deliver the posters to be affixed to mail trucks and on post office walls in a nationwide program.

Sign of the times. AFR 67-5 authorizes payment of rewards for information leading to the recovery of such lost items as communications equipment, flying clothing, aircraft, and now . . . missiles.

To persons or organizations (except for military and civilian Air Force personnel, government agencies, and some others) providing information leading to recovery the standard award is \$100 for a missile.



Airmen who served with the 12th Tactical Reconnaissance Squadron any time from 1917 through 1956 are asked to communicate with unit historian, Lt. D. W. Littlefield, of above unit at 67th Tactical Reconnaissance



"You know—these things remind me of dragon flies . . ."

Wing, APO 328, San Francisco. He's compiling a unit history. This unit was known during its history as 12th Aero Squadron, 12th Observation Squadron, and 12th Reconnaissance Squadron.



As the Space Age advances, not only is there the widely reported shortage of highly trained technical personnel for work in such areas as missilery, but also there's a relative dearth of secretaries and clerical personnel who can understand the terminology of science and engineering.

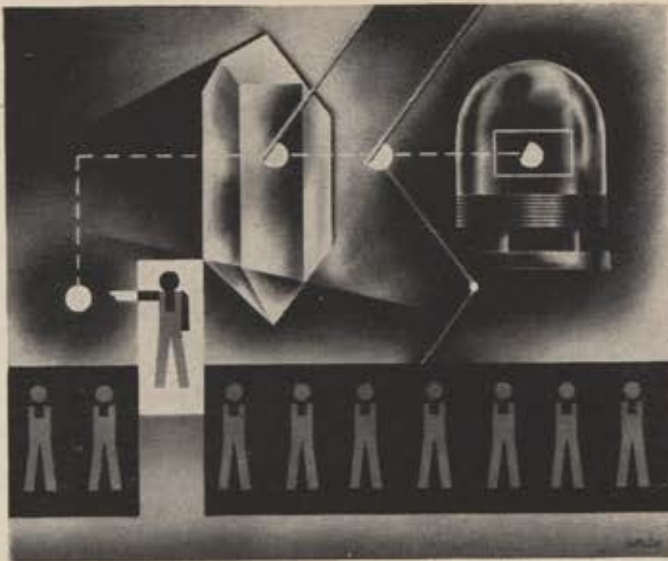
To help solve this problem, an interesting new training program has been inaugurated to train "tec-secs"—technical secretaries, in several business colleges.

The programs, called TESTS, technical-engineering-scientific training for secretaries, is a specially designed two-year, diploma course. It covers the usual secretarial subjects plus training in mathematics, engineering, and science terminology, engineering and science shorthand and dictation, drafting, basic science, advanced machines, statistical typing, and a selection of electives, which can include additional science specialties.

(Continued on page 37)



MISSILE COMPONENTS Bulova's infra-red seeker cells are designed to lock any missile on target; Bulova's fuzing systems do the rest. Powder-driven gyros, timers, safety-and-arming systems and other electronic and electro-mechanical devices, designed and made by Bulova, play vital roles in the Sidewinder, Dart, Talos... in all, 18 key missiles.



AUTOMATION Bulova R&D designed mechanized plant and equipment for Signal Corps goal of 10,000 perfect quartz crystals per 8 hour shift—with 1/10th the manpower. From systems analysis through equipment development, Bulova engineers devise industrial and military facilities for automatic production of electronic components and ordnance items.

Bulova precision helps to solve today's most challenging problems

Time, mass, length... the age-old concepts man relies on as he enters the Age of Space.

Time alone is unique. Its accurate measurement demands the highest order of precision in the design and manufacture of electro-mechanical devices.

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the growing challenges of miniaturization.

Miniaturized systems and components by Bulova are now working for our nation's defense and automated industry. The same vision and experience that developed them are available to assist you... from concept to reliable mass production.

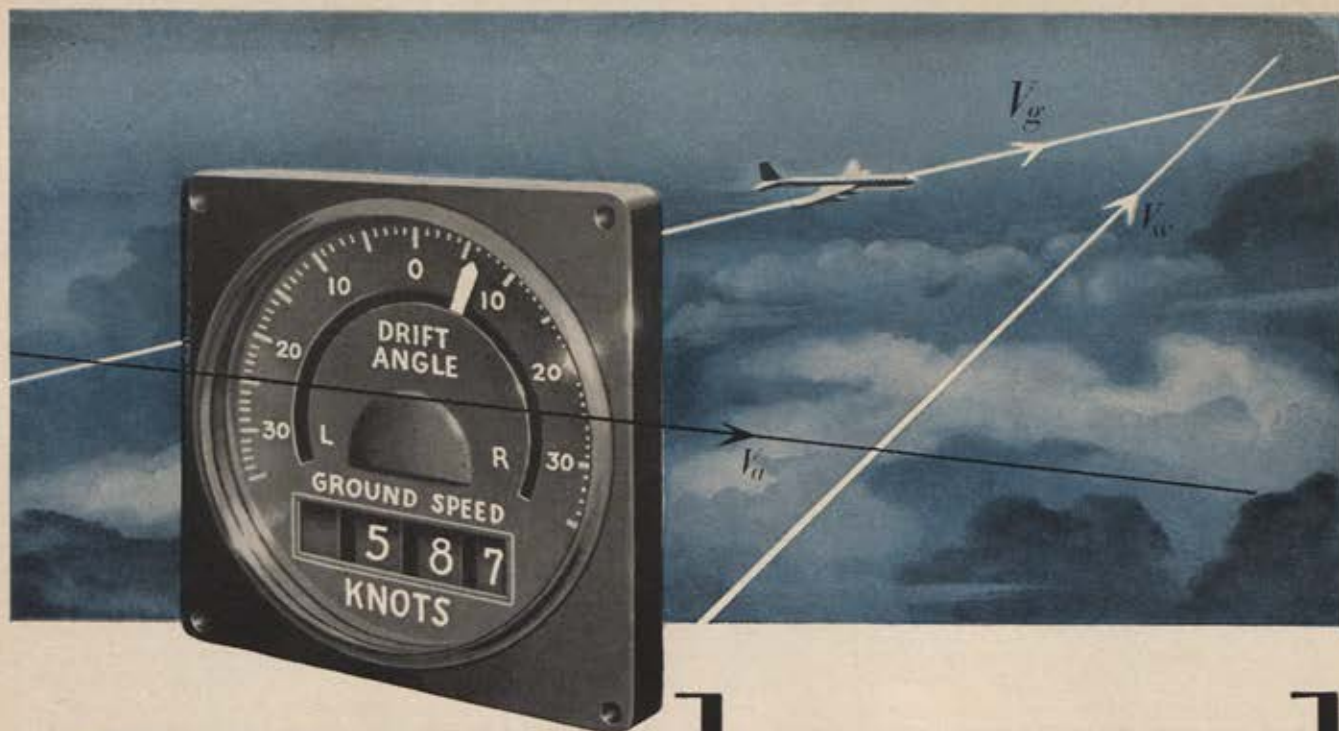
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PRECISION MANUFACTURING Bulova-built servo muscles steer our nation's first ballistic guided missile—the Corporal. When critical tolerances demanded uncompromising accuracy, Bulova solved tooling and assembly problems on a crash basis. Bulova experience and facilities are unexcelled where precision, reliability and capacity are vital.



AIRCRAFT INSTRUMENTS Bulova's new Servo Altimeter combines unsurpassed sensitivity and accuracy with direct-reading tape presentation. Special pressure devices created by Bulova include transducers for air data computers... remote pressure sensors for weather stations and airports... climb and dive indicators... and autopilot altitude controls.



ground speed & drift angle

ANY TIME, ANYWHERE, ANY WEATHER



One of GPL's ground speed and drift angle measuring equipments, AN/APN-81, provides basic input information to computers which tell Air

Force WB-50s exactly where they are every flight second.

GPL auto-navigators give an instantaneous and continuous display: Ground Speed and Drift Angle; Wind Speed and Direction; Longitude and Latitude; Shortest Course-To-Destination; Steering Signal To Pilot (or autopilot).

The systems were developed for the Air Force (WADC). They are the result of an achievement comparable in magnitude to the breaking of the sound barrier: GPL's harnessing of the Doppler-effect to air navigation.

The benefits of these GPL systems extend to every area of flight. Their vast potential has just begun to be explored.

One look and the pilot KNOWS. At a glance, he reads actual ground speed and drift angle, displayed on his flight panel — automatically, accurately, and continuously.

How? Through the famous RADAN* family of self-contained GPL Doppler auto-navigators, recently released for civilian use.

For civilian aircraft, RADAN systems mean pinpoint navigation, reliability, savings in precious time and fuel, a priceless margin of safety. In its wide and growing applications for the military, RADAN provides all these, and continuous velocity data as well.

- GPL systems have behind them many millions of operational miles in transcontinental, oceanic and polar flight. RADAN systems herald a new era of faster, safer, more economical civilian flight.

RADAN is ready and available *now* to everyone.



GENERAL PRECISION LABORATORY INCORPORATED, Pleasantville, N. Y.

*Trademark

ENGINEERS — GPL achievements have opened up some unusual research and development opportunities. Send resume to Personnel Manager.



AFA helped in the campaign for funds to restore St. Clement Danes, the church of the Royal Air Force, which was destroyed in the 1941 blitz and has now been completely restored with funds raised from RAF personnel worldwide. USAF personnel contributed £30,000 sterling for a memorial pipe organ dedicated to USAF flyers who died in European theater.

We are gradually building up sets of bound volumes of *Air Force Magazine* for AFA Headquarters staff use and would appreciate receiving any of the following issues our readers can part with:

1946: July, August, September.

1947: February, March, May, June, November.

1948: January, February, March, May, August, October.

1949: January, February, April, June, October.

1950: February, March, April, September.

1951: All issues.



As man advances ever onward and upward to the planets, his literature and art will doubtless reflect the move.

Newest entry in drama-with-a-space-theme is the soon-to-open (December 26) "Starward Ark," scheduled for tryout at Washington, D. C.'s Shubert Theater.

Billed as a comedy-melodrama in which all the action takes place aboard a spaceship on its way to colonizing another planet, "Starward Ark" is being produced by Eddie Dowling and was written by Tom Sweeney, a World War II naval veteran who has worked in the guided missile field.



Any newsman will testify that there are some things you can't learn in a journalism course, such as how national headlines emerge from a "background-only" press briefing.

At the recent Space Medicine Symposium in San Antonio (see page 68) there was an open-air press party held on the banks of the city's river. Around 10 p.m., a sudden, rather nervous message was circulated to the effect that the Army's Dr. Wernher von Braun—who had previously indicated he would grant no interviews—would talk to some of the "top" press people in a hotel room within the hour.

Every newsman considers himself as "top" as any other, so whoever heard the secret call showed up. Throughout the "briefing," the newsmen were told that pretty much of everything the doctor was saying was "strictly" in the room.

And as chicken sandwiches and other refreshments were consumed, the famed missileman expounded on such diverse items as the modest approach the Army was taking in its moon shot, as compared with the complicated ap-

proach of the Air Force in its Pioneer launchings. To anyone who has followed the missile maze in the past several months, it was quite clear, that what was being said here was very much for the next edition, and that it was designed to give the rather unsportsmanlike impression that those fellows in the Air Force really ought not try such fancy maneuvers as an orbit of the moon—that perhaps only the experts at Huntsville had the requisite skill to spend the large sums of money that go into space projects.

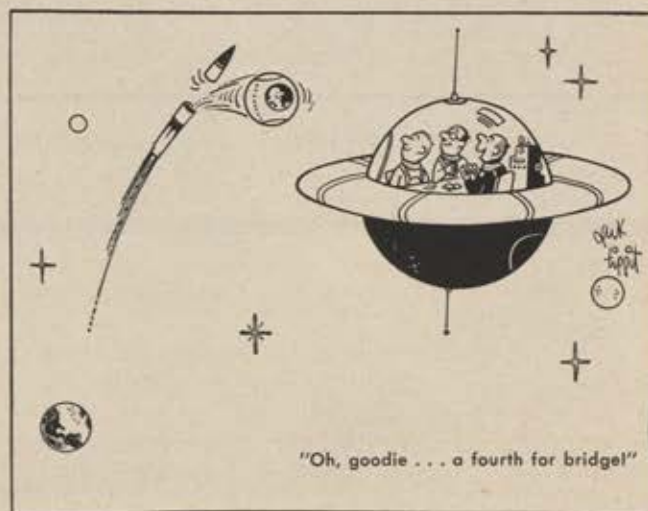
"We're going to aim our probe to impact on the moon but of course we don't expect to hit it," declared Dr. von Braun expansively, "but we do give odds of one-in-two we'll pass the moon within 50,000 miles."

After several more interjections by the fellow who had arranged the clandestine meeting that "This is for background only," an exchange that went something like this took place between Dr. von Braun and one of the reporters present:

"Dr. von Braun, you say you're planning to aim for an impact of the moon. If, contrary to your expectations, you actually did hit the moon, would you then say you had planned it that way?"

Dr. von Braun's indication, with a smile, was that, it was not impossible that such a claim might be made.

Phones were rather busy after the "background-only" briefing.—END



pro·fi'cien·cy: weapons that perform their missions and ask no special favors

Crusader fighters — flown for the first time only three years ago — today operate with squadrons in two oceans. *Regulus II* this year was fired from a submarine in the nation's first supersonic sea-to-shore missile strike. On other subs, *Regulus I* assault missiles are on station — primed, proved — as they have been since 1955.

These weapons fitted easily into organizational units. They are demonstrating prolonged effectiveness. They have asked no special favors... under every operating condition, from arctic cold to equatorial heat.

This is the mark of weapons proficiency. It comes, partly, from long experience with tasks that lie beyond the test range. Vought engineers, for example, have helped redesign existing military equipment and operating procedures to take advantage of the striking power of new weapons.

Vought's proficiency is based, too, on unmatched

dedication to reliability... establishing, eight years ago, aviation's first Reliability Group. Vought engineers' analytical approach made reliability a measurable factor in weapon systems.

Now Vought is developing weapons for space. Astronautics-design teams are studying crew quarters for spacemen and devices for escape from orbit. They are drawing on near-space cockpit and capsule knowledge gained in the development of the *Crusader III* all-weather fighter.

Thus, even in this advanced activity, Vought is calling on past experience, building reliability... holding to its pattern for proficiency.

CHANCE
VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS

Vought Vocabulary

dy·nam'ic: a manned weapon for space-edge duty designed in the image of a champion

With Chance Vought's new FSU-2 *Crusader*, America's defense strength rockets to the threshold of space. This Navy fighter has the speed, range and staying power to master the upper atmosphere. A manned aircraft, its pilot brings human intelligence to an advanced aerial weapon whose capabilities outstrip those of ordinary jet fighters. At his command, this lethal weapon can hide and seek... strike and strike again.

On its first flight, the FSU-2 easily beat the fastest official speed of the record-breaking FSU-1 *Crusader*. It climbed to heights reached a few years ago only by

rocket-powered research craft. It carries advanced fire-control and radar systems, and awesome armament: cannon, rockets, missiles.

The dynamic design of this new carrier-based fighter is a proven one... incorporating the finest features of the celebrated FSU-1 *Crusader*, already giving Navy pilots unmatched air/sea strength.

CHANCE
VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS



Vought Vocabulary

e·con'o·my: when round-trip missiles save taxpayers \$102,950,000

Most missiles land head-first — and, like a bomb, just once. This destruction is desired in a missile strike, but it makes development costly. Scores of missiles often are expended before development problems are solved.

Vought's *Regulus I* and *II* reduce this expense by their dual application. Tactical versions of these guided missiles can strike head-on, with a devastating nuclear wallop. Test and training versions, used in development, can be recovered to fly again.

One *Regulus* was flown and recovered 15 times... another made 16 successful flights. Six hundred recov-

eries of both missiles have saved \$102,950,000 and gained an inestimable quantity of technical data.

Regulus I has armed submarines, cruisers and carriers with a nuclear punch since 1955. *Regulus II*, with a range of more than 1,000 miles and able to exceed twice the speed of sound, soon will join the Navy's underwater and surface Nuclear Fleet.

CHANCE
VOUGHT AIRCRAFT
INCORPORATED · DALLAS, TEXAS



Vought Vocabulary

in'ge-nu'i-ty: designing a 12-ton missile to fit inside an atomic sub

Chance Vought's *Regulus II* missile is twice as long as a city bus. It is crammed with delicate instruments, armed with a nuclear warhead. Yet Vought engineers designed *Regulus II* to serve safely, efficiently aboard the Navy's newest nuclear-driven submarines.

They shock-proofed the missile against underwater blasts. They conditioned it for polar ice, or equatorial heat. They made it—like Vought's smaller Fleet veteran, *Regulus I*—a dependable weapon, accurate from conventional or nuclear subs, from surface ships or highly maneuverable, mobile shore launchers.

Aboard its special, globe-girdling sub, *Regulus II* will move invisibly any distance to its launching point. There it can begin a supersonic, long-range strike in minutes. Or it may lurk unseen for months as a patient and ready deterrent.

A chilling prospect for would-be aggressors, this example of Vought ingenuity.

CHANCE VOUCHT AIRCRAFT
INCORPORATED • DALLAS • TEXAS



Vought Vocabulary

cham'pi-on: the fighter whose record is written on aviation's most honored trophies

Again the aviation world salutes the F8U-1 *Crusader*. The Collier Trophy, one of America's highest tributes, has been awarded to the Navy and to Chance Vought for 1957's most significant aviation achievement: development of this record-smashing jet fighter.

The *Crusader's* first triumph was the 1,015 mph national speed record that won the coveted Thompson Trophy. Next came history's first cross-continent, ocean-to-ocean, carrier-to-carrier flight. Following that flight, a *Crusader* streaked across the nation in "Operation

Bullet." This 200-minute flight set an official world's record and marked the first supersonic crossing of the U. S.

The blazing performance that has taken aviation's top honors brings unmatched air combat strength to the U. S. Navy. The Vought *Crusader* is now aboard Fleet carriers...strengthening America's power for peace.

CHANCE VOUCHT AIRCRAFT
INCORPORATED • DALLAS • TEXAS



Vought Vocabulary

ac'cu-ra-cy: guided all the way, this long-range missile pinpoints distant, hard-to-hit targets

This nuclear-armed "bird" is the supersonic missile with which the U.S. can retaliate against the toughest of enemy targets—distant, hard-to-hit military fortifications.

Chance Vought's *Regulus II* provides the extra margin of accuracy that enables the Navy to zero in on such "small"—and deadly—strongholds as H-bomb storehouses, submarine pens, ballistic missile bases.

The instant *Regulus II* launches, its advanced

guidance system takes control...constantly compensating, correcting...keeping this Mach 2 missile on target to the instant of impact.

In production now, *Regulus II* provides double deterrence: the power to help forestall nuclear war—pinpoint accuracy to deter localized trouble.

CHANCE VOUCHT AIRCRAFT
INCORPORATED • DALLAS • TEXAS



Vought Vocabulary

re-li'a-bil'i-ty: Service-proved heritage of *Crusader III*, backed by 41-year Chance Vought tradition

Reliability, like superior speed, altitude and maneuverability, is built into Vought missiles and aircraft. This vital ingredient is the proven heritage of *Crusader III*, Chance Vought's new automated all-weather fighter.

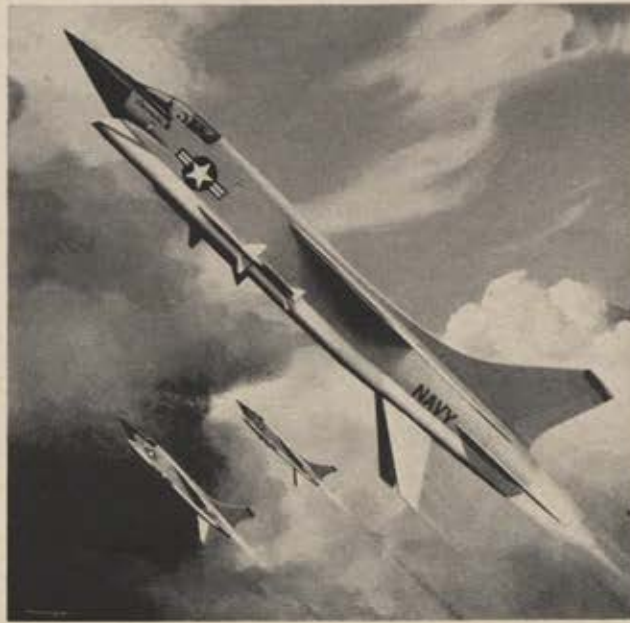
Its predecessor, *Crusader I*, achieved a major breakthrough when it became the first 1,000-mph-plus fighter to operate from aircraft carriers. This airplane established U. S. and world records...became operational faster than any modern jet in history. In an era of increasing technical complexities, it is proving its reliability in active service today.

Regulus I became an operational missile as early

as 1953. It has proved its reliability with a record of more than 700 flights. *Regulus II*, carrying on this tradition for reliability, in September accomplished history's first flight of a supersonic missile from a submarine.

Experience gained with *Crusader I* and the *Regulus* missiles is the heritage of *Crusader III*—a heritage backed by 41 years of developing, producing and servicing reliable weapon systems.

CHANCE VOUCHT AIRCRAFT
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*A TALENT FOR
SYSTEMS MANAGEMENT*

STROMBERG-CARLSON



A DIVISION OF GENERAL DYNAMICS CORPORATION
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ELECTRONICS AND COMMUNICATION FOR HOME, INDUSTRY AND DEFENSE

Firm central control...
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under a member of
top management whose
authority is undiluted—
this, the Stromberg-Carlson
concept of Systems Management,
is a definite departure from
conventional methods.
It's working extremely well.
Unified direction of all our own
divisions, leading consultants
and qualified subcontractors
assures a tight control of costs
and more efficient utilization
of facilities.
Currently, this concept is
helping develop an electronic
countermeasures system vital to
the defense of the free world.

Our talent is equally
applicable to
Communication,
Navigation, Test
Equipment and
other complex
electronic systems.
Our brochure 709
would be of interest.



SOME form of reorganization is clearly needed if we are rationally to operate the large and sprawling Department of Defense and enable it to better carry out its mission: the defense of the United States' interests and values in the thermonuclear age. That change is necessary has been demonstrated. . . .

The problem we confront is not unique. Each people, each generation, faces a challenge to its powers. Upon the American people has devolved the awesome responsibility of maintaining a way of life and guarding a civilization which could be destroyed in an instant. . . . We must see that the Department of Defense, a prime instrument in efforts to secure the free world, can meet the heavy and novel burdens which the future will impose.

—FORGING A NEW SWORD, by William R. Kintner

How Sharp THE NEW SWORD?

Claude Witze

SENIOR EDITOR

A SMALL army of carpenters, electricians, and painters was banging its way last month through Ring E on the second floor of the Pentagon, between the River and Mall entrances. Old walls were coming down and new walls going up. Vast quantities of lumber, wallboard, and wiring cluttered the hallway.

The activity provided the primary overt manifestation in Washington that the Defense Department will be reorganized by January 1, ready to carry out the edict of Congress and the President calling for a streamlined operation. These men, with their hammers, screwdrivers, and paintbrushes,

were an advance corps preparing office space for the new and enlarged Joint Staff. The law provides for a maximum of 400 assigned officers, which is about double that of the old JCS organization.

One of the most important results of reorganization will be the fact that the Joint Chiefs of Staff, the corporate body for which this Joint Staff will work, will be the executive agency for the Secretary of Defense over the operational military forces of this nation. This means that the Chiefs of Staff of the Army, Navy, and Air Force are no

(Continued on following page)

HOW SHARP THE NEW SWORD?

longer the bosses of the combat units of their respective services in preparing for or fighting a war. Their individual command authority over unified and specified combat commands gone, the service Chiefs are allowed direct supervision over units and personnel that do not happen to be assigned to unified or specified commands. For the most part, they will be housekeepers with the mission of making certain that the needed forces are combat ready when the unified or specified commander wants to use them.

In testimony before the House and Senate Armed Services Committees last spring and early summer, the new program received some of its most enthusiastic support from the Air Force. Gen. Thomas D. White, USAF Chief of Staff, endorsed the Administration bill, as did Gen. Carl A. Spaatz, first Chief of Staff of the Air Force. The Air Force Association, which had gone on record in 1956 as favoring a single military service, also lent its approval. AFA's viewpoint was that the new bill did not go far enough, but called the plan, "clearly a move in the right direction."

Up on Capitol Hill, as the questions and answers wore on, a score or more of objections were brought up. Most of these were concerned in one way or another with the preservation of congressional prerogatives of control over the military. There was a fear that too much authority would be shifted to the Executive branch. There were expressions of deep concern over how much power would be given to the Joint Chiefs of Staff. The synthetic bugaboo of the Prussian General Staff reared its shopworn head. There were warnings against a dilution of civilian control over the military by concentrating this civilian authority to a greater degree in one person—the Secretary of Defense. Some modifications had to be worked into the law before Congress would pass it. Yet the Defense Department and, presumably, the Administration were satisfied with the results.

This history of last month's hammering and rehabilitation of Pentagon office space started early last April. At that time President Eisenhower sent his recommended Pentagon reorganization plan to Congress, declaring that "separate ground, sea, and air warfare is gone forever."

The President stressed the "vital necessity of complete unity in our strategic planning and basic operational direction." He said that the combat forces had to be organized into unified commands, given the best possible tools, and "prepared to fight as one, regardless of service."

At the same time the White House turned down the idea of a single service. Regardless of how the President felt about the traditional forms and patterns of the military—and he paid tribute to them—the hard political fact was that esprit de corps of the individual services spills over into Congress. Even a flawless program would be doomed from the outset if it menaced in any way the right of the Leathernecks to wear a distinctive red stripe on their dark blue pants—or the Air Force right to wear its silver wings.

It is almost universally felt in the Pentagon that the most important part of the new program is the effort to increase combat effectiveness of the unified and specified commands. The President called these the "cutting edge" of the new sword and declared that the entire Defense Department exists only to keep them sharp.

At present there are two *specified* commands, only one of which is a combat-ready outfit. This, of course, is the Strategic Air Command, headed by Gen. Thomas Power, with headquarters at Offutt AFB, Neb. The other is the Eastern Atlantic and Mediterranean Command, which is more or less a paper command, to be assigned forces by the Navy in event of a crisis. It is headed by Adm. James L. Holloway in London. All forces in a *specified* command are drawn from a single branch of the armed forces.

There are six unified commands, drawing men and equipment from the Army, Navy, and Air Force. They are:

- **US European Command**—Gen. Lauris Norstad, USAF, Paris.

- **Caribbean Command**—Lt. Gen. Ridgely Gaither, USA, Quarry Heights, Canal Zone.

- **Atlantic Command**—Adm. Jerauld Wright, USN, Norfolk, Va.

- **Pacific Command**—Adm. Harry D. Felt, USN, Pearl Harbor, T. H.

- **Continental Air Defense Command**—Gen. Earle Partridge, USAF, Ent AFB, Colo.

- **Alaska Command**—Lt. Gen. Frank A. Armstrong, Jr., USAF, Elmendorf AFB, Alaska.

The first of the unified commands to do business is CONAD, which has been in existence for a long time as the US component of the North American Air Defense Command. General Norstad's European unit began operating on a unified basis last September 15. The remainder will all be activated by January 1.

The technique is not new. It was tried in both the European and Pacific theaters in World War II, as well as in Korea. But, Congress was told, the heads of unified commands have never had full authority over their own forces. In the best-known case, that of CONAD, the general in charge of the Army component was responsible to the Army Chief of Staff, who filled out his fitness report and supplied the beans and bullets. CONAD's commander had considerably less than full authority over his Army and Navy components. The Reorganization Act makes it clear that the forces assigned to a unified or specified command are under the "full operational command" of the unified or specified commander. They can be withdrawn only by authority of the Secretary of Defense, with the President's approval.

A second major aim of the reorganization is to straighten command channels, often torturous and weedy. President Eisenhower told Congress that the old chain of command was "cumbersome and unreliable in time of peace and not usable in time of war." USAF's General White emphasized this point when he was on the stand before the Senate Committee. Challenged to show what was wrong with the old setup, General White said that it delays things.

"You cannot act with instant precision," he said, "and in this day and age of nuclear weapons, high-speed aircraft, and missiles that is essential." He went on to acknowledge that he would lose his statutory command over SAC under the new law but made it clear he thought this was best for the country.

Thus, under the new law the Secretary of Defense is boss, and the branches of the armed forces no longer serve as executive agents. The Joint Chiefs, of course, will serve as military advisers to the politically appointed Secretary.

Here it is legitimate to stop for a couple of provocative questions. Currently there is a substantial amount of public confidence in Neil H. McElroy, Secretary of Defense. But who will be his successor? Some appointments of the past have not been such as to inspire confidence either in the military judgment of certain Secretaries or, worse, their inclination to listen to expert military advice.

A future President conceivably could give the job as a political reward to a political hack and still win Senate confirmation for his choice. This is a real source of skepticism and worry to some Pentagon veterans who have seen the fortunes of the armed services and the security of the country menaced by such vagaries.

Another question concerns the unified and specified commanders. It is traditional that a combat commander puts

his force in being, its state of readiness, and its degree of combat capability above all other interests. After all, that is his duty, and it is most important to his mission. But is this necessarily best for the Army, Navy, and Air Force? Who will fight for adequate research and development of new weapon systems? Who will speak for the needs of tomorrow?

These questions are not raised by cynics or foes of reorganization. They are brought up by honest men who see pitfalls ahead and who sincerely wish to avoid them. Certainly these are factors that must be considered and deserve discussion.

Concerning the Joint Staff, now moving into its enlarged Pentagon quarters, the Administration proposal found three major weaknesses in the old organization and its functions. One was the limitation to 210 officers. Second was the lack of an integrated operations division and the reliance on a slow and cumbersome Joint Staff committee system. Third was the fact that members of the Joint Chiefs of Staff wore two hats, carrying a heavy responsibility as chiefs of their respective services in addition to their jobs as advisers to the Secretary of Defense.

The new strength of 400 officers on the Joint Staff will be drawn equally from the Army, Navy, and Air Force. Except in time of war the tour of duty is set at three years and reassignment is restricted. The Joint Staff committee system has been discontinued, and the members of the Joint Chiefs are permitted to delegate their duties as heads of their respective services to their top aides—in General White's case, to Gen. Curtis E. LeMay, his Vice Chief of Staff.

The committee system has been replaced by a J-staff system with the personnel in each directorate representing a liberal mixup of the three armed services. Top directorates are Personnel (J-1), Intelligence (J-2), Operations (J-3), Logistics (J-4), Plans and Policy (J-5), and Communications-Electronics (J-6). In addition there is a Joint Military Assistance Affairs Directorate, a Joint Programs Office, and a Joint Advanced Study Group. Most of the directorates are headed by officers with two-star rank.

A key factor in renovating the JCS setup was the assurance, in the President's words, "that the Joint Chiefs of Staff act only under the authority and in the name of the Secretary of Defense." From the standpoint of the services, this has resulted in conflicting opinions about the stature of the individual Chief of Staff. Is he more important or less important than before? More powerful or less powerful?

In the Air Force, for example, General White is no longer operational boss over USAF's combat-ready forces. It is still his responsibility to keep them combat ready, to provide training, equipment, doctrine, logistics, and other support functions. He has contributed seventy-five officers to the Joint Staff.

On the other hand, it can be argued that General White has, in a sense, gained stature. He has traded worldwide control over USAF forces for a one-third voice in the control of the Army and Navy. Using the corporate parallel, he has turned in two-thirds of his Air Force stock for one-third of the stock in each of the other two services. And, what may be more important, on the Board of Directors he retains his post as "Mr. Airpower"—the Defense Department's expert on what we can do in the atmosphere and outer space. This is a bonus, a sort of stock dividend, in that his advice will carry great weight with the Secretary of Defense in dealing with the specified and unified commands on airpower matters.

In this airpower-expert capacity, General White will lean heavily on a man who otherwise would be out of a job.

That is his Deputy Chief of Staff, Operations. While General White loses his command control to the unified and specified commanders, he still must have his own adviser on his own staff in the operational field.

An avowed goal of reorganization is to strengthen the authority of the Secretary of Defense. The old National Security Act of 1947 stipulated that Army, Navy, and Air Force were to be separately administered by their Secretaries. The Secretary of Defense, then, had no real power to eliminate overlapping or duplication by abolishing, reassigning, or transferring military functions. Charles E. Wilson found this out when he tried to curtail Army activity in ballistic missiles.

Under the new law, Secretary McElroy is empowered to do what he thinks necessary "for more effective, efficient, and economic administration and operation to eliminate duplication." Congress, however, retains the right to veto his actions. As a first step the Pentagon last month was preparing a new "Functions Paper." In effect, this is a revision of the 1953 "Key West Agreement" and the 1956 memorandum on "Clarification of Roles and Missions."

The Defense Department activity that has won most brickbats and catcalls in the past few years has been the research and development effort. There has been general agreement, especially since Sputnik I, that it has not been effective. One school of thought has favored more centralized control. The dissenters have maintained that decentralization is the real solution, putting the job back in the hands of competent military weapon developers. Overcontrol from the top, these critics said, has been hamstringing progress.

The solution in the Reorganization Law of 1958 is abolition of the Assistant Secretary of Defense for Research and Engineering and substitution of a new Director of Defense Research and Engineering.

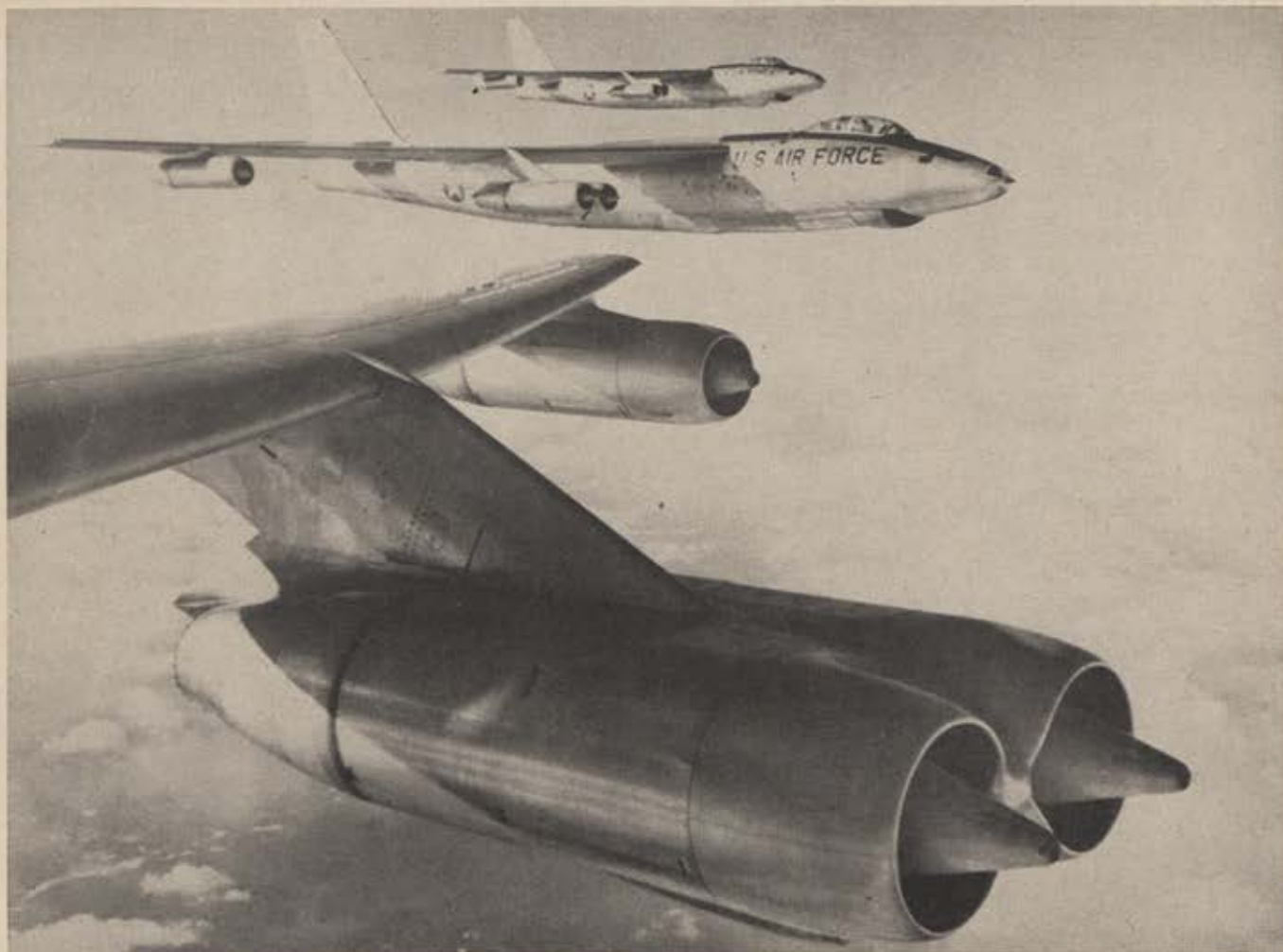
Nearly four months after the law went on the books the position remained open, and not for want of an intense man-hunt. There is a strong suspicion that no capable candidate will take the post because the basic idea of strong centralized control of all R&D is not a proven success. Indeed the Pentagon retains a number of outside offices, such as the Directorate of Guided Missiles and the Advanced Research Projects Agency, while vowing to put more firm leadership at the top. Having created a many-headed monster in this vital area, it is not an easy task to find its master.

If this situation is not the Achilles heel of the new Pentagon program, it certainly is one in which the flaws will be most evident and most likely to be fatal. The new Director of R&E, the law says, will "direct and control (including their assignment or reassignment) research and engineering activities that the Secretary of Defense deems to require centralized management." This policy, carried out to the letter, could separate the operating command and the procurement command from the research activity by infinite distances, all traversed by reels of red tape and blocked by mountains of decision-making machinery.

It is not our purpose here to pass judgment on the reorganization or even to question that it was a step in the right direction. Rather, it is to point out that there are still a lot of answers to some questions, no answers at all to others. The real impact of the changes in the Pentagon will not be known until long after the new offices are bloody and scarred. But this we can report with confidence: Thoughtful men on the other side of the Potomac see serious problems ahead, mostly in the areas where the Reorganization Law was most conservative.

Unification is still a goal, not a reality.—END





Symbols of US deterrent strength, USAF SAC B-47s streak across the California sky at March AFB during "world series."

*Night after night, the bombers of two mighty nations
grappled in the skies high over California during the . . .*

SKYGRID CLASSIC

Hugh Duncan and Ed Mack Miller

MOST Americans weren't aware of it—but on four nights in mid-October the air arms of two great nations grappled in "The Central Blue" above the United States.

Fortunately, both forces were friendly. Ranged against each other were the B-36s, B-47s, and B-52s of the US Strategic Air Command and the Vickers Valiants of the Royal Air Force.

The competition was keen, serious,

During the SAC World Series, maintenance men keep giant B-52s in top form.

professional. It was the annual "SAC World Series"—where the cream of the bomb crews of the strongest air arm in the world vie with each other (and their guests, the best British crews) for fame and trophies—and for heightened proficiency against the day war might come.

It is Strategic Air Command's maximum effort at precision bombing. And the arena covers half a continent, with contestants traveling higher and faster and farther than anything dreamed of not too many years ago.

It is the climax of SAC's annual

"paper war," ordinarily held in the late summer or early fall. During the rest of the year SAC crews are graded on their regular missions and in elimination competitions so that only the very best are sent to the Series.

Headquarters for the competition was March AFB, Riverside, Calif., nest for B-47 mediums and headquarters of the Fifteenth Air Force. For days prior to the competition opening—Monday, October 13—scores of B-47s and RAF Valiants flew in from terminal stations all over the globe.

(Continued on following page)

Three hundred miles north of March is Merced—"Gateway to Yosemite"—in the San Joaquin Valley. Here the "heavies"—the B-36s and the B-52s—streamed over the Sierra Nevadas and smoked down the runway at Castle AFB, Fifteenth Air Force satellite base from which the heavies operated.

The flight lines were as colorful as a carnival. One B-47 sported white sidewalls. Davis-Monthan's 303d Bomb Wing maintenance crews were proud of their blue coveralls with "World Series of Bombing" in orange across the back. All along the line you could feel the exuberance as old friendships were renewed and memories of the real thing—Ploesti, Koblenz, Merseburg, Peenemünde—were revived.

Show-stoppers at the competition were the four-jet Vickers Valiants flown by two wings of four crews each from the RAF's Bomber Command. The RAF, flying from England to March with one refueling at Goose Bay, Labrador, was back for the second straight year.

"They've got the equipment," said a worried Maj. Bruce D. Jennings, Jr., navigator from Hunter's 308th, "and they know what to do."

Air Vice Marshal Kenneth B. B. Cross, Commander of No. 3 Group, RAF Bomber Command, was enthusiastic about the intercontinental bombing-navigation rivalry. Arriving at March AFB in a Handley-Page Victor ("A good aircraft with no vices," says pilot Squadron Leader Anthony W. Ringer), Cross hailed the competition as accelerating "the bombing capabilities of the Royal Air Force by about two years."

Despite heavy odds (thirty-nine

SAC wings against two RAF wings) Cross was optimistic. "I have been in close touch with our detachment here," he said, "and our chaps have got on splendidly with their training."

Stuart Gunnill, liaison officer for the RAF crews ("We're the only Air Force in the world, if I may say so, with all-jet offensive and defensive capability") remained cautious regarding the RAF's chances ("We realize we're up against the aces of this business") but confident of RAF ability ("Our chaps are quite good, you know").

"I'd like to see them take some hardware home," said 12th Air Division Commander, Brig. Gen. Robert B. Miller. "It wouldn't hurt things a bit."

The "hardware" included SAC's massive Fairchild Trophy. Affectionately termed "The Sunday-Punch Bowl," the award was established by Hughes Aircraft in honor of Gen. Muir S. Fairchild, Air Force Vice Chief of Staff who died in 1950.

Seated in the droop-winged B-47 on the flight line at March AFB was Lt. Col. Ernest "Tick" Ticknor, sturdy-looking aircraft commander of Select Crew 91 (S-91). Behind him, face glowing eerily in the cockpit light, was slender Capt. Forrest Engle, who looks rather like a sharp young corporation executive. Strapped in the "mad scientist's gadget emporium" in the nose was Maj. Grover Malone, S-91's dependable "bombnagator"—observer, navigator, and bombardier. They were one of four crews selected to represent MacDill's 306th Bomb Wing.

Malone wiped the perspiration from his forehead and connected his oxygen mask and radio cord. Ticknor and

Engle were running through the multitudinous items on the pre-start check list.

"Approach light employ-deploy switch. . . ."

"Check."

"Pilot's ejection seat. . . ."

"Check."

Tick had already run through the "Stations" inspection, bailout briefing, mission review, and oxygen discipline briefing. There were over fifty pre-start items to be checked out. Oxygen had been reserveced, inflight lunch stowed, precomputations on celestial fixes made out.

In the aisle seat was an "umpire," listening carefully as Ticknor and Engle ran off the final items on the pre-start checklist. The "umps" (who do not fly with crews from their own wings) are official representatives of the Competition Arbitration Committee, sent along to ensure strictest adherence to the rules: No visual or radio aids on a RBS (Radar Bomb Scoring) run. No unauthorized target materials. Nothing that isn't approved by CINCSAC (SAC's Commander in Chief).

The Competition Arbitration Committee (consisting of four officers) scores the final "verdict" in the event of a dispute between crews and umpires.

Malone rechecked his oxygen and settled down to his job. Outside, the six engines whined, then settled to an ear-crushing roar. Ticknor and Engle were running rapidly through the pretaxi checklist. The sound of the six engines died to a sonorous rumble, then increased in tempo.

"March tower. Taxi and takeoff for Air Force jet 17066."



Top-scoring bombing crew at the meet was Fairchild AFB, Wash., 92d Bombardment Wing (Heavy). They scored 450.2 on B-52 mission, winning over an outstanding field of 155 other SAC and eight RAF Valiant crews. Crew represented the Fifteenth Air Force. After their win, beaming winners posed for victory photo with their aircraft commander, Capt. Ray A. Elliott, who is the third man from left.

Ticknor trundled the "bird" into position. Before him was the bomber stream—B-36s, B-52s, Valiants, and B-47s, disappearing into an ebony sky at ten-minute intervals. Down the runway, its shadowy form barely visible between the runway lights, was the last B-47 ahead of S-91. Ticknor held his brakes as he ran the engines to full power in a final check.

In the darkness off the end of the runway he could see the six apricot flames on the preceding '47. He made a final check on the instruments: Tail-pipe temperatures, rpm gauges, fuel pressure . . . *everything O.K. No sweat.*

The tower cleared him for takeoff. He released the brakes and the big bird began rolling slowly down the runway. Engle called off speeds as Tick held the bird between the flanking lights. *Max refusal speed!* There was a sudden exhilarating feeling as the wheels lifted off the ground and the last runway lights whipped by below. In a matter of seconds they were climbing at 300 knots over Riverside.

• • •

Competition aircraft began winging over California on Monday, October 13. Represented were 164 crews, the cream of the free world's bombing commands. Under the revised rules four crews were drawn from each wing. Each crew got only one mission—and that one would stand (in previous competitions two crews from each wing flew three sorties each and kept the best two).

The lead aircraft, a B-36 commanded by Lt. Col. Edgar W. Cate, Jr., of Biggs's 95th Bomb Wing, lifted off the runway at Castle shortly before noon. There had been no "peeking at the deck before the cards were dealt." The arena was a massive 2,825-mile oval, with targets at San Jose, Calif.; Boise, Idaho; and Butte, Mont.—and, to heighten the tension, a night celestial leg from Butte to Phoenix, Ariz., had been added. Targets in the three cities were revealed shortly before the competition, and entered crews were allowed no precompetition runs.

Following the B-36s and the B-52s from Castle were the Valiants and B-47s from March. First plane out was a Valiant commanded by Squadron Leader Peter James Clifton, based at Wittering, England. Following, at ten-minute intervals, were twenty-seven B-47s and another RAF Valiant, piloted by Wing Commander Sidney Baker.

Everybody settled back. . . .

• • •

Seventy miles southwest of Helena,



Fantastic gadgetry helps SAC bombardier-navigator make superquick decisions.

and 100 miles east of the rugged Bitterroot Mountains, lies Butte, Mont. Boring in on a northeast heading, at a range of 100 miles and an altitude of 35,000 feet, was Colonel Ticknor's B-47.

In the nose section of the plane Major Malone was checking his scope picture against target data taped to his work table. An invisible finger probed the ground ahead of him—the radar beam transmitted by the K-system.

Soon the configurations of Butte began to take form on the radarscope. The target was the northwest corner of Hennessy's Department Store. If the theoretical bomb was precisely "on the brick," the crew was credited with a "shack" (indicating that the crew had struck within six inches of aiming point). Within a city block would keep S-91 in the scoring column. Anything outside that wasn't worth recording.

At the RBS site seven miles below radar equipment was plotting the approach of Ticknor's B-47. A pen crept across the plotting board, calculating the speed of the plane, altitude, heading—all in response to an electronic beam cast by aircraft 17066. And, with the radar beam suddenly discontinued by the K-system, the pen would lift from the board, indicating the point of "bomb away." By computing known factors such as speed, ballistics, and other factors, the plotters could calculate within inches the impact area—"ground zero"—of the "bomb."

Actually, there is a brief moment in which the K-system flies the plane—when its electronic computers have considered all the variables of wind, altitude, speed, when Malone has fed it the "poop" and adjusted the cross-hairs to "zero in" on target. Then it is up to the "K."

The tension becomes almost unbearable when the high-pitched hum which has permeated the cabin suddenly stops.

Malone's bomb on Butte is dropped.

• • •

Late the first evening of the competition, October 13, the scores began trickling in. The lead Valiant, piloted by Squadron Leader Peter James Clifton, had suffered a "bloody malfunction" on the Butte run and scored badly. However, the second Valiant, piloted by Wing Commander Sidney Baker, was runaway leader.

"Everybody is very gratified," said liaison officer Stuart Gunnill. "Of course, it's still early in the competition."

Then things started tensing up.

Ramey Air Force Base's 72d Bomb Wing entry (defending wing-navigation champ), a B-36 commanded by Lt. Col. Earle H. Ambrose, took off as scheduled from Castle at 11:10 a.m.

Ambrose's problems were suddenly myriad. Shortly after liftoff he found that he could not retract his landing gear. The crew worked frantically. They managed to retract all but the port landing gear on the run to the first target at San Jose.

(Continued on following page)

Then Ambrose lost an engine.

Increased fuel consumption forced the aircraft down at Davis-Monthan AFB, Ariz.—but not before the die-hard B-36 and its laboring crew had completed the mission for score.

By early the following morning, the first day's competition tabulations were complete. Leader in the B-47/B-36 competition (and in the over-all) was Colonel Ticknor's B-47 from MacDill's 306th Bomb Wing. First in the Valiant/B-52 competition (and third in the over-all) was Wing Commander Sidney Baker's Valiant from RAF Team No. 1.

"We did well," said Gunnill. "The consistency of Baker's three bombs was magnificent."

And, to no one's surprise, first day honors in navigation (and fourth in the over-all) went to Ramey's 72d Bomb Wing, represented by Colonel Ambrose's trouble-ridden B-36.

Each morning a jubilant, optimistic crowd would gather before the gargantuan scoreboards at Castle or March and watch as the "barker" posted the scores.

"Hear the poop? Hunter's Second got a shack."

"I'm laying five to one MacDill wins the Fairchild."

"McDill, MacSchmill. My boys from the 92d have it knocked."

Off to one side stood a weary-eyed major, still dressed in flight suit. "No sweat," he said to his companion. "We're fat."

"Hope so. I've only averaged three hours sleep a night since this Pickle Barrel Derby began."

"This ain't no old man's racket."

"Roger. It was a piece of cake when we were in B-17s, flying at 20,000 and 140 knots. Now, at 450 knots and 40,000 feet . . . Well, it isn't a slice of angel food."

There were parties and "coke-tails" every night for flight-weary crews. In every corner you could hear a dash of kidding mixed with a dollop of razz.

By mid-morning Thursday, October 16, competition standings were firming up and all bets had been placed.

The competition aircraft flew a total of almost 476,000 miles in the four days of competition and accumulated almost fifty solid days of flying time (1,150 hours). There were individual booths for each of the forty-one competing wings. Huge signs were emblazoned across hangars: "Strategic Air Command Bombing and Navigation Competition." Involved were nearly 800 inflight lunches and, according to one source, "a million gal-

lons of paint painted and a zillion miles of wire wired."

Quite a show. "A piece of lint on your radarscope can mean the difference between success and failure," said Col. Bill Garland, Commander of Biggs's 97th Bomb Wing.

"Scratch your head in the wrong place," said another commander, "and you've lost the tournament."

Record scores were turned in by Capt. Ray A. Elliott's hot 92d Bomb Wing crew from Fairchild AFB—which posed a distressing problem. Elliott's B-52 crew had won the summer bombing competition held by the RAF in the United Kingdom, and subsequently had been spot promoted. PIOs at Castle were frantically examining the rule book to find out if a "spot-on-spot" was possible. It was going to be an embarrassing problem, all right. One of the crew members had been spot promoted to captain at the age of twenty-three.

"If a spot-on-spot is possible," said one, "he's going to be the youngest major in the Air Force."

Examining the records, officers found that spot-on-spot promotions had been abandoned in SAC. "I feel a lot better," said one young first lieutenant. "That captain made me feel old."

It looked like the B-52 was coming of age.

Other scores were about as expected. Running a hard second in crew over-all was another team from MacDill's 306th Bomb Wing, commanded by Capt. Jesse W. Spring, to keep the 306th in the running for the Fairchild. The one-two-three leaders from the previous day's running had been shoved down to three-four-five by Spring's and Elliott's hot B-52 crew. Wing Commander Sidney Baker's Valiant crew was running third in the B-52/Valiant crew competition, with RAF Team 2 sitting seventh in the over-all.

You could feel the tension building every place. Along the line at March anxious crew chiefs waited for their droop-winged birds. Others were in the "Scan" (Scandinavian) room, ironing out the kinks with a muscle-slapping rubdown. Some visited the International Shrine of Aviators and lovely St. Francis' Chapel at the headquarter's hacienda—the Mission Inn.

But everything extracurricular was forgotten temporarily as the final round began. This was it. The last act of the really big show.

At California twilight, Thursday, October 16, the final results began

ticking into headquarters. Some were disconsolate ("Even the doggone course is shaped like a goose egg!"), but there were laurels aplenty for the others.

Ninth in the crew over-all was Squadron Leader R. W. Richardson's RAF Crew 6, Team 1, from Marham, England. In for sixth in Wing Navigation, capturing seventh in the over-all, was RAF Team 2. Capturing third in the B-52/Valiant competition was Wittering's RAF Group 3.

At an impressive ceremony Saturday, October 18, Gen. Thomas S. Power, SAC's Commander in Chief, presented the beautiful silver-and-mahogany Muir S. Fairchild Trophy to the top over-all wing—MacDill's 306th Bomb Wing (B-47)—which had won the navigation and placed third in bombing to emerge as the top over-all wing.

Somebody thought they saw an extra twinkle in General Power's eye. The reason: For the first time "the Long Rifle," the big B-52, had proved itself.

The B-52 crew of Capt. Ray A. Elliott, from Fairchild's 92d Bomb Wing, had won the over-all crew competition. SAC's heavily outnumbered B-52 wings had garnered three of the top ten positions in the wing over-all, three each in wing bombing and navigation, two in over-all crew competition (including the 92d's first place), three in crew bombing, and four of the top ten spots in crew navigation—thus vindicating SAC's faith in the bomber that will be the "big muscle" in the deterrent program for some years.

"The B-52," said one officer, "has acquitted itself with honor." And all over the nation big people and little people who had worked for years on the B-52 program sighed happy sighs.

The B-52 had proved itself in its toughest test as a bomb platform in the hardest competition this side of war: The Annual SAC World Series. —END

ABOUT THE AUTHORS

Messrs. Duncan and Miller are both avid observers and reporters of the aviation scene. Readers will recall, long before Sputnik, their jointly written "Window into Space," in this magazine in 1956—a closeup picture of the quiet work then being done, and now so celebrated, at the Department of Space Medicine, USAF School of Aviation Medicine. Mr. Miller is currently working on a new novel. His book *Tales of a Flier's Faith* was published earlier this year.

Interceptor phase of 1958 weapons meet held at Tyndall AFB

OPERATION WILLIAM TELL



Over the Gulf of Mexico ADC interceptors warm up for big ADC meet. They are the F-102, F-86 (background), and F-89.

Claude Witze
SENIOR EDITOR

TYNDALL AFB, FLA.
OPERATION William Tell, the Air Defense Command's interceptor phase of the Sixth Worldwide Weapons Meet in October, was more than an exhibition of pilot skill. It was a demonstration of weapon system accuracy and reliability, a vindication of the USAF-industry approach to development and production of improved vehicles, radar equipment, and air-to-air missiles.

(Continued on following page)



If not completely destroyed, Ryan Firebee drone target is parachuted to the sea, retrieved for salvage by Vertol H-21. Firebees have been known to make fifteen or more flights before being clobbered. New electronic scoring system, which is called Parami, tape records the accuracy of the weapons.

Among the contestants there was not a single pilot, crew chief, or other operator of air or ground equipment who was more earnest and alert than the small army of aircraft and electronic industry representatives who monitored the ten-day show. It was evident that contractors looked upon the meet as a testing ground for their equipment and the concept that produced it.

William Tell provided the closest approach to reality ever achieved in an interceptor weapons meet. The targets no longer are muslin sleeves towed through the air by piston-powered light bombers. Out over the adjoining Gulf of Mexico, ADC pilots were vectored in on 600-mph Ryan Q-2A Firebee jet drones, launched from under the wings of B-26 bombers and pushed to altitudes above 30,000 feet.

The Firebee is one-tenth the size of a potential enemy bomber. Yet it did not simply provide a practice tar-

get; it provided a complete exercise, from early detection to destruction. Individual missions began with the Ground Control Intercept unit at radar scopes. After detecting the Firebee's rate of speed, direction of flight, and altitude, the controller determined the line of intercept and then scrambled the aircraft, vectoring them to the target.

Twelve teams competed in three categories, according to their aircraft and armament. Here are the categories and the winners:

- **Category I.** Northrop F-89J, armed with Douglas MA-1 Genie rockets without atomic warheads. Winner was the 465th Fighter-Interceptor Squadron, Griffiss AFB, N. Y., with 39,500 points. Of these, 32,900 points were scored by Col. Frank Keller, giving him the team captain's trophy. Colonel Keller was tied with Col. George F. Ceuleers of the 84th Fighter-Interceptor Squadron, Hamilton AFB, Calif., and took the top prize

in a shoot-off event in which he made a perfect hit.

- **Category II.** Convair F-102, armed with Hughes GAR-1 Falcon guided missile. Winner was the 326th Fighter-Interceptor Squadron, Richards-Gebaur AFB, Mo., with a final score of 39,900 points. High individual score in this event was won by Col. Roy B. Caviness, captain of the 482d Fighter-Interceptor Squadron out of Seymour Johnson AFB, N. C., who had 32,900 points while his team ran second with 34,100 points.

- **Category III.** North American F-86L, armed with the Mighty Mouse, a 2.75-inch rocket made by Aerojet. Top honors went to the 125th Fighter Group, an Air National Guard entry from Jacksonville, Fla. The unit's star performer was a Regular USAF officer, Col. Robert E. Dawson, who won high score for the division with 39,600 points and also was top scorer for the entire meet. He registered six perfect hits.

TV CAMERAS PROVIDE COCKPIT VIEW OF SHOOT



Dage 320 TV camera monitors takeoffs, landings from front of control tower.

Operation William Tell is the first military exercise in history that could qualify for a Hooper rating. The entire operation, from flight-line activity to takeoff, target interception, and firing of the weapon, was seen by thousands of television viewers in the Tyndall AFB area. Through arrangements made with the Federal Communications Commission, TV Channel 4, unassigned to commercial broadcasting in the Panama City, Fla., area, was turned over to USAF to be used for the duration of the William Tell competition.

In addition to the realism introduced for judges and spectators at Tyndall, the TV coverage brought the show to residents of Panama City, and performed a topnotch public relations service for ADC. For years, USAF bases have stirred up local community

resentment, much of which can be overcome once the citizens understand more fully what the airplanes are for and where they go when they roar over the roof tops. The William Tell TV show brought this message to the Tyndall neighbors in a new and spectacular way.

The coverage was programmed by USAF with special equipment developed by Dage Television Division, Thompson Products, Inc., Michigan City, Ind., and tied together with Philco Corp. electronic devices. Most important is a small TV camera that could be carried in the F-102 and TF-102 serving as a chase plane. They operated perfectly even at supersonic speeds and always kept the attacking interceptor in clear focus on the TV screen. They could transmit the picture 150 miles.

The firing of drones, approach of the interceptor, and scoring were all relayed to a Dage mobile television unit and control center on the flight line. Other shots were introduced from the GCI center, showing how the target drone was tracked, and maps displayed the exact point of the intercept. During the final approach to launch point of the air-to-air rocket or missile, a period of about six to eight minutes, the TV audience listened to the conversation between the interceptor pilot and the GCI operator.

In addition to the airborne camera



Transistorized camera in TF-102 gave viewers thrilling picture of intercept.

others were spotted on the ground, in front of the control tower, and on the flight line. A final camera was at the TV control center, where an USAF captain provided an excellent running commentary, reported the scores, and added color or information when it was needed to explain more fully what was being done by personnel and equipment.

Kinescope recordings were made for later use by the Air Force and for possible editing and use in commercial broadcast programs.

The new TV equipment has obvious applications in the areas of training, testing, and evaluation of weapon systems. It already is in use at Patrick AFB as a silent monitor on the launching pads when missiles are tested, carrying the picture to the men at the firing controls.—END



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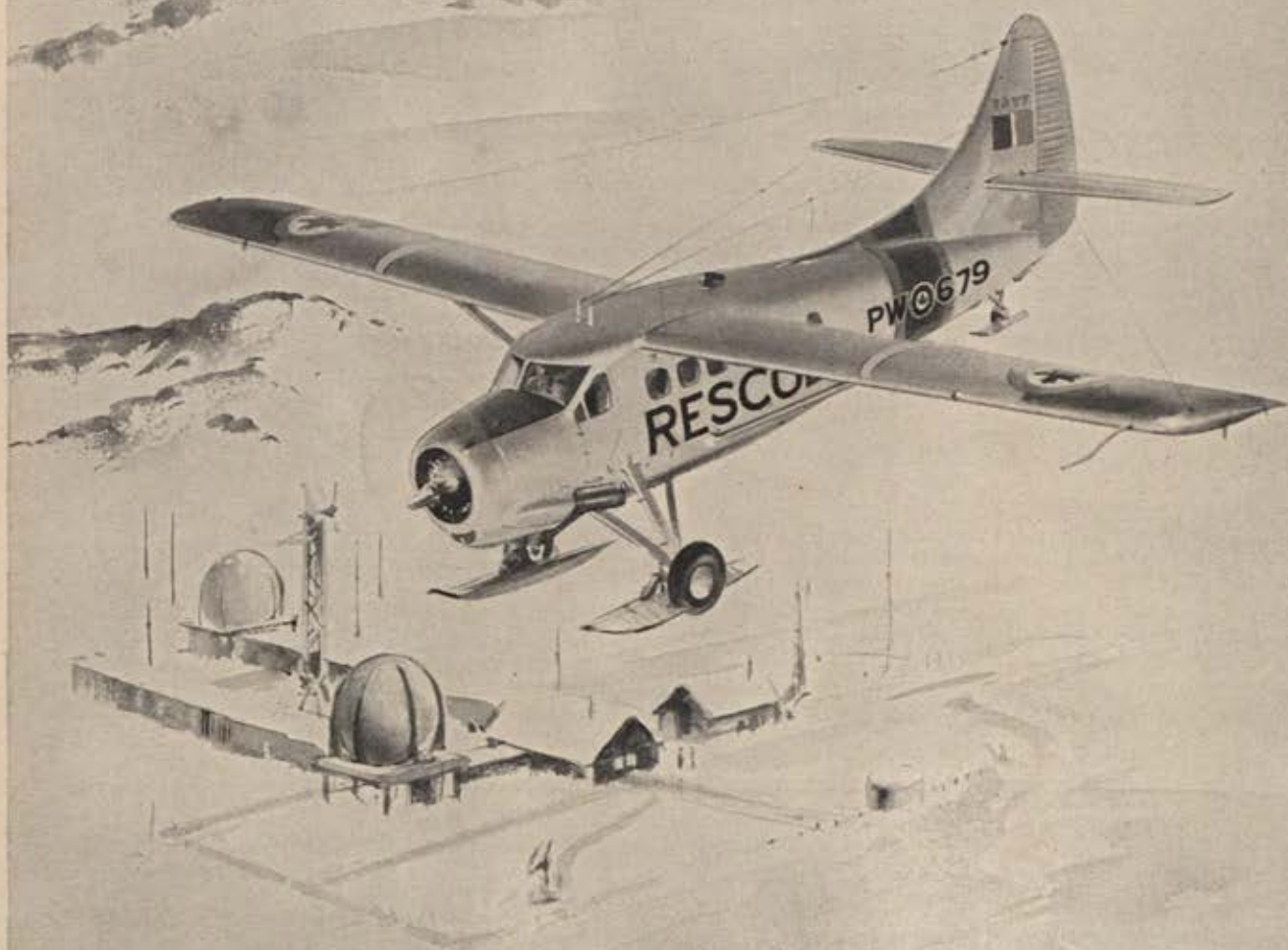
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Boeing KB-50 tanker prepares to refuel McDonnell RF-101, Douglas WB-66, North American F-100 during the Nellis meet.

Fighter weapons meet in the skies over Nevada

TAC SHOWS ITS STUFF AT NELLIS

THOUSANDS watched the TAC-sponsored Nellis AFB, Nev., phases of the USAF Weapons Meet, which featured all of the Century series of tactical fighters in a startling variety of combat operations and missile capability demonstrations, including Sidewinder firings from F-100s and F-104s. Also demonstrated was the Navy-developed Bullpup air-to-ground missile being tested for Air Force use.

Crowds saw a zero-launch of an F-100 Super Sabre using Astrodyne rocket power, demonstrating how future tactical pilots could operate from aerial platforms even after runway destruction in nuclear attack.

The public saw, too, demonstrations of air-to-air refueling. A TAC KB-50 tanker refueled three types of jet craft at one time, an F-101 Voodoo, an F-100 Super Sabre, and a B-66 bomber.

Another highlight was TAC acceptance of the world's fastest airplane, the new F-104C Starfighter, the "missile with a man in it," with air-to-air refueling capability. TAC Commander, Gen. O. P. Weyland, accepted the new craft.

Top winners at the meet included Nellis' own fighter weapons team, representing Air Training Command, with 26,078 points. USAF Vice Chief of Staff Gen. Curtis LeMay did the

honors. Col. Bruce Hinton was team captain. Runners-up was TAC's Turner AFB, Ga., 31st Tactical Fighter Wing with 23,040 points, commanded by Col. Gordon Graham. Top individual scorer was Maj. Jack F. Brown, Nellis AFB, with 7,478 points. Major Brown was runner-up in special weapons and conventional weapons events. Second in over-all scoring was Capt. Waymond C. Nutt, also of the Nellis team, 7,327 points. Top scorer in special weapons event was Capt. Walter S. Bruce, Turner AFB, Ga., while the conventional events champ was Capt. Garry A. Willard, who is from Seymour Johnson AFB, N. C.—END



F-100, demonstrating tactical ability, drops deadly napalm bomb as thousands watch during supersonic Nellis show.



Top scorers at Nellis included Col. Bruce Hinton, center, with Captains Maulsby, Nutt, Pogreba, and Maj. Jack Brown.

WHAT ARE THE PROSPECTS FOR A NUCLEAR TEST BAN?

Earl Voss

AS THE United States, Britain, and the Soviet Union began their negotiations on a nuclear test ban at Geneva last month, there were still misgivings in the Pentagon and the Atomic Energy Commission about the wisdom of completely binding the United States' hands against further experimentation.

Developing cleaner and smaller nuclear weapons for both air and surface warfare is still rated a highly desirable preparation for any new war.

Presumably there were parallel misgivings in the Soviet government, for the Communists reportedly were some distance behind the West in producing a broad spectrum of nuclear weapons.

Despite the doubts, however, President Eisenhower and Premier Khrushchev decided to start the talks.

They could hardly have done less after last summer's Geneva conclave of East-West scientists concluded that it is technically feasible to set up—with some limitations—"a workable and effective control system."

Suppose, then, that the many difficulties looming in the way of a final agreement could be overcome. What kind of a world would we have?

For one thing, tensions in the cold war might actually increase, instead of decrease, as hoped. To explain, one must begin by sketching briefly the positions of Washington and Moscow.

The Soviet Union insists that a flat, all-inclusive ban be imposed immediately and for all time, whether or not agreement is reached on an effective inspection system.

The Anglo-American offer is less sweeping and tied closely to effective inspection. "We will suspend," Ambassador Henry Cabot Lodge recently told the United Nations, "for one year without controls, unless the Soviet Union continues testing during that period. And we are ready to extend our suspension indefinitely as long as each year we know that the inspection system is working and we are making reasonable progress on other aspects of disarmament."

America and Britain began a one-year period of suspension without controls last October 31, but were prepared to resume testing if the Soviet Union did so first. When the Russians exploded two more bombs, November 1 and 3, President Eisenhower reclaimed the United States' freedom to test, but withheld actual testing to see how Moscow intended to proceed—with many tests or only a few.

Assuming only a few further tests, Washington probably would go on negotiating for a test ban and it was calculated that inspection details could be ironed out at Geneva by October 31, 1959. It would take another year—until October 1960—to install the inspection system. Britain and the United States would be prepared to extend their ban during this second year, provided there were no intensive testing or hitches in placing the inspectors.

After October 1960 Britain and the United States say they would want to see at least some progress in other phases of disarmament—reducing conventional capabilities, confining use of outer space to peaceful purposes, etc.—before making the test ban permanent.

Officials in Washington concede, however, that it would be extremely difficult for the West to break the ban, once it were in effect so long.

Between the all-or-nothing Soviet position and the cautious Anglo-American position some compromise might be possible—perhaps in the direction of a two- or three-year unconditional ban, as Moscow once suggested.

Secretary of State Dulles, however, is not optimistic.

He attaches considerable validity to what he calls "speculation" that the Geneva technical talks last summer "opened the eyes of the Soviet Union to the fact that our own knowledge was considerably greater than theirs about nuclear weapons . . . that they realized they were considerably behind in this matter and therefore they lost interest in the suspension, so that their primary purpose now is to extricate themselves from the suspension of testing without excessive damage to their propaganda position."

Not all State Department officials share the Secretary's view. Some of those who participated in last summer's Geneva talks are convinced that the basic, long-range interests of the Soviet Union would be served by a genuine test ban. They expect an agreement after a long, hard negotiation and have Mr. Dulles' backing to make the try.

These officials point out that a test ban would help the Kremlin "stigmatize" nuclear weapons, so that the West would find it harder to use them against superior Soviet conventional forces.

A ban would also help to freeze out of the nuclear "club" West Germany and Red China, two countries which Moscow genuinely fears. (Whether or not France tests a few nuclear weapons makes little difference to the Soviet Union, it is reasoned, as long as France has not the resources to develop a big stockpile. France reportedly is close to the testing stage and refused to join in the Geneva test-ban talks.)

For its part the West sees three main advantages to an effective test ban. Russia would be opened to international inspection; the race would stop while the West was ahead; and there would no longer be world moral pressure against the United States and Britain for risking genetic damage to the human race by increasing the radioactive fallout hazard.

Assume, then, that some compromise test-ban proposal is finally agreed upon. What then?

Signs from Moscow are that the war of nerves might actually increase and the atmosphere for further disarmament steps might really become less favorable.



The US will suspend for one year its nuclear testing, Henry Cabot Lodge has told the UN.

Source of the tension would most likely be the loopholes in the test-ban agreement. Neither side could be sure the other was not testing secretly.

That there are bound to be loopholes scientists of East and West agree. In their technical report last August 30, scientists from the United States, Britain, Canada, France, the Soviet Union, Poland, Czechoslovakia, and Rumania all conceded:

"It has been estimated on the basis of existing data that the number of earthquakes which would be undistinguishable on the basis of their seismic signals from deep underground nuclear explosions of about five-kiloton yield could be in continental areas from twenty to 100 a year."

From two to eight times a month, in other words, there may be underground disturbances that one side or the other would have to regard as an attempt by a potential enemy to break its test-ban agreement.

The report provides that "these unidentified events which could be suspected of being nuclear explosions would be inspected" by one of the 180-odd control teams spotted strategically around the globe. The teams would be provided with "equipment and apparatus appropriate to their tasks."

The scientists' report estimated the inspection teams would have to comb an area of forty to eighty square miles, because detection devices could not pinpoint the area any more closely. Whether the team could complete one exploration before another suspect disturbance occurred was not discussed in the report.

Prospects are, under these conditions, that Soviet inspectors might someday want to scour a city like San Francisco (44.6 square miles) or Baltimore (78.7 square miles) for evidences of an underground nuclear blast.

To be effective they would have to be given authority to take soundings—with drills or other excavation equipment—in suspicious areas. Persuading big-city mayors of the necessity for tearing up key pieces of real estate, especially in areas where tremors are fairly common, might pose difficult problems in national-local relations. Resistance in the Soviet Union might be on a different basis, but no less difficult to overcome.

Reluctance to permit careful inspection, of course, would only intensify suspicions. The trail of litigation in the wake of the inspectors might be imposing.

Even if both sides are able to guarantee adequate access to suspicious areas, however, the most eminent seismologists in the United States have warned publicly that an unscrupulous power might cheat on a test ban.

Shortly before the technical talks began at Geneva last July, the Senate's Special Committee on Disarmament, headed by Senator Hubert Humphrey, Democrat from Minnesota, polled thirty-one eminent American seismologists on the wisdom of a test suspension.

One of the key questions Senator Humphrey asked was how these seismologists would cheat "if you were given the problem of determining a set of conditions under which an underground nuclear explosion could be carried out without detection."

Answers emphasized that no system of detection could be absolute, as the East-West conclave later agreed. There were many ingenious suggestions for evading an international inspection system.

The most popular region for conducting clandestine tests would be earthquake-prone areas like eastern Siberia, in the Kamchatka Peninsula and Kuril Islands, or the central Asian area, on the slopes of the Himalayas. The United States, too, has "highly seismic areas," like California.

Many seismologists suggested to Senator Humphrey that a clandestine blast might be triggered by an actual earthquake. The bomb's trigger, they said, could be hooked up

to a seismograph so the blast would go off at the instant an earthquake of large magnitude occurs.

The seismograph reading of a combined earthquake and nuclear blast would be difficult to distinguish from a routine earthquake, at least until precedents had been carefully analyzed.

Experts at Geneva established to their satisfaction that underground explosions of more than five kilotons could be distinguished from earthquakes, mainly by seismograph readings. Earthquakes produce compressions on one side and rarefactions on the other side. Explosions produce compressions in all directions.

Thus if seismographs at five or six points of the compass register compressions at a given instant in the same general area, the assumption would be that a man-made explosion had occurred. Whether it was nuclear or chemical would have to be checked on the spot.

However, if some seismographs recorded compressions and others rarefactions, the evidence would point to an earthquake.

But seismograph readings of this kind would be normally reliable only for explosions of five kilotons or greater. The theory is that clandestine testers could rig smaller explosions and extrapolate the results for application in bigger bombs, if necessary.

Concealment above ground would be as important as below ground, many seismologists advised Senator Humphrey.

Dr. William B. Heroy, Jr., Vice President of the Geotechnical Corporation of Dallas, Tex., suggested locating an underground test beneath a heavily wooded, highly seismic area, near normal mining operations where there are many man-made explosions. An abandoned mine would make a good site, he speculated.

Equipment and supplies for the shot should be brought in by helicopter, not by a truck whose road tracks would point to the site, he said, and the hole for the nuclear device should be drilled, not tunneled. A body of water nearby would be convenient for dumping waste material from the excavation, he suggested.

Shock waves from earthquakes travel at different speeds and to different distances, depending on the geological formations through which they pass. Relatively soft areas absorb the vibrations and reduce the distance at which earthquakes can be detected.

Therefore, some seismologists advised that clandestine blasts might be set off in very porous, dry layers where the explosion would be muffled. The Arctic was said to contain such areas.

Jamming of inspectors' seismographs is also considered a likely method of concealing a secret test.

How, some seismologists inquired, would shaped nuclear charges show up on seismographs and other detection instruments available to inspectors?

The Rev. Daniel Linehan, a Jesuit seismologist at the Weston Observatory of Boston College, suggested that "several explosions might be set off with slight delays, and the effect of one could mask another, confusing the interpreter of the gram [seismograms]."

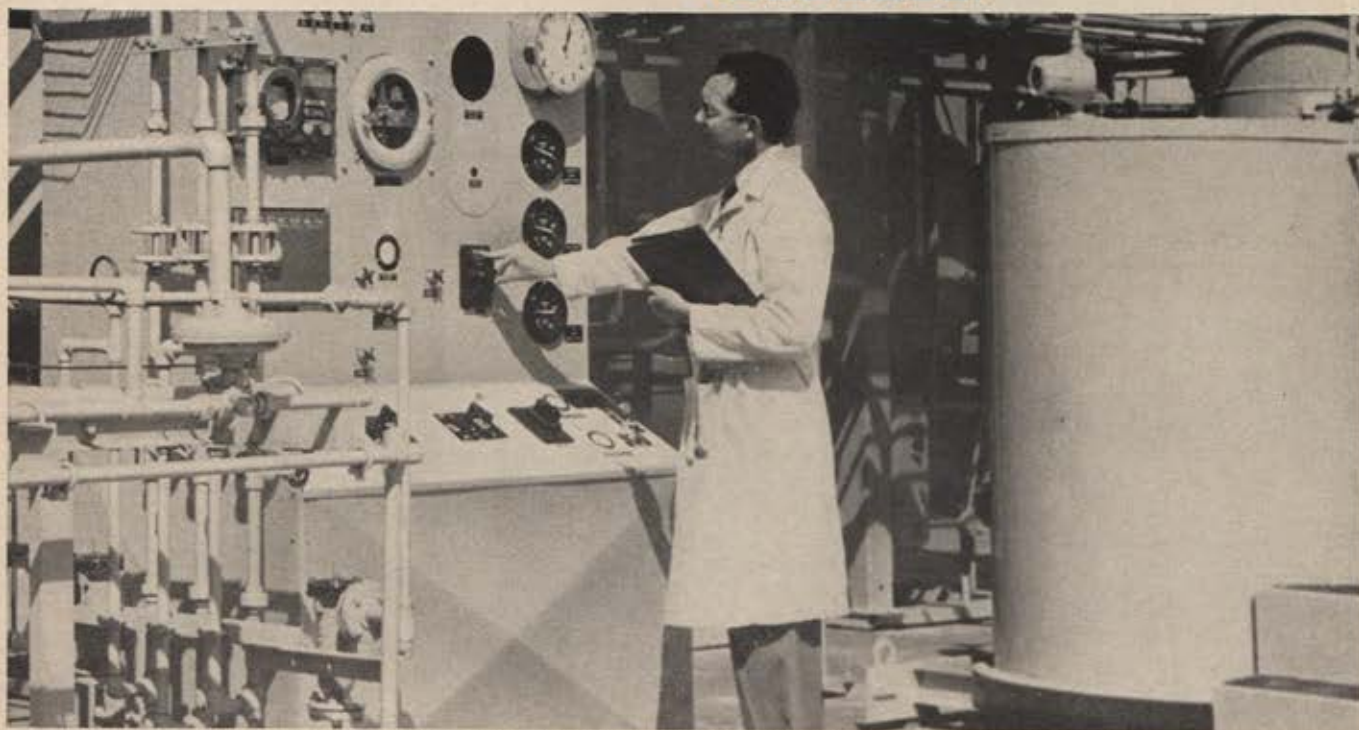
Dr. Thomas C. Poulter, of Stanford Research Institute, believes that no positive identification could ever be obtained from seismographs alone. Inspectors would have to go to all suspicious areas and conduct tests to produce proof, he said.

On the other hand, he says, evaders would need only to have explanations for two factors: the underground explosion and any suspicious surface activities.

"It would therefore seem that, if a nuclear shot were fired in conjunction with a rather large mining or quarrying operation," he wrote, "it might well be possible to conceal it from even the major portion of the personnel
(Continued on page 57)

...speaking of *Missile Ground Support*

EQUIPMENT



Shown above is the central control section of the advanced Bomarc fuel system adopted for launching bases.

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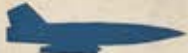
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REDSTONE

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BOMARC

Erector-launcher and
power unit



NIKE-HERCULES

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working at the mine or quarry. The necessary underground tunneling could be conducted on the excuse of exploring the extent of the deposit. The security could be disguised in many ways, such as a safety measure to personnel, etc. *Subsequent mining operations could proceed within less than 100 feet of an actual shot location without detecting radioactivity.*"

One of Senator Humphrey's consultants proposed that a clandestine shot might be fired in a well, "drilled deep under the bottom of a shallow sea." He reasoned that "even if the event was suspected from seismic evidence to be an explosion, it seems exceedingly unlikely that nuclear proof could be produced by inspection teams."

Ice is a very poor transmitter of seismic energy. It was suggested that a clandestine tester might go to Antarctica and fire in the thick ice there. One expert said "it is doubtful that a blast as large as ten kilotons would even be noticed."

Large Arctic areas, of course, lie within the territories of the Soviet Union, the United States, and Canada.

Professor James T. Wilson of the University of Michigan brought up yet another disquieting aspect:

"The Rainier [first United States underground] blast might have passed almost unnoticed seismically in the United States had it been fired in, say, western Nebraska, northern North Dakota, or a number of other such places. This is despite the fact that the United States has quite a large number of seismograph stations. It would undoubtedly have been recorded but would have probably entered the historical file as a minor earthquake in an odd location."

These suggestions for cheating are reported in some detail here to make a point that is seldom made. It is not that the Soviet Union would necessarily try to cheat, although this could not be ruled out.

But a power as suspicious and sensitive as the Soviet Union would be sorely tempted to use its vast propaganda machine to charge the United States with conducting clandestine tests.

Senator Humphrey's thirty-one scientist survey, of course, is ready-made material for Radio Moscow to charge that America is "plotting" to break the ban even before it is signed.

Proof that the Soviet Union is alert to American testing came last summer during the technicians' talks in Geneva. Tass, the official Soviet news agency, suddenly announced that the United States had tested thirty-two nuclear tests in the Pacific between April 28 and July 26, or eighteen more than the Atomic Energy Commission had officially admitted.

Later it was reported that the United States had actually exploded only about thirty weapons—two less than the Soviet Union had charged.

There is no sure way for the bystander to judge, of course, whether the right number was fourteen, as Washington reported; thirty-two, as Tass announced; or some other figure. A Japanese government monitor backed up the AEC in reporting there were only fourteen, but this figure is now widely believed to be low.

The Tass report marked the first time that the Soviet Union had attempted to report on American nuclear tests, however. Some officials indicated the Reds came close to giving the right number. There was even some suspicion that Moscow added a few to the number it knew had been exploded, to see how the United States would react.

This kind of unreliable reporting, deliberate or not, could have exceedingly dangerous consequences once a test ban had been put into effect. With twenty to 100 chances a year to wonder whether an underground dis-

turbance was a bomb or an earthquake, Soviet propaganda organs would have a large, new field for maneuver.

Past precedents are not encouraging. In the Korean War the Communists manufactured the big lie that American forces had used germ warfare. It would hardly be less difficult, some observers fear, for the Reds to pin a charge of clandestine testing on the United States.

Even if the American people did not believe it, the charge could be expected to have considerable effect in less sophisticated areas—enough effect to make the attempt attractive for Soviet propagandists.

At the same time there is the risk that the Soviet Union might herself try to cheat, of course. In the case of the germ warfare charges in Korea, it was always a suspicion that the Reds were preparing a "cover" for themselves in case they needed it. Laboratories breeding possible germ warfare cultures were captured in Pyongyang, the North Korean capital, during the Korean War.

Some American officials have advanced the idea that the Kremlin might try another method of discrediting the United States, particularly if it wanted to resume testing once a suspension were ordered.

Suppose, they say, that the Soviet Union were to dispatch a submarine to the United States' Eniwetok proving grounds and "plant" a nuclear explosion there. Then Moscow could denounce the United States for breaking its agreement and justify resumption of its own tests.

Those who think it best to press forward with a test ban contend that all these attempts at sowing confusion could be exposed. Moreover, they believe, the basic interests of the Soviet Union would better be served by maintaining quiet.

Senator Humphrey believes that the risks of accepting a test-suspension agreement are preferable to the risks of going on with the feverish arms race.

He wrote in his report last summer that "an inspection system for a nuclear test moratorium could provide a high degree of assurance that no country would risk violating the agreement by trying to conduct tests in secret."

Scientists of East and West calculated the "high degree" was about ninety percent. Cheaters would run a ninety percent risk of being caught, they reported. Some American officials believe a mere fifty percent risk would be enough to deter the Soviet Union or any other power.

Even if they are right, the West may find it more difficult to protect against psychological warfare in this deadly serious area, where a propaganda feint might lead to war.

Last spring the Soviet Union took a similar risk. Moscow aired charges in the United Nations that the American Strategic Air Command was sending its bombers toward the Soviet Union and risking retaliatory strikes from Russia.

This may be the prototype of the war of nerves in store for the world if a nuclear-test suspension is ever arranged.

The Administration appears to have decided an agreement will be worth it—in terms of opening the Soviet Union to inspection and confining the spread of nuclear weapons to other countries.—END



ABOUT THE AUTHOR

Mr. Voss is diplomatic correspondent for the Washington Star. He was formerly on the editorial staff of the Sunday Star. Before joining the Star in 1951, Mr. Voss served six years in General MacArthur's public relations office in Tokyo.



Some Practical Problems in the Pentagon

Charles A. Coolidge

SOMETIMES reorganizers get so enthusiastic reorganizing that they lose sight of the purpose for which the organization they are reorganizing exists. That seemed to be true of many suggestions we received for the organization of the Department of Defense. Its fundamental purpose of defending the United States had been forgotten. Let me give a few examples.

The suggestion that military personnel be economized by using civilians for activities not requiring combat training overlooks the fact that civilians cannot be ordered overseas and can quit when they choose. So if the Army, Navy, and Air Force are to feed, clothe, and administer themselves in an overseas theater or in case of a domestic disaster, they must have military personnel who know how to perform these noncombatant functions. The services can, and do, use many civilians, but the military must retain a substantial participation in the "housekeeping" activities of their service.

Another suggestion was that the usual two- to four-year rotation period for military personnel should be abolished in many fields, so that officers would become more skilled by staying longer on one job. But this cannot be applied too broadly. History proves that military personnel tend to go to sleep on the job if they are kept too long at one assignment. Further, to a substantial extent officers must be "jacks of all trades," so that in time of war casualties will not cripple any given activity.

The suggestion that military hospitals which have empty beds and skeleton staffs should be consolidated into a few efficient units overlooks the fact that even in a limited war there would be no empty beds, and in case of a nuclear war we would be woefully short of beds.

The same considerations apply to suggestions to disband the tanker fleet of the Military Sea Transport Service and the planes of the Military Air Transport Service.

In the research and development field the suggestion that civilian scientists should replace the research organizations of the Army, Navy, and Air Force overlooks the necessity for military men to possess real scientific knowledge in order to hit upon ideas which will meet particular service needs, to develop the full potentiality of new weapons to meet service conditions, and, most important, to devise tactics and strategy which will take full advantage of those potentialities.

The suggestion that a single Chief of Staff should replace the present Chairman and four service Chiefs of Staff ignores the danger of relying for the solution of problems involving national life or death on the fallible judgment of one individual who would have the power to suppress differing opinions.

These and other examples too numerous to mention here demonstrate that the Pentagon is full of cross-pulls. I do not mean cross-pulls arising from interservice rivalries. I mean those which arise from the desire for efficiency on the one hand, and the necessity of instant readiness for war on the other. These cross-pulls bedevil the ablest Secretary of Defense. It is rarely possible for him to establish a general rule without also establishing exceptions. As a corollary, he faces a major administrative problem in preventing the services from converting the exception into the rule when they so desire, and so defeating his efforts to avoid duplication and waste.

All this has a bearing on why the Department of Defense does not, as many citizens expect and demand, operate with the same efficiency as a private industrial concern. The huge size of the Department is another reason. It is many times the size of our largest industrial concern. But, important as they are, none of these considerations seems to me to be controlling. There are other factors which, in my view, make it hopeless to expect that the Department of Defense ever will attain the same degree of efficiency as a private company.

In the first place, it is a fundamental national policy that our military establishment be under civilian control. In the absence of special legislation (such as was enacted for General Marshall) no professional military man can be Secretary of Defense. That is like insisting that the president of a steel company cannot be a steel man. He can be anything else, but not a steel man. To the business world this seems an odd way to go about obtaining efficiency, but it is the price we pay for this policy.

In the second place, both the Secretary of Defense and his "vice presidents" (service Secretaries and Deputy and Assistant Secretaries) are political appointees in the sense that they are appointed by the President with the approval of the Senate. Able as they generally are, their average term of office is less than two years. That hardly compares

(Continued on page 61)

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favorably with the life training most industrial vice presidents have received.

I have mentioned the service Secretaries. Let me digress for a moment on them—the Secretaries of the Army, Navy, and Air Force. Theoretically, they are the principal assistants of the Secretary of Defense in carrying out unification as laid down in the National Security Act. Actually they must be advocates of their particular service, or else they will lose the confidence of that service and become useless. Talk about conflict of interest! The difficulties Mr. Wilson and many others have encountered under the so-called "Conflict of Interest Statutes" pale in comparison with the conflict of interest faced by the service Secretaries. I happen to be one of those who think the service Secretaries are very important persons. They are the immediate bosses of the three major segments of the Department of Defense. Each segment has numberless problems which are purely its own. If the service Secretaries were abolished, or even if their title was changed to "Undersecretary of Defense," many of these problems could not be settled short of the Secretary of Defense, because "everyone wants to see the boss." So the service Secretaries do take a great load off the Secretary of Defense, in spite of their conflict of interest. In my judgment, the ultimate full success of the Department of Defense depends in large measure on the skill with which the service Secretaries maintain the confidence of their service and at the same time respond to the efforts of the Secretary of Defense to avoid duplication and waste.

There is a third major obstacle to efficiency. The rank-and-file administrators of the Department of Defense consist of military officers and civil servants. As I have said, the officers rotate their jobs every two to four years as a general rule—a far shorter period on the job than in industry. Further, in noncombat jobs the military do not always put their heart in their work. They are trained to fight and understandably many find it difficult to generate enthusiasm over desk jobs. With the civilians rotation is not a problem, but there is an automatic process of selection working against the government. Able civilians are drawn off into private employment by much higher salaries, leaving the less able behind. To some extent this also applies to military officers.

From the point of view of manpower, therefore, to expect the Secretary of Defense to run the Department of Defense with high efficiency is like expecting a man who is not a carpenter to make a fine piece of furniture with blunt tools.

And there is still another important obstacle to high efficiency. Throughout our history cases of graft and dishonesty in the spending of public money have periodically been uncovered. As a result, the laws governing the spending of public money have been buttressed with provisions designed to prevent dishonesty. Inevitably such provisions deprive government buyers of discretion. While lack of discretion does not materially hamper routine buying, much of defense buying is not routine. And without discretion, initiative withers. No one dares to take a chance. Judgment is replaced by paper work. Form governs substance. Efforts to improve the situation have given partial relief, largely in the field of new weapons, where competitive bidding will not work and costs cannot be ascertained in advance. But the chances of the spending rules being changed so that buying may be done with initiative and shrewdness comparable to that in industry seem dim. In government the same rules must govern the able and honest buyer and the incompetent or dishonest buyer; at least that is so to date, and no satisfactory mechanics have



Sharers of the US defense burden. USAF Vice Chief of Staff, Gen. Curtis LeMay; Defense Secretary Neil H. McElroy; Chairman, Joint Chiefs of Staff, Gen. Nathan F. Twining.

yet been devised to segregate the two. The numbers and semipolitical considerations involved make the difficulties too formidable.

The situation is aggravated by the so-called "do-good legislation"—certain laws which have a social purpose. In addition to requiring that government contractors pay prevailing wages and practice no racial discriminations, these laws require that varying degrees of preference be given to American shipping, to American manufacturers, to small business, to dispersed plants, to distressed areas, and even to distressed businesses in nondistressed areas. Further, there is often potent political pressure to establish, or continue, activities in the area where constituents of various members of Congress are located, even though that may not be the most economical thing to do.

All this adds up to a pretty gloomy picture. And I have not covered such well-publicized problems as interservice rivalries. Fortunately, however, interservice rivalries which reach a high enough pitch to be harmful are largely confined to the Pentagon. There the future of the service is at stake, so competition for money and position is at its keenest. In the field service rivalries are rarely a problem; when there is a job to be done, cooperation is first rate.

Fortunately, too, the gloomy picture I have painted deals almost exclusively with "housekeeping" matters. I have not considered the combat efficiency of our services. And in my view that is high. I have the greatest admiration for the fighting skill, morale, and general character of our officers. They justify a high degree of pride on our part.

Then, too, I have been comparing the efficiency of the Department of Defense with the best in private industry. That is a high standard. My real point is that it is too high a standard for you and me to use. We should be satisfied with a reasonable degree of efficiency—reasonable in view of the unsolvable difficulties I have outlined. I think this is ultimately attainable.—END

Mr. Coolidge, as Special Assistant to the Secretary of Defense, has been studying some of the problems he enumerates with a group of military and civilian people appointed to advise the Secretary on the reorganization of the Department. The material from which the above is condensed appeared originally in the Harvard University Bulletin. It is printed in AIR FORCE with special permission.

Airports

AND THE JET AGE



Every modern civil airport also is a facility that adds to our military strength. About 250 have defense tenants.

Waiting rooms are already crowded and will get worse as jet transports go into service, haul more passengers.



WASHINGTON, D. C.
WHEN the Eighty-sixth Congress convenes next month, one of the first bills to go in the hopper—on the opening day—will be presented by Sen. A. S. Mike Monroney, Oklahoma Democrat. The bill will call for renewal of the Federal Airport Aid Program at least through fiscal 1963 at an increased level of \$100 million a year. An almost identical bill (S. 3502) was passed last year and vetoed by President Eisenhower.

There is no doubt that the outlook for passage this year has been greatly improved by the election results, along with some changes that have taken place in administrative posts. The only expressed opposition to the program last year came from Sinclair Weeks, then Secretary of Commerce, and from Louis S. Rothschild, Undersecretary for Transportation. Rothschild was the spokesman, and he was frank in his testimony before the Subcommittee on Aviation of the Senate Committee on Interstate and Foreign Commerce:

"We have no doubt as to the need for enlarged and improved airports over the country. We just have a pretty strong conviction that this is no longer the function of the federal government; that airports in general are becoming adequately able to develop enough income to meet their own requirements. . . .

"Airports to a very great extent are in somewhat the same class as other municipal services. I don't believe that most municipalities expect their schools and their hospitals and their libraries to show a profit. . . . We feel that airports are in that same class."

At the Dallas Convention in September, Air Force Association delegates made it clear they do not agree with the approach of Secretary Weeks. Far from comparing airports to libraries, the delegates pointed out that they are parts of a nationwide transportation system, essential to the national welfare and defense.

AFA cited a need for the kind of national planning that is going into the highway program and pointed to the fast development of improved airplanes, such as jet transports, that put new and heavier demands on airport facilities. It also was able to draw attention to the fact that the federal government itself is planning vast improvements in air navigation facilities and traffic control. These are costs that will be incurred because they are necessary to commercial and military aviation; airport improvement is a natural corollary.

The fact that Secretary Weeks has left the cabinet, replaced by Adm. Lewis L. Strauss, is secondary in early 1959 to the fact that the Civil Aeronautics Administration has been dug out of the basement of the Department of Commerce and turned into the Federal Aviation Agency. As most Air Force veterans know, FAA is headed by

Elwood R. Quesada, who has given up his USAF commission as a retired lieutenant general to take the position.

Last spring, when hearings were held on S. 3502, Pete Quesada headed the Airways Modernization Board. In that capacity he recognized that airports are aviation facilities but pointed out that AMB was not authorized to comment on the federal aid program. His standing as chief of the new FAA will permit him to take a more decisive stand this year, with support at least as positive as that of the Civil Aeronautics Board, which said that some kind of an expanded airport program is necessary.

Quesada's office is reported to be drafting a program of its own, which may represent an administration compromise. There have been no hints of its contents, but speculation is that the plan will differ from the Monroney bill in that it will involve less money, less than four years of projected aid, and a new formula for allocating the money.

These objectives, modest though they may be, represent considerable progress beyond the Rothschild conviction of last year that airports are becoming strong enough as business ventures to pay their own way. But the trouble is that the shoe is not as big as it looks.

The Airport Operators Council reports that airport revenues in 1957 increased by twenty-five percent over 1956 at twenty-eight of the largest cities. Despite this, total capital and operating expenses continue to be more than double the operating revenues at these airports. Over the past seven years, AOC says, capital outlay alone has averaged more than twice as much as operating revenues at the twenty-eight large municipal fields.

What this means is that despite some black ink on the ledgers in recent years, the capital improvements simply cannot be provided out of the current revenue. Any city that wants an airport capable of meeting the demands of the jet age has to provide for it with bond issues, plus federal aid.

Here is where the Air Force Association can help overcome opposition on a local level. Bond issues in the community always result in a local fight against either organized opposition or the common lethargy that brings the evil of nonsupport—which can be almost as bad as opposition itself.

A near-classic example took place last summer in Omaha, Neb., home of Strategic Air Command headquarters. To prepare the city for the jet age it was proposed that there be two bond issues, each to raise \$1 million. One was to be a General Obligation issue, repaid from the city's regular tax revenue. The other was to be repaid from airport revenues. Both were defeated.

Omaha opposition came from seven railroads, which

flooded the local newspapers with paid advertising that argued the program would benefit only a small percentage of the citizens, that it amounted to an airline subsidy and that there would be more demands once the money was spent. Support for the program came from Omaha's Committee for Airport Progress, which pointed to the airport improvements in other cities and what the improved airport would do for Omaha business. They lost, and Omaha will not have an airport to meet the demands of the jet age.

The Airport Operators Council says frenzied and weighty opposition to airport improvements comes from railroads only in those centers, like Omaha, where the rails are big factors in the local economy. More common is nonsupport due to disinterest or lack of intelligent information on what the improved field will mean to the community, the national transportation system, and the national defense effort.

The council offers these "compelling and urgent" reasons for support of national and local airport improvement programs:

- **Stability in planning.** The present four-year program of federal aid expires on June 30 and the benefits will be in peril if work is not continued. In the past four years the Secretary of Commerce has been authorized to obligate \$63 million annually on a matching fund basis. Advent of the jet age, along with increasing complexity and costs, makes the \$100 million a year proposal reasonable for the next few years.

- **Airport capacity must be kept in balance with airway capacity.** Federal aid is justified because air transportation is interstate and is important to both the national economy and national defense.

- **Air traffic growth continues unabated.** Operations have quadrupled since 1946 and will do it again in the next ten to twelve years.

- **The capital investment requirement is far beyond the capability of the local communities.**

The war against improved transportation is as old as the industry. Canals were fought because they would bring strangers to the community and breed disease. Railroads were opposed as belchers of smoke, fire hazards, and creators of noise, as well as a menace to life and limb. The horse-drawn street car, the automobile, and even the bicycle were bitterly condemned at one time or another in their early history. The transportation history of the world is the story of a long fight put up against the inevitable march of progress.

AFA's interest in the airport program, nationally and locally, surpasses that of any concern over how men and cargo move from point A to point B. The airport program is an essential part of America's airpower program.—END



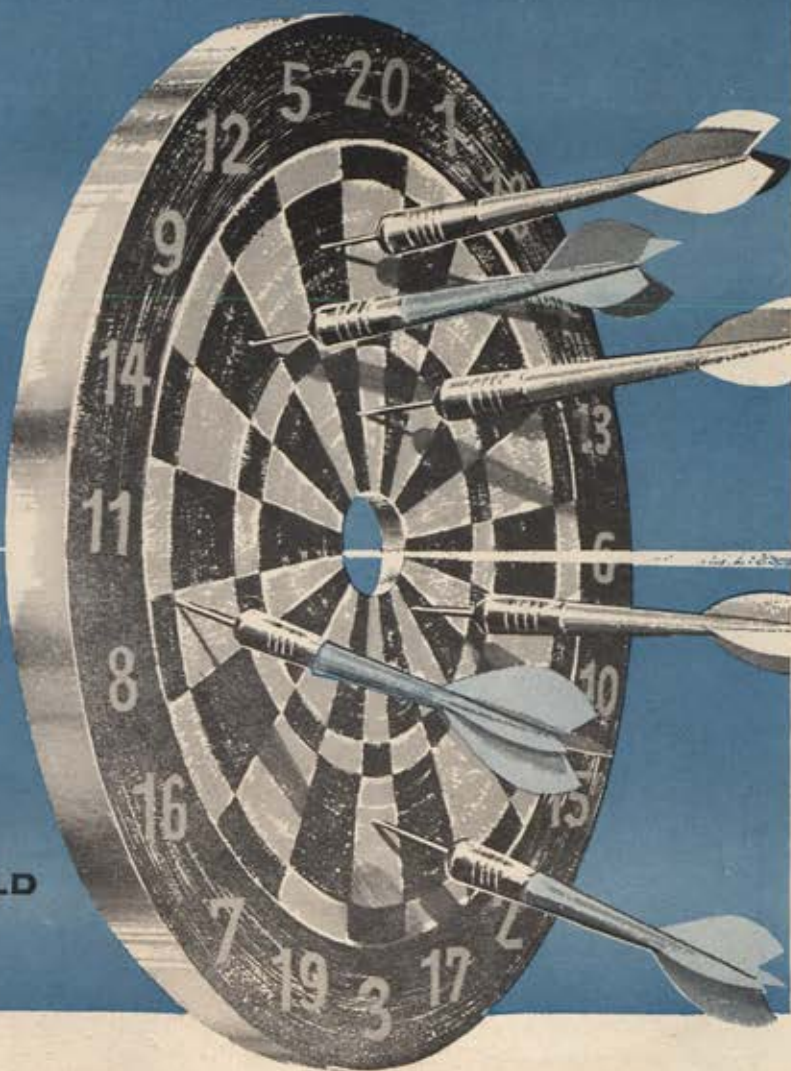
Airlines have \$2.5 billion of jets on order, four times present investment.

◀ US will spend \$810 million on air traffic control devices in the next few years.



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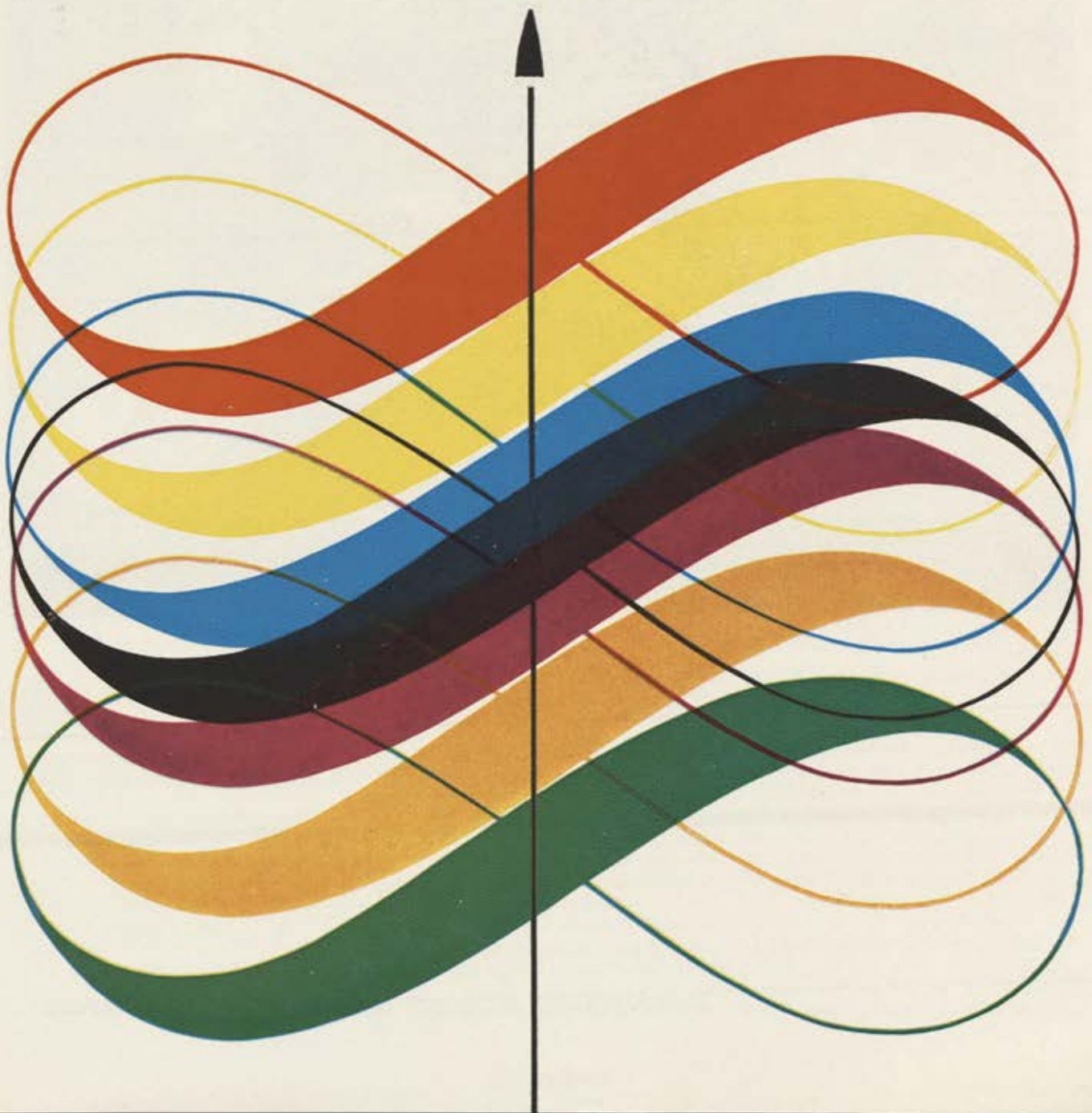
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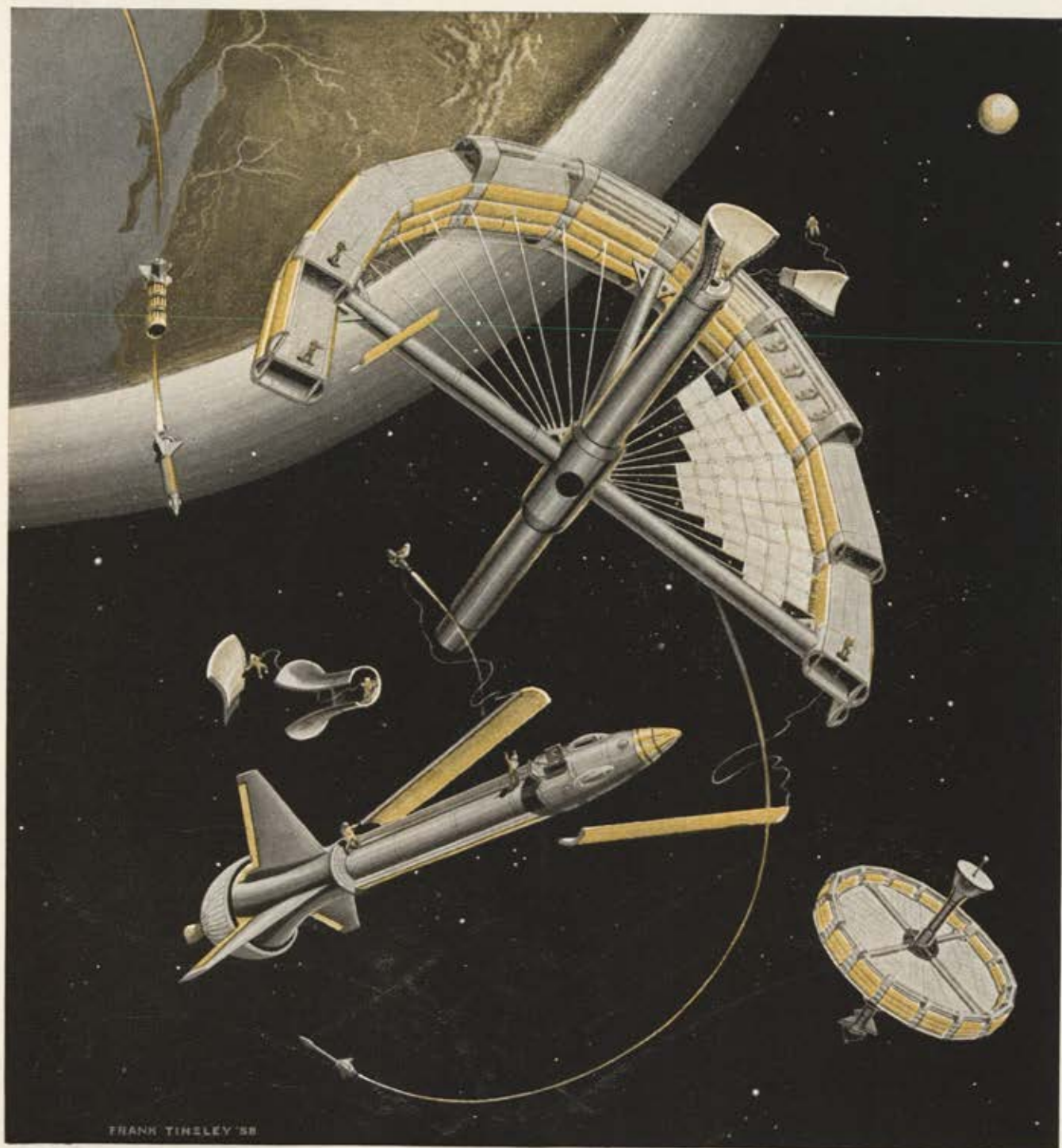
SPACE



DIGEST

THE SPACE AGE IN PERSPECTIVE





STEPS IN THE RACE TO OUTER SPACE

Assembling a station in space

This imaginative but technically accurate illustration shows a permanent satellite (center) being constructed in orbit around the earth. It generates its own heat and electricity from solar rays. Basic vegetation (such as algae) for oxygen as well as protein-rich foods are grown in hydroponic tubes in upper level "greenhouses."

New vistas in astronomy will be opened up by such a space station, because of perfect conditions for photography and spectroscopy. It will

also provide unique conditions for advanced research in physics, electronics, weather prediction, etc. Three such stations, properly placed, could blanket the entire world with nearly perfect TV transmission.

Atomic rocket vehicles with prefabricated skin layers (lower center) provide building materials for the station, then return (bottom) to earth. Similar craft will service an established station

(lower right), docking by electromagnetic pull in lower section of station's axis.

Inertial navigation systems will play an increasing role in the exploration of outer space. **ARMA**, now providing such systems for the Air Force TITAN and ATLAS ICBM's, will be in the vanguard of the race to outer space. **ARMA**...Garden City, N.Y. A Division of American Bosch Arma Corporation.

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SPACE DIGEST

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From the Editors...

AS MEN probe the unknown, a segment of sour opinion always asks: "Why bother? What's in it for us? Why spend all this money?"

The space age is no exception. For these questions there can be no pat answers—although on the subject of spending it isn't often pointed out that most of the investment in space-technology hardware is part of military necessity, which only the foolhardy can question. Beyond the basic expenditure for military missilery it is a fairly small financial step to space conquest.

No one can say today: "Put your dollar down, stake out a claim in space, and you'll get untold riches." But it is characteristic of human history that the search for knowledge has resulted in a

better, if considerably more complicated, world.

We cannot know where the advance into space will lead us. Yet we cannot turn back. This irrevocability encompasses more than mere competition with our adversaries. It is part of our humanity.

We have but the mistiest picture of our universe. The conquest of space will give us new understanding not only of the cosmos but of our place in it.

Of course it will be expensive. Anything that is worthwhile usually is.

To some men, the search for knowledge will be enough of a reason to risk their lives. Yet all will share the adventure.

CONQUEST OF SPACE

"The End of the Beginning"



WILLIAM LEAVITT
Associate Editor

ONE DAY, possibly within the next three years, a man (we hope he is an American) will see the blue curve of the earth (doubtless through some sort of periscope) from a low-orbit vehicle hurtling around our planet.

If all goes well—and this is a giant *if*—he will return alive to tell his story. The course of human history will have taken a new, wondrous, and irrevocable turn.

The orbiting man—contrary to whimsical Sunday supplement suggestions—will not be an introspective midget or a schizoid personality. He will most likely be a fully trained airman, possibly a physician. He will, before his flight, undergo the most realistic simulation of orbital conditions possible on the ground and will fly in the nose cone of an ICBM in a ballistic trajectory from point to point on earth.

The army of researchers planning his flight will give him an eighty-five to ninety-five percent chance of returning safely from orbit. He will go because he wants to go and because he will have been adjudged, from every conceivable angle, to be the best man for the job.

Long before the man boards the nose cone to go into orbit, the best *monkey* for the job will have been orbited safely and returned.

But all this preparation notwithstanding, the first man into orbit will not—by the very nature of the business—know all the answers to all the questions involved in spaceflight. How he will react to extended weightlessness or to being completely "out of this world," no one can know absolutely. The practical answers to questions applicable to later, longer spaceflights are even further from solution.

But they are being studied intently, and if one searched for a suitable phrase to describe the current state of the art of spaceflight, from the space-medical and propulsion sides, the best description might be Sir Winston Churchill's "end of the beginning."

Without every answer, but with a good chance for survival, man is about to enter orbit. Spaceflight has left the realm of science fiction. Aside from important international prestige and military factors, the dates of accomplishment are unimportant, because the advance of science and the march of events make the attempts a surety.

This was the conclusion that emerged and was reported worldwide from a significant meeting of scientists during the second week of November at San Antonio, Tex. The occasion was the Second International Symposium on the Physics and Medicine of the Atmosphere and Space. The meeting, attended by more than 500 scientists and the press, was sponsored by the USAF School of Aviation Medicine and arranged by the Southwest Research Institute, a bustling complex of brains and equipment which belies the deceptive languor of the easy-going city of the Alamo.

From Radiation to Goats

The topics covered in the some forty scientific papers presented during the three-day meeting (November 10 through 12) give an idea of the scope of today's growing space technology and its twin science, space medicine. They ranged from the hazards of the newly discovered radiation zone surrounding the earth to the possibility of using goats as a source of food during extended space voyages. Propulsion, reentry, psychology, physics, and every applicable approach to spaceflight, were covered in formal or informal discussions.

Discussed, too, was the apparent fact, (see "Travel Faster and Live Longer," page 88) that in our universe, as explained by Dr. Einstein, a man traveling to the stars at nearly the speed of light would not age physiologically at the same rate as the people who stayed at home. Theoretically this would make possible, if highly sophisticated new propulsion systems were developed, flight beyond our solar system.

On hand to discuss the much-current cosmic-radiation problem were Iowa University's Dr. James Van Allen, designer of the Explorer satellite radiation counting devices whose name graces the radiation zone; and University of Maryland's Dr. S. Fred Singer, who recently made the intriguing proposal that "sweeper" satellites be launched into the radiation zone to absorb dangerous particles and create safe corridors for space travel.

Dr. Van Allen told the Symposium that he believed the radiation band begins at about 400 miles, gradually increases in intensity, and then fades away at an altitude of about 40,000 miles. He stresses the need for many satellite launchings into different orbits to give a more accurate reading of intensities and locations of the radiation. He added that a soon-to-be launched Army probe, programmed to pass the moon and end as a miniature "planet" around the sun, could confirm his theories on the depth of the radiation.

Hopefully, he suggested that there are radiation-free "zones of escape" near the polar areas. This, he indicated, is because the extraterrestrial "hot zone" is caused by a conglomeration of solar and cosmic particles and smashed earth-atmosphere particles trapped in the magnetic field of the planet. The magnetic field curves away from the planet at the magnetic poles.

Dr. Singer, who followed Dr. Van Allen on the first day's program, had a more complicated theory, based on extrapolations of what is now known of cosmic radiation. He believes radiation is divided into two distinct bands, one "hard" and one "soft" due to different causes. There is some overlapping, Dr. Singer believes. By hard he means hard to shield against, and vice versa.

He suggested that the hard band is the result of the trapping of particles caused by the smashing of cosmic rays (not solar in origin) into our atmosphere. As the cosmic rays rush into the atmosphere, they cause a release of uncharged particles of earth gases (neutrons), which then decay into charged protons, some of which then get trapped and ride back and forth in the magnetic field. This hard belt, said Dr. Singer, reaches maximum intensity at about 6,000 miles above the equator, and the shielding needed to protect crews and vehicle surface might be prohibitively heavy. One weight-saving suggestion of Dr. Singer's is the use of a shielding "ring" around space vehicles, rather than a complete shield casing. But such a ring would have to be aligned at exact angles to the movement of the radiation. He repeated his earlier suggestion that large satellites

launched into orbits might be able to absorb radiation in the hard belt to create corridors of safety. This might work, he said, because his theory considers total radiation a result of a long buildup of particles.

What Dr. Singer calls the "soft" belt is the result of a shower of particles originating in the sun and accelerated as they near the earth. The soft belt, much further out, he says is variable in intensity, is dependent on solar activity, is concentrated in the auroral latitudes, and represents much less of a shielding problem.

How High the Jets?

A provocative follow-on discussion on cosmic radiation was given by the Navy's Dr. Herman J. Schaefer. With Emory University's Dr. Abner Golden, he outlined the present knowledge of biological damage to be expected from radiation "hits" on human tissue.

The Schaefer-Golden paper brought up another subject of significance: the radiation situation involved in flying high-altitude commercial jetliners. The paper gave good news.

According to Drs. Schaefer and Golden, jet pilots flying 1,000 hours or so a year at altitudes of 35,000 feet would *not* receive intolerable doses of radiation. Their estimate was that pilots would receive a dosage equal to about twice the normal "background" dose that most people get in a year's time just by living on the planet.

"This," they said, "is certainly a small exposure as judged by present radiation safety standards. It can be termed perfectly safe from the standpoint of the individual somatic health of the pilot."

The authors added that radiation at jet altitudes is lowest over the ocean.

The crowded meeting also heard from the "Father of Space Medicine," Dr. Hubertus Strughold of the USAF School of Aviation Medicine's Department of Space Medicine. With Dr. Oskar L. Ritter, also of SAM, Dr. Strughold called for careful attempts to chart space in terms of gravitational fields and local "planetary" climates. These, they believe, will provide workable guides for tomorrow's space venturers.

Not too many hours after the conclave started, it was getting world attention, thanks to the efforts of the scores of newsmen on hand. By now the theme had switched from the physical environment of space to the more immediate problems of man and machine—human factors and propulsion.

The USAF Ballistic Missile Division Com-

mander, San Antonio-raised Maj. Gen. Bernard A. Schriever, opened the discussion.

"Cooperation and two-way-street communication and sharing among our civilian and military people have become perhaps more important than at any other time in our history," he told the scientific audience.

His assertion was underscored by the request announced in Washington, by the National Aeronautics and Space Administration (NASA), for industry to submit designs for a recoverable, sealed capsule for carrying a man into orbit, to be launched, as most observers expect, by the Atlas ICBM.

Are Mars and Venus Next?

In a press conference General Schriever told reporters that present equipment could possibly reach Mars or Venus but added that the green light for such projects was in the hands of NASA.

The spectrum of today's and tomorrow's propulsion systems was explored by Britain's Dr. L. R. Shepherd, president-elect of the British Interplanetary Society; the Army Ballistic Missile Agency's Dr. Wernher von Braun and Dr. Ernst Stuhlinger; and Convair-Astronautics' Krafft Ehrlicke.

Dr. von Braun, formally and informally, got headlines with his descriptions of the Army's approach to its December-scheduled moon probe. He said the Army would aim for an impact on the moon, with practically no expectation of hitting it, but with what he described as a one-in-two chance of passing within 50,000 miles of the moon and then coursing on into space to become a solar satellite. Dr. von Braun's odds on receiving useful, reliable data on radiation and other vital areas: one in three.

The possibilities of nuclear or the highly speculative ion and photon propulsion systems were also discussed.

The speakers agreed that an enormous additional amount of research must be done before we can think seriously in such terms. One conclusion, by Dr. Shepherd, was that the final solution may be through the use of atomic fusion, rather than fission. In fusion atoms are combined to create energy. The H-bomb is an example of a fusion process, which is triggered by uranium fission. But science is only at the beginning of controlled fusion.

Convair's Krafft Ehrlicke made a telling case for speedy development of manned satellites. They are essential, he said, to serve as a "test bed for

crew training and selection . . . and for long-term evaluation of . . . living conditions . . . in the advanced [interplanetary] vehicles. . . ." There are certain imponderables, such as extended weightlessness, which we cannot duplicate on earth, he stressed.

From propulsion, the meeting advanced into fascinating discussions of the medical aspects of spaceflight.

How Much Can a Man Take?

Simply stated, the question was how much can a man take? And, as corollaries, how can a space-man be fed, sheltered, and rescued?

He can take a lot, declared such experts as Col. John Paul Stapp, who has served as his own guinea pig in demonstrating human tolerance to the enormous acceleration pressures expected in the spaceships at launch time. Properly protected, man can survive the G stresses of launching, Colonel Stapp told the meeting.

The amazing adaptive processes of humans were underscored in a paper by Drs. Alberto Hurtado of Lima, Peru, and Robert T. Clark, Jr., of SAM.

They described studies of Peruvian Indians living in the Andes at altitudes near 15,000 feet. Their bodies, long-term study showed, adapted readily to handling unusually low-oxygen pressures, and they could play rough games of soccer in their environment and turn in a hard day of manual labor.

Even people accustomed to normal altitudes, after a stay on a mountain, will adjust and be able to perform reasonably well, the doctors said, citing USAF tests conducted by a SAM team on a mountain, which showed that even a middle-aged man (team leader Dr. Bruno Balke) was able to acclimatize himself. A far more difficult question, the medical men suggested, is psychological acceptance of the unknowns of spaceflight—isolation from the home planet, deprivation of the usual stimuli, weightlessness, the possibility of having to consume recycled human wastes as food.

Intellectual stagnation, irritability, even hallucinations are potential problems, Dr. George T. Hauty, Air Force psychologist, told the meeting. Such phenomena have occurred in experiments confining men in artificial environments. It might even be necessary to consider such methods as drug controls to keep men on an even, alert keel, he suggested. He stressed the need for intensified research and maximum simulation devices for preparing spacecrews.

The constant "bogey" of spaceflight—weightlessness—was covered, too, in a report by the Army Ballistic Missile Agency's Dr. Siegfried Gerathewohl and Capt. Julian E. Ward of SAM. They described the results of parabolic flight experiments by the Air Force in which pilots and subjects are subjected for periods of up to about forty seconds, to conditions approximating zero gravity. The subjects have experienced three kinds of reactions. Some got utterly sick and befuddled. Others actually enjoyed the experience, while the largest group tolerated it. Performance tests (such as aiming a stylus at a dartboard-like affair) indicated that subjects, once they got used to lack of gravity, improved their aim and could operate fairly efficiently. But, as the two scientists pointed out, these exposures cannot show how a man's mind and body will react to extended weightlessness. Only in orbital spaceflight can that reaction be examined.

The space-feeding problem was explored, too, at the sessions. The use of algae as a source of oxygen and possibly food was described by Texas University's Dr. Jack Myers. Although it has been demonstrated that the process will work, knowledge of why and how it works is minimal today, Dr. Myers said. An interesting suggestion was made by University of Mississippi's Dr. Robert G. Tischer: Why not use an animal such as a goat (which will eat practically anything including algae) as food on spaceships, a system in which the diet could include both algae-based foods and animal meat? Opinion was fairly universal at the meeting that humans could scarcely be expected to live indefinitely on plain old algae, done by the space chef in a thousand unpleasant varieties.

Manual or Automatic Controls?

The session on medical problems included an interesting discussion by North American X-15 Test Pilot Scott Crossfield and Dr. W. Randolph Lovelace of Lovelace Foundation, on the comparative advantages—in terms of human control—of ballistically launched manned capsules and orbiting vehicles such as the Dyna-Soar. They felt that designing controllability into the vehicle would be much superior, regardless of the additional design complications, because it would supply more valuable biomedical data.

The completely hypothetical problem of space rescue was covered in a series of reports, suggesting that at launch, the problem was relatively easy—soluble by an adaptation of today's jet

ejection capsules or blastoff to safety of the nose cone itself. But, the speakers pointed out, once the ship is high in its trajectory or actually in space, the problem is highly complicated. Suggested solutions: Building maneuverability into all or part of the nose cone, or some day, having a kind of space Coast Guard, regularly patrolling and ready to reach distressed expeditions.

Fittingly, the meeting closed with a session on the sun, the planets, and the possibilities of life on other worlds.

Our Neighbors in Space

Eons ago, man worshipped the sun as the supernatural source of all life and power. Today we discount its supernatural powers, but expert observers like Dr. Walter Roberts of the University of Colorado suggest that a storm in Texas probably is caused by solar activity. And, he said in his paper, if we study and learn more about the sun, someday we may be able to predict weather years in advance.

The moon, our neighbor and probable earliest manned flight target, is a dead and airless world, pocked with volcanic craters and smooth in vast areas with hardened volcanic flow.

Mars has a thin atmosphere dominated by nitrogen, with some water in a frozen state in its atmosphere. Mercury, nearest to the sun, is essentially minus an atmosphere. Venus has a dense atmosphere dominated by carbon dioxide.

This was the tour of our planetary neighbors as given by the Yerkes Observatory's Dr. Gerard Kuiper.

Although we cannot know except by going to Mars whether life in any form exists there, evidence of the existence of what scientists call the carbon-hydrogen bond that is a basis of life on our planet has been discovered on the Red planet, according to Dr. Gerard De Vaucouleurs of the Harvard College Observatory.

Further evidence of the adaptability of life to what we on earth consider extreme conditions was described in the paper by USAF's Lt. Col. John D. Fulton. He reported on the surprising survival of bacteria in extreme temperatures and oxygenless environments similar to those expected to prevail on Mars. More work is being done on higher forms of life, simple algae, lichens, and mosses, he told the symposium. If they can survive on earth, why not on Mars?

And if they can survive on Mars, why not on other worlds? Only time and man's further achievement will tell.—END

THE need for protective suiting against radiation has been manifest since the earliest days of nuclear technology. In the past, a number of attempts to design effective suiting have failed because radiation attenuation is proportional to the atomic weight of the shield, and suits so designed are far too heavy to be worn by a human.

The need for such a suit increased with the development of nuclear warheads, and studies were made for protective suiting for infantrymen.

But again excessive weight barred the success of the studies.

A new emphasis was added to the search when nuclear-powered airplanes got on the drawing boards and crew protection came sharply into focus.

Now the recent great success of the Air Force in launching a sizable, instrumented body into deep space has brought manned spaceflight closer to feasibility. And the information already gathered on cosmic radiation in space further

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Radiation Protective Suiting

*A biophysicist's suggestion to save
critical weight in spaceships*



emphasizes the necessity for crew protection. Both cosmic radiation and so-called radiation leakage from nuclear powerplants which may be used in spaceship propulsion will require adequate protective devices for human crews.

In spaceflight protection weight is a critical factor. Hence, the methods of radiation protection now used in nuclear submarines or in earth-bound nuclear plants do not lend themselves to protection in spaceships.

In a nuclear reactor or in a nuclear-powered

submarine the weight factor is not so critical; therefore, the total amount of necessary shielding material is placed around the reactor. The shield mass is chosen to reduce radiation leakage to an insignificant figure, allowing personnel to operate in the vicinity of the radiation for many months. In airborne vehicles such a condition cannot be achieved. In nuclear-powered airplanes or space vehicles the direction of radiation is not restricted; radiation will hit the crew from all directions.

In the case of a nuclear-powered airplane,

What We Know — and Don't Know — About Radiation

It might be instructive to mention briefly the symptoms of absorption of high doses of nuclear radiation, the so-called radiation syndrome. It has three distinct phases—initial shock reaction or radiation sickness, the acute state, and subacute state. The initial shock state can last from three to forty-eight hours. Death will not occur during this period, not even if extremely high doses are delivered. The symptoms in such cases are diarrhea, urination, and frequent vomiting. The acute period lasts from nine to twenty-one days during which most deaths occur. Individuals surviving thirty days or more are in the subacute state, accompanied by anemia and loss of hair. This state is followed by the chronic phase, characterized by the shortening of life and increased occurrence of tumors. The delayed effect of radiation includes temporary disturbances in the menstrual cycle and sterility in males and females. Also organs with higher radiation sensitivity are impaired in their action, and cataracts in the lens of the eye occur, as well as a higher incidence of leukemia and malignant tumors. Furthermore, there is a tendency to bleed and a high susceptibility to infection.

Methods of treatment of radiation damage in the human body are still very primitive. The greatest concern of the physician is to treat the symptoms and to try to avoid infections.

The genetic effects of radiation have received much public attention, too. Unfortunately, not enough is being done to inform the public about this matter, and consequently there are hair-raising misconceptions even among technically trained people. Although the genetic effect of radiation is a serious problem and deserves further consideration, it is fairly certain that even

in this skyrocketing atomic age of ours our grandchildren will not have five legs and three heads.

But, in terms of manned spaceflight, it is sufficient to state that all radiation energy absorbed in cells increases the number of mutations and most mutations are undesirable. The absorption of about 100 roentgens will double the frequency of the normal or the spontaneous mutation. This in itself is not too frightening. But the same statistical evaluation of the so-called mutagenic action of radiation reveals that not only the mutation frequency will be doubled if one person absorbs 100 roentgens, but the same number of mutations will occur if 100 persons absorb one roentgen each. This fact gives the absorption of ionizing radiation a serious aspect. We have to face the facts and live with them.

How, then, can we protect human beings, who are driven by their scientific curiosity and the challenge of adventure into space, from the damage of cosmic radiation?

Can we do the job with chemicals? Biochemical investigations have shown that the administration of certain drugs will increase the radiation tolerance of mammals and probably also of man. Chemical compounds which show marked protective action include cysteine and aminopropiophenone, among others. And recently a compound—aminoethylthyronium—was used and showed a protection factor of two, which means a one hundred percent increase in dose tolerance. Much research is required, however, before these drugs can be knowledgeably administered to human beings. During such investigations it was found that in decreasing the oxygen intake radiation tolerance was significantly increased. This factor will probably also be taken into consideration.



especially if it is an air-cooled system, fast neutrons will leak out and be slowed down in the air. This process is called thermalization because the speed of the neutrons will be about the same as that of the gas molecules in the air, depending on their temperature. During this slow-down process, and during the capture of the thermalized neutrons by atoms of the air, strongly penetrating gamma radiation is created. Consequently, even the *front* of a crew compartment in a nuclear-powered airplane will receive a significant amount of radiation. In *space vehicles* cosmic radiation is again multidirectional, although there are variations in strengths depending on certain conditions in the solar system.

Because of this multidirectional radiation the crew compartment must be shielded from every side. It is known that in aircraft for every pound of additional payload there is from about ten- to twenty-pound weight penalty in airframe, other equipment, and fuel. This weight penalty in spacecraft is more than a thousand pounds for each additional pound of payload. Under these ground rules it becomes evident that the smaller the crew compartment the less weight is needed for its shielding. On the other hand, for long missions in a space vehicle, crew space must be very carefully computed and cannot be cut below a limit of human endurance. This consideration, in turn, would require a shield weight which would be prohibitive economically. It would take an unreasonable amount of fuel to lift a compartment shield to space velocity.

There is a possible solution to this development. We could bring the shield quite close to the body of the crew members. This could give the *maximum* protection with *minimum* weight, depending on the number of crew members. The more people in the crew compartment, the closer you get to the situation where the compartment shield weight is less than the total weight of several personal shields. But large-crew situations are in the very far future. For a long time to come the first manned space vehicle would probably not carry more than three people.

It should be emphasized that it is not yet a matter of certainty whether to shield against high-

energy particles, because the problem of providing exactly enough shielding always exists—that is, too little shielding could cause a scattering of fragmentary secondary particles, compounding the damage. (See *AIR FORCE*, October 1958.)

We know that different organs and parts of the human body have different radiation sensitivity. Therefore, if the more sensitive parts of the body are shielded, dose tolerance for the total body surface can be increased. We can draw curves on the surface of the human body representing the tolerance limit under a particular surface area, taking into consideration the sensitivity of the organs below the surface. These curves are called *tolerance isodoses*. It is feasible to apply along these lines so much shielding material that the tolerance isodose should be uniform upon the body.

A further increase of radiation protection can

Following are Dr. Helvey's interpretations of total body dosage effects on health and performance, based on dosages listed in the 1956 report issued by the National Academy of Sciences-National Research Council.

THREE ROENTGENS per day, applied for eighty days, will cause no drop in the efficiency of the person;

TEN ROENTGENS per day, if received in irregular distribution for thirty consecutive days, would also not disable;

TWENTY-FIVE ROENTGENS per day, in weekly intervals, can be tolerated for eight-ten weeks by most people;

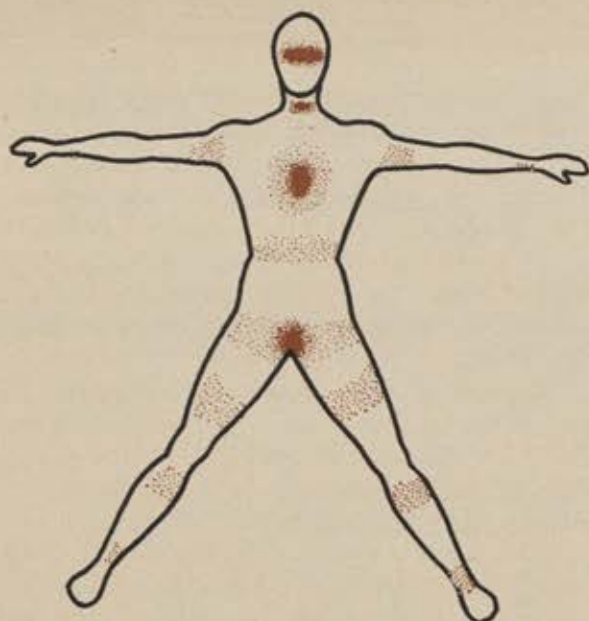
FIFTY ROENTGENS per day, received for six consecutive days, will cause serious performance decrement in many persons;

SIXTY ROENTGENS per day for ten consecutive days will cause crippling disability and a very high mortality;

ONE HUNDRED ROENTGENS per day for two consecutive days will incapacitate most people;

FIVE HUNDRED ROENTGENS per day for one day will be destructive with no chance for recovery for most people;

SIX HUNDRED ROENTGENS in one day is one hundred percent lethal.



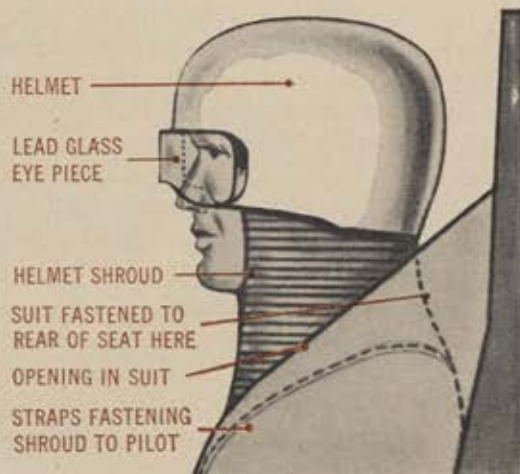
More sensitive body areas must be well shielded.

be achieved by the proper arrangement of shield elements on the surface of the body. This effect is called the *grid effect*. This phenomenon was discovered recently and says that *weight for weight* the *smaller* the skin surface which is covered by the shield, the greater the protection. In other words, if you have a pound of lead in the form of a quarter-inch plate and protect with it a certain surface area on the body, and then take the same piece of lead and cut it into strips, covering the same surface on the body—leaving some places without protection—by putting two strips on top of each other, amazingly enough, this surface of the body is much better protected against radiation damage than if it were completely covered with lead. This so-called grid effect is valid only within certain limits, but it should be utilized in the construction of a protective suit because it may give as much as thirty percent increase in protection. This grid effect is not at all a mysterious phenomenon and has been explained properly by radiation biophysics.

The material of the protective suit into which

the shield would be embedded is made of glass fibers of the lead silicate type. This glass contains approximately eighty percent lead and has an attenuation for gamma-rays equivalent to that of steel.

Because of the relatively high sensitivity of the eyes toward radiation it is anticipated that the space pilots will wear heavy lead glass goggles. These goggles would be built into a helmet which also bears a lead curtain around the neck to protect the sensitive lymph vessels.



Tomorrow's radiation helmet? Eyes would be protected by lead glass, lymph glands by a curtain.

For aeronautics a suit weighing about 150 pounds could be designed so that almost the entire weight would be borne by the pilot seat. The design of this suit or body shield is such that it can be shed easily and fast and the pilot can be ejected from it even when unconscious.

For spaceflight the suit could be carried in the crew compartment and not worn at blastoff. In free flight the weight problem will have lost its significance, and the suit could be a component of the crewman's spacesuit.—END



Dr. Helvey, experienced in both academic and industrial approaches to biophysical problems, completed his thesis for his doctorate at the Kaiser Wilhelm Institute in Berlin. He did post-doctoral work at the University of Halle Medical School in Germany and was associated with the Institute of Nuclear Studies at Oak Ridge, Tenn., prior to academic assignments at Cornell University, the University of Miami, and the Canadian Research Council in Ottawa. He taught six years at Oneonta College in New York, and was with the Martin Company's Human Factors Division at Orlando, Fla., before joining Radiation, Inc., from which he is now on leave.



The Aeromedical Realities of Space Travel

BRIG. GEN. M. S. WHITE

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Star clouds in our galaxy, the Milky Way. Even "locally," cosmic distances are unspeakably vast.

WHEN we speak of reaching the stars, we frequently talk glibly of spaceflight and outer space. Here pause must be made to analyze our present position and determine how far we have penetrated the infinite universe in which our small planet earth exists. To gain a proper perspective and outline obtainable goals for the future some orientation is necessary. Photographs of the heavens have been made in a sky survey conducted by the Palomar Observatory and the California Institute of Technology. The telescope used in the survey, the Big Schmidt, with a forty-eight-inch mirror, is able in its maximum range to capture clear, high-definition photographs of heavenly bodies as distant as a billion light years. The extent of this measure is realized when we consider that just one single light year calculated at the speed of light of 186,000 miles a second is a distance of 5.8 million million miles. The objectives of this sky survey were to increase man's knowledge of the celestial bodies and other phenomena in the Milky Way, the galaxy of which the solar system containing the earth is a part. Based on present concepts of space and time, this goal of spaceflight to the stars is beyond our attainment. However, it does illustrate how inconclusive and incorrectly we frequently use the terms "space" and "spaceflight." When we draw closer to the earth and direct our attention to this planet's nearest star, the sun, which is only 8.3 minutes away by speed of light time, or a mean of 93,000,000 miles, we see that again we are forced by time and space factors to relatively limited space travel. Under present concepts, a trip to the planet Pluto located in our solar system but farthest from us and the sun—a distance of five and one-half hours at the speed of light or fifty years in supersonic flight—would be beyond one man's active lifetime.

Perhaps in some future generation a reorientation in, or a totally new theory of, relativity will permit true space exploration to other areas within our own Milky Way galaxy, or to those thousands of other galaxies now measured as millions of light years away. We must recognize the futility of this type of space travel today and return from these metaphysical regions to present-day atmospheric flight and the role of aviation medicine. The distance between any neighboring galaxy system averages 2,000,000 light years of distance. A manned mission from earth would have to travel 15,000 light years just to cross the Milky Way's nearest frontier before it could be claimed that intergalactic travel had commenced.



Our immediate attention must be focused on a very small area of the universe that is our own front yard. Though we may speak facetiously of space travel, we are really referring only to the further extensions of height, duration, and speed that have always been the goals of man's increasing penetration of the atmosphere.

The atmosphere of the earth can be considered for significant functional purposes to extend to 120 miles with approximately ninety-nine percent of its mass within twenty miles of the earth.

The remaining one percent may extend from 6,000 even to 60,000 miles, dependent on various interpretations of molecular distribution. At the present, man has conquered atmospheric flight and space-equivalent flight. The next important step prior to entering true space will be circumplanetary flight at the outer fringes of the atmospheric layer. The attendant medical problems of such flight, of which we are well aware, have been analyzed and most have been solved. Progressively, the objectives are clear and a timetable has been drawn. Following earth satellite flights and the unmanned lunar probes, the next goal of man will be the moon, a distance of about 240,000 miles, or 1.3 seconds if measured at the velocity of light, or, if measured in projected flight times, one day to one week dependent on the trajectory of flight and the initial velocity of the vehicle.

The successful accomplishment of lunar flight will pave the way for further exploration and interplanetary travel which, while similar from a mathematical and medical point of view, will be more extensive in having a greater number of major phases. There will be problems associated with markedly extended times of flight, new navigation methods, strain on present communication techniques, entry into unknown atmospheres and radiation belts, and the fact that some requisite knowledge, as the precise composition of planetary masses, is still unknown. Venus and Mars, the most intriguing planets as well as the closest to earth, with Venus only six minutes away measured in speed of light time or 26,000,000 miles, and Mars twelve and one-half minutes away or 35,000,000 miles, will undoubtedly merit attention first. Here consideration must be given to flight time which will consume years rather than days under hoped for conditions of travel. Because of the cloud cover of Venus, nothing concerning its surface is known. Venus will be a surprise planet when visited by the pioneer astronauts. Much more is known about Mars. Conditions on its surface are very similar, with regard to temperature and pressure, to stratospheric conditions eleven miles above the earth's surface.

As techniques improve, and the many problems of vehicular propulsion, guidance, and internal environment for longer voyages are conquered, the further exploration of our solar system can become a reality. Future scientific exploration will be impossible, however, without the continued contributions of aviation medicine, or flight medicine, as it should now properly be called. The eventual benefits to mankind from the research endeavors in the basic medical problems associated with spaceflight are unlimited. Many notable dividends to medical progress have been made through past activities of aviation medicine. Contributions have been made in oxygen and carbon dioxide studies, pressure breathing, dysbarism, cardiovascular and respiratory dynamics, and body temperature response. In public health, advances have been made in the practical field of bringing rapid succor through airlift to stricken communities, in the air transport of critically ill patients, and in the development of protective measures for crash deceleration.

Untold possibilities for increased knowledge are in store for the future in the exploration of new environments, new worlds, and a radical change of earthbound perspective. Man must be studied in this new situation by a careful analysis



of his systemic capabilities and limitations. Research must be directed to the biochemical and biophysical reactions of the central nervous system, to problems of the special sensorium and impulse transmission, and to musculoskeletal, respiratory, cardiovascular, gastrointestinal, genitourinary, humeral, and glandular activities. We can hope that the phenomenal discoveries awaiting us in all scientific fields, as man's endless exploratory quest continues, will also aid in solving many of the baffling medical problems now facing us here on earth.

A view of our small planet following its orderly course in the infinite universe containing billions of more suns larger than ours, each with its own planetary system, cannot fail to make one appreciate the universal brotherhood that unites earthly humans into one family. With such an outlook, international goals become as one. Aviation supported by aviation medicine has shrunk world dimensions, making all nations neighbors. The next step into circumplanetary flight on the fringes of our atmosphere, an environment shared equally by all inhabitants of a revolving earth, will contribute even more to this sense of one family and one world.

Medicine with the noblest humanitarian goals serves as a common denominator to human brotherhood and everlasting peace. Aviation or flight medicine and its extension into space is at the forefront of that relationship, to speed the day when nations are composed of men of good will, when human dignity is respected, and the common good is the goal of all people. Advances gained in scientific knowledge of the earth, the

solar system, and the universe, will benefit all mankind as we continue our quest higher and higher, closer to the secret of life itself.

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This article is an extract of material originally presented on September 23, 1958, at the Third European Congress of Aviation Medicine, Louvain, Belgium, by Brig. Gen. M. S. White, M.C., who is president of the Aero Medical Association and director of staffing and education, Office of the Air Force Surgeon General, Washington, D. C.

Born in New York City, General White received his B.S. Degree in 1928 and his M.D. in 1931, both from New York University. He was commissioned a first lieutenant in the Medical Reserve in 1931. In 1935 he entered the School of Aviation Medicine, Randolph Field, Tex., and became a flight surgeon after he graduated in 1936. In 1951 he became air surgeon of Tactical Air Command, where he was stationed until receiving his present appointment.

General White's full presentation appeared in the October 1958 issue of *The Journal of Aviation Medicine*, official publication of the Aero Medical Association, and is reprinted here with special permission.

Space Age
Developments in **LONG**



The stepchild of the radar family—FM/CW (frequency modulated, continuous wave)—is finally coming into its own as a result of the extended range requirements of missile and space operations. World War II saw the introduction of radar as a device for detecting aircraft beyond the range of the human eye and through night and bad weather. But because radar waves travel in straight lines, and aircraft operating heights were measured in tens of thousands of feet, the "radar horizon" never exceeded a few hundred miles at most. Thus, up to now there has not been any real premium on very-long-range performance. Nonetheless, a special kind of radar known as FM/CW has seen some limited applications in missile guidance and airborne weapon control.

It now looks as though the FM/CW technique holds bright promise in the field of long-range missile and space operations. As described in the accompanying article, FM/CW radar makes it possible to see small objects at greater distances than with conventional "pulse" radar. In fact, it would be impossible to obtain the many thousand miles of range needed for these new operating conditions with any reasonable amount of radar transmitter power using pulse radar techniques. Such power levels in "conventional" pulse radars would not only be extremely difficult to produce but would call for heavy and expensive equipment.

The control of man-made objects in space will depend critically on position data and navigational techniques. Thus the long neglected field of FM/CW can now be expected to accelerate rapidly and will open the door to intelligence gathering and control in space operation.

RANGE RADAR

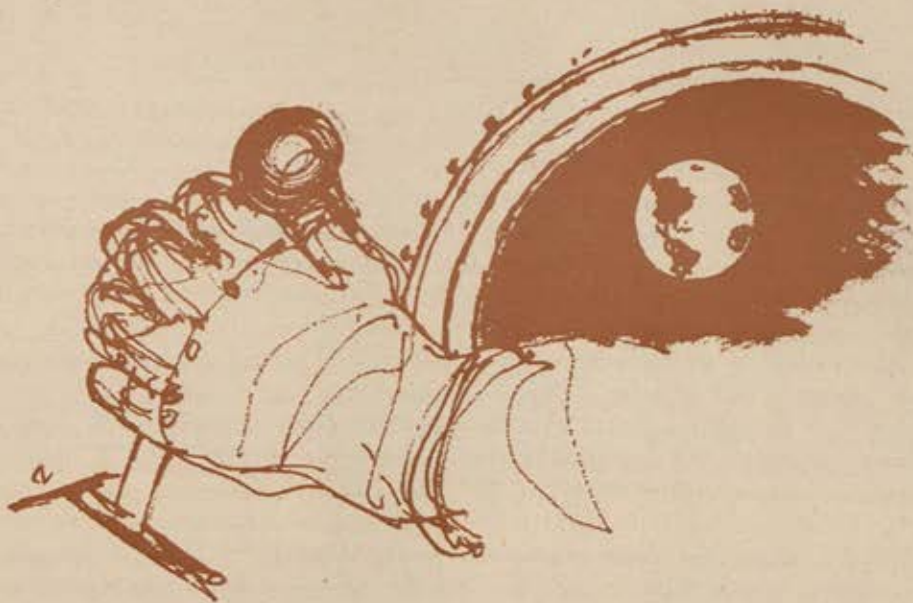
DR. ROBERT I. BERNSTEIN

Associate Director of Columbia University's
Electronics Research Laboratories

THE urgent need for defense against long-range missiles has speeded efforts in the field of long-range radar. Until recently the techniques and components available were generally refinements of World War II developments. However, recent advances have made long-range radar capable of reaching 2,000 miles for targets moving at 15,000 miles an hour.

Military security veils many important developments. But enough has been revealed publicly about the key developments such as FM/CW radar and MASERS so that, together with the basic theoretical knowledge that is available throughout the world, an interesting story of progress unfolds.

An important aspect of the current work is that problems of navigation and tracking of interplanetary space vehicles will undoubtedly be



solved by the same techniques being developed today.

The type of radar developed during World War II was made altogether obsolete by the requirements posed by defense against long-range missiles. While an operating range of about 200 miles was adequate for early warning and interception of 200-mile-an-hour bombers, it is [becoming] necessary to detect and accurately predict the trajectory of an oncoming missile warhead at least two thousand miles away and coming at four miles a second.

To determine the oncoming warhead's target and to launch a countermissile to destroy the warhead it is necessary to predict the trajectory of the enemy missile with great accuracy. This requires a precise knowledge of the position and velocity of the warhead while it is still thousands of miles away.

The culmination of World War II radar research was microwave-pulse radar; this type of radar achieved great accuracy in measuring the position of a target by sending out a pulse so short, a millionth of a second or less, that its time of travel to the target and back could be measured with great precision. However, for measuring the target's velocity this type of radar is very poor.

The most precise means of measuring velocity with radar is by use of the Doppler effect. When the radar wave is reflected from a moving object, the reflected wave has a higher frequency, by an amount directly proportional to the object's velocity. A familiar manifestation of the Doppler

effect occurs when a passing automobile or train blows its horn. As the source of the sound approaches the listener, the tone rises in pitch, and as the source recedes the frequency of the tone decreases.

Large Uncertainty

The measurement of the Doppler frequency shift, however, is basically limited in pulse radar because of the small length of time the echo is observed. This means the uncertainty in measuring the Doppler shift is large.

If the echo is available for only a short observation time, the difference in frequency between the outgoing and returning waves doesn't have a chance to become very great. It's much like measuring an angle. The longer the sides of the angle, the more apparent is the angle itself, and the easier it is to measure accurately. If the radar echo is available for a long observation time, then the phase difference between the two waves becomes quite substantial, and it is relatively easy to make a measurement that reveals this difference.

While the pulse radar affords only a short opportunity for the phase difference to grow, the continuous-wave (CW) radar provides a long opportunity and gives a proportionately better measurement of the Doppler shift.

Target's Position

However, knowledge of the target's position is obviously required as well. In pulse radar the position information is obtained by sending out

a very short pulse whose time of travel to the target and back can be measured closely. But if the pulse is not short, then the instant at which it returns to the radar receiver cannot be measured as accurately. Therefore, it would seem that continuous-wave (CW) radar sacrifices accuracy in determining the target's position (distance, etc.).

This would indeed be the case were it not for an additional technique, and that is the use of frequency modulation (FM) of the radar's CW signal. This, in effect, consists of "tagging" one part of the continuous wave so it can be recognized on its return in the echo. The time it takes for the "tagged" part to go out and back gives position. This "tagging" can be done in many ways.

Another problem whose solution is greatly assisted by the use of FM/CW radar is that of seeing a target at very long range. In World War II pulse radars transmitting one or two megawatts (a megawatt is a million watts) operated effectively against bombers at a range of about 200 miles. Today the requirement is for reliable operation against missiles at a range of at least 2,000 miles. Other things being equal, it would be necessary to increase the power by 10,000 in order to increase the radar's range by ten. Another way of saying this is: If you want to double the pulse-radar range from two to four miles, you must increase the power sixteen times.

It would be impossible at present to scale up a one-megawatt radar to 10,000 megawatts (this would be ten billion watts).

It is not really necessary to receive an echo of the same power as was obtained with World War II radars in order to obtain good results. Once the principle of FM/CW radar is adopted, it is possible to utilize echoes of much smaller power as long as the total received energy is adequate. Energy is the product of power times time.

The fact that the energy received back is the important quantity in determining whether a signal is usable is well known to every amateur photographer. Various combinations of diaphragm opening and shutter speed may be used for any given situation. The more the diaphragm of a camera is opened, the more powerful the entering light, and, therefore, the shorter the pulse of light admitted by the shutter should be.

In the same way, the usability of a radar echo is determined by the total echo energy collected. In conventional pulse-radar the signal is of very short duration. However, in FM/CW radar the signal is of long duration, and therefore need not

have as much power as in the case of pulse radar because the necessary energy can be collected over a much longer time.

The development of FM/CW techniques has made possible a large increase in radar range while still using moderate levels of transmitter power, and at the same time permits greatly improved accuracy in making velocity measurements.

Concern about the amount of echo energy received is based on the fact that the returning signal must compete with noise generated within the radar receiver. This internally generated noise occurs in every radio and radar receiver.

The noise is generated partly by the random motion of the molecular and submolecular particles in various components in the receiver, and partly by the normal operation of amplifying devices such as vacuum tubes or transistors.

The only way to reduce this cause of noise, which is called thermal noise, is to bring the temperature of the receiver components as close to absolute zero as possible. With vacuum tubes or transistors this has not yet been satisfactorily accomplished.

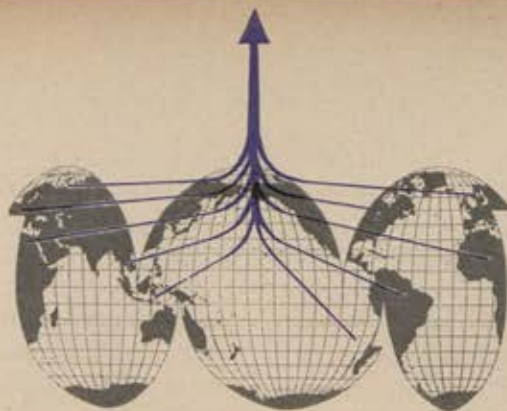
A technique, called the "MASER," recently developed by Professor Charles H. Townes and his associates at Columbia University, reduces receiver noise by applying a new phenomenon for signal amplification. It inherently produces very little noise and functions quite well at extremely low temperatures.

"MASER" stands for "Microwave Amplification by Stimulated Emission of Radiation." It utilizes the fact that under appropriate conditions molecules can be caused to give up energy in the form of radiation.

MASERS have been developed in which the stimulating field is at radar frequencies, so that they can be used to amplify radar echoes. Because they operate near absolute zero temperatures and are inherently not very noisy, MASERS permit good reception of signals one to ten thousand times weaker than previously.—END



Dr. Bernstein is the Associate Director of Columbia University's Electronics Research Laboratories and an associate professor of engineering. He is responsible for the basic design of the ORDIR long-range radar system, which Columbia is developing with Air Force sponsorship. This article appeared originally in the N. Y. Herald Tribune, Engineers News Supplement, October 26, 1958.



International Cooperation in the Exploration of Space

FROM A STAFF REPORT OF THE SELECT COMMITTEE OF THE
HOUSE OF REPRESENTATIVES ON ASTRONAUTICS AND SPACE EXPLORATION

THE opportunity now exists for the United States to accept the leadership of an international space effort in the infancy of the art. We can thereby ensure that this effort starts and remains truly peaceful and productive. If the United States acts with speed and decision, it can organize a working international space body, with its cornerstone fixed in the productive and political capacity of this country.

By a "working international body," we do not mean a series of international conferences which can be sidetracked from their real purpose by the political issues that so often plague East-West relations. Just as the higher unity of Western Europe is evolving from the military urgencies of NATO and the enforced economic partnerships of OEEC, the Common Market and—more recently—Euratom, a world unity of space and astronautics development can issue from a functioning organization of governments, cooperating scientific bodies, and individual scientists.

The basis for such an organization is implicit in the mandates for international cooperation which Congress has given the National Aeronautics and Space Administration. But these mandates will not become effective without further effort.

The Opportunities

It has often been noted that the efforts of European scientists were indispensable in the dis-

covery and development that lead to nuclear fission and fusion in the United States. What is not so often stressed is the fact that their zeal in the atomic effort, as well as their appearance on the American scene, was a direct consequence of totalitarian persecution in the 1930s. In a real sense, it was the scientists who pressured the US government to turn their discoveries to military use against an enemy from whom most of them had suffered. No such clear-cut zeal exists at present in the world scientific community. It is therefore necessary that the United States, if it wishes to put a world space program on a sound footing, should demonstrate the compelling necessity for a united scientific effort.

Fortunately, there is strong evidence that most of the world's scientists do look to the United States for leadership. This is not only a matter of common social and political outlook. It comes also from a dawning realization that the freedoms of Soviet science are qualified by Communist political aims.

In August and September 1958, scientists, particularly those working in space explorations and allied fields, held an unprecedented number of significant international meetings. These took place in Amsterdam, Geneva, London, Moscow, New York, Los Angeles, and elsewhere. At all these meetings there was a wide consensus on certain important premises:

- A highly competent, friendly, and critically

needed source of scientific manpower is available outside the United States.

- Some of the most respected and competent scientists abroad are hampered in their work, not only by lack of money and facilities, but also by lack of governmental encouragement.

- In many countries non-Communist scientists, engineers, and technicians are turning to the United States as the best outlet for their creative abilities.

Against this growing disposition to work on the space effort under American auspices, there remains doubt about how far their cooperation could extend. United States insistence on watertight security in scientific matters, some of which may be only remotely concerned with the national military interest, has become an object of wide criticism. This criticism is nowhere stronger than among our allies.

American concern for security has in the past been especially resented by our allies in the field of nuclear research. Congress recognized this resentment, and took steps to eliminate its valid causes, in the bill for a wider exchange of information with our allies in the atomic energy field. This bill was made law in the closing days of the Eighty-fifth Congress. It is a valuable guide to the free information policy which can pay dividends if adopted in the area of space development and exploration. Naturally, the nation's legitimate military security, both in the nuclear and the space fields, must be safeguarded; but a free information policy, to gain real international confidence, needs to be restated and followed through. This was the position taken by Congress when that body wrote the National Aeronautics and Space Act.

Views on the subject were strongly expressed to Committee representatives in discussions with scientists from many countries attending the ninth congress of the International Astronautical Federation (IAF) in Amsterdam. This was the first such gathering arranged in what we can justly call the Space Age. Approximately 400 delegates from some twenty-five countries attended, among them important scientists and high administrative and military figures.

Most foreign delegates were already aware that the National Aeronautics and Space Administration is the first agency of its kind established in the free world and the first to set as its goal the peaceful exploration of outer space. Conversely, in spite of the recognition among the delegates that the Soviet Union has made great advances

in space technology, they had begun to doubt if the world can rely upon continuous cooperation from the Soviet Union in the exploration of outer space.

Both government and industry in Western Europe have shied away from astronautics, in many cases because the expenditures involved are too great. Individual scientists and technicians, on the other hand, are eager to get to work. Actually, a good deal of work is under way which could benefit the entire free world if coordinated. Much of this effort is hampered by lack of equipment or financial support. Limitations on the exchange of data, also, have led to retracing the ground already covered by the United States or the Soviet Union.

Western European scientists were asked which were the greatest contributions they could make in advancing the free world's astronautical progress. They invariably stated that the most effective work could be done either through an internationally coordinated program or in specific American astronautical projects employing facilities in the various participating nations. It could also be useful to bring some of these men here to work on our projects in exchange for similar American services abroad.

If friendly foreign scientists are excluded from the development of astronautics, the science of the future, their individual achievements will be nullified. Without American cooperation it seems doubtful if Western Europe will be able to launch any space vehicle for some time to come. Conversely, by allowing European scientists to share their know-how with the United States, substantial benefits will accrue to both, and unnecessary expense to the United States may be avoided.

Past experience clearly indicates that the component parts necessary to any major scientific breakthrough often lie—inert and ineffective—in different parts of the world at any given time. It is obviously in the common interest to bring them all together whenever possible. In the West's drive to maintain a superior scientific position, this unifying impetus must be provided by the United States.

In Western Europe, the United Kingdom is visibly the most advanced in the field of space technology. The Ministry of Supply has asked the Royal Society, a private group which corresponds somewhat to the National Academy of Sciences in this country, to survey the British need for a space program and to outline what steps might best be taken in this field. The British

space program will probably depend upon the recommendations of the Royal Society, which has formed a special group, headed by Professor H. S. W. Massey, an outstanding scientist and professor of physics at the University of London, to study the matter.

In the missile field, meanwhile, the British have not been idle. They have developed the Black Knight missile, which could be used to launch a satellite, or in conjunction with another missile, the Blue Streak, to place as much as half a ton in orbit. The Black Knight recently rose 300 to 400 miles in a single-stage firing during tests in Aus-

tralia. This in itself is a most impressive feat.

Since their resources are limited, British officials can be expected to exercise caution in their advocacy of new and costly projects in space technology which might detract from the immediate effort in guided missiles. However, Mr. Duncan Sandys, the British Defence Minister, recently expressed a positive interest in future space travel—a fact that may be a clue to official thinking on the subject.

There appears to be a real desire among key British officials to work cooperatively with the United States and to develop particular British

Recommendations for an International Body

The Select Committee, in its report of May 21, 1958, called for a four-point program to secure the benefits of international cooperation in the peaceful development of space research and exploration.

This included information collection and dissemination in several languages; graduate-level science scholarships, available internationally and on an exchange basis; international competition to design payloads for incorporation into US satellites; and a call for an international conference on the peaceful applications of rocket power.

Now, with the passage of time, it is possible to amplify and refine those suggestions for implementation by the National Aeronautics and Space Administration and other government agencies.

It is the recommendation of the staff that:

1. The new space agency consider establishing some form of permanent liaison facilities devoted to the encouragement of cooperative arrangements with other countries. Precedents for such action already exist, for example, in the overseas offices of the International Cooperation Administration and the armed services.

2. The agency strive to catalog on a comprehensive scale the work projects and talents of both teams and individuals, at home and abroad, where a desire to cooperate in the peaceful development of space technology has been demonstrated.

3. The agency consider the establishment in this country of facilities for the evaluation of foreign proposals to assure the fullest benefits from the free world effort in all the space sciences.

4. The agency use the authority granted it by law to contract with public and private groups, overseas as well as in the United States, to carry on studies and actual construction of components or to perform other operational tasks.

5. Specific plans be developed for the exchange of scientific personnel among those countries willing to cooperate in a common effort.

6. There be an expansion of training facilities in the space sciences required to meet growing needs for scientists and technicians as the American program for the peaceful use of space develops. Such plans should include opportunities for foreign students to compete for fellowships. As talented students of all countries decide on careers in the space sciences, the United States and not the Soviet Union should be the place to which they will turn for training. Congress may wish at its next session to implement such a plan.

7. Congress and the President give continued encouragement and financial help to the work of the International Geophysical Year. The IGY has been too beneficial to the scientists of the world and the cause of good political relations to be allowed to expire with the end of 1958. Some progress has already been made by the scientific community in carrying this work into the future, but government aid might prove invaluable.

All these are immediate and attainable goals, within the power of the United States to achieve. They are each a necessary step toward working out a truly international approach to the space effort. But by themselves they are merely stop-gaps. If acted on individually, they will fall far short of their sum effect. . . .

specialties as partnership ventures. It was suggested, for example, that the United Kingdom could build remote-control probe vehicles for moon or Mars shots while the United States continued to develop the main boosters. There is sound basis for cooperative action of this type to the fullest extent possible. . . .

The Soviet Attitude

The Soviet Union's achievements in the art and technology of space exploration have made the Soviet attitude of basic importance to the world space effort. This attitude, at times, has seemed open-minded and favorable to a fair sharing of information in the space field. At other times, the attitude appears to harden in the opposite direction of secrecy and suspicion—qualities which the world sadly has come to recognize as traditional in Soviet policy on other matters.

Only recently, for example, the Soviet Union released to the world the key to one of the transmission codes being employed by Sputnik III, enabling the United States and other nations to decipher much of the data being broadcast by that "moon." This occurred about the time most non-Soviet scientists had given up hope of such Soviet cooperation. The Soviet Union has also agreed to participate in the new Committee on Space Research being organized by the International Council of Scientific Unions. On the other hand, the Soviet Union has failed to reveal anything comparable to American disclosures of satellite launching techniques; Soviet Sputniks have violated international agreements relating to broadcast frequencies; and the Soviet government has shown little disposition to collaborate on specific plans for future space explorations.

Whatever the exact net balance of these several acts may be, the discrepancy between original expectations for cooperation and the actual Soviet performance, thus far, has been enough to dampen the hopes of scientists throughout the free world.

The demonstrated professional ability of many Soviet scientists has led us to hope that mankind as a whole can share in the results of their work. Science in general has traditionally been non-political and dedicated to the advancement of all men.

However, there are peculiarities in the Soviet position in science which must not be ignored, even if we hope they may be corrected. The rest of the world can work better with the Soviet Union if it is thoroughly aware of them. On the

one hand, the Soviet Union has made a major effort to overcome technical backwardness among its people and has engaged in a long-term effort to train scientists and engineers. On the other hand, the Soviet system is frankly dedicated to certain political and social aims which are anathema to free men. These two facts are constantly at war with one another. In the end, any tendency toward enlightenment from greater education has to face harsh political reality. Soviet science, like everything else in the Soviet society, including what we regard as inalienable rights of individuals, is subordinate to the goals of the ruling Communist Party.

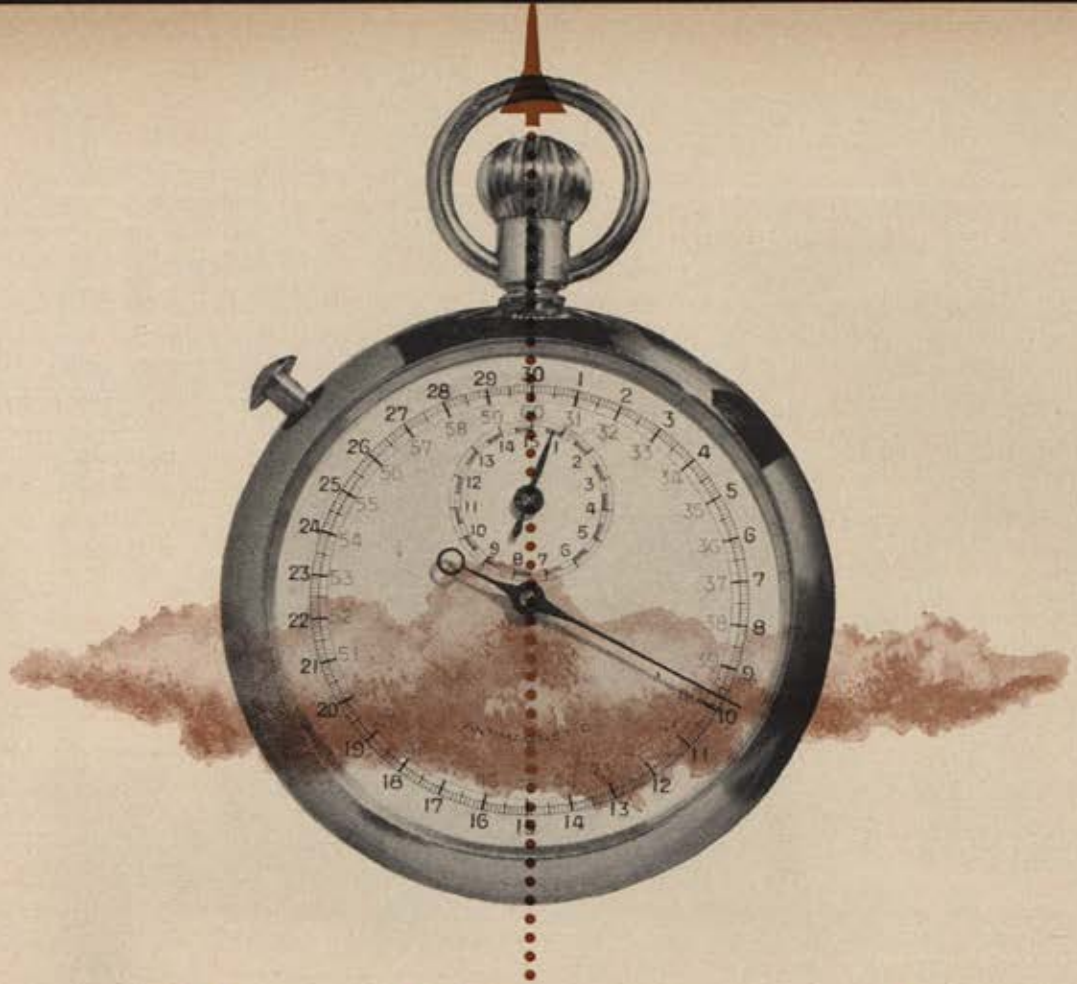
The Soviet Union furthermore openly avows an eventual goal of Communist world domination, and many of its acts in international fields we would view as nonpolitical are colored by its totalitarian approach to life.

Moreover, the Soviet government has already made such progress in the space sciences that it now exhibits a certain scorn for what others can do. It sees limited reason for cooperating only in those areas which can (1) pay off in military strength or (2) promise opportunity for spectacular developments politically useful in shaping world opinion. Undoubtedly, Soviet scientists are under considerable pressure to support Soviet ambitions with such "political" science. In the eyes of the Kremlin complete scientific cooperation would hardly further these aims.

Therefore, it remains to be demonstrated whether the Soviet Union will share wholeheartedly in a broad space science program of the kind the free world is coming to regard as essential. The burden of proof rests on the Soviet government.—END



This material has been excerpted from the Staff Report of the Select Committee of the House of Representatives on Astronautics and Space Exploration, Eighty-fifth Congress, Second Session. Chairman of the Select Committee was John W. McCormack, Massachusetts, and committee members included: Overton Brooks, Louisiana; Brooks Hays, Arkansas; Leo W. O'Brien, New York; Lee Metcalf, Montana; William H. Natcher, Kentucky; B. F. Sisk, California; Joseph W. Martin, Jr., Massachusetts; Leslie C. Arends, Illinois; Gordon L. McDonough, California; James G. Fulton, Pennsylvania; Kenneth B. Keating, New York; and Gerald R. Ford, Jr., Michigan.



Travel Faster and Live Longer

LLOYD MOTZ

Associate Professor of Astronomy, Columbia University

ONE of the most profound consequences of the theory of relativity is that space and time can no longer be considered as absolute concepts in the Newtonian sense, but rather as sections of a space-time continuum which have different aspects for different observers moving in relation to one another. What this means is that our universe cannot be represented by a sequence of events having a unique separation in space and a unique order in time. Each observer in the wide universe, depending upon his state of motion, will find different distances between objects and different time intervals between events; concepts such as simultaneity and length lose their absolute meanings.

We may illustrate this by considering the results obtained by two observers moving past each other if they were to measure the distance between the same two points. Take as our two subjects a man in a moving train and another one standing on the railroad bank. Suppose that each of them measures the length of the car in which the man in the train is riding. The theory of relativity teaches us that the results of the two measurements will not be the same. The length of the car as measured by the man in the train will be greater than that obtained by the man on the railroad bank, and the difference between the two results will increase if the speed of the train increases. In other words, the observed dimension of a mov-

ing body parallel to the direction of its motion, as measured by a fixed object, shrinks more and more as its speed increases, and approaches zero as the speed of the object approaches the speed of light.

Just as the length of a moving body changes with its speed, so too, according to relativity, does the rate of a moving clock. If the man on the side of the track were able to compare his watch quite accurately with a watch in the moving train, he would find that the moving watch was running slow compared to his watch. The faster the train moves, the slower will be the rate of the moving watch, finally approaching zero as the speed of the train approaches the speed of light.

A space platform will enable us to test this consequence of the theory of relativity: We now have clocks, such as the MASER clock (Microwave Amplification by Stimulated Emission of Radiation) developed by Professor Charles Townes of the Columbia University physics department, which are accurate to one part in a billion. If such a clock were placed in a satellite or on a space platform traveling at 18,000 miles per hour, then, according to the theory of relativity, it should, after one day, lag behind a similar clock on the earth by about one twenty-thousandth of a second.

Professor Leon Lederman of Columbia is one of several scientists who have obtained direct evidence supporting this time dilation (as scientists call it) in studying the lifetime of mesons. These ephemeral particles, with masses a few hundred times that of an electron, are born during energetic collisions of protons and neutrons with nuclei of atoms. In general, mesons have very short lives, living for no more than a few one-hundred-millionths of a second; but Professor Lederman has observed that the lifetimes of mesons increase, in accordance with relativity theory, as the speeds which they have at birth increase. In other words, if two mesons are created during two different collisions, the one that is moving faster through space is observed to live longer as a meson than the other one.

Once we get to the moon, the MASER clock will enable us to check a prediction of the general theory of relativity concerning the effect of a gravitational field on a clock. According to the theory a clock in a strong gravitational field should lag behind one in a weaker gravitational field. Since the surface gravity on the moon is only one-sixth of that on the earth (a person on the moon will weigh only one-sixth of what he does on the earth), a clock on the moon should run ahead of

an identical clock on the surface of the earth. This prediction can be tested by placing a MASER on the moon.

Now a rocket that lands on the moon should, of course, carry enough fuel to take off again and return to the earth. Since the speed needed to escape from the moon is less than one-fourth that required to escape from the earth (because the force of gravity is less), a rocket need only carry additional fuel amounting to less than one-sixteenth the quantity necessary to escape from the earth.

Professor Jan Schilt, director of Columbia's Rutherford Observatory, has suggested that a trip may be even more readily managed to and from one of the two moons of Mars. If we landed on Deimos, which is 14,000 miles from the center of Mars, we would require very little fuel to take off again for the earth, since we would have to acquire a speed of only 4,000 miles per hour relative to Mars.

Our spaceship would already be moving at almost this speed, since Deimos moves at about 3,000 miles per hour relative to Mars. And the mass of Deimos is so tiny that it has practically no gravitational field of its own to be overcome.

Once interplanetary trips have become usual, the next step in space travel will be to the stars. Here problems of an entirely different order of magnitude will have to be solved because of the vast distances to be crossed. The star nearest to us, Alpha Centauri, is so far away—about twenty-six trillion miles—that it takes light four and a half years to traverse the distance. This means that if interstellar navigators are to journey to the stars and back in times that are conveniently short within their own lifetimes, they must travel at speeds approaching the speed of light. If such speeds can be achieved by man, the relativistic time dilation discussed above will have an extraordinary effect. To a crew in a spaceship traveling at four-fifths the speed of light, a ten-year journey into space and back again, as measured by a clock here on the earth, will last only six years as measured by a clock on the ship; at nine-tenths the speed of light the duration of the trip will be only slightly more than four years.

It should not be supposed, by the way, that this difference in the duration of the trip as measured by an observer on the earth and by one on the spaceship means that the travelers will detect any change in their metabolism or in any other biological or psychological processes. So far as our travelers are concerned, the four or six years they

spend in transit will be the same as any other four or six years spent here on the earth; the aging process will go on as usual, and only on their return to earth will they be aware of the difference in times. They will return to an earth which is ten years older.

A Trip Through the Universe

In principle, there is no reason why trips to remote galaxies may not be possible if man can achieve speeds close enough to the speed of light. But in practice it is doubtful that mankind will go very far beyond the nearest stars within the next few centuries.

Still, let us suppose for the remainder of this article that a space traveler could achieve the speed of light—an impossible speed for a body of finite mass. Let us consider what such an imaginary traveler might see as he explored all corners of the universe. The times referred to in what follows will be those measured by a clock on earth, *not* a clock moving with the traveler.

Our imaginary traveler will reach the moon in less than two *earth-time* seconds. After he sweeps past this lifeless sphere, it will take him another eight and a half minutes to reach the sun. He will have to be very careful to avoid being vaporized by the intense radiation pouring out of its 5,500° C. surface, but a few more minutes of travel will take him well beyond the danger zone. Lifeless Mercury, the planet closest to the sun, with one face in perpetual light and the other in eternal darkness, will rush quickly past, to be followed immediately by the mysterious Venus, with her veil of everlasting clouds completely obscuring the planet's surface from the earth. So similar to the earth is Venus in its geometrical features that scientists feel it is the likeliest site for another advanced form of life.

Our traveler will stop only a moment at Mars to convince himself that the green coloration in its equatorial region is indeed due to a low form of vegetation. He will then rush on to the largest and most massive of all the planets, Jupiter. With its atmosphere composed of noxious gases like ammonia and methane, and with its 15,000-mile-thick surface layer of ice, this forbidding king of

the planets will present all kinds of hazards to explorers from earth. Ours moves on.

Five and a half hours after leaving the earth, the spaceship will have traveled about four billion miles, passing the planet Pluto at the very outskirts of our solar system and heading toward Alpha Centauri, the star nearest to the earth. But so empty is space, and so vast the distances between the stars in the neighborhood of the sun, that four and a half years, as measured by a clock on the earth, will elapse before this star is reached. If the ship heads toward the very densest part of the Milky Way in the direction of the constellation Sagittarius, our traveler will find after some 15,000 years (earthtime) that the stars become much more numerous and also undergo a change in character.

By this time he will be leaving the outer spiral arm of our galaxy and entering the nucleus. He will have passed many millions of stars, most of them redder and fainter than the sun, but many others tens—and even thousands—of times more luminous than the sun. Among these will be the very hot blue-white stars to be found only in the spiral arms of the Milky Way. These stars are probably no more than a few million years old, the infants of our galaxy, born just recently of the dust and gas expelled by the dying gasps of the very oldest stars, those which were formed about seven billion years ago from the primordial hydrogen. Our tourist will meet only these very old stars during the 30,000 years it takes his ship to move through the dust-free nucleus by earthtime. At the very center of the nucleus, which is 30,000 light-years away from us, he will find the stars so crowded that were he living in that neighborhood, he would receive as much light from these stars at night as we might receive here on earth from 300 full moons.

After the ship has passed through the nucleus, it will spend another 25,000 years rushing through the dusty spiral arms on the other side of the nucleus, and it will then proceed to the galaxies (the so-called spiral nebulae) that lie beyond. Our explorer will find that these galaxies, which are spaced millions of light-years apart, look in many respects like his own Milky Way. Most of them contain many billions of stars and have the same dusty spiral arms swirling around a densely populated nucleus. Like our own galaxy, they are thousands of light-years across, with the very old stars extending out from the nuclei to form the bulk of the stellar population, and with the younger second- and third-generation stars like our sun





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scattered along the spiral arms. He will observe that the galaxies do not live in isolation but belong to huge clusters, some of which contain thousands of members, all moving together through space. So numerous and closely spaced are the galaxies in many of these clusters that collisions between two such galaxies are quite frequent. These titanic collisions release vast amounts of energy which come to the earth in the form of cosmic rays and radio waves.

Our traveler will discover that it is not the individual galaxy that is the fundamental cosmological unit of matter but rather the cluster of galaxies. These clusters extend uniformly out into space as far as our telescopes can see, and, by the radiation that we receive from them, we know that they are rushing away from us with speeds that increase as their distances from us increase. We must not suppose, however, that this means that our Milky Way occupies a central spot in the universe from which all things are receding; we would find the same thing to be true no matter which galaxy our solar system belonged to. For in fact all of these clusters of galaxies are receding from *one another* as if they were remnants of a huge explosion that occurred billions of years ago. It is this feature of the motion of the galaxy clusters that we refer to when we speak of the theory of the expanding universe.

According to this theory about seven billion years ago all the matter in the universe was in a highly compressed state concentrated in a sphere not many times larger than the sun. This unstable condensed universe gave way to an explosive state in which the expanding gases (principally hydrogen and neutrons) broke up into huge turbulences which became clusters of galaxies.

This conception of the expanding universe is a direct consequence of the general theory of relativity, but it is not the only possible conception. As Fred Hoyle, the British astrophysicist, has shown, it is possible to obtain a steady-state model of the universe from the theory of relativity by postulating that matter is being continuously created. As the galaxies rush away from us, and ultimately disappear, the Hoyle theory requires that one proton be born in each gallon of space every billion years to keep constant the total amount of matter in the observable part of our universe. These protons ultimately collect into huge clouds which then become new clusters of galaxies, only to rush away from each other and disappear.

The most recent data on the recession of the

galaxies, gathered with the 200-inch telescope at Mount Palomar, seem to favor the evolving universe (the model expanding from an initial condensed state) as against the steady-state model of Hoyle. In fact, it appears that our universe is in the expanding phase of a pulsating motion, so that we may expect the expansion that is now going on to be replaced by a contraction, which will then be followed by another expansion, and so on ad infinitum.

This conclusion is supported by the recent observations made at Mount Palomar that the most distant observable galaxies (almost two billion light-years away from us) are receding faster than they ought to be if the universe were simply expanding at a constant rate. In other words, the expansion of the universe two billion years ago was proceeding faster than it is now, which means that a slowing down in the expansion has taken place since then. From this it follows that in about fifteen billion years the expansion will come to a halt altogether, and the universe will begin to collapse and finally reach a highly condensed state again. Then another expansion will begin, in which all the changes in the universe which are now taking place will recur in the same order.

Such a pulsating universe follows from the general theory of relativity and has important consequences for our imaginary traveler, whom we left wandering among the galaxies. A pulsating universe is necessarily one in which space is curved and completely closed back upon itself—finite but boundless, so that our space tourist will ultimately find himself back again at the point from which he started if he continues traveling in what he takes to be a straight line. Since billions of years as measured on the earth will have elapsed by that time, he will certainly not find the earth as he left it. But he will have had a fairly memorable—though still, alas, impractical—trip in the interim.—END



Lloyd Motz is an associate professor of astronomy at Columbia University. The author of *This Is Astronomy*, published in August by Archer House, he has also written *The History of Time and What Astronomy Is All About*. This article is digested from "A Jaunt to the Limits of the Universe," which originally appeared in the Fall 1958 issue of *Columbia University Forum*, a quarterly journal of fact and opinion, and is used here with special permission.

"MIKING" THE WORLD



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Space Technology Laboratories, Inc., previously a division of The Ramo-Wooldridge Corporation, became a separate company on October 31, 1958. Space Technology Laboratories will be directed by Lieut. Gen. James H. Doolittle, Chairman of the Board (after January 1, 1959); Dr. Louis G. Dunn, President; and Dr. Ruben F. Mettler, Executive Vice President. The other members of the Board of Directors are Robert F. Bacher, Head of the Division of Physics, Mathematics and Astronomy at the California Institute of Technology; James T. Brown, Vice President of the Mellon National Bank, Pittsburgh, Pennsylvania; and Samuel E. Gates, Attorney with the New York firm of Debevoise, Plimpton and McLean.

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Thompson Products, Inc., has been for many years a large manufacturer of components and accessories for the automotive and aircraft industries. In recent years, it has also been active in the fields of Missiles, Electronics, and Nuclear Energy. Thompson has concentrated on products which require a high level of competence in engineering and precision manufacturing.

The Ramo-Wooldridge Corporation was organized five years ago to conduct research, development, and manufacturing operations in the field of electronic and missile systems having a high content of scientific and engineering newness. In addition to the work performed by Space Technology Laboratories, Inc., Ramo-Wooldridge has been engaged in major systems work in such areas as digital computers and control systems, communications and navigation systems, infrared systems, and electronic countermeasures.

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Cultural Implications of Man in Space

LAWRENCE K. FRANK

Condensed from the Annals of the New York Academy of Sciences

THOSE who embark on space trips will be faced with the problem of supplanting their earliest formed patterns of organic functioning and motor coordination with new habits and practices—highly specialized patterns. Their basic body habits—breathing, swallowing, eliminating, sleeping, walking, sitting, and resting—must be altered in space travel. Their usual thresholds to various sensory stimuli and to emotional provocations must also be altered if they are to learn to accommodate themselves to the many unfamiliar conditions of space travel. Likewise, they will be cut off from many of the cues by which they orient themselves in time and space, with possible serious consequences for normal mental functioning and personality stability, as foreshadowed by recent experiments on the complete isolation of subjects.

Obviously the space voyager will not be able to continue his customary interpersonal relations. He may have to learn a new set of inhibitions for regulating his emotional reactions and his interpersonal relations, especially tactual contacts.

If we consider MIS as providing occasions for bold, imaginative explorations into the problems of unlearning and relearning, we might greatly advance our understanding of these processes. We might even discover methods for group unlearning with far-reaching possibilities for cultural and social change in those areas in which we are now burdened by so many archaic survivals.

The public will be curious about these activities and will speculate on how the space voyager will manage these personal functional processes, including the sexual. People will speculate as to what will happen to a man's wife and children when he embarks on a prolonged space trip, perhaps for years, with every chance of not returning. How long a separation in space would justify divorce and, if he should return, how will this Enoch Arden triangle be handled?

The response to the question, "Would you go on a space voyage if invited?" will probably in-

voke some highly significant replies from those who are eager to get away from this troublesome world or to try their courage and endurance in a new and untried area of living. It will be difficult to distinguish such people as the neurotic, the near-psychotic, the adventurer, the bored-with-life, and the escapee from unwelcome obligations from all who are eager for space travel.

As the history of ideas and religions indicates, the emergence of new ideas and exposure to novel situations evokes from people a process of assimilation and accommodation whereby they try to fit the new into the old framework of their traditional beliefs and activities. It would contribute to our studies of the reception of MIS if we were to study the process of accepting, modifying, distorting, and encapsulating the new concepts that have evolved from modern physics during the past fifty or sixty years. It is clear that MIS has become feasible only through the development of concepts, modes of thinking, and criteria of credibility radically different from the former climate of opinion, which included such factors as classic physics, the traditional beliefs about matter, energy, space, time, and human nature.

We must remember that MIS is being introduced to a culture characterized by many anachronistic beliefs and archaic survivals. Will MIS create even more anachronisms, or will it evoke a large-scale reorganization and bring about a modernization of the human mind? This, I submit, may be the crucial issue, an issue we should not overlook in our proposed investigations of people's reactions to MIS and the alterations that may be evoked in their ideas and feelings.

The permeation of our culture by MIS will take place basically through the arts and literature, as has happened in previous periods when new ideas were translated by artists and poets into form, language, and feelings that were generally understandable and acceptable. Long before the underlying concepts of MIS have been understood and accepted, their meaning will have been interpreted through the arts, as we are already seeing.—END

Speaking of

SPACE

Those of us who have been vaguely disconcerted by thoughts of the lonely earth as a small planet orbiting around a small star on the spiral arm of a minor galaxy can find encouragement in Dr. Harlow Shapely's new book, *Of Stars and Men* (Beacon Press, Boston, 1958). The Harvard astronomer tells us man can no longer take a geocentric, heliocentric, or even an anthropocentric approach to the realities of the universe. Dr. Shapely assures us that we are *not* alone:

"The researches of recent times have enriched and clarified our concepts of habitable planets. Through discovering the true stellar nature of the spiral 'nebulae,' through the sounding of star-and-galaxy populated space to such great depths that the number of knowable stars rises to billions of times the number formerly surmised, and through the discovery of the expansion of the universe with its concomitant deduction that a few billion years ago the stars and planetary materials were much more densely and turbulently crowded together than in the present days of relative calm, we have strengthened our beliefs with respect to the existence of other 'worlds.'"

Among the multibillions of galaxies, Dr. Shapely conservatively estimates, there must be a hundred million planetary systems suitable for organic life, perhaps a million times this number, and that "many but not necessarily all of these planets probably have

the plant-animal interdependence in which we ourselves participate."

He proposes that the "high probability of the existence of senses, and of sense organs, now unknown to man . . . is indeed so reasonable as to seem axiomatic. Their importance to the imagination is obvious . . . Many realities may lie beyond the comprehension of human terrestrials, simply because our out-fitting with sense organs is limited."

As to the future of man, Dr. Shapely sees it as bright—except for the "real danger . . . man himself."

In a mordant reappraisal of his *Brave New World* of 1931, Aldous Huxley predicts that space on earth will be more important to our descendants than the space of cosmic exploration. In *Brave New World Revisited* (Harper & Brothers, New York, 1958), he says: "A new age is supposed to have begun on October 4, 1957. But actually, in the present context, all our exuberant post-Sputnik talk is irrelevant and even nonsensical. So far as the masses of mankind are concerned, the coming time will not be the Space Age; it will be the Age of Overpopulation. . . . A settlement on the moon may be of some military advantage to the nation that does the settling. But it will do nothing whatever to make life more tolerable, during the fifty years that it will take our present population to double, for the earth's undernourished and proliferating billions."

GEORGE "MOON" MEYERS—By Jack Tippit



"Well, Colonel Meyers, how do you know it wasn't green cheese if you didn't taste it?"

ON THE SPACE CALENDAR

December 15-19: Second Australasian Conference on Radiation Biology, in Melbourne, Australia.

December 26: World Meteorological Organization, second session of Regional Association IV, in Havana, Cuba.

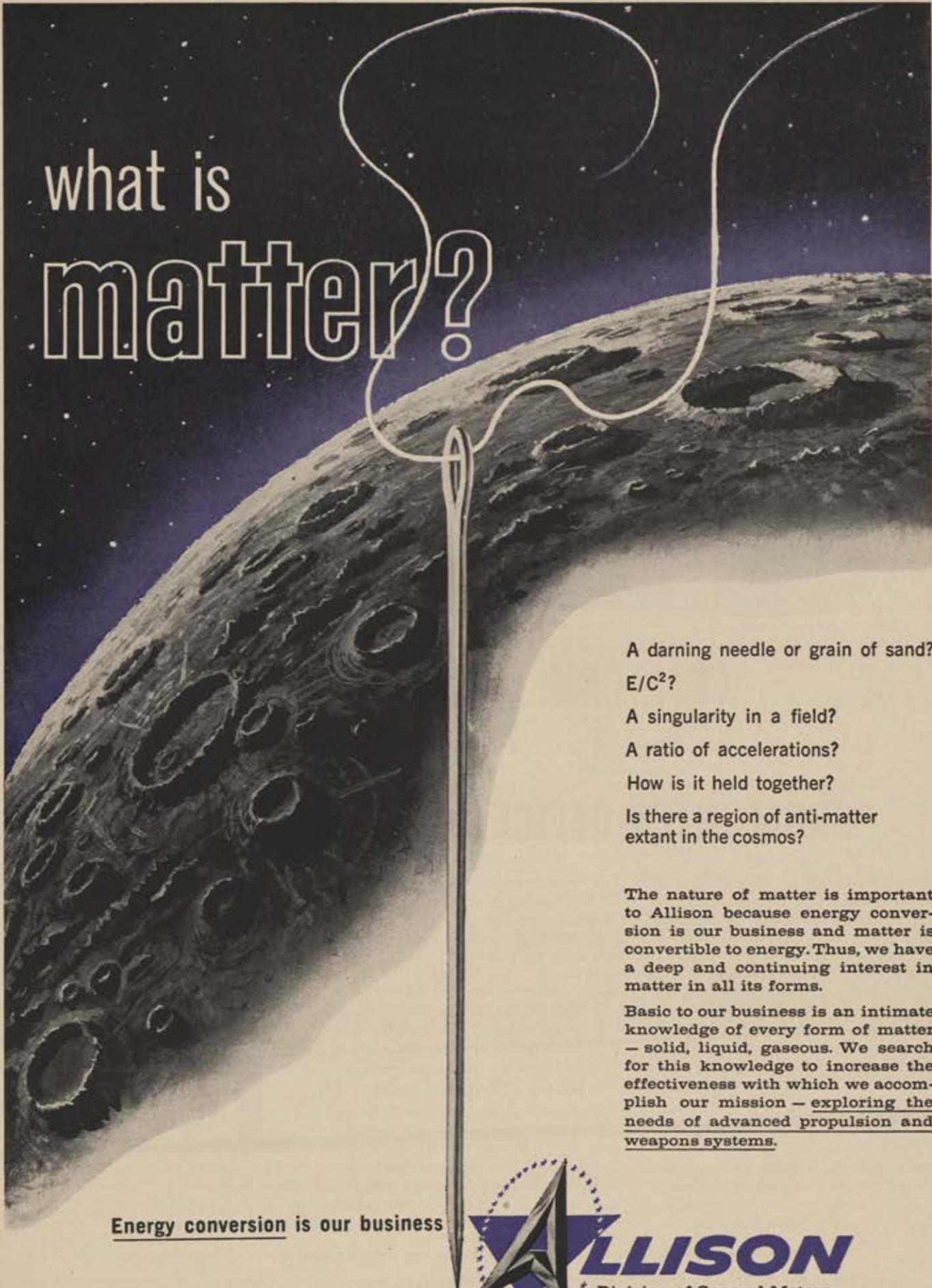
December 26-31: 125th Annual Meeting of the American Association for the Advancement of Science, in Washington, D.C.

December 27-30: First Teenage Rocket Exposition and Symposium, at Naval Air Facility, Miami, Fla.

January 26-29: Institute of the Aeronautical Sciences Twenty-Seventh Annual Meeting, at the Hotel Astor, N.Y.

January 28-29: Symposium on Nuclear Fuel Elements, sponsored by Columbia University and the Sylvania-Corning Nuclear Corp., at Columbia University, N.Y.

(Continued on page 101)



what is matter?

A darning needle or grain of sand?

E/C^2 ?

A singularity in a field?

A ratio of accelerations?

How is it held together?

Is there a region of anti-matter
extant in the cosmos?

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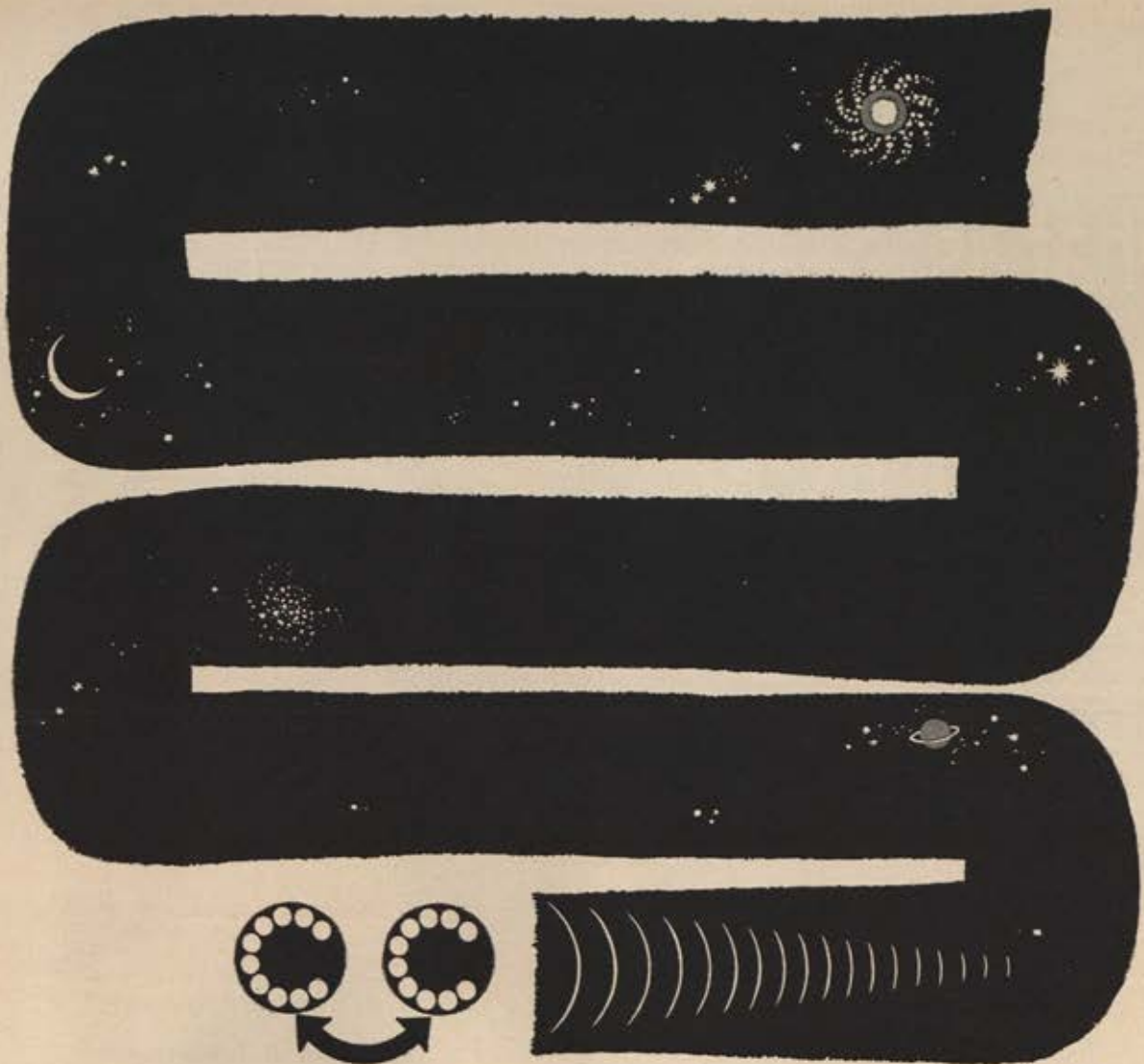
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A definitive study of the Russian approach to the Sputniks has been translated by the Technical Documents Liaison Office, Wright-Patterson AFB, Ohio. A. Shternfeld is the author of *Artificial Satellites*, printed by the State Publishing House for Technical and Theoretical Literature, Moscow, 1958. The Office of Technical Services of the US Department of Commerce, Washington 25, D.C., is selling the volume, PB 141351 T, for \$6.

Also distributed by OTS is the Central Intelligence Agency's *Scientific Information Report*, presenting abstracts from publications of the USSR, China, and Eastern Europe. The reports cover scientific developments in chemistry, electronics, engineering, mathematics, medicine, and physics. Important scientific meetings are summarized. *Scientific Information Report* is issued semimonthly, at \$28 a years or \$2.75 an issue.

The USAF *Air University Quarterly Review* Summer 1958 issue was devoted to the human factor in space travel. Topics covered include: *From Aviation Medicine to Space Medicine*, by Dr. Hubertus Strughold; *Biodynamics of Manned Spaceflight*, by Col. John P. Stapp; *Human Performance in the Space Travel Environment*, by Dr. George T. Hauty; and *The Military Impact of Space Operations*, by Maj. Gen. Lloyd P. Hopwood.

The American Rocket Society held its thirteenth annual meeting in New York on November 17-21. USAF Col. John P. Stapp, chief of the Aeromedical Laboratory of Wright Air Development Center, was elected president for 1959. James R. Dempsey, vice president of Convair, Division of General Dynamics, and manager of Convair-Astronautics, as well as a new member of the AFA Board of Directors, was elected to the ARS board for a three-year term, along with William H. Pickering, Director of the Jet Propulsion Laboratory of the California Institute of Technology; Lt. Col. David G. Simons, chief of the Space Biology Branch of the Aeromedical Laboratory at Holloman Missile Development Center, N.M.; John L. Sloop, chief of the Rocket Branch of the Lewis Research Center of NASA, Cleveland, Ohio; and Antoni K. Oppenheim, Associate Professor of Aeronautical Sciences at the University of California.

The lecture series on astronautics, "Ten Steps into Space," delivered at the Franklin Institute in the spring of 1958, is available for \$4 from the Institute, 20th and The Parkway, Philadelphia 3, Pa. The program included: *Celestial Mechanics—Orbits of the Satellites*, by Paul Herget; *Probing the Atmospheres of Venus and Mars*, by J. I. F. King; *Satellite Instrumentation—Results for the IGY*, by S. Fred Singer; *The Rocket and the Reaction Principle*, by Kurt Stehling; *The Long History of Space Travel*,

by Willy Ley; *Satellites and Travel in the Future*, by I. M. Levitt; *Space Medicine—the Human Body in Space*, by David G. Simons; *Space Navigation: The Path to the Planets*, by Krafft A. Ehrlicke; *Rocket Fuels, Liquid and Solid*, by Harold W. Ritchey; and *The Explorer*, by Gerhart Heller.

According to a recent *NATO Letter*, the Advisory Group for Aeronautical Research and Development (AGARD) of the North Atlantic Treaty Organization accepted an invitation from the Danish authorities to hold its eighth General Assembly in Copenhagen, beginning on October 28. A round table discussion on the theme "Impact of Space Technology on Research and Development" was arranged. Dr. Norman F. Ramsey, Science Adviser to the Secretary General of NATO, was chairman for this discussion.

Among the papers presented were *The Selection, Training, and Maintenance of Spaceflight Personnel*, by Dr. W. Randolph Lovelace, of the Lovelace Foundation, Albuquerque, N. M., and *Biomedical Aspects of Spaceflight*, by Brig. Gen. Don Flickinger, Director of Life Sciences, ARDC.

The thirteenth AGARD Aeromedical Panel Meeting also met in Copenhagen, on October 23, to conduct a symposium on escape and survival.

The Association of Military Surgeons had its 65th Annual Convention at the Statler Hotel, Washington, D.C., on November 17, 18, and 19. More than 2,000 medical people, including sixty representatives from twenty-eight countries, met to discuss the advancement of all phases of medicine. This year's theme was *Dynamic Medicine and Rehabilitation in the Space Age*. Among the panel discussion topics were *Occupational Health Problems of Spaceflight*, headed by Maj. Gen. Willford F. Hall, Command Surgeon of AMC, and *Problems of Space*, led by Brig. Gen. Don Flickinger.

The Association's newly elected president is Brig. Gen. Harold H. Twitchell, USAF, Command Surgeon of USAF in Europe.

Speaking before the National Security Industrial Association at the Hotel Waldorf-Astoria, New York, Gen. Lauris Norstad, Supreme Allied Commander, Europe, described NATO as a military structure that "continues to be a necessity of life for all of us. Our property, our freedom, perhaps even our civilization, will flourish or fail, according to how this alliance fares. . . . The pressure on us is tireless. Serious troubles develop in areas which only a few years ago seemed secure. Yet . . . it is plain that Soviet expansionism has been frustrated in its main objectives. In Western Europe, for example, where the stakes are all-decisive, it has not gained an inch. For this we can thank the NATO alliance."—END

SPACE *Lines*



Scale model of a moon building that would be made of pre-engineered aluminum alloy sheets secured by nut and bolt fasteners and welded structural connections was designed by the Wonder Building Corp., Chicago, Ill., to house the first lunar explorers.

Telemetered data from the Pioneer I lunar probe (See *SPACE DIGEST*, November '58) has suggested to some observers the existence of two radiation bands encircling the earth. Dr. Carl Mellwain, physicist of the University of Iowa, who is one of the designers of the 1.5-ounce radiation detector aboard the rocket, has also reported that data telemetered from Pioneer from about 11,000 miles showed an average radiation intensity of about ten roentgens an hour, falling off to less than a few tenths of a roentgen an hour at about 19,000 miles.

But there has developed some question as to the complete reliability of the Pioneer data. Dr. James Van Allen, Dr. Mellwain's colleague, believes there was "leakage" in the Pioneer's radiation-counting equipment.

The third Air Force lunar probe, launched from Cape Canaveral on November 8, climbed to an altitude of only 1,000 miles before falling back toward the earth. The third stage did not ignite.

William M. Holaday, Director of Guided Missiles for the Department of Defense, has been appointed chairman of the Civilian-Military Liaison Committee to ensure cooperation between the National Aeronautics and Space Administration and the Department of Defense's Advanced Research Projects Agency. In the bill setting up NASA, the President was charged with responsibility for "providing effective cooperation" between NASA and DOD. Mr. Holaday will retain his present job until a Director of Research and Engineering, DOD, is appointed.

Other members of the committee will be Dr. Hugh

L. Dryden, Deputy Administrator of NASA; Dr. Abe Silverstein, Director of Space Flight Development, NASA; Dr. Homer J. Stewart, Director of Program Planning and Evaluation, NASA; and Ira H. Abbott, Assistant Director for Aerodynamics and Flight Mechanics Research, NASA. Representing DOD will be Roy W. Johnson, Director of ARPA; Maj. Gen. W. W. Dick, US Army Director of Special Weapons; Vice Adm. R. B. Pirie, US Navy Deputy Chief for Naval Air Operations; and Maj. Gen. Ralph P. Swofford, USAF Deputy Chief of Staff for Development.

The fourteenth Convair Atlas was launched from Cape Canaveral, Fla., on November 17. All three engines ignited, and the flight was successful. This was a trouble-shooting flight—a limited test of 3,100 miles in preparation for a second full-range test.

The Russian Crimean Astrophysics Laboratory is reported to have observed an eruption on the mountains of the moon last month. Soviet scientist N. A. Kozyrev said that Observatory witnesses had watched a nearly doubled light intensity in the peak of the moon crater Alphonse for almost thirty minutes, shortly after three in the morning. A member of the Soviet Academy of Sciences, A. A. Mikhailov, stated that this evidence would "demonstrate the similarity of moon and earth processes" and would cause a revision of the theory of the origin of the moon and its existence as a dead celestial body.

(Continued on page 105)



The Astrotarium, inflated nylon planetarium, is now touring the country to demonstrate the many wonders of the solar system, stars, and satellites.



"TURN SIGNALS" FOR A BALLISTIC MISSILE

BURROUGHS ELECTRONIC COMPUTER "MASTERMINDS" THE ATLAS INTERCONTINENTAL BALLISTIC MISSILE

Steering the 250-mile-per-minute Atlas into the precise trajectory required for the missile to accurately strike its target 5,500 miles away, calls for incredibly close computation. And that's where Burroughs comes in—with an electronic computer specially designed to receive complex information, compare it with the

pre-calculated direction, and signal the missile necessary changes to set it unerringly on its course.

Important contracts are not new to Burroughs Corporation with its 70 years of demonstrated competence. But it is the recent defense projects that serve best to underscore Burroughs' breadth and complete capability, from research through mass production to actual field installation and service. Burroughs Corporation, 6071 Second Avenue, Detroit 32, Michigan.

BURROUGHS
CORPORATION

THE FOREMOST NAME IN COMPUTATION



A giant step has been taken in the U.S. military development program with contracts for the creation of an unprecedented primary strategic weapon system. It is the Air Force DYNA-SOAR, now in Phase-I design stage by a six-company project team under Martin direction.

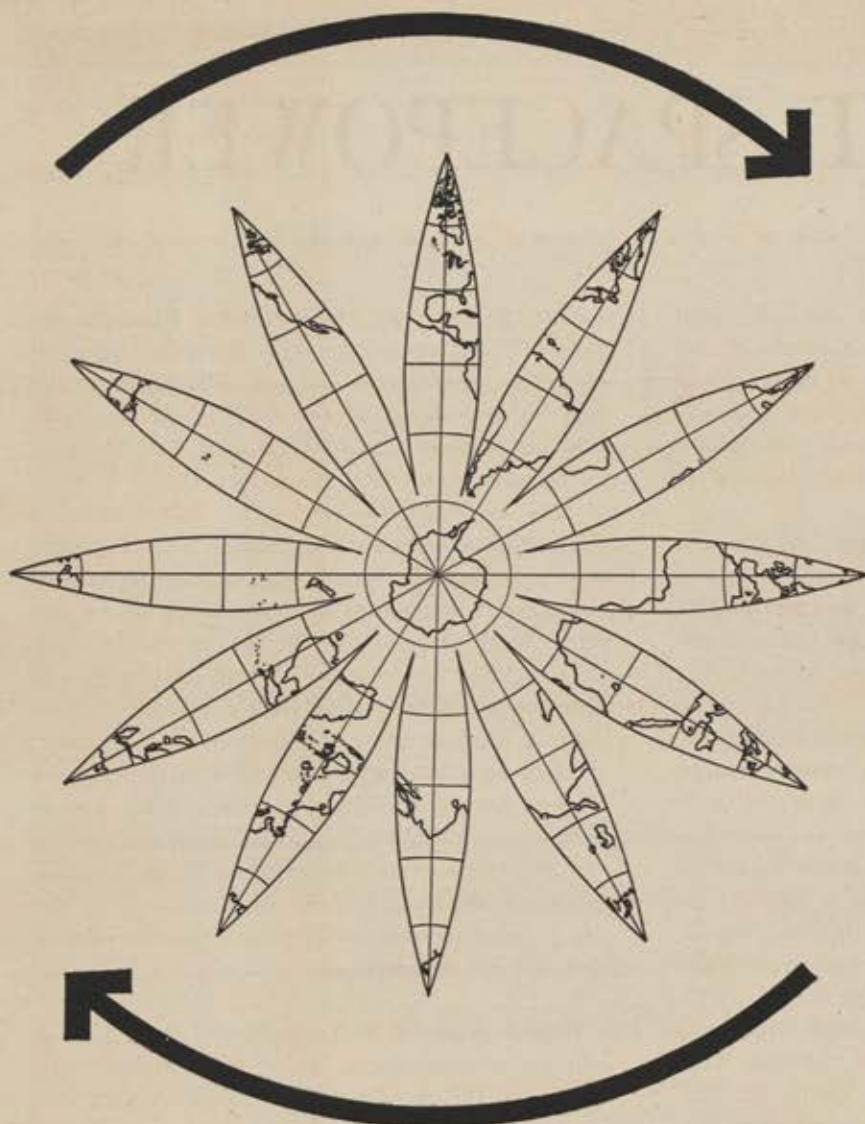
DYNA-SOAR—the most advanced military weapon system now in development—is a pilot-controlled bomber-reconnaissance space vehicle, its mission being to circle the earth at orbital velocity, with controlled aircraft landing capabilities. It will be propelled by several stages of rocket boosters, enabling it to operate from ground level to the ionosphere at hypersonic speeds.

In an entirely new and advanced concept of integrated industry coordination, the six companies teamed in this No. 1 military program constitute top capabilities in the basic areas of airframe, propulsion and radar guidance system development.

Bell, a pioneer in the boost-glide field, will design and build the airframe of the vehicle ...Bendix will develop communication, telemetry, hydraulic and electrical power conversion systems...Goodyear will produce the crew-escape capsule and the radar systems ...Minneapolis-Honeywell will be responsible for guidance and navigation to keep DYNA-SOAR on course and supply position and velocity information to the crew. American Machine & Foundry's responsibility is an advanced system of ground handling and launching equipment...And Martin will establish the configuration and design of the rocket boosters, carry out an experimental aerodynamic program for the complete vehicle, and assemble a full-scale mockup of the system.

Because of the challenging technical problems involved, the presidents of the six companies — aggregating assets of over \$2 billion — comprise an active advisory panel, with their top engineering teams participating.

Never before in military history has so formidable a task force of specialized industrial capabilities been applied against such an advanced concept.



SPACE LINES CONTINUED

A General Electric Company space engineer, Robert O. Haviland, has patented a "liquid flywheel" for controlling spacecraft in the near-vacuum of outer space where aerodynamic fins won't operate. The control device consists of a hoop-like arrangement of pipes, through which liquid is pumped at varying speeds to determine the force applied in any direction. The liquid flywheel, according to Mr. Haviland, will not only orient and guide the spaceship, but will serve as a storage area for liquids needed on the journey.

In the speculative area of readying for space travel, Dr. Blaine Levendahl, a zoologist at the University of California at Los Angeles, has suggested that it might be feasible to breed a new kind of man or animal that could breathe water or gas instead of air. Dr. Levendahl's theory is that a creature with gills or with lungs that could be even temporarily filled with water would stand a much better chance of tolerating the crushing effects of being shot into space and the pressure of return to the earth's atmosphere. The evolution of such a creature would be a kind of reversal to the forerunners of man and animals, to the gilled creatures that inhabited the waters of prehistorical earth.

Another consideration, according to Dr. Levendahl, is the development of some kind of breathing organ to enable man to stay alive in an atmosphere of ammonia or methane gas.

The National Aeronautics and Space Administration invited thirty aviation companies to a meeting in Washington early in November to arrange for bids on a US manned space capsule. Proposals are due by December 4, and the contracts are to be awarded after the first of the year. The capsule is to be designed to ensure the recovery of its occupant. It will replace the nose cone of an Atlas-D and will be launched into orbit with standard Atlas equipment for a minimum of two orbits and a maximum of twenty-eight hours. A solid-propellant escape rocket will be mounted on the forward end of the capsule. Retrorockets will reduce re-entry speed.—END

MARTIN
BALTIMORE · DENVER · ORLANDO

SOVIET SPACEPOWER

.....

The Russians continue to give out additional details on the flight of two dogs to a height of 280 miles and their successful return to earth. Their reports indicate that during blastoff the dogs exceeded their own weight by several times, and experienced the anticipated weightlessness after the engines cut out.

During free fall after reaching apogee, the rocket separated into two parts, with the nose section, containing dogs, instruments, and equipment, ejected away. Aerodynamic brakes reduced the speed of the payload as it entered the denser layers of the atmosphere.

About three miles above the earth, a small parachute brake was released; shortly afterward a large parachute went into operation, bringing the dogs back to earth.

The Russians say they launched the rocket in a well-populated area, but brought it down in an uninhabited one—which might indicate northwestern Siberia. They say they had some new infrared recording equipment in the rocket which picked up data on cosmic rays at high altitude.

The dog launchings suggest the Russians may be well ahead of the West in developing detailed subsystems and technology for carrying man into outer space. The achievement with dogs, in effect, presented problems similar to those that will be encountered in getting man safely into space and back.



Recent Russian comments on controlled thermonuclear reactions indicate quite clearly that they have known how to produce plasma jets since sometime prior to 1954; indeed, that they have understood how to regulate or control plasma jets with magnetic "plugs" since then.

They also have done work on ion propulsion. This is indicated in their nontechnical literature even more than in their technical literature to date.

Both systems could be important in working out propulsion systems to be used in outer space. Chemical or nuclear rockets would be used to launch space vehicles into orbit, but more refined equipment would be needed for controlled navigation in space.

German scientists who worked in Russia in the early 1950s report that the Russians were inclined to copy a great many of their ideas for design and production of missiles from abroad. This was particularly true of fuels and the manufacturing equipment used to produce them.

This, the Germans say, is no reflection upon Soviet theoretical capability. In fact, the Russians were excellent in theory—but lacked the experimental, developmental facilities to prove or disprove their ideas. Also, the Soviet theoreticians were inclined to work things "out on paper" and drop matters there, rather than to go on to prove them in practice and as production-ready items.

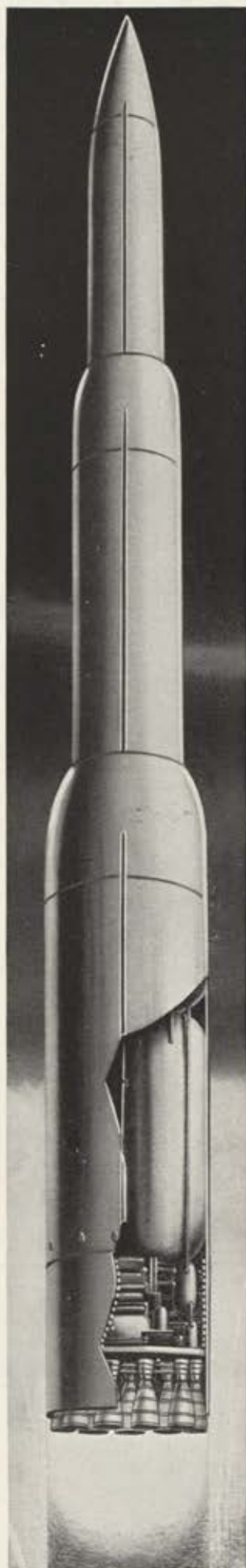
Thus, in effect those charged with the creation of new designs and materials for rockets always were somewhat out of tune with those responsible for production of such items in the USSR. This encouraged copying, at which the Russians are very adept. Similar observations have been made of Red aircraft development.

.....

It now is pretty well established that Russian military missiles come under the over-all jurisdiction of the Academy of Artillery Sciences as far as research and development are concerned. The Academy was set up in 1946, soon after the end of the war in Europe. It does some research in the field of heavy guns, but its major effort has been in rockets. There are several lesser institutes which carry out practical experimental work, including a rocket engine development center at Kuibyshev.

Two leading Soviet experts in missile technology, A. A. Blagonravov and G. I. Pokrovsky, are members. Blagonravov, who was in the US at the time of the Sputnik I launching, is president of the Academy.—END

This column is a summary of the latest available information on Soviet spacepower. 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 EDITORS



COUNT DOWN!

for the conquest of space



IS THE ROCKET ENGINE MAN'S ONLY WAY TO OUTER SPACE?

Strapped and cushioned against the relentless grip of acceleration, a man lies supine and helpless as his crew of robot devices controls the upward drive of his ship. He watches the firing seconds tick away—300...450...600—until suddenly, both sound and acceleration stop simultaneously. In that second all weight ceases.

He is in Outer Space.

The only power that can put him there today is the large rocket engine. No matter how far and how fast space travel develops, these high-thrust engines provide one basic essential—the sheer brute force that can lift a payload from the surface of the planet to the airless void outside.

Endurance for vast distances

Once space is reached, a wealth of intriguing possibilities beckons. Entirely new aspects of propulsion are being developed to maneuver ships between the moving gravi-

PACKHORSE OF SPACE. Only means to put stores or people out beyond atmosphere is the big, high-thrust rocket.

tational fields of Earth's neighbours in the solar system.

One advanced propulsion system that may be built soon is an ion rocket. This ultra-high-specific-impulse power plant provides low thrust for extended periods.



OUTWARD BOUND, man's robot reporter heads off to a rendezvous with planet Mars.

An endurance of months, or even years, is possible. Mounted in a suitable unmanned vehicle, such an interplanetary "private eye" would make the cislunar region seem like our own front yard. It could be sent off to reconnoiter the mysteries of Mars, Venus, or the Asteroid Belt.

Rockets ready today

To date, the vast bulk of successful missile and space projects in America have used Rocketdyne engines—Atlas and Thor for the Air Force, Jupiter and Redstone for the Army, the historic Explorer satellites, and the all-important first stage of the lunar probes. And Rocketdyne continues to improve the techniques of rocket engineering. High-energy fuels—storability—a full range of proven engine designs: these are some of the contributions Rocketdyne has made to weapon system operation for our nation's defense.

Million pounds of thrust

Rocketdyne is now at work on two approaches to propulsion systems that will deliver thrusts up to 1,500,000 pounds. One is a single-chambered engine, the other a grouping of engines adapted from the Thor-Jupiter engine family. From these will stem the multi-million-pound-thrust systems that are essential to launch the manned exploration of interplanetary Space.

FIRST WITH POWER
FOR OUTER SPACE

ROCKETDYNE

A Division of North American Aviation, Inc.—Canoga Park, California; Neosho, Missouri

COLLINS SYSTEMS ARE NOW IN PRODUCTION FOR (LEFT TO RIGHT) THE NAVY'S MCDONNELL F4H-1 AND CHANCE VUGHT F8U-3 FIGHTERS AND NORTH AMERICAN A3J-1 ATTACK BOMBER, AND THE AIR FORCE'S REPUBLIC F-105 FIGHTER-BOMBER.



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Collins integrated electronics systems achieve building-block flexibility through modular design of all basic units. Designed into each aircraft, a space-saving *custom* Collins system retains the economy of standardized production and simplified maintenance.

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People Helping People . . .

The Good Samaritans of SAC

Michael Gladych

THERE was a tense hush in the briefing room. Making ready for another twelve-hour, war-detering mission, the crews of the B-52 jet bombers focused on their target assignments with deadly concentration. As with every Strategic Air Command mission, this one could be the "real thing."

At the rear of the room one tail gunner fidgeted in his seat and glanced at his watch, obviously distressed. The briefing over, he sidled up to his aircraft commander. "Sir, I can't fly this mission," he blurted.

"Joe, we need you on the job," the commander said. "What's wrong?"

"My wife's going to the hospital, sir, and there's nobody to take care of our three kids. . . ."

The aircraft commander put his arm around the worried gunner. "I know your wife's going to be all right. And the kids—well, let's call the FS."

Within the hour, the gunner's wife phoned to say that an FS volunteer had just come in and taken over the family chores—bib, crib, and diaper. "Good luck on the mission, darling," she said. "We're all set at home—don't worry about a thing."

"FS" is probably the most invoked abbreviation in the Strategic Air Command. It stands for "Family Services" (formerly "Dependents Assistance")—a round-the-clock, round-the-globe volunteer help program run by the SAC airmen's wives. Each year the sixty-one FS centers on SAC bases answer some 200,000 "SOS" calls, solving a thousand and one family emergencies, boosting the morale, and generally backing the SAC job of global peace officer.

Gen. Curtis E. LeMay, the tough architect of SAC and the promoter of the FS program, and now USAF Vice Chief of Staff, says, "The welfare of the airman's family is a vital factor in the success of the SAC. Neither an officer nor an airman can perform his duty well if he is burdened with family problems."

Just in case you think the SAC men and their wives are a bunch of helpless cry babies, here's their strategic "big picture." SAC men live under incredible pressures. They train constantly for circus-team precision. They must be ready to fly at a minute's notice. And to make matters worse, they must keep up their

supersonic routine while shifting from base to base to plug the critical manpower shortages.

And the SAC wives?

"My husband is one of the 'three-headed wonders'" (a crew member trained to be an expert pilot, navigator, and bombardier), says the wife of a B-47 aircraft commander. "But I need at least three heads, two pairs of hands, and a private pipeline to Fort Knox to run my family."

She moves her home about twice a year, following her husband on his global-go. Trip expenses ruin her carefully balanced budget. The furniture is always late. "But as soon as we

(Continued on following page)



B-47 jet bomber units are sometimes away on temporary duty for three-month stretches. During that time Family Services helps "TDY widows" over "TDY blues."

arrive, I've got to find a place to live, get meals on schedule, see to the laundry, find schools for the children, and take care of the emergencies which invariably arise. And I must do everything with a big, convincing smile—I want my husband's mind free from worry when he's flying." That's where the FS comes in.

To see how the FS runs its "Back the SAC" operation, let's drop in at their Westover, Mass., AFB center where the program was first field tested. The center is located in a temporary World War II barrack doing a permanent job under a fresh coat of white paint. Inside, gay window curtains, rugs, and comfortable furniture create a relaxed atmosphere.

Four small, sleepy-eyed children slump on a couch, just in from a base-to-base trek, and their parents hopefully listen to Mrs. Pat Prosser, an FS Housing Committee worker. She pulls out a rental listing card. "I think this might suit you," she says. "Good neighborhood—close to everything and we have good reports on the landlord. Would you like to see the place?"

The father nods. The mother glances at her tired children, and Mrs. Prosser smiles with understanding. "You can leave the children at the nursery until you find a home. And before you go, why don't you all have a bite to eat at my house?"

The Housing Committee is one of the FS's busiest. Winter or summer, off-the-base rentals are either hard to find or at Palm Beach premium. But the committee members have a knack

for ferreting out what the homeless airman wants, be it a trailer, an apartment, or a house—budget-sized rent and all.

One captain hounded the civilian realtors for weeks only to conclude that there was no house in the neighborhood large enough for his family of ten. Then he came to the FS. As luck would have it, the housing files had nothing suitable either. With their reputation at stake, the committee members combed the area and in two days found exactly what the captain needed.

Finding a place is one thing, but living in it is another, especially when the furniture is late. A motel for a couple of weeks too often means financial ruin. FS volunteers, who have been through the mill themselves, have found a simple solution. Any household item donated or discarded by the SAC's global gypsies is gratefully received at the FS center and stored for emergency. Thus their stockrooms at all bases have everything from beds to baby bottles.

"Every move would cost me about \$25 a day without the FS furniture loans," says M/Sgt. Alfred H. Brown, a veteran Air Force supply man. "Last time, when we came from France, the FS saved me almost a month's pay." When he returned the borrowed items, Sergeant Brown also brought along an electric iron. "That's the interest on my loan," he said.

Perhaps even more popular than the FS real estate "brokers" is the Information and Referral Committee,



SAC wife Mrs. Dorothy Kennedy adds equipment to Family Services stockpile.

who get all the initial queries to the FS. Once, a young sergeant phoned long distance. While traveling to his new base, his car was wrecked in an accident, and his wife taken to a private hospital for a series of operations. "I need a lot of money—I'm broke—can you help me?" he asked.

"Sure can," said the FS information worker on duty, flipping through her files. "Call the Air Force Aid Society—here's the number. You'll get an interest-free loan or even a grant." Then she added thoughtfully, "Say, there's a motel five miles from where you are. An Air Force veteran owns it. I know he'll help you while you



"People helping people" headquarters at Westover. Photo was taken before name was changed to "Family Services."



SAC wives, new members of Family Services Temporary Duty Committee at Westover AFB, Mass., get briefing from Family Services officer, Capt. Catherine Cassidy (right). Soon they'll be busy helping other folks in the SAC way.

wait for the loan—we stayed there last year.”

The sergeant got a warm reception at the suggested motel and a cash grant from the Air Force Aid. Later, he wrote to the FS. “. . . my wife is joining the FS as soon as she is well. May God reward you for the quick help you gave me. . . .”

Not all queries are as dramatic. One busy morning an airman's wife called. “I'm in real trouble,” she said, slightly hysterical. “My window screen broke and the house is crawling with bugs and things. Please, do something!”

Momentarily taken aback, the information worker dryly explained the FS is not in the pest-control business. However, she did look up a number in the yellow pages. “Call Acme Exterminators,” she said. “And for goodness sakes, close that window.”

“We get all kinds of calls,” says a comely FS, Mrs. Darleen Brenner. “People want us to send a cab, ask what's for dinner at the mess hall, or if it's going to rain the next day. I try to answer them all and when I get stumped, I let Captain Cassidy take over.”

Capt. Catherine M. Cassidy, a trim-slim-and-regulations WAF, is the FS officer at Westover. Although every FS center has one such officer to help run the program Air Force fashion, many airman families around the SAC earnestly say there is no one quite like “Casey” Cassidy. For while the FS is a nerve center of the Westover self-help program, the graying, blue-eyed Casey is its heart.

“I'm tough as nails,” she warns you. “I have to be. I can't alert my Emergency Committee, for instance, unless I'm sure there is an emergency. The FS volunteers have families of their own—they can't drop everything to pull some deadbeat out of a mess.” Then she adds, “Of course, we've had



New arrival at SAC base gets counsel from Family Services representative. Information will speed his orientation.

very few of those. . . .” Then, pensively, “Well, I suppose even a dead-beat needs help.”

Around the Westover FS center they say that if Casey can't do it—it can't be done. She once even played private eye to help an airman in distress. The man, just back from temporary duty overseas, came to Casey with an unusual problem. “Captain, my wife's missing,” he said.

Calling the police right away might mean unnecessary and perhaps bad publicity, reasoned Casey. She soothed the airman, sent him home, and methodically unraveled the mystery herself. A phone call to the missing wife's parents disclosed she was not there. Another call—to the Air Force finance office—showed that the woman had just drawn her allotment check, therefore she was alive. “Where was the check cashed?” demanded Casey.

The office supplied the name of the bank. The bank, in turn, gave Casey the wife's address and a tactful inquiry by Casey's fellow FS officer on the spot located the missing wife. Apparently the woman suffered from recurring amnesia. She had started for her parents' home, lost her memory en route, and simply stayed at a

rooming house. Casey turned the information over to the husband, and the mystery was solved.

Volunteer members of the FS Office Committee work in two shifts and relieve one another throughout the month. Yet during four years at Westover, they have never missed an SOS call nor misfiled a letter. This is sometimes trying on Casey, especially when she finds a note from a volunteer clerk saying, “Remember to call the sergeant who forgot to say if he took the house he thought was too small for him.”

What you see in the FS office is only a small part of the “Back the SAC” operation. The Emergency, Publicity, Welcoming, and Casualty Committees usually take care of their own dependents at home until Casey sends an “alert” call. When that happens, the busy SAC wives rush to the rescue like a volunteer fire brigade.

Last winter an airman called the FS early one stormy morning. He had just landed, back from overseas, his seven-year-old son was running a fever, and his wife, traveling on another plane with their critically ill daughter, was delayed by the storm. The problem was to find an apartment before the wife's arrival.

Immediately, an Emergency Committee member took the small boy to her home. The Housing Committee women braved the blizzard to get to the office and stayed on the job until they found an apartment, helping furnish it from the FS stock. The Welcoming Committee traced the airman's wife's plane, met the woman upon landing, and escorted her to her new home. And still another Emergency Committee volunteer took the sick girl to the base hospital and stayed at her bedside, relieved by other volunteers, until the child recovered.

Many of the FS stay-at-home volunteers form what Casey calls a “Talent Pool.” Need a baby sitter in an emergency? A practical nurse, an expert seamstress, a driver with a car, somebody to run your home in case of sickness? Once the request passes Casey's scrutiny, the help is given instantly and with a smile, no matter how hard the task.

Says pretty, blonde Mrs. Kitty Anderson, a pilot's wife, “Hard work? Why, I think it's fun helping people—you make so many friends.”

It is not always fun. Once, when Mrs. Anderson was serving on the Casualty Committee, a plane of her husband's squadron crashed with several married crewmen on board. Kitty Anderson went to one of the widows and stayed with her until the initial

(Continued on following page)

shock was over. "Being a pilot's wife myself," she says, "I guess I was able to give her more understanding than even her relatives."

Fortunately, SAC units have a good safety record and casualties are rare. However, there are other, far more numerous "casualties"—the so-called "TDY widows"—and a TDY Committee of the FS helps them over the "TDY blues."

Westover and other B-52 bases have little TDY (temporary duty) troubles. The problems are with the shorter-range B-47 jet bomber units that jump from their home bases to some strategic spot overseas and stay there for three months at a stretch, bag and baggage. When that happens, the local FS center's TDY Committee is the busiest on the base.

"Seeing the crews off is no problem," explains Lt. Allan C. Klepper, the FS officer at Pease, N. H., AFB. "But when the squadrons come back, this place is worse than Grand Central Station and Idlewild Airport put together."

All the dependents—some of them in diapers—want to greet their men. And hours before the scheduled arrival of the planes, Mrs. Jean Carson, the TDY Committee Chairman, and her fellow workers start preparations. The base Special Services lounge is taken over as a waiting room. Since the planes may be delayed, there are free refreshments—cakes, sandwiches, and orangeade.

On a large blackboard Lieutenant Klepper prints the estimated times of arrival and the unit numbers, erases them as there are delays and writes in new figures, keeping his fingers crossed. As a rule, the waiting period takes only a few hours, but sometimes it may be an overnight vigil or even longer.

A few weeks ago, for example, the planes expected early in the evening did not land until the following morning. Mrs. Carson stayed on the job until 3 a.m. chatting with the TDY widows, trying to keep everybody happy and comfortable. And Lieutenant Klepper just shuttled between his office phone and the blackboard all night long.

"Of course, all the dependents have to be notified seventy-two hours in advance," says Lieutenant Klepper. "The TDY Committee keeps lists of addresses and we mail post cards by the ton and phone wives living close to the base."

Although the mailing lists are carefully kept, sometimes there is trouble. "Once a wife called me about the



Two SAC ladies devote spare time to helping out with the numerous clerical chores at the Family Services office.

plane's arrival time and I gave her the information," says Lieutenant Klepper. "Later, the wife called again—at least, I thought it was the same woman. But when the plane landed, the airman's wife and his girl friend greeted the returning hero. You should have seen the feathers fly!"

During the three months TDY period things are reasonably quiet, except for occasional SOS calls from the TDY widows. "They hate to bother us," explains Mrs. Charles Wimberly, the wife of the 100th Wing Deputy Commander at Pease AFB. "But I know what it can be like—you get a couple of flat tires, you lock the car keys inside—the furnace goes on the blink and the kids get the measles—no major crises—just an accumulation of small things. You feel helpless and alone, you need a shoulder to cry on. And who could understand your problems better than another SAC wife?"

"We're not trying to pamper the wives of the SAC," adds Mrs. Wimberly, a veteran SAC wife herself. "We are teaching them to be self-sufficient, to run their families alone if need be, and to help their husbands do their job well."

The FS has its own training program—an Orientation Course where the SAC wives learn about the Air Force benefits, services, and facilities, including the Family Services itself. Some of the wives attending the course volunteer for the FS work, in which case they receive further, specialized training in various committees.

This is the usual way the FS gets its tireless workers, although some wives join in another way. "SAC life is tough on new Air Force wives,"

says Casey Cassidy. "Very often they come to the center distraught and bewildered. Well, there's no better way of forgetting your own troubles than to learn about the troubles of others. So, we put them to work here until their 'SAC shock' is over. Of course, many of them stay on."

With most of the SAC men married, the high pressure of SAC life took a heavy toll in pre-FS days. Many of the SAC wives cracked under the strain and the divorce rate soared over the national average of 2.3 percent. Naturally, the morale of SAC warriors suffered.

Other SAC-weary wives drew their husbands out of the SAC toward more stable civilian jobs. The result—SAC no sooner trained a man than it lost him. "It was a critical manpower problem with the power of the women at the bottom of it," says a SAC personnel expert.

General LeMay, then the boss of SAC, recognized the ticklish situation and he called upon his wife to help. Mrs. LeMay traveled the SAC bases, talked to the wives, and came home with a solution. The FS program was born and in the four years of its busy life the FS volunteers have changed the sad SAC situation. Last year the SAC divorce rate dropped to one percent—less than half the national figure. And within the past three years SAC's reenlistment rate has increased by almost twenty percent.

Naturally, the FS is not the only factor responsible for the improvement. But both the top brass and the lowliest airmen give the FS a lion's share of credit.

One veteran FS, Peggy Wooten, wife of Westover's Base Commander, Col. Edward Wooten, believes the FS concept should be expanded. "I think the whole world needs a sort of FS program where people would sacrifice to help the less fortunate ones in the true Christian spirit," says petite Peggy Wooten.

The Westover Base Commander agrees. "The FS is probably the only outfit in the SAC that has no manpower problems," says Colonel Wooten. "But more woman-power to it—God and General LeMay know we need its support."—END

Michael Gladych needs little or no introduction to readers, so many of whom have enjoyed his warm accounts of the devoted efforts of the unsung people in unheralded places who make up the US Air Force.

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Realism, down to the last detail, features Revell's

Make-Believe AIR FORCE

Marvin Miles



Aerospace engineer, left, Krafft Ehrlicke of Convair-Astronautics, checks details on Revell's first experimental model of his Helios space vehicle with Jack Rehman, of Revell's research section.

IN THE last few years, millions of USAF planes have been built in basements and living rooms of American homes. In the next year or so more millions of rockets and missiles will be assembled by the same builders.

These aircraft and space weapons are made of plastic; they come in scale-model kits, ready for the model builders to put them together. Though poised for flight, the planes don't really get off the ground, nor do the rockets blast into space except in the imaginations of their builders. But they do have other uses—for education, for relaxation, for military training, for scientific research, even in

wind-tunnel experiments, and, of course, for fun. And they're in demand by all branches of the armed services, by the State Department, US Information Service, by museums, schools, and hospitals—and by young and adult hobbyists everywhere.

As a result the jet age and the dawning space age have become more meaningful to uncounted thousands to whom otherwise a jet might have been only a contrail high overhead and a rocket, a colorful addition to a Fourth of July celebration.

Man has built scale models ever since he learned to use tools. But with recent developments in plastics and advanced technology, modelmaking



As many as 800 man-hours can go into perfection of Revell models. Here modelmaker works on Convair F-102 replica.



After handmade model is approved, steel molds are cut. This moldmaker duo is inspecting Revell ship model.



How realistic can you get? This is a Revell model of Lockheed's F-104 streaking across a photo backdrop of sea and sky.

has become big business. Lewis H. Glaser, president of Revell, Inc., Venice, Calif., the world's largest producers of plastic scale-model kits, says that today his company turns out more than 30,000,000 units a year, approximately half the entire industry's production.

This is quite a jump from 1950 when Revell produced its first scale-model plastic kits, old-time cars, primarily to satisfy those model builders who hadn't the time or skill to make balsa-wood models. The extraordinary detail possible in a plastic kit and the ease with which these models can be

assembled sparked the imagination of large numbers of people who take as much satisfaction in assembling these models as master craftsmen may derive from creating the most intricate miniature.

But in 1950 not even Glaser realized
(Continued on page 117)



When steel mold is finished, it is placed into injection molding machine into which plastic is poured for production.



These nimble-fingered ladies perform intricate job of assembling display models of what Revell kits will build.




 A B-52 is rolled into its spacious, well-illuminated maintenance dock.

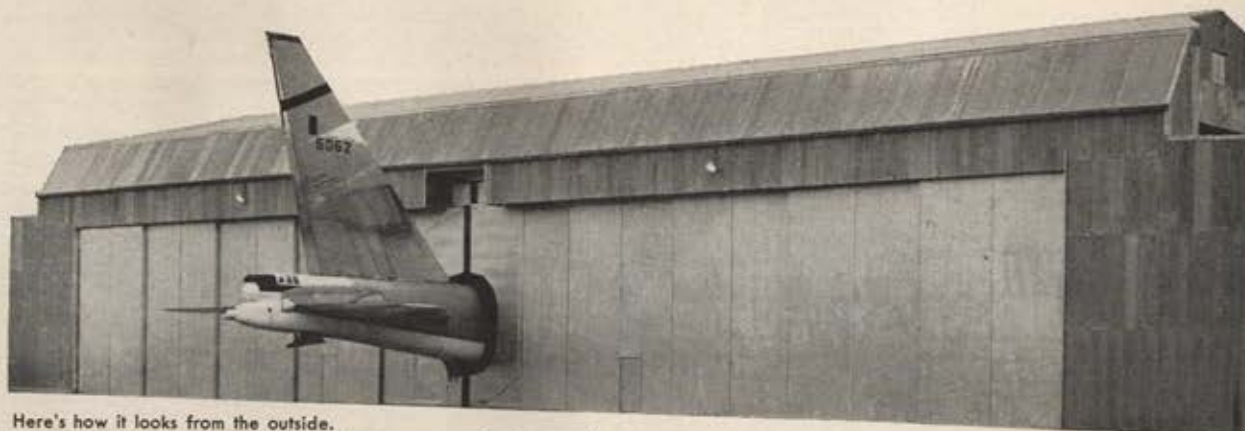
Specially designed platforms are positioned and work gets under way.
 

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The "family" we refer to is that of today's operational aircraft, such as the B-52, C-124, C-133 and the KC-135. Their tenancy in Luria-designed and constructed maintenance buildings is brief. This is due, to a great extent, to the improved working conditions provided by the new buildings and the Luria-designed work platforms which make air-

craft engines and systems more easily accessible. This structure is representative of many similar types evolved and built by Luria working closely with the Air Force over a period of several years. By increasing maintenance efficiency, Luria aids in keeping our defense aircraft operational. Luria is proud of its role in the nation's defense.



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the potential of these kits. Since then, teachers and others have discovered the value of scale-model kits as "three-dimensional textbooks."

"I am pretty sure that building models helped me make up my mind in a big way to take up aviation," says Tony Levier, Director of Flying Operations, Lockheed Aircraft Company. "It was more than a hobby with me. It was, I guess, a kid's way of life. But I must say I learned a great deal from these models, knowledge which even today I still retain."

And a survey by Vice Adm. Harold M. Martin, USN (Ret.), indicated that a majority of today's naval air cadets were influenced by modelmaking.

In schools across the country, youngsters, familiar with planes as a result of assembling model kits as well as from the information on the accompanying instruction sheets, are usually several Mach numbers ahead of their teachers when it comes to space age knowledge. A Lincoln, Neb., school superintendent, Stephen N. Watkins, says that many school systems now recognize the need to develop an understanding of the implications of aviation. Toward that goal, model kits are now coming to the aid of the teachers.

This past summer, thousands of teachers attending Aviation Education Workshops sponsored by the Civil Air Patrol, the US Air Force, and leading educational institutions, used model kits as part of programs to familiarize teachers with the fundamentals of the space age. An Aviation Education Workshop at Los Angeles State College resulted in the California State Department of Education's recommending the use of model kits throughout the state educational system. Similar findings are being made in other areas of the country.

The studies indicate that although the solid model familiar in audio-visual education serves a useful purpose, the scale-model kit which requires assembly has distinct advantages. It compels the student to concentrate on his subject and thus absorb knowledge. And, at the same time, it provides satisfaction he cannot gain by merely looking at a solid model.

Recommendations also are being made for the use of aircraft models in social studies and political science, as well as in geography, history, and even mathematics classes, as a means of dramatizing the changing environmental conditions being brought about by these new forms of propulsion and travel.

Modern model kits are amazingly authentic. Such organizations as Ramo-Wooldridge have found models to be accurate enough to be used in experimental work. From the Air University's Air Force Institute of Technology, Capt. Arnim Brantley and David Hall report that Revell's ninety-eight-cent F-104A models used in wind-tunnel experiments perform as well as the formerly used handmade models, which cost many hundreds of dollars. Harold C. Larsen, head of the Department of Aeronautical Engineering of the same institute, believes that the models can be used for complete stability testing in classroom instruction.

Model airplane and shipbuilding contests for youngsters, designed to increase their knowledge of the military services, have been successfully conducted by military recruiters in many parts of the country. Recruiters also use models to explain to prospective servicemen the various types of equipment used in different operations, their prime task, and the duties of the men serving them.

Hospitals find definite therapeutic value in these kits. Veterans at the Hines Veterans' Hospital, near Chicago, put together more than 100 models of airplanes, which they presented to the Air Force for its school program. At the 3275th USAF Hospital, Parks AFB, Calif., neuro-psychiatric and restricted bed patients assemble airplane models as do ambulant convalescents. One physician, who is not connected with the military, uses prescription forms to order kits

for his patients, for relaxation purposes.

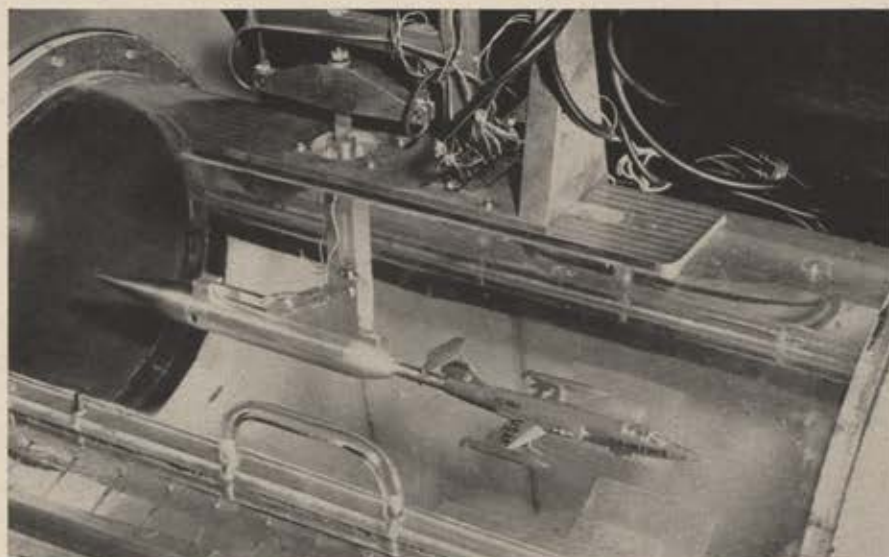
Commercial airlines and shipping companies believe model kits are important factors in bringing their story to the public. Companies such as American Airlines, United Air Lines, Eastern Air Lines, Fairchild Aviation, Moore-McCormack, and the United States Lines contribute to the tool-and-die costs in order to have the models bear their names. The use of these kits as an advertising medium is appreciated when you realize that the average model kit sells over a million units—with no great lessening of sales as time goes by.

All these uses of model kits, as well as others, are, however, by-products of their main purpose. Today the assembling and collecting of scale-model kits is the top hobby among youngsters, replacing even stamp collecting. A survey made by a leading boys' magazine shows that an estimated eighty percent of the nation's youngsters between the ages of ten to fifteen participate in modelmaking, building from three to five models a year.

Deciding which models to produce is not an easy task for a company such as Revell. Thousands of suggestions are received, many from veterans and members of the armed forces. They feel, some quite strongly, that a kit should be made of the particular plane they fly, or ship or tank they serve on.

"We sympathize with these people," says Revell president Glaser, "because we understand how gratifying it must

(Continued on following page)



Models do more than just provide fun for building enthusiasts. They also help cut costs in the expensive test process for today's aircraft. Here a Revell F-104A model undergoes wind-tunnel tests at USAF's Institute of Technology Lab.



Model building is a "natural" for aerospace education. Here youngsters at a Los Angeles school have fun, learn about flight by assembling Revell kits.

be for a man to be able to build a model of something so important to him. Unfortunately, though, we must limit ourselves to what we can develop, about fifty to sixty new models per year. And when you bear in mind that the initiating cost of any kit might well run from \$50,000 to \$75,000, it is understandable that we must move quite carefully."

"A hobby kit," Glaser explains, "must provide a model that is as nearly perfect as possible. It must present a challenge, lest it become frustrating work, yet must not be difficult to assemble. It should have significance, either historical or of news value."

The tedious labor once required in model building has been reduced to the point where authentic models can now be assembled in a matter of hours. It takes about two hours to put together a jet fighter and seventy-two hours for a full-rigged sailing ship.

Engineering and market research are constant factors with model companies in an effort to anticipate demand as much as possible. At Revell about thirty new products are always in the research stage and it takes an average of eight to nine months to produce the tools and dies for a model.

Occasionally the selection process produces amusing sidelights. An Air Force major with the 962d Airborne Early Warning & Control Squadron barraged Revell with demands that it produce an RC-121C radar Super Constellation kit. The major was happy to find that this plane was already on the drawing board, but he insisted on having a running commentary on how it was coming along and its estimated date of arrival.

At length, the kit reached the market, and soon afterward the major blew his top. Revell researchers had decided that the radar plane should bear Navy decals, and, to the Air Force stalwart, this was treason! Furthermore, he argued, the Revell model was inaccurate!

Then it was the Revell researchers turn to blow *their* tops. To them "inaccuracy" is a fighting word. They answered the major, point by point. In a few days Revell received an apology. "I am amazed," the major wrote, "that pilots, myself included, who have flown this airplane thousands of hours didn't know the correct number of windows on the right side."

But despite the Navy-marked Super Connie, Revell's line can hardly be said to discriminate against the Air Force. It includes most of the operational Air Force aircraft now in use—planes of the Strategic Air Command, Tactical Air Command, Air Defense Command, Air Rescue units—as well as many of the Air Force's space weapons.

Product decisions are based on extensive analysis, consumer suggestions, and news impact. Although at present aircraft, particularly jets, hold the edge in consumer interest, missiles and space vehicles are coming along with a rush.

Government decisions are a big factor. If the Department of Defense orders a go-ahead, Revell pushes its plans apace. Its researchers strive to anticipate which experimental projects will become operational. Their guesses have been relatively good. But on one occasion tooling had already started on a missile kit when the project was

abandoned in Washington. Thousands of dollars of work was shelved in Venice.

To assure the utmost authenticity, blueprints as well as other technical information are obtained from either the prime contractors or from government bureaus as soon as declassified. Extensive engineering research and skilled craftsmanship are required before the initial handmade prototype model can be completed. During this time, the blueprints and the various steps in modeling are checked for accuracy, whenever possible by engineers or designers of the prime contractor of the original project.

When the scale model checks out, it is broken down into components to be redesigned for kit production. Steel dies are made for injection molding machines to form the hot plastic and turn out a complete, many-part kit—some in multicolor—in a twenty- to twenty-six-second operation.

Sometimes a crash program is able to get a new model into production in six or seven months instead of the usual ten to twelve. Models frequently are planned piece by piece, with secret sections of new weapons or conformation added and refined as information is declassified.

Obtaining plans of Russian equipment, for which there is a demand, is extremely difficult. When Revell decided to produce a model of the Russian T-4 tank, plans simply were not available. However, the Israeli army captured some of these Soviet-built tanks from the Egyptians during the Sinai peninsula campaign, and the cables grew hot between Venice and Tel Aviv. Finally the ordnance branch of the Israeli army agreed to measure and photograph one of the captured tanks. Eight months later, the T-4 model was on the market.

Meanwhile, reports from Russia indicate the extensive use of models in the Soviet educational system. But in the field of scale models, there is little doubt that the youth of America are far ahead. In the US model kits may one day be as common in schools as blackboards and textbooks, helping prepare the boys and girls who will guide this nation's destiny in the Age of Space.—END

ABOUT THE AUTHOR

A native of Los Angeles, Marvin Miles became aviation editor of the Los Angeles Times in 1941. A World War II naval veteran, he has covered most of the important aerospace stories of the last two decades. His "beat" now includes space technology.



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The READY ROOM

RESERVE AND AIR GUARD NEWS

An important resolution affecting the Air Reserve Forces was adopted by the Air Force Association at its recent Dallas Convention. In drafting this resolution, the delegates emphasized their grave concern for our national defense and underscored the fact that airlift is a vital factor to our national defense. Pointing out that our relationship with nations to which we are bound by mutual defense pacts depends partly on our airlift capabilities and that our Air Reserve Forces are capable of assuming greater airlift responsibilities than at present while the Civil Reserve Air Fleet alone is not capable of adequately supplementing our cargo airlift requirements in an emergency, the delegates directed AFA to urge the modernization of MATS with jet transports and turboprop cargo airlift consistent with military objectives, and that the Air Reserve and the Air National Guard be equipped with modern transport aircraft as rapidly as such aircraft can be made available. This resolution now is undergoing a thorough study by the Department of the Air Force.

Other resolutions having to do with Reserve Forces that were adopted in Dallas included:

- A directive to the AFA President and Board of Directors to take immediate, positive action to advise DOD of the urgency of presenting to Congress this year an All-Service Bill to amend ROPA.

- That AFA recommend to the Air Force and the Congress that the Executive for Reserve Affairs and staff positions under these offices at USAF Headquarters and CONAC be filled by Reserve officers called to active duty for four-year tours for the express purpose of serving in these positions.

- That AFA urge the new Congress to " earmark " all Reserve Forces appropriations to ensure that they be used for no other purpose than support, maintenance, and operation of the Reserve Forces.

- That AFA petition the Department of Defense to remove present restrictions and drill pay ceilings and that all qualified individuals in the augmented forces along with program units of the Air Reserve Forces program be paid for inactive-duty training.

About 250 Air Force Reserve, Air National Guard, and Civil Air Patrol leaders attended a Reserve Forces Seminar in the Pentagon on November 7. This was the first of an annual series of programs designed to inform key members of the Reserve Forces of the objectives, plans, and programs of the Air Force.

At the seminar Gen. Thomas D. White, USAF Chief of Staff, described the United States Air Force as probably the largest business in existence, with operations virtually all over the face of the globe. He told the gathering that as veterans of prior service, as civil leaders in communities, and by virtue of Reserve and auxiliary affiliations, they were "the representatives of our preferred stockholders." He added, "The success of our operation is not judged by the size of annual dividends paid, but by the proficiency and readiness achieved toward fulfilling the Air Force's sole purpose for existing, to serve as a member of the defense team in carrying out national policy."

Gen. Curtis E. LeMay, Vice Chief of Staff of the USAF, encouraged the group to keep the public informed of the many activities that go to make up an Air Force of highly qualified professional people, whose dedication to their job and their country is the primary mark of their work.

Another principal speaker, Lt. Gen. Emmett O'Donnell,

Jr., Deputy Chief of Staff, Personnel, informed the seminar audience that the problem of keeping people in the service, which has plagued the Air Force since World War II, is being overcome. He declared, "This year we are beginning to get retention—in some areas very good retention—and in almost all areas better retention. Retention is up enough that we need no longer aim in desperation at bulk manpower. . . . We can afford to pick and choose, to turn down those who can't handle the job the way we think we want it handled. . . . In short, where you have heard us talk about retention as the number-one problem, we will in the future be talking about selective retention and quality control."

The agenda for the seminar included a powerful backup of speakers on behalf of the Air Force in addition to Generals White, LeMay, and O'Donnell. Others who spoke



Prior to his Seminar appearance, General White had addressed fall meeting of Air Reserve Policy Committee, which will hold its spring meet at World Congress of Flight.

before the group were: Lt. Gen. Dean C. Strother, Deputy Chief of Staff, Operations; Lt. Gen. John K. Gerhart, Deputy Chief of Staff, Plans and Programs; Lt. Gen. Roscoe C. Wilson, Deputy Chief of Staff, Development; Lt. Gen. Manuel J. Asensio, Comptroller of the Air Force; Lt. Gen. Clarence S. Irvine, Deputy Chief of Staff, Materiel; Maj. Gen. William P. Fisher, Director of Legislative Liaison; and the moderator for the seminar, Maj. Gen. Richard A. Grussendorf, Assistant Chief of Staff for Reserve Forces.

The reorganization of the Office, Assistant Chief of Staff for Reserve Forces, which received the Chief of Staff's approval on October 22, will have the following impact: The restatement of responsibilities provided by the new charter puts the Assistant Chief of Staff for Reserve Forces in a position of authority for surveillance over and guidance of Air Reserve Forces and assures alignment with Air Force objectives. It provides a linkage with the National Guard Bureau. It complies with a long-standing request by the Air Force Reservists for an office in the Air Staff responsible solely for the Air Force Reserve.

"The ISO and the Changing Air Force" was spotlighted by the 9215th Air Reserve Squadron during its Fourth Annual Information Seminar at the Hotel Manhattan, New York City, last month. More than 200 conferees representing the Air Force active-duty and Reserve components

(Continued on page 122)

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THE READY ROOM

attended the special events which featured lectures and panel discussions by outstanding personalities in the news media and public relations fields.

Continental Air Command observes its tenth anniversary during this first week of December. It will highlight its Decade of Readiness observances through a series of open houses at Air Reserve Forces installations throughout the country on Sunday, December 7, Pearl Harbor Day. The theme of the celebrations will be the "Ready Reserve." The Air National Guard has joined in commemorating CONAC's birthday by urging the Adjutants General of the various states and territories to participate in open-



ANG's continuing contributions are underscored by missions like the mercy flight pictured. Korean War vet Rudolph Miller was transported to a VA Hospital nearer home by New York ANG's 106th Aeromedical Transport Group. Checking her patient is AF nurse Capt. Norma Parsons.

house festivities. The purpose of the celebrations is to publicize the missions and capabilities of the Air Reserve.

CONAC has advised that December 7 will be a regularly scheduled unit training assembly for all members of Category A units. It will also be a voluntary training date for all units of the Individual Reserve Program. Reservists participating will be awarded training points for retirement, but will not receive pay. It will be an additional training period and will not be a substitute period for regularly scheduled periods.

Monthly themes will highlight a program of planned promotions for Reserve units throughout the United States. CONAC began this series of "months" in November, which was labeled Family Support Month. The Air Reserve Forces are currently celebrating CONAC's Tenth Anniversary Month. February will be highlighted as Business and Industry Month, and April has been scheduled as Recruiting Month. Commanders of Reserve units will receive Reserve Motivational Newsletters outlining the promotional kickoff for each programmed month far enough in advance for plans and coordination of special activities.

The Air National Guard Council of the Air Force Association, under the leadership of Chairman Bob Campbell, will attend as a body the Air Warfare Systems Orientation Course at the Air Command and Staff College in January.

The Distinguished Flying Cross has been awarded posthumously to Capt. John T. Ferrier. Captain Ferrier, who flew with Colorado's Minute Men jet-precision team, was killed during an air show at Wright-Patterson AFB on June 7, 1958. Disobeying instructions to abandon the air-

craft, he flew his crippled jet into an open field rather than risk crashing it in an area of closely packed homes.

M-Day capabilities of the Air Reserve Forces will be dramatized in a thirteen-and-half-minute, full-color motion picture. Air Force Photographic and Charting Service has scheduled production within the next few months. The film will feature such actual Air Force Reserve and Air National Guard missions as troop and cargo drops, air defense, and similar activities. Training at Air Reserve Centers and activities of M-Day assignees will be depicted. Air Reserve and Air Guard units will be advised if and when it will be necessary to shoot film at their locations.

A limited number of college graduates will be offered Air Force commissions as second lieutenants under a new program. Inactive and active-duty airmen with accredited college or university degrees, as well as civilian graduates, may apply. The new Officer Training School program will be used to fill specialized officer shortages and furnish needed officers to meet requirements received on short notice. Accepted applicants must complete a three-month training course at Lackland AFB, Tex., and the first students are scheduled to begin training in November 1959. Following completion of the course, they will be commissioned Air Force Reserve second lieutenants. Applications will not be accepted until after April 1, 1959. Airmen—active and inactive—should apply through their respective AF channels. Civilian applicants will be able to apply through AF Recruiting Offices.

Medical Reserve officers in many cases may now serve in a Reserve status at a USAF medical facility convenient to them. Consultant visits by Air Force Reserve doctors are considered an authorized training period for individual training in accordance with paragraph 8A, AFR 45-15.

The mission of four Air National Guard wings was changed from air defense to tactical fighter on November 10. The four wings transferred to TAC are: 102d Tactical Fighter Wing, Boston, Mass., with squadrons in Massachusetts and Connecticut; 107th Tactical Fighter Wing, Niagara Falls, N. Y., with squadrons in New York State; 113th Tactical Fighter Wing,

Washington, D. C., with squadrons in Washington, Maryland, Delaware, and West Virginia; and the 146th Tactical Fighter Wing, Van Nuys, Calif.

To date twelve ANG wings have been marked for assignment to TAC and twelve to Air Defense Command, although ADC continues to have first call on the ANG in event of an attack upon the US.

Qualified Air Reserve and Air National Guard pilots and navigators

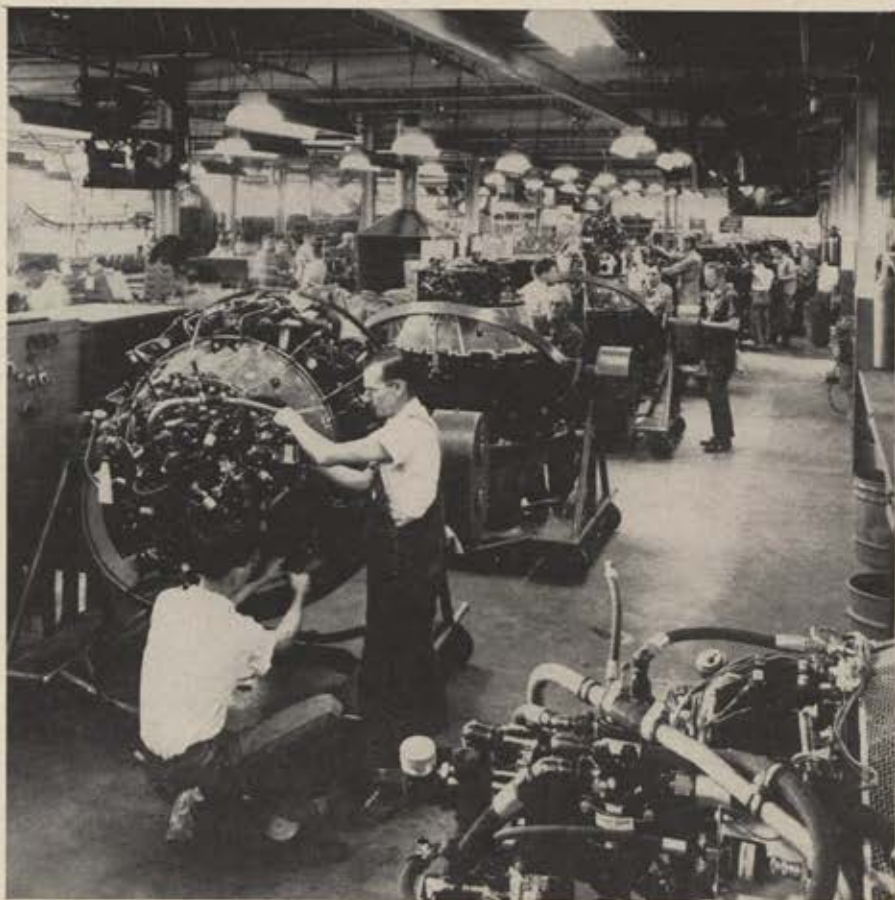
with B-52, B-47, KC-135, and KC-97 experience are still being sought under the recall program being pushed by the Strategic Air Command. Forty-two company graders were recently recalled for duty with SAC units.

Arizona's reelected Sen. Barry Goldwater, an Air Force Reservist, last month received his diploma from the Air War College after completing the College's correspondence course.

—BY THE STAFF

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THE almost unanimous retention rate, loyalty, and ambition for Air Force careers that spark the graduates of the USAF Officer Candidate School at Lackland AFB, Tex., are of the highest significance to tomorrow's aerospace arm. Here is the crucible in which sergeants are transformed into officers, where non-coms who enter with ambition leave with a sense of responsibility that surpasses any previous experience.

What is USAF OSC-1958-like, in this second year of the space age?

The course gives each officer candidate general training for his career in the Air Force, but does not try to create specialists. That is left to the advanced and technical schools which are the next stop for each student. This is a change from the original concept of OCS. The first students, nearly twenty years ago, were taught enough about supply, administration, and operations for a hard-pressed and brash Army Air Corps to assign them to duty almost immediately. But nowadays each service task calls for a higher degree of knowledge and

training. This is provided for the student at the specialized school, leaving to OCS the sole task—rather specialized in itself today—of developing leadership and maturity in each candidate.

What the Air Force needs from OCS are: Indoctrination of an officer candidate in the traditions of the service; a strong general background of knowledge of items ranging from the geopolitics of Russia to appreciation of financial responsibility; and a solid physical and military proficiency.

Even now, the OCS curriculum relies more on such familiar courses as physical training and obstacle courses than the old grad might suspect. And it includes some courses the old grad wouldn't expect at all.

Communicative skills, for instance. The present curriculum includes more hours of training in this field—107 hours—than in any other branch of study, including drill and ceremonies—to which are allotted ninety-eight hours.

Why? Continuing reports and surveys of the needs of the Air Force—

and the deficiencies ascribed to some of its present-day officer personnel—indicate that OCS should stress officer ability to pass along to others the information obtained on flight missions, on reconnaissance, at briefings, and at meetings.

Class time on communicative skills starts with a basic course in English and works up to staff studies. For some that's easy. O/C Doris Young of Seattle, who majored in English in college for two years, wasn't troubled at all. But Waldean Deines of Denver, who spent six and one-half years repairing, maintaining, and inspecting radar sets before OCS, reports, "The hardest subject for people like me is communicative skills." Concentration and application ease the path to the new skills.

During discussions of geopolitics the students argue about the roles of Asia, Africa, the United States, and the UN in international affairs and world trade. They discuss the political philosophies of the countries of Europe, what they appear to offer to their people, and wherein they fail.

"So you're at **OCS** now..."

Louis Alexander





In class, OCS personnel learn intricacies of today's geopolitics, vital knowledge in planning successful missions.



As always, inspection is extremely important measurement of officer potential. Here candidates get the "close look."

The Russian-and-Communism phase is prefaced by a short course—refresher to some, brand new to others—in American history, the Constitution, and the United States' position in world affairs. In all, the students spend ninety hours of class time learning about the world and its politics.

After the students are introduced to the concept of weapon systems, they deal with problems such as:

Given a wing of fifty-three B-47s and a squadron of sixteen KB-50 tankers, from bases in England, bomb the missile launching sites, major airfields, and industrial complexes of Russia and get as many planes and men back to NATO territory as possible.

One student becomes weather officer, another refueling officer, another wing commander. For two weeks they research each phase of the problem and hold staff meetings in class to discuss the various solutions. In these meetings they discover how military problems are interrelated.

"I can't make any estimates on refueling," the student refueling officer says, "until I know our route. Once the route is set I'll arrange a rendezvous point that the B-47s can reach, and load the tankers with fuel to feed each of the bombers enough to return to England."

Choice of a route, he sees, hinges on whether it is more important to delay radar detection by flying down the Baltic Sea, or to save fuel by following a direct route from England over northern Germany and Poland. The choice of a route can depend on other factors, too—the political feelings of the people over whose heads you are going to fly. Estimates on assistance to downed flyers in emergency are significant, too.

If anyone ever has to bomb the Soviets, the bomber stream will probably include a mixed force of missiles

and planes. OCS students get an insight into the nature of the problem—and also the value of deterrent power as they plan their "mission."

Military drill is an essential part of the training, too, as are exercises in voice and command. Any group of three people or more going together from one place to another becomes a marching formation. The OCS formations are among the few places where men and women members of the Air Force march together. Incidentally, the women report that although the thirty-inch step is a standard measurement, the masculine concept of it usually causes female ranks to fall a little behind the ranks of men, making the formation a little uneven. Maybe the female concept of the thirty-inch is just different.

The transformation of an enlisted man into an officer is probably most obvious in such activities as the above. During formations he has, at times, full charge of a large marching unit. There is no one actually in command over him. In such a situation the student gets a sudden, and concrete, realization of what command and responsibility means.

"When I was a tech sergeant," as one OCS candidate puts it, "I only had to think up. I just had to please my officer. But now I'm learning to think up and down, like an officer. I'm learning to take responsibility, whether I win a popularity contest or not."

The demerit system works to train an incipient officer in thinking both up and down. Upper classmen issue demerits to lower classmen. And the instructors leave that chore to the upper classmen, whenever possible. Meanwhile, they concentrate on disciplining the upper class.

One lecture that surprises students (and new instructors, too) is the hour of explanation about what happens when a man signs a check, the nature

of his financial responsibility, and what happens when a man's bank account doesn't measure up to either his sense of responsibility or the amount he has drawn upon it by check. Like voice and command, learning financial responsibility is part of becoming an officer.

"I wish I had had something like that when I was going through West Point," comments one instructor.

The lectures on financial responsibility also include a brief introduction to wills, insurance, and budgeting. A career officer will eventually acquire a financial estate, and it is for the good of the Air Force as well as for his own good that he know how to manage it wisely.

Disturbed by the defections and "brainwashings" of the Korean War, the Air Force has injected more history, more about democracy, and much about the proper conduct of a prisoner into courses at OCS. Besides discussing the Uniform Code of Military Justice and the ethics of an officer, the students learn the new post-Korean Code of Conduct.

To find out who are the real leaders among these future leaders, and who are the cautious, the brash, or the crafty, OCS has put a little extra zing into the obstacle course.

Near the end of the training, each group of O/Cs runs through a series of construction nightmares that would have been called an "obstacle course" in World War II and Korean War days. But the real obstacles here are not the wood-and-rope structures. The real obstacles are psychological.

Students must run up the side of a low wall and leap blindly into a pit without wavering. They must swing on a lopsided, low trapeze until they can spread-eagle themselves and fall flat, nose down, into a bed of sawdust. It takes neat timing, and a little on-the-spot self examination.

(Continued on following page)

Their feelings, as well as their physical coordination, are involved as they climb a tower and descend, level by level, by hanging from a bar swinging out into space until they can swing back onto the next floor a few feet below.

As the tactical officers of the faculty observe each group of students, they clearly see leaders emerging. And, by the time the candidates have stepped off a variety of high supports onto uncertain footings below, they not only have confidence that will serve them in good stead later, they radiate it.

With this background of physical training, leadership training, geopolitics, and communicative skills, the candidates are equipped to get the most out of the eighty-four class hours they spend studying the structure and organization of the Air Force and the eighty-six hours of Air Force history.

School Commandant Col. M. C. Barnard reports that there is a move within the Air Force to require officer candidates to *qualify* themselves with each weapon that they study. Up to the present they have been required only to become *familiar* with the weapons. This is in line with the trend toward making training more realistic, the commandant suggests. He points out that the Army requires each officer to become qualified with each weapon, as do the Marines.

Another *must* for each officer candidate is attendance at a church of his choice. OCS policy makers believe that the habit maintained (or formed) during the critical weeks of school will hang on more strongly afterward.

This highlights a newer side of the OCS curriculum—adjustment to society. Policy makers for the school believe that career officers will never have a better time to learn how to get along as members of American communities than they have in OCS. The public judges the Air Force by the officers who represent it. Air Force officers should be equipped to make the contributions to the community that responsible citizens are capable of.

Many young men and women learn at college the attitudes and background information that result in their participation in community affairs. For many Air Force officers OCS is the nearest thing to college they will ever get, Colonel Barnard points out. The social part was devised to prepare each of them to take his place in American society as an officer and a gentleman.

Every candidate takes part in club activities. He attends social events devised and graded to prepare him—just as surely as leadership courses and voice and command drill—for a long career.

Some dances, for example, include a reception line through which the student must progress. On two nights a week he must take part in a club activity. Members of the Book Club make reports on what they have read—usually from the Air Force Officers Reading Guide. Members of the Industrial Arts Club use the woodworking machines to shape out signs for the OCS buildings and area. The pistol range resounds with the marksmanship exercises of the Pistol Club. The Production Club produces plays and the Journalism Club produces *The Shavetail*, the class yearbook. There's a Drum and Bugle Corps and a very popular organization whose members practice the art of making speeches.

Nevertheless, many students say they do not, themselves, feel that OCS is a replacement for college. Most of them do hope, eventually, to attend or complete their college training later on. Meanwhile, they have been exposed to important atti-

tudes and connections with community life.

The faculty keeps the training flexible, Colonel Barnard stresses. They keep in touch with the needs of the Air Force and periodically adjust the curriculum to provide officers who can meet these needs. As a result, the faculty has found that it must write its own textbooks, and no textbook is more than two years old.

OCS is a goal to the airman in the ranks. It is the only route through which he can get a commission, with extremely few exceptions. OCS appeals to the ambitious airman and the ambitious noncom.

For the officer in command of airmen and noncoms, OCS is the ever-present opportunity toward which they can encourage their men. It's a path to a career on which the unit commander can set the airman's foot.

The average student is a former tech sergeant with six to seven years in the Air Force already behind him. He's twenty-six years old, married, and has two children. He is not likely to have been to college; the average amount of college training for all OCS students is just two-tenths of a year.

About one-third of the students go on to pilot training, including many married men who would not have been eligible in any other way. Few students drop out during the six months course, for the faculty makes every effort to keep those who want to make the grade and are qualified by ability and temperament. There is no "quota" or standard attrition rate; the school may graduate more or less than the specific number for which it is programmed.

During its World War II epoch at Miami Beach, the Officer Candidate School absorbed 35,393 young men and graduated 29,775 officers. With the class of 44-H it moved to San Antonio Aviation Cadet Center (now Lackland AFB). It has been there ever since, with one brief interlude, and has graduated 10,000 more officers.

Says one former Lackland commander, Maj. Gen. H. L. Grills, "OCS is a terrific challenge to a noncom, and has tremendous appeal."

The ninety-five percent career retention figures bear him out.—END



No fun but helpful indicator of leadership, daring, is the obstacle course.

ABOUT THE AUTHOR

A long-time observer of the aviation scene, Louis Alexander has written several articles for this magazine. He is a veteran newsman and an active member of the Aviation Writers Association. Mr. Alexander, now a free-lance, lives in Texas.

SPERRY INTRODUCES...

New portable radar safety meter for survey of microwave power fields

Like many technical developments, the high-power microwave systems now coming into wide military use present an unexpected problem. Medical and military leaders alike are concerned with the safety of personnel working with these "super radars" which generate tremendous microwave energy fields in their transmitters and antennas.

Current information indicates the surest methods for establishing safe working conditions near powerful microwave devices involve survey measurements of microwave power density in the area. But, until now, application of this principle has been restricted because engineers have lacked suitable portable equipment for

making these measurements.

As a leading producer of advanced radar systems, Sperry has devoted extensive research to the problem of assuring safety in their operation. Result of this investigation is the new Microwave Power Density Meter. Weighing only 6 pounds, the meter provides a simple but highly accurate method of exploring the existence of concentrated energy or "hot spots" close by high-power microwave antennas, transmitter tubes and plumbing. It is completely portable and contains its own power supply.

Utilizing the presently accepted safe energy level of 10 mw/cm², the Sperry meter quickly registers the relative

power density above or below the acceptable level. The meter is scaled to read in mw/cm². A single knob operates the meter, permitting its use by nontechnical personnel.

If you'd like more information about the new Sperry Microwave Power Density Meter, write for Microline 646 data sheet.

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AFA NEWS

SQUADRON OF THE MONTH

Boise Valley Squadron, Idaho, Cited for

the Space Age Symposium, which not only attracted large numbers of adults but brought home to hundreds of college students the many and varied problems of the dawning Space Age.

In a departure from their normal programming policy, the Boise, Idaho, Squadron staged a Space Age Conference on October 17 on the campus of the College of Idaho, at Caldwell. More than 1,000 students, instructors, parents, and visitors to the annual Homecoming Day attended the three presentations and the evening banquet. This was one of the most outstanding AFA programs of the last several years (*see cut below*).

Speakers on the panel included: Col. Otto J. Glasser, Program Director for the Minuteman, upcoming solid-propellant ICBM to be assigned to Strategic Air Command; Dr. Frank E. Sorenson, professor at the University of Nebraska and Secretary of AFA's Lincoln Squadron; and Dr. Everett T. Welmers, Director of the Research Institute of Bell Aircraft, Buffalo, N. Y. Dr. Welmers also addressed the banquet, which too attracted an overflow throng.

James M. Trail, AFA's Chairman of the Board, served as toastmaster for the banquet and master-minded the entire program, which the local newspaper called, "The biggest weekend in recent history." Sharing the effort with Trail were Dale Hendry, Boise Squadron Commander, and Dr. Donald J. Mammen, conference coordinator of the College of Idaho. This was an outstanding program, and AFA is

proud to salute the Boise Squadron for its effort.

Charles Alexander, Commander of the Queens Squadron, part of the New York Wing, has announced that the 1958 Safety Award of the Squadron has been presented to Vernon A. Taylor, Chairman of the Safety Committee for Seaboard & Western Airlines. The award was presented at a dinner in the Brass Rail restaurant on November 1.

A veteran of AF service during World War II, Taylor is credited with, among other things, the development of an emergency exit system for transport-type aircraft, emergency lighting systems, and has been a long-time member of the Flight Safety Foundation's Industry Advisory Committee.

No flying was done, except that of the "hangar" variety, but we think it's worth mentioning that the Thunderbirds and the Blue Angels, famed jet aerobatic teams of the USAF and the Navy, recently gathered in Las Vegas, Nev., for a couple of days of informal reunions. Barney Rawlings, hard-working assistant manager of the Las Vegas Convention Bureau, spent one evening with them and has sent word that verbal battles were the only kind fought. The competitive hatchet was

buried while the team members enjoyed themselves (*see cut on opposite page*).

Just before the 1958 Convention in Dallas we learned of a most intriguing program sponsored by the Colorado Springs Squadron, under the leadership of Squadron Commander Don Olson. It seems that during World War II research on jet-engine performance was carried out on Pikes Peak, and Olson now, some fifteen years later, decided it was time someone recognized this effort.

With the cooperation of the Air Defense Command, which presented a "retired" Lockheed F-94 Starfire fighter-interceptor for the occasion, and more cooperation from the city, which donated a site at the summit of Pikes Peak, the Squadron hauled the F-94 by road up to the site. It was permanently mounted in cement there as a striking monument to the experimental work carried out on Pikes Peak (*see cut at upper right of next page*).

Participating in this unique program, besides Olson, were: Thayer Tutt, AFA National Director; City Manager John Biery, who accepted the memorial on behalf of the city of Colorado Springs; Lt. Gen. Joseph H. Atkinson, Commander of the Air Defense Command; Maj. Gen. T. A. Bennett, of ADC; Clay Banta, Colo-



Above, left, is part of the capacity crowd that attended the Boise Space Age Conference. At right, Dr. Donald J. Mammen introduces members of the panel, who were, from left, Col. Otto J. Glasser, ICBM project officer for Minuteman; Dr. Everett T. Welmers, Bell Research Institute Director; and Dr. Frank E. Sorenson, University of Nebraska professor.



Cmdr. Ed Holley, left, and Maj. Robbie Robinson, leaders respectively of the USN Blue Angels and the USAF Thunderbirds, with Barney Rawlings at recent Las Vegas reunion.



AFA's Don Olson, Carl B. Squier of Lockheed, Maj. Gen. T. A. Bennett of ADC, and AFA Director Thayer Tutt shown with the F-94 atop Pikes Peak in Colorado (see text).

rado Springs Chamber of Commerce Manager; and Carl B. Squier, vice president of Lockheed, builders of the F-94.

Cleveland's imaginative Squadron, led by Will Dougherty and featuring good programming by individual leaders, is rolling along in fine style and making a determined bid for "Squadron-of-the-Year" honors. The latest function to attract attention was the annual Outer Space Symposium, held in conjunction with the Sales Executives Club of Cleveland, which presented space expert Krafft A. Ehricke, of Convair-Astronautics, to the Ohio city.

Three hundred leading executives of the area attended the luncheon program, held on October 20 at the Hotel Cleveland. It was the largest turnout ever to attend a regular meeting of the Executives Club (see cut) and was a fine tribute to the work of Dougherty, Erwin Cooper, Ray Sachs, and Bob Leonelli, all from the AFA Squadron.

In September, cooperating with the Cleveland Kiwanis Club, the members of the Squadron sponsored a "Kid's Day" at Youngstown AFB, where twenty underprivileged youngsters were treated to a full day of briefings, demonstrations, and lunch. Phil Cochran, long-time AFA booster and inspiration for the cartoon character "Flip Corkin" in Milton Caniff's former comic strip, "Terry and the Pirates," was the honored guest and speaker at the luncheon. Cooper and Leonelli also had a hand in the arrangements for this program, as did Glenn Cowles, Ken Vetter, Tom McCleaster, and Chuck Tracy, aviation editor for the Cleveland Press.

(Continued on page 131)



At the head table of Cleveland's Outer Space Symposium (see text), Willard Dougherty, Squadron Commander, is second from right, and Krafft Ehricke, the guest speaker, is third from left. Thirty firms took part in this program.



The entire town turned out to welcome the new Chico, Calif., Squadron when it held its Charter dinner. Shown here are Sankey Hall, Squadron Commander; John R. Alison, former AFA President who addressed the meeting; and Chico's Mayor Ted Meriam. Also present was AFA's Far West Vice President Harvey McKay.



Ryan Firebee jet drone missiles are flying longer, farther, higher, faster on target missions— and more of them “live” to fly another day.

For example, at Vincent Air Force Base recently, the 4750th Drone Squadron launched 44 Firebees *in a row*, which averaged one hour's flight duration each. And 39 of them—many after target “hits”—were recovered successfully for re-use!

Other Firebee firsts: the one that completed 19 missions; the one that flew 1 hour, 42½ minutes; the one that made a flight 152 miles away from ground control and returned to be recovered in a pre-selected area; the drones that regularly fly target missions at Mach .9; and the *production* “birds” that have flown above 50,000 feet.

An elusive, pilotless plane, the Ryan Firebee is the most widely used jet target in training operations... the most realistic stand-in for “enemy” aircraft. That's why the Firebee is used as the target for such weapons as the Air Force Falcon and Genie; Navy Sidewinder, Sparrow, and Terrier; and Army Nike. That's why the Firebee was the exclusive target drone used in the Air Force's recent Project William Tell to evaluate the combat readiness of America's air defense system.

RYAN BUILDS BETTER

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Gill Robb Wilson beams as West Virginia's Gov. Cecil Underwood awards him a Distinguished Service Medal.

As a complete change of pace, the Squadron in August cosponsored the Cleveland premiere of "The Hunters," the 20th Century-Fox film about the jet air battle in Korea. Together with the normal amount of ribbon-cutting, searchlights, and bands, a feature of this program was the introduction of Brig. Gen. Frank P. Lahm, USAF (Ret.), the nation's oldest living military aviator, who holds Military Pilots License Number 1 and learned his flying in a Wright Flyer under the tutelage of the Wright brothers themselves.

These three programs are typical of the planning that has been going into the work of the Cleveland Squadron. The efforts of this group have maintained a high level of airpower interest in the community and deserve the congratulations of all members of the Air Force Association.

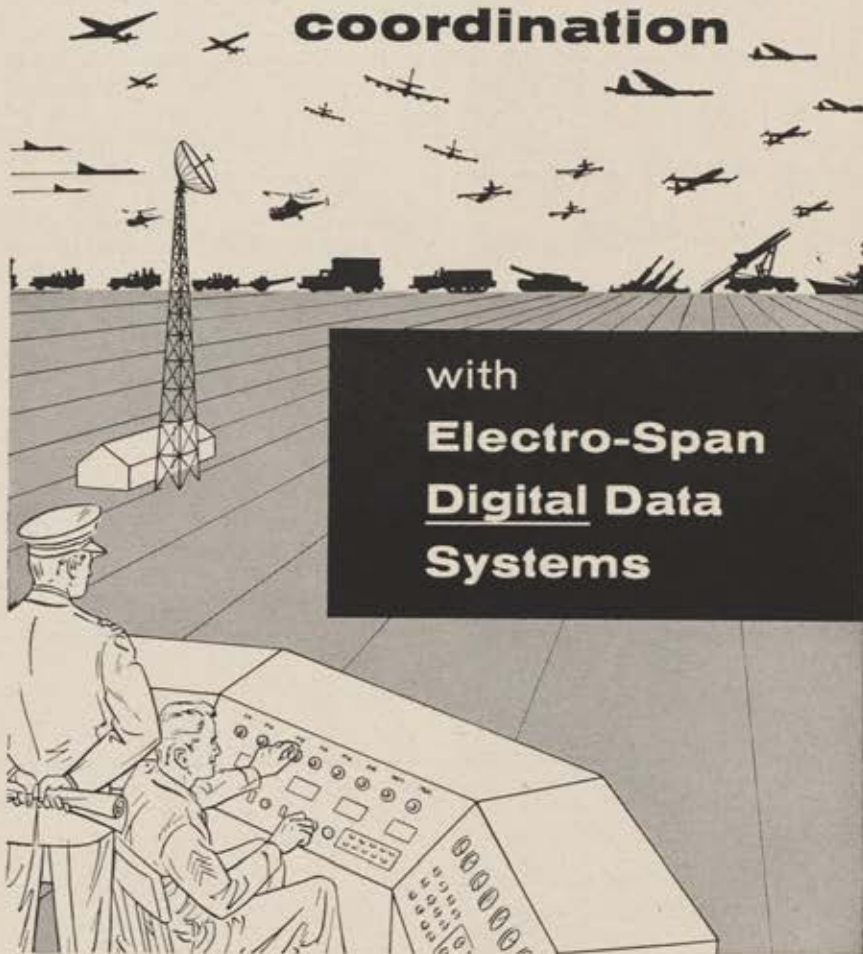
Gill Robb Wilson, a Past President of AFA, has received almost every aviation award available; however, in a ceremony October 3 in Charleston, W. Va., his home state, he was honored with the State Distinguished Service Medal, presented by Gov. Cecil H. Underwood.

In the citation accompanying the award Governor Underwood praised Gill's many outstanding contributions and said, "West Virginia is proud to recognize this native son of Parkersburg" (see cut above). Some 35,000 people were on hand for the presentation and the air show that followed. Maj. Gen. John W. Persons, who is the Commander of the Fourteenth Air Force, also participated in the program.

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airman's bookshelf

There's a story behind every book. Two years ago Frank Taylor, chief editor of Dell Publishing Co., crawled into the cramped cockpit of a B-25. The flight from Mitchel AFB to Albuquerque, N. M., was a rough, uncomfortable, noisy introduction to the mysterious world of working airmen. Few would have found it inspirational. But Frank Taylor did and began searching for a book that would explore the strange and exciting realm of the air and the men who fly.

His idea came full circle months later during a chance meeting in the Pentagon with Frank W. "Doc" Anderson of the Air University, and former University of North Carolina professor of English. Anderson undertook the job of scanning the literary output of fifty years of flight for a representative group of air adventure stories from the stick-and-wire days to jets and rockets.

The result: Twenty yarns by top contemporary writers appears in *Great Flying Stories*, (35¢)—an exceptional paperback anthology.

Another project, one that started thirteen years ago, has been completed with the appearance of *Services Around the World*, the seventh and final volume of the history of *The Army Air Forces in World War II* (University of Chicago Press).

This volume covers the service support organizations of the AAF worldwide and reflects the definitive and objective treatment evident in the previous six volumes. It covers air transport—the ATC worldwide; airways to North Africa and the Middle East; the northwest air route to Alaska and across the Pacific; the aviation engineers in Europe, Africa, the Far East, and the Pacific area; weather and communications—the AAF Weather Service and the Army Airways and Communications System; medicine, morale, and air-sea rescue; women in the AAF; redeployment and demobilization programs; and reorganization of the AAF in March 1946 in preparation for its establishment as a separate service.

The seven-volume series was prepared under the direction of the USAF Historical Division, Air University, and edited by Dr. Wesley F. Craven (professor of history, Princeton University) and Dr. J. L. Cate (professor of history at the University of Chicago). Both editors combine unique qualifications—professional ca-

reers as historians, teachers, and scholars, with experience as key air historians in the Air Force in World War II. Their competence shows in the quality of the history they have produced, a scholarly, documented chronicle of the war in the air.

The complete set now lines up: Vol. I, *Plans and Early Operations* (January 1939 to August 1942); Vol. II, *Europe: Torch to Pointblank* (August 1942 to December 1943); Vol. III, *Europe: Argument to V-E Day* (January 1944 to May 1945); Vol. IV, *The Pacific: Guadalcanal to Saipan* (August 1942 to July 1944); Vol. V, *The Pacific: Matterhorn to Nagasaki* (July 1944 to August 1945); Vol. VI, *Men and Planes*; Vol. VII, *Services Around the World*.

Each volume is encyclopedic in nature, a massive compendium of fact and interpretation running more than 700 pages and containing maps, charts, and folios of official combat photography.

The set is an invaluable reference. Airmen, especially veterans of World War II, will find here many hours of informative reading about the old outfit and how it played its part in the pattern and organization of the war. Each volume lists at \$8.50. AFA's Airpower Book Club members can buy the complete set at the special reduced price of \$40.

Clayton Knight's recent *Plane Crash!* analyzes major American air disasters from 1908 to the present and explains how crash mysteries are solved, and now British aviation writer Oliver Stewart provides an exceptionally thorough sequel in *Danger in the Air* (Philosophical Library, \$6). In it Stewart lists crash causes under categories including topographical traps, instrument failures, crew fatigue, control faults, criminal action, split responsibilities, structural failure, icing, engine failure, fire in the air, pilot error, and collision. Using British aircraft disasters (from the R-101 tragedy to the more recent Comet crashes) to illustrate each category, he explores specific cases by reconstructing events leading up to each crash. He logically sifts out the causes and points up the lessons to be learned. Both the Knight and the Stewart books lend valuable documentation to flight-safety literature.

Students, technicians, and aeronautical engineers will welcome the

second of a three-volume series, *Aircraft and Missile Propulsion*, Vol. II, by Maurice J. Zucrow (Wiley, \$13). This one covers the fundamental principles of five specific types of engines: gas turbine, turboprop, turbojet, ramjet, and rocket. The book discusses engines, fuels, designs, processes, operations, and performances.

Long-range, high-powered radio equipment for route flying and low-powered equipment for air traffic control in terminal and local areas are technically treated in *Aircraft Communications Systems*, by J. H. H. Grover (Philosophical Library, \$6). This reference and study guide covers theoretical circuits, operations, instructions, procedures, and descriptions of modern radio equipment and ancillaries.

Several recent books have dealt with that curious breed of World War II military flyer—the Japanese Kamikaze pilot. And two who were Imperial Japanese Navy officers, former members of the Naval Special Attack Force (Kamikaze) study the beginnings, organization, training, combat operations, and psychological attitudes of famous warriors in *The Divine Wind*, by Capt. Rikihei Inoguchi and Cmdr. Tadashi Nakajima, with Cmdr. Roger Pineau, USNR (US Naval Institute, \$4.50). The book tells an incredible story about these dedicated flyers, more than 4,000 of whom flew to certain death against the US Pacific Fleet in the latter stages of World War II.

American naval personnel casualties from these suicide aerial offensives greatly exceeded those suffered by our ground forces in the entire Okinawan campaign. Our losses in ships to Kamikaze action, ranging from aircraft carriers to small escort vessels, were staggering, and the weapon was analogous in many ways to modern guided missiles.

Henry B. Lent, noted author of boys books, hits a new high in descriptive career adventure for the teen-ager with *Jet Pilot* (Macmillan, \$3). The story tells how Dick Martin (any American boy just out of high school) becomes a combat-ready supersonic jet pilot in the USAF.

Background is factual, characters are fictional. Lent takes his hero, step by step through the AF Flying Training Program: preflight at Lackland; primary and T-37 training at Graham AB, Fla.; basic and T-33 flying at Greenville AFB, Miss.; and finally jet-fighter training in F-100s at Nellis AFB where Dick wins his silver wings and an Air Force commission. All aspects of the aviation cadet officer

training program—ground and flight—are covered.

The author lived every bit of it as he researched the story. He attended ground school, flew in all types of training planes with ATC instructors, lived and ate with the cadets, and shared their off-duty recreation. Few career-book authors today write from such thorough first-hand experience. Lent is now putting finishing touches on a sequel—Dick Martin as a combat pilot in TAC's First Fighter Wing at Morón AB, Spain.

Airmen and What They Do, by Charles A. Coombs (Watts, \$3), describes the most popular career fields in aviation today. Chapters cover eighteen military and civilian specialties such as jet pilots, airline hostesses, line mechanics, etc. The book is written in the smooth, simple, clear prose that has made "Chuck" Coombs a favorite author with the younger set.

Fighter Planes That Made History, by David C. Cooke (Putnam's, \$2.50), is leadoff volume in a new series. It features thirty-nine fighters of many nations from the French Morane-Saulnier Bullet of 1915 (the first true fighter) through the latest USAF Century series. Each is pictured in full page with accompanying development-operational history and important specification and performance data. Like many recent air books, this one is designed for readers of all ages. Subsequent volumes in this series will treat bombers, transports, etc., rounding out full photo-narrative coverage of famous combat aircraft.

Rockets and Satellites

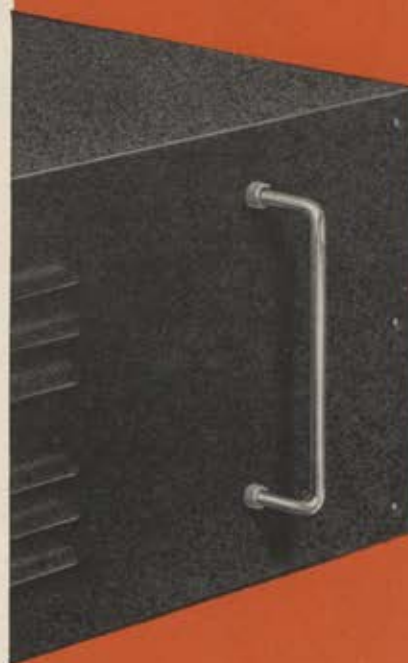
Bird watchers now have new competition—satellite watchers.

First of a new kind of book for the night-sky gazer on how to distinguish one artificial moon from another and follow its speeding track through space is *Handbook for Observing the Satellites*, by Neale E. Howard (Crowell, \$2.50). This extremely well written small volume is a basic primer on satellites, explaining the fundamental principles of scientific law by which they behave, and offering simple experiments that can be done at home to demonstrate the physical laws governing satellites.

How to locate a satellite, plot it by various systems, determine its magnitude, and calculate its course and speed, by eye, binoculars, and telescope are some of the many questions answered. A section on how to make and operate a moon-watch telescope stirs the reader's imagination.

(Continued on page 136)

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Other chapters include description of the Smithsonian Astrophysical Observatory's moon-watch program, discussion of satellite photography, an answer to why scientific effort is being given to the launching of artificial moons, and the tremendous amount of scientific knowledge we are gaining from them. A glossary of satellite-watching terminology, and appendices of data charts for observing and calculating satellite orbits adds to the completeness of this unique volume.

Soviet Writings on Earth Satellites and Space Travel (Citadel Press, \$3.95) helps broaden understanding of Russian scientific progress with stress on Soviet accomplishments in the missile and satellite fields.

The first section, "From Earth Satellites to Interplanetary Travel," by Ari Sternfeld, traces astronomical history from ancient legends to present. Against this background the author speculates on the problems and realities of space travel, spaceships, and man in space, basing his presentation on Russian scientific fact and theory. Chapters on satellites, their orbits, and the knowledge gained from Sputniks provide the setting for Sternfeld's most creative and interesting portion. He describes futuristic Soviet spaceships and flights, projects a Soviet space station, chronicles Soviet trips to the moon and planets, and predicts that future Soviet satellites will carry a man (replacing Laika) in orbit around the earth. This 128-page essay contains an unusual amount of scientific fact and is fat with drawings and tabular data.

Part II, "The Sputniks," features fifteen articles, nine by top Soviet scientists, the others reprinted from the Soviet press. All deal with the three Sputniks. The articles cover subjects like earth satellites, geophysical problems, optical observations, satellite discoveries in radio-wave propagation and radio electronics, like in a Sputnik, structure and design of Sputniks, solar batteries, space travel, and the Russian Air Force.

The articles contribute little new data to the world scientific community, but they do connote the extent to which the Soviets are forging ahead in every aspect of rocket, missile, and astronomical research.

This book, like much Soviet scientific writing today, is iceberg-like. What is important and significant doesn't show. All things considered, it makes good reading, especially for the layman, for whom it was intended.



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Out recently also is the new revised edition of the *Aviation Dictionary and Reference Guide*, by Ernest J. Gentle and Charles E. Chapel (Aero Publishers, \$7.50). This standard air dictionary has 2,000 new definitions on atomic energy, electronics, guided missiles, jet propulsion, radar, rockets, and television. It contains something like 7,000 definitions.

The memoirs of two opposing ground force generals shed new light on World War II history:

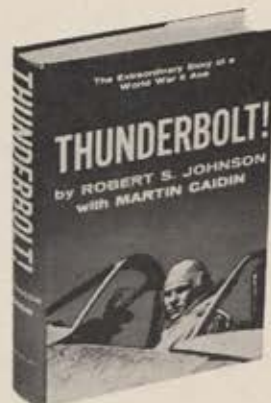
Lost Victories, by Field Marshal Erich von Manstein, edited and translated by Anthony G. Powell (Regnery, \$7.50), analyzes Germany's victorious war years up to 1942 and her defeats thereafter, giving an unflattering portrayal of Hitler as a military planner. Von Manstein was architect of the military plan which defeated France in 1940, the conqueror of Kharkov and the Crimea—the latter described by historians as “a brilliant military operation.”

The Business of War: The Narrative of Major General Sir John Kennedy, edited by Bernard Ferguson (Morrow, \$5) is a frank, crisp account of top-level planning in World War II, revealing some of the little-known facts behind the great war—the decisions, and the men who made them. It describes the weaknesses and strengths, defeats and victories of the British Army, and the Army's continuous quarrel and dissatisfaction with the RAF.

It is especially good in describing the idiosyncracies, personal habits, and thinking processes of the Chiefs of State and Kennedy's top military colleagues. The author was Director of British Army Military Operations from 1940 to 1943 and until December 1944, Assistant Chief of the Imperial General Staff—an important figure on the combined Allied Staff.

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